

Gudrun Corvinus †

PREHISTORIC CULTURES IN NEPAL

from the Early Palaeolithic to the Neolithic and the
Quaternary Geology of the Dang-Deokhuri Dun Valleys

Vol. I

Herausgegeben von
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Volume II

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Insertion: CD-ROM of all Photos of the sites (Plates 202-256) and additional Photos (-Sc)

Forewords

When in 1982 I was asked to take care off an intended venture by Dr. Gudrun Corvinus on the quaternary geology of the Siwaliks and eventually the prehistoric finds gained from this, hopefully to be supported by the German Research Council (DFG), little did I suspect that an undertaking thought of rather as a survey would develop into a project of over 20 years duration.

When together with Dr. Corvinus in October 2005 in Erlangen necessary additions and corrections to the finally completed manuscript were carried out and the next visit of the authoress to Germany was agreed for the summer of the coming year never could I suspect that, on New Year's Day 2006, Gudrun Corvinus would be the victim of a brutal murder in Pune/Poona, the Indian town she loved and which after more than 20 years in Kathmandu should become her home.

At the time of the murder, the complete illustration part (Volume II) as well as copies of all text illustrations were already at the printers. Only the text awaited editorial processing. I regarded it as completely finished regarding in form and content. However, shortly before her tragic end Dr. Corvinus asked me by e-mail of 28.12.2005 for a few additions and corrections concerning her chapters on India and China. „I'll send everything, floppy and text, within the next few days“. This text failed to reach me and all efforts of the Indian colleagues and friends in Pune to be allowed to look for it in her personal computer confiscated by the police, if there ever had been one at all, were fruitless. Responsible for the fast appearance of the work, to wait any longer would have been futile so that the text published now corresponds in construction and contents to the one which Dr. Corvinus had declared finished in October 2005. However, according to the e-mail of 28.12.2005 she attached great importance to the planned additions. Therefore, those Indian colleagues to whom Gudrun Corvinus had particularly close contact are asked when reviewing the book, to which the editors invite them and all specialists for the Asian Palaeolithic warmly, to go into these respective problems specially.

It may be unusual to describe in the preface in such detail the complications which the death of the authoress brought about. For colleagues and friends it is to this hour an incomprehensible end to a stony path of 20 years of research in Nepal. That this path could be followed up to the final publication, the DFG has my deepest gratitude. Following careful selection of suitable research areas by the authoress the lithic and palaeontological material rapidly increased, the sites grew in number and the possibility of a multiple geostratigraphical anchorage became visible. The „survey“ rapidly developed into a long-term research plan. Without the insight, the patience and permanent support of Dr. Jochen Briegleb the year to year renewed funding by the DFG in the frame of a normal procedure („Normalverfahren“) would not have been possible. I for my part combined my assistance with the request that Dr. Corvinus may through travels and studies in the neighbouring Asian countries be in a position to include the results of the research in Nepal in the broader context of the Asian Stone Age and the Quaternary. Her geological-palaeontological work in the foothills of the Himalayas which was predominant in the first years, appeared to me to be, in comparison with such in the neighbouring countries, of special value. For this extended plan Dr. Briegleb was always open and helped to get over many obstacles during more than eleven years. To his successor Dr. Hans-Dieter Bienert I am deeply indebted, as with the means of the DFG he enabled the two-volume publication, the extensive illustration part of which I hope will provide a service for the enti-

re Asian Palaeolithic research. All characteristics of striking techniques and raw materials should be optimally represented.

The critical reader will find some unconventionalities in the text and some slight insufficiencies in text illustrations, captions and bibliography. It seemed unwarranted for me to make corrections in the author's absence which might introduce new mistakes. Some problems remain necessarily open in the face of the general state of research. Here in my view should be mentioned primarily the Brakhti industry, which makes up such a large part of the material. Character, dating and cultural position as well as its relationship to industries of the neighbouring countries are a rather open question.

I am left with the memory of lively discussions with a deeply engaged, yes passionate, geologist, palaeontologist and prehistorian who at the same time was an outstanding expert on historical Asian cultures and who, after decades in Africa and Asia, was no longer able to live in Europe. Thus, India became her destiny. It is not without tragedy, that she was not allowed to witness the publication of her book. *

Erlangen, Spring 2006

Gisela Freund

The monograph presented here is the outcome of many years of fieldwork and of subsequent detailed analysis and documentation of the abundant data collected in the field in Nepal.

The project titled originally "Quartäruntersuchungen in Nepal, Erforschung der Stratigraphie und Urgeschichte in den Churia Hills (Siwaliks)", began in March 1983 and ended in August 1994. It included two aspects of research in the Siwalik foothills of the Nepal Himalayas, namely palaeontological and stratigraphical investigations within the Siwalik Group of molasse sediments and a prehistoric and Quarternary geological survey of the hitherto unknown prehistoric resources in the Himalayan foothills.

The project was funded throughout by the Deutsche Forschungsgemeinschaft (DFG) (German Research Council), for which the author is intensely thankful. I am particularly indebted to Dr. J. Briegleb for his patience and goodwill in promoting this project over the years and his understanding of the many time-consuming problems that arose and helping to overcome them in order to guarantee the success of this research. His successor, Dr. Bienert, I thank for his patience in waiting for the successful ending of the extensive manuscript. The project was headed by Professor Dr. G. Freund who was then Head of the Institut für Ur- und Frühgeschichte of the University of Erlangen-Nürnberg, Germany, where I was engaged as research fellow for eleven and a half years. Dr. Freund remained up till now the responsible person behind the project. I wish to extend my deep gratitude to her for her constant support and encouragement so as to bring the research to a successful end. She also visited Nepal several times to see my work and the material. Similarly my thanks go to the present Head of the Institute, Professor Dr. L. Reisch, who made it possible that the Erlangen Institute and his staff remained my second home during the yearly two-months stay in Germany. Amongst his staff I want to particularly thank Dr. Chr. Züchner, Mrs. M. Kemper and Mrs. I. Seeberger.

During the entire project I made my home in Kathmandu, where I learned to speak Nepali, which was a necessity. I was affiliated to the Central Department of Geology of Tribhuvan University, Kirtipur, Kathmandu, through which I got all the necessary information and assistance for my research, for which I am extremely grateful. At this place I want to thank particularly the then Head of the Geology Department, Professor Dr. M.P. Sharma and later the present Head, Professor Dr. P.C. Adikhari. Many thanks are also extended to the other colleagues of the Department, especially to Dr. Vishnu Dangol and Mr. Lila Nath Rimal, for accompanying me into the field.

* For the translation I am thankful to Bettina Stoll-Tucker and David Tucker, Halle.

Assistance for obtaining the necessary maps and aerial photos for the fieldwork was thankfully received from His Majesty's Government (HMG) Department of Geology and the HMG Survey Department at Kathmandu.

Thanks are due to the HMG Department of Archaeology for information, advice and assistance. In this respect it is a particular joy for me to thank the former Directors, Mr. Ramesh Jung Thapa for his interest and suggestions during the time of my planning the research and later to Mr. Janak Lal Sharma, who was always willing to engage in discussions during the first years of my work. Dr. S. Amatya, who later was Director of the Department is also respectfully remembered. Particular thanks are also due to Mts. Riddhi Pradhan, who later became the Director of the Department and who gave me much encouragement, when I needed it most.

I must not forget the Nepal Research Centre at Kathmandu and their various German Heads, who have provided a kind of home away from home for German scholars working in Nepal. The hospitable lunch table offering a Nepali daal-bhaat (rice lentil) meal and friendly talks with other scholars of many different disciplines was an often welcome change from work. Similarly the Kathmandu branch of the South Asia Institute (Heidelberg) and their various representatives over the years was a source of information and welcome discussions.

The research included yearly field expeditions during the winter seasons between December and March. These extended often into the hot season of April and even May if the findings were particularly abundant. The first season in the first year was done in May and June 1983, in the expectation that the first results would be promising. These months of extreme heat are, however, absolutely intolerable for fieldwork in the low-lying terrain north of the Indo-Gangetic Plain. But the unimpaired conviction of obtaining results in the first year was the driving force behind the efforts, and proved to be justified. In all following years, however, the fieldwork was carried out in the cooler winter seasons.

A total of 35 months of fieldwork was undertaken between 1983 and 1994 through the grants of the DFG and between 1995 and 2001 by my own means.

In order to be able to carry out these field expeditions I am very grateful to have been able to obtain a research permit from the Research Division of Tribhuvan University with the assistance of the Central Department of Geology. This permit entitled me to conduct surveys and fieldwork in the Siwaliks in order to investigate the palaeontological and prehistorical potential. As no prehistoric sites had been known previously the investigations consisted primarily of detailed explorations, mapping and data collection and no full-scale excavations of prehistoric sites were envisaged or provided for.

The project was a single-person project, not a team project. But it became soon apparent that the wealth of data was so abundant that need for help from other disciplines arose. I was able to interest scholars from the Wadia Institute of Himalayan Geology (WIHG) at Dehra Dun, India, the Birbal Sahni Institute of Palaeobotany (BSIP), Lucknow, and the Archaeology Department of Deccan College, Pune, India, in providing help for field- and specially laboratory work, for which they drew upon their own institutes' resources. I am therefore extremely grateful to their Directors, Dr. V.C. Thakur (WIHG), Drs. M.R. Sahni and B.S. Venkatachala (BSIP) for their valuable assistance. Dr. A.C. Nanda from the WIHG was very helpful in identifying the rich vertebrate fauna of the investigated Siwalik area, and so was Dr. Nina Jablonski, California Academy of Science in later years. The very abundant plant and pollen flora was studied by scholars from the BSIP, Drs. N. Awasthi, S. Sarkar and M. Prasad. A number of ^{14}C analyses were also carried out by that institute. Other ^{14}C datings were carried out by the Landesamt für Denkmalpflege, Hannover, for which I want to thank Dr. M.A. Geyh. TL sampling was done by Dr. A. Bronger (Kiel) and was analysed by Dr. L. Zöller (Heidelberg), while the later OSL sampling was undertaken with the help of Professor Dr. G. Wagner (Heidelberg) and analysed by Dr. A. Kadereit (Heidelberg), for which I want to thank all of them very much.

Since many of the prehistoric findings were found within red soils which cover the terrace and fan surfaces I appreciated the help of Professor Dr. A. Bronget and his student P. Wichmann in studying the red soils and in trying to give me age indications for them. Dr. Wichmann has since completed his Ph.D. thesis on the red soils of the Dang-Deokhuri valleys.

For the Quaternary geology of the study area there was no literature or previous surveys available. But as most of the prehistoric findings were associated and embedded within alluvial sediments, investigations into the stratigraphy of the Quaternary deposits were necessary and were carried out by me. Later the outcome of these studies was discussed with colleagues from the Deccan College, Pune. Dr. S.N. Rajaguru and Dr. Sheila Mishra from that college came out into the research area in November 1997 to discuss the problems of the Quaternary geology in the field with me. Dr. Rajaguru is the expert in India on Quaternary studies and climate in connection with the prehistoric periods. I am very thankful to my colleagues for these necessary discussions.

For all other comparative studies on the prehistory in South Asia I am very thankful for all the fruitful discussions with many colleagues, particularly to Dr. V.N. Misra, the former Director of Deccan College, Pune, and to Drs. K. Paddayya, S. Misra, G.L. Badam, M.D. Kajale, V.J. Sathe, Sushma Deo, Mrs. Sonali Naik and others.

For the comparative studies in East- and Southeast Asia I am indebted to so many colleagues in China, Korea, Vietnam, Thailand, Malaysia, Indonesia and Burma who helped me to study the cultural material in their institutes and museums and for arranging field excursions that it is impossible to name all of them. I am very grateful to all of them for their hospitable assistance. I also want to thank at this point again the Deutsche Forschungsgemeinschaft (DFG) for their travel grants to the various Southeast Asian countries.

All the collected material of the palaeontological and prehistorical investigations is housed in Kathmandu in various museums and institutions.

The abundant collection of vertebrate fossils collected during the survey from the Siwaliks is now housed partly at the Natural History Museum, Swayambunath, Kathmandu, and at the Central Department of Geology of Tribhuvan University. The section of vertebrate fossils in the Natural History Museum, which consists mainly of fossils found during this project, was inaugurated in July 1989 by the then Ambassador, Dr. Schneller, of the Embassy of the Federal Republic of Germany. I want to extend my thanks to the German Embassy and their staff for always giving me valuable assistance when needed. Particular thanks are extended to the late Ambassador, Dr. Scholtzseck, and to the then Nepali Ambassador in Bonn, Dr. Kishor Rai, for their help and support during a critical period of my work.

It was also with particular joy that I was able to arrange an exhibition of the prehistoric and palaeontological findings of this project in the Goethe Institut at Ganabahal, Kathmandu, in 1988, assisted by the staff of the Goethe Institut and the German Embassy.

The material of the entire prehistoric findings, from the Early Palaeolithic to the Neolithic, is now housed at the National Museum at Chauni, under the care of Mrs. Rehana Banu. My idea to establish a permanent exhibition of the most important findings of the Nepali Stone Age period, discovered during this project was encouraged by the then Director of the Archaeology Department, Dr. S. Amatya. Since these findings were the first of their kind in Nepal, I felt it necessary to make a beginning towards such an exhibition and for proper storage. In order to have space for the material I wanted to build two rooms for storage and exhibition. I was very glad when I got the friendly help of the Nepal-German Friendship Association, Cologne, and its President Dr. W. Donner and Secretary Mr. Ram Thapa, who made it possible, with a donation, to construct these two rooms where the material is now stored. The establishment of the exhibition has still to be done. The first priority was, however, the completion of this monograph, and only then I would give my time to choosing and arranging the exhibits with proper legends and explanations for the public to understand. Mr. Sukrasagar Shrestha from the HMG Department of Archae-

ology has promised to give me his support and help for this work. I would be very happy if such work could be supported by further help from Germany or Nepal.

The entire prehistoric material has been photographed by myself and was then developed by the Ganesh Photo Laboratory at Kathmandu, whom I thank for their excellent black and white enlargements. At this point I want also to thank Frau M. Kemper from the Institut für Urgeschichte in Erlangen for her wonderful artefact drawings and the documentation of the artefact photos for the plates, for which she invented a new technique, (see artefact plates of volume II).

For making the maps by Freehand on the computer and for most of the profiles I have to thank Michael Griesbaum at his Karro-Atelier in Kathmandu, while other profiles were made by Multigraphics (Nepal Traveller Pty. Ltd), Kathmandu, and also by hand by a draughtsman, Mr. B. Tuladhar. Many thanks also are extended to Miss Richa Jhaldiyal, Deccan College, Pune, who did the Excel computer work of all my statistical data. For the english correction of the text I am indebted to Mr. Philip Pierce, Nepal Research Centre, Kathmandu, and Mrs. Dr. Starita Wadia, Pune. All this work was done after 1994, and funded by myself.

With great appreciation I want to thank all my helpers in the field, without whose help the field research would not have been possible: the porters who carried all my heavy equipment of tents, work utensils, cooking vessels etc, often over steep, slippery tracks on the mountain slopes or through heavy currents of streams; to the cook, Saila Tamang, who over all the years prepared us the simple daal-bhaat meals in spite of sometimes not getting the ingredients for the food in the jungle or in spite of heavy rainstorms or dust storms; the drivers, particularly Man Bahadur Gurung (Dui Number, Number Two) who had to drive often through trackless jungle and rivers and had to get the landcruiser out of mud holes. And I thank them also for their companionship, especially my loyal head porter, Man Bahadur Magar (Ek Number, Number One), who was with me untiringly through all the field trips, and for the stories they told me at the evening fires, and their loyalty over the years in staying with me in spite of the many hazards and in spite of the leopards who sometimes strolled through our camp at night. Finally I want to thank my loyal assistant and friend, Lila Nath Rimal, who was constantly helping me during many problems and difficulties in the field and in Kathmandu, which I would not have been able to solve alone. He was a never-failing supporter of my work.

The completion of the monograph was much more time consuming than was anticipated after the project and the funding came to an end in 1994. The data were so manifold and so abundant that the analysis, and the documentation of drawings, photowork, computerwork, statistics etc. took much more time and money than was foreseen by the end of the supported project. It must also be said at this point that the procurement of the necessary literature was very difficult and time-consuming, because almost nothing on this subject was available in Nepal, and I had to obtain it through colleagues from all over the world and particularly from the library of Deccan College in Pune, to whom I extend my gratitude.

At the end I want to say that my research results are just the beginning of the story of Early Man in Nepal and of the evidence of the earliest cultural heritage of its people. I am extremely happy and honoured that I was able to make the first start in unravelling this story. I hope, therefore, that I will be excused when later scholars may find gaps or shortcomings in my interpretations.

Kathmandu, November 2003

Gudrun Corvinus

I. Introduction

1. Aims and aspects

The Himalayan kingdom of Nepal, a small, landlocked country north of the Indian Peninsula, had never yielded any definite evidence of prehistoric cultures, though its large southern neighbour, India, has a long prehistoric heritage – from Early Palaeolithic handaxe cultures in the Middle Pleistocene to Chalcolithic settlements in the Late Holocene.

It would have been surprising, therefore, if its northern neighbour Nepal had not been occupied by groups of people of prehistoric cultures. At least the Terai plains at the foot of the Himalayas and the lower hilly regions of the Siwalik Hills should have attracted prehistoric settlers during favourable climatic periods.

In 1983 I finished my work in the Diamond Mines in southern Africa (Corvinus 1983) and returned to Asia to continue working in the Indian subcontinent where I had previously worked (Corvinus 1981, 1983). I had visited Nepal in 1981 to look at the possibilities of palaeontological and prehistoric exploitations in that country, and it was on this trip that the idea to work in this area took shape. It was at that time, when I met the then Director General of the Department of Archaeology, Ramesh Jung Thapa, that the question was raised about working in the Siwaliks. Mr. Ramesh Jung Thapa was very interested in searching for prehistoric remains, and it was he who encouraged me to take up such work and I am very grateful to him indeed. It is to his encouragement and interest, and later to that of Mr. Janak Lal Sharma, his successor, that I owe the possibility of carrying out my prehistoric research in Nepal.

When I went to Germany to search for funds it was Professor Dr. Gisela Freund, who knew about my earlier work in India and gave me her wholehearted support and encouragement to fulfill my research ideas. It was because of her support that I received the grant from the German Research Council (DFG) which enabled me to carry on my work in Nepal for almost two decades.

At this juncture, though, I would like briefly to describe the path which led me to do this research. Being basically a geologist, but having always earlier combined my knowledge in geology and stratigraphy with my second field of study, that of prehistory, I was fascinated by the potential of work in the Siwaliks in Nepal. Detailed biostratigraphical studies of the Siwalik Group of sediments was lacking at the time that I began my research and definite prehistoric sites of Palaeolithic Man were also not known from Nepal. The greatest fascination of the Siwaliks for a palaeontologist and prehistorian is the fact that here at the Himalayan margin, as nowhere else in the world, there existed an uninterrupted sequence of still hidden geological and palaeontological records from 13 million years ago up to the present time, which, in effect, covers the whole time span of the period of evolution and change of the environment which was so crucial for human evolution in Africa from its earliest roots upwards. Africa did not yield such uninterrupted sequences of Neogene sediments and yet it yielded an enormous amount of data about the origin of human kind and the evolution of the environment in which Early Man evolved. Here in the Siwalik

belt was an almost untapped source of potential data for the evolution of the environment in South Asia since the Late Miocene and its influence on the evolution of mammalian life and eventually Early Man. This untapped potential was the focus of the start of my research, which, if investigated, should be able to answer many unsolved questions about that period of time in Asia, during which Early Man evolved in Africa.

The research in the „Geo-archaeological Project in Nepal“, financed by the Deutsche Forschungsgemeinschaft (DFG) since 1983, was aimed at investigating this obvious gap in Nepal's earliest heritage. At the same time the research extended back into the Neogene to the earliest evidences of hominoid existence in Nepal, that of *Sivapithecus*, whose existence was proved by the find of a molar of *Sivapithecus* in 1981 (Munthe et al. 1983).

The aim of the research was twofold. The first was a stratigraphical and palaeontological survey of the Siwalik Group of sediments in several chosen areas where well-exposed sections could be found with fossiliferous strata which would establish a biostratigraphic chronology for the Nepal Siwaliks and its palaeo-environment. The earliest records of vertebrate faunas had been previously made from various areas in western Nepal (West et al. 1978, 1991). Lithostratigraphic studies and geological mapping had been carried out by a Japanese team in an area east of Butwal (Tokuoka et al. 1986) but with no biostratigraphic data.

The other, second aspect combined a search for prehistoric occupation sites in the Siwalik foothills and at the foot of the mountains, as well as the study of the post-Siwalik Quaternary sediments.

Occupation sites of prehistoric settlements of the Palaeolithic period were not known from Nepal, nor was there as yet any existing survey of the Quaternary stratigraphy and environment during the time of possible human occupations. This was still virgin ground. I concentrated my search in two areas, one in the west and one in the east (Fig.1).

A total of 35 months of fieldwork was undertaken, as follows:

1983: May and June and parts of November and December, 2 months and 3 weeks;
 1984: Mid-January till end of February and 17 days in November/December, 2 months and 3 days;
 1985: January, February, March till 23rd April and a few days in May/June, 4 months;
 1986: Mid-January till 20th April, 3 months and 2 weeks;
 1987: 1st February till 17th April, 2 months and 2 weeks;
 1988: January in India for comparative work, then 16th February till 10th April, 2 months and 4 days;
 1989: Mid-January till 15th April, 3 months;
 1990: 20th January till 22nd April, 3 months;
 1991: Mid-January till 15th April, 3 months;
 1992: 24th–27th February, 4 days;
 1993: February/March and October/November, 1 month and 4 days;
 1994: 3 weeks in March, 5 days in May, 12 days in November, 1 month and 8 days;
 Altogether 30 months and 61 days i.e. 32 months.

Fieldwork outside the DFG project:

1995: 5 days in November (own money);
 1997: 13 days in November (own money);
 1998: 8 days in November, 26 days in December, 34 days;
 1999: 14 days in March, 17 days in December, 31 days;
 (the last two were funded by a Leakey Foundation field grant);
 2001: 10 days in November (own money);
 Together 93 days, i.e. 3 months.

This report deals with the second aspect, while the first has been dealt with in yearly reports to the Research Division of Tribhuvan University, Kathmandu and in a number of articles (Corvinus 1988, 1991, 1993, 1994, 2001).

However, the search for suitable and fossiliferous geological sections within the Siwaliks took precedence in the earlier years, after I located a very promising long sequence of Neogene sediments through the Siwalik hills along the Surai Khola stream in Dang District in western Nepal (Fig.2). A new road was un-

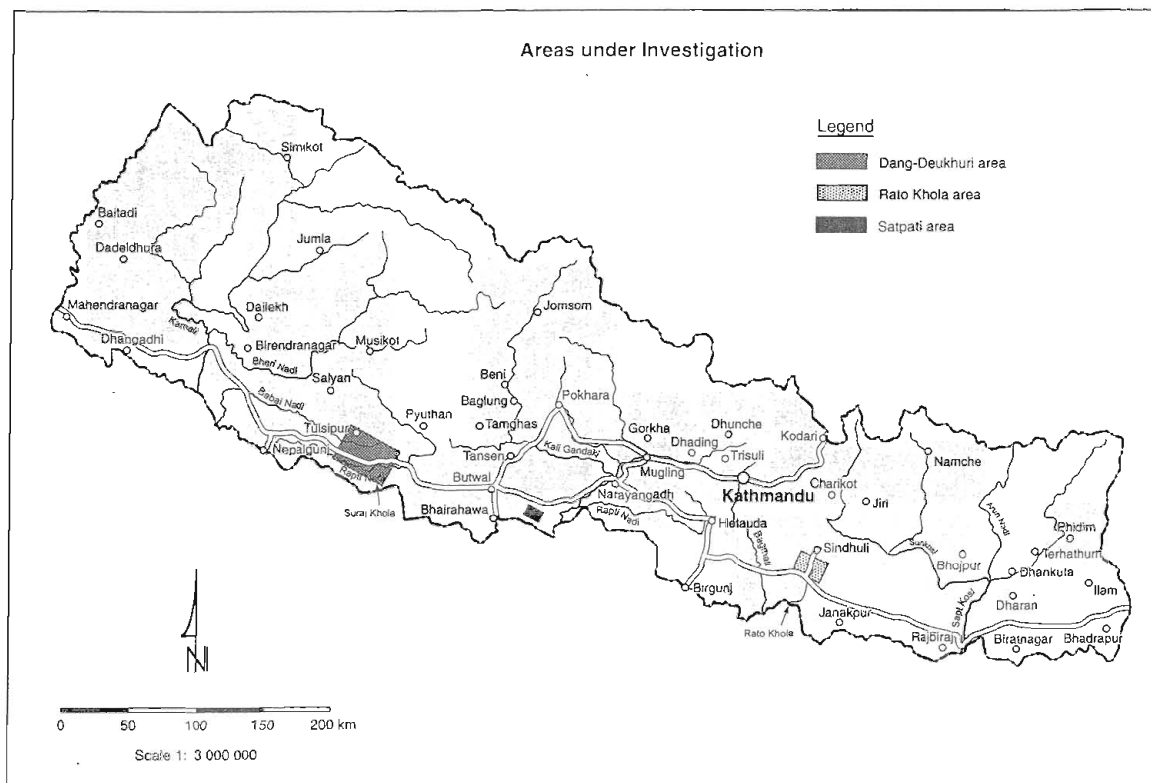


Fig. 1. Map of Nepal with areas of investigations indicated.

det construction through the hills during 1983–1986, exposing all sediments in fresh conditions. When these rocks proved to be fossiliferous as well, and when, after several consecutive traverses through the Siwalik belt, another area of Upper Siwalik sediments at Rato Khola in Mahottari District in eastern Nepal yielded a rich vertebrate fauna, I received permission from the Central Department of Geology through its Head of the Department, Dr. M. P. Sharma, to work in these areas. Thus I started to concentrate the investigations on a biostratigraphical study of the Surai Khola Siwaliks in the Dang-Deokhuri area.

During the geological and palaeontological fieldwork in the second year (1984/85) of the investigations I was fortunate to locate a first occupation site of a microlithic assemblage at Lamahi in the Deokhuri valley in Dang District, northwest of the Surai Khola traverse. The Deokhuri valley was formed as a tectonic valley within the Siwalik Hills during the uplift of the Siwaliks and was filled with post-Siwalik deposits. Artefacts had been eroded out from the top layer of a yellow silt fan overlying Siwalik bedrock at the northern margin of the Deokhuri valley.

Encouraged by the discovery of a microlithic occupation site, followed by another near Kurepani in the southern Dang valley, a survey was started on foot along the southern margin of the Dang valley, which was situated beyond the next Siwalik range to the north of the Deokhuri valley (Fig. 1 and 2). This valley was chosen because it was found to be filled-in with thick alluvial sediments of fluvial and lacustrine character. The deposits were in the process of being rapidly eroded away due to the heavy deforestation in the last 50 years, thus exposing the sediments down to bedrock.

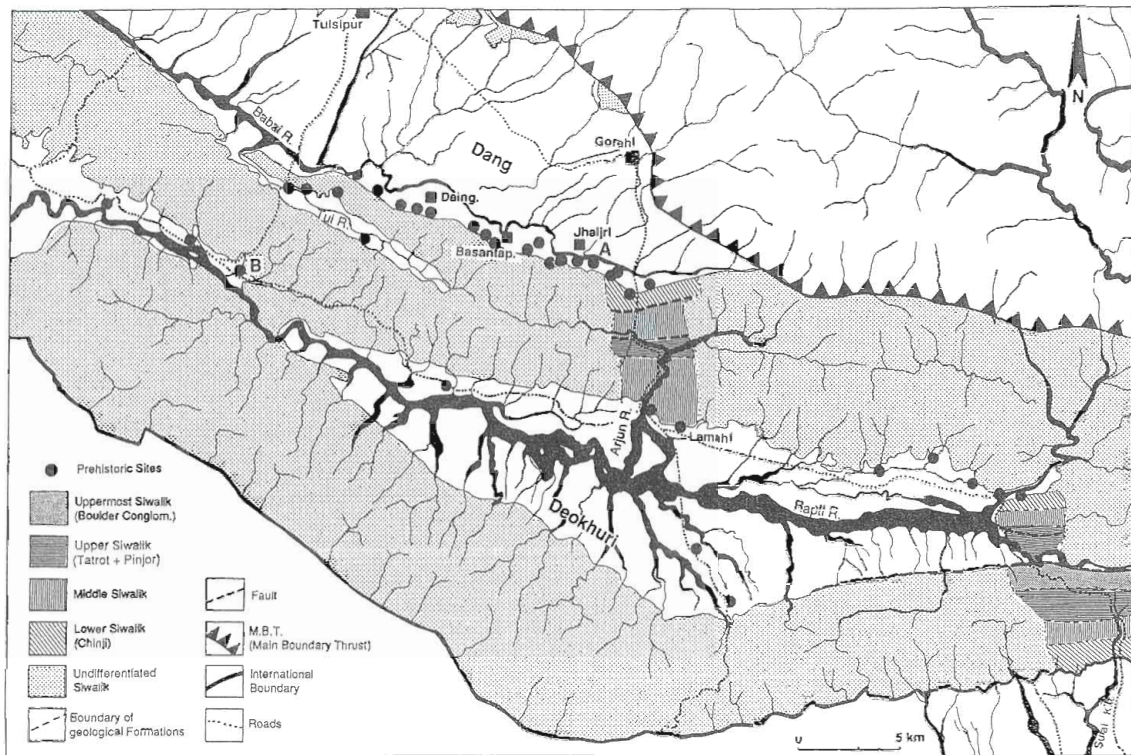


Fig. 2. Map of the Dang- and Deokhuri Dun valleys, western Nepal.

The heavy erosion, which dissected the alluvium into deeply cut badlands (though devastating in its effects on soil denudation) was a fortunate circumstance for discovering archaeological sites. It exposed sites of prehistoric settlements which had existed during and after the time of the valley alluviation.

The first survey yielded twelve sites in Dang valley, two in the adjoining Tui valley and three in the Deokhuri valley (Corvinus 1985). All these sites seemed to belong to Late Palaeolithic cultures of the Late Pleistocene or of the time of transition between the Pleistocene and the Holocene.

The discovery of these sites proved beyond doubt that Nepal, at least in the Dang-Deokhuri valleys, was not sparsely but quite densely occupied.

The survey in the next few years, which went side by side with the palaeontological investigations in the Siwaliks, led to the discovery of an abundance of sites, particularly in the Dang-Deokhuri area, but also in the other area of palaeontological study in the Rato Khola area in Mahottari District.

In the Rato Khola area (Fig.3) in the eastern Siwalik Hills, the richest fossil collection of an Upper Siwalik (Plio-Pleistocene) fauna so far known from Nepal has been made from within thick sandstone exposures along the Rato River (Corvinus 1988; Corvinus & Nanda 1994; Corvinus & Rimal 2001). This river emerges from the Siwaliks into the Terai and has formed a well-developed terrace system near the village of Patu. The highest 60 to 80 m terrace, yielded in its upper silt horizon a very rich Mesolithic workshop with thousands of artefacts eroding out at the terrace slopes.

This site, called Patu after the village, was studied in detail between 1985 and 1987 (Corvinus 1987, 1989).

After 1987 the survey was again concentrated in the Dang-Deokhuri area, where the previous sites were found. The aim was to establish a chronological order of the various cultural units and sites. At the same

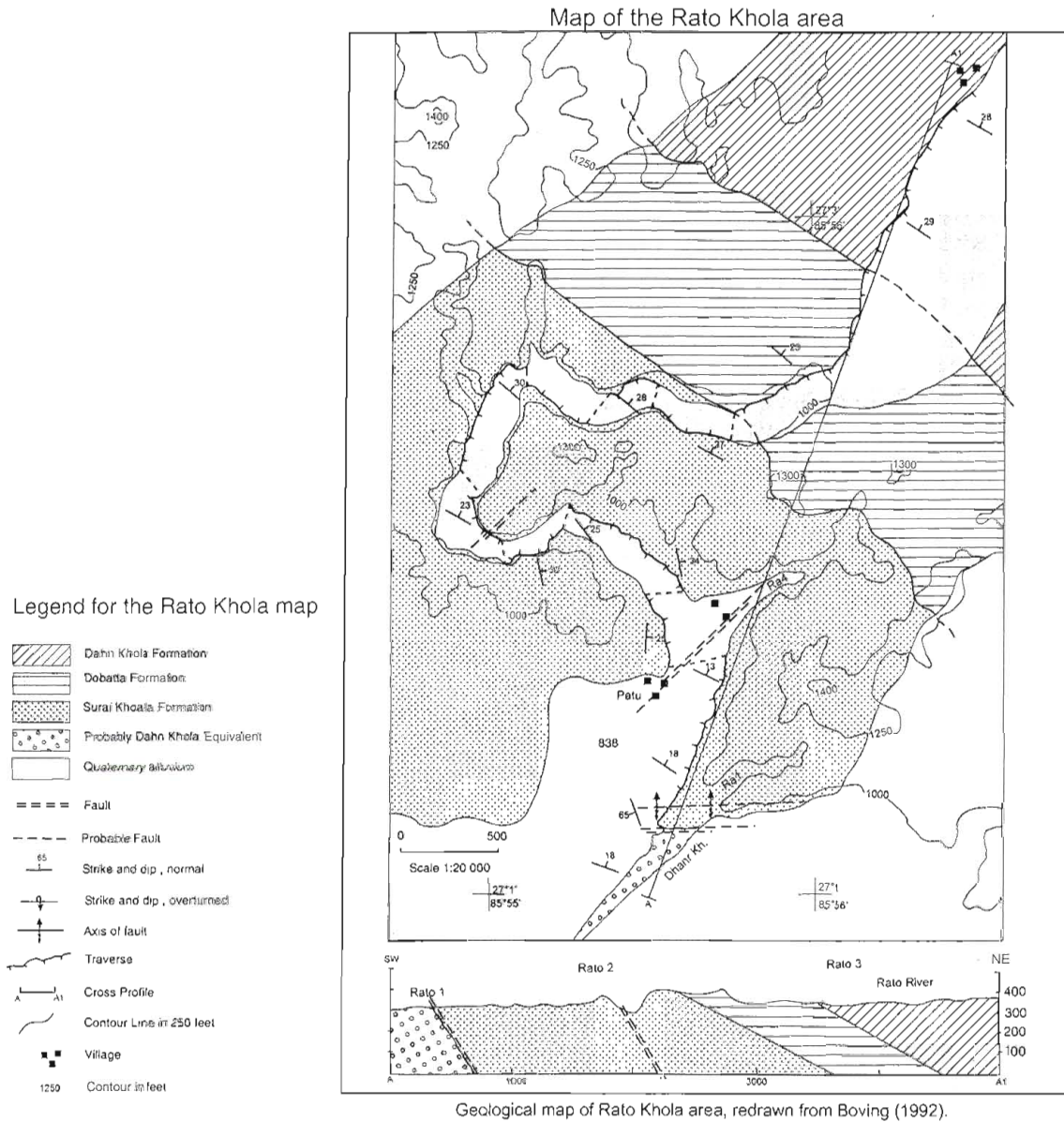


Fig. 3. Geological Map of the Rato Khola area, eastern Nepal.

time the stratigraphy of the valley alluvium and the Quaternary geology of the area had to be studied and understood.

Many more sites were discovered during these investigations. Of particular interest was a site, called Arjun 3, near Lamahi in Deokhuri valley. It was embedded at the base of an 8 m alluvial silt deposit and consisted of a Middle Palaeolithic flake industry with blades, points and levallois-prepared cores, the first of its kind in Nepal, and in a stratified context.

The most unexpected site, however, was found in March 1990 in the Dang valley, where at Gadari a number of handaxes, a cleaver and other associated artefacts of the Early Palaeolithic came to light from a

basal rubble gravel in the Dang alluvium. This discovery established the fact that Palaeolithic occupation in the foot hills of the Himalayas in Nepal had already started in Early Palaeolithic times.

This, though, is not the only occurrence of Early Palaeolithic handaxes in Nepal. In January 1991 another site was located in a particularly interesting situation at the foot of the Himalayas in western Central Nepal where the Narayani river emerges into the plains. Here, while mapping the geological structures along the Frontal Churia Thrust with Japanese colleagues in January 1991, a few handaxes and other bifacial tools were found in steeply dipping and tectonically folded sandstones of Upper Siwalik origin which became involved in the last phase of the Himalayan uplift and folding. It proved, that Early Palaeolithic man had lived here at the foot of the rising mountains before the latest folding of the Himalayan foot hills.

Other interesting sites discovered include two more microlithic localities (apart from Lamahi) which were found in 1990 within alluvial silts of the Deokhuri valley near Bharatkund and in a colluvial silt fan at Ammapur in the Tui valley. A few small localities of Neolithic appearance with hand-made, cord-marked pottery sherds and small polished axes could be found in the Dang and Tui valleys. At Sanpmarg and Lape at the eastern-most end of the Deokhuri Dun valley an industry consisting almost exclusively of end-choppers was found in a horizon of a buried red soil within the oldest terrace.

In the narrow river valleys of the Mashor and Arjun river, between the Dun valleys of Dang and Deokhuri, a survey of the well-exposed Siwalik strata along the Arjun river was carried out as well. Here a number of flaking sites on the surfaces of the highest 60 to 80 m terraces could be located.

These are only a few of the more interesting localities, but altogether more than 100 sites were recorded during the survey (76 in Dang-Deokhuri alone) and these will be described area-wise and then in chronological order after the site-description and artefact analysis.

No previous records of the palaeolithic history of Nepal existed, and the Quaternary geology of the Duns and the river terraces remained unsurveyed till now. This is a first attempt at interpreting the vast collection of data in a hitherto virgin area, and the author excuses herself for any shortcomings which may be the result of pioneering work. Future researchers will be able to fill in the gaps and reinterpret the history of Nepal's earliest inhabitants in the light of future additional data.

2. Previous Work

In the years preceding the present research several attempts had been made to investigate Nepal's prehistoric past. The Kathmandu valley was explored for prehistoric remains by Joshi (1964) during an archaeological mission from India, but though the survey yielded no findings he postulated that further systematic search would prove successful. Bannerjee and Shatma from the Department of Archaeology, Kathmandu, investigated the Narayani River valley in the Nawal Parasi district in the Terai (Bannerjee 1969). They mention a few tools found on the surface below a pebble bed in the vicinity of the village Danda. They called these „handaxes, cleavers and scrapers“, though they gave no descriptions nor figures in their publication. The author has visited the site and has also seen the artefacts but is of the opinion that the artefacts are naturally worked river cobbles rather than man-made tools. They seem to have been eroded out from a recent to subrecent river gravel, probably reworked, of a young terrace close to the Rapti River in the Chitwan Dun, in a situation where prehistoric artefacts would not be expected. The merit of this investigation, however, is that it was the first attempt at looking into Nepal's prehistoric past.

Later in the same year, Bannerjee & Sharma (1969) described a number of unstratified Neolithic polished axes from Nepal and Sikkim found at various places. The most interesting one is an elongate polished

axe, picked up from the surface on the bank of a small stream. Made of a whitish-grey phyllite, it had been reported by Panday in 1966 from the Dang valley near Tulsipur. This tool must have had its origin from some site nearby. Sharma (1983) described a few more polished axes, of which only the one from Kottari on the Danda Khola is of interest, as it represents the only specimen where „the find spot is known“. Most of the other axes are of black dolerite or basalt, like the ones one can occasionally buy in the bazaars of Kathmandu and may have been brought into Nepal by migrants, having been used as „shaligrams“ for religious practices.

Some preliminary neolithic survey had been carried out by the late A. Laming-Emperaire (1975) and she quotes the surface findings of two polished celts at Timal, 45 km east of Kathmandu, but without further description.

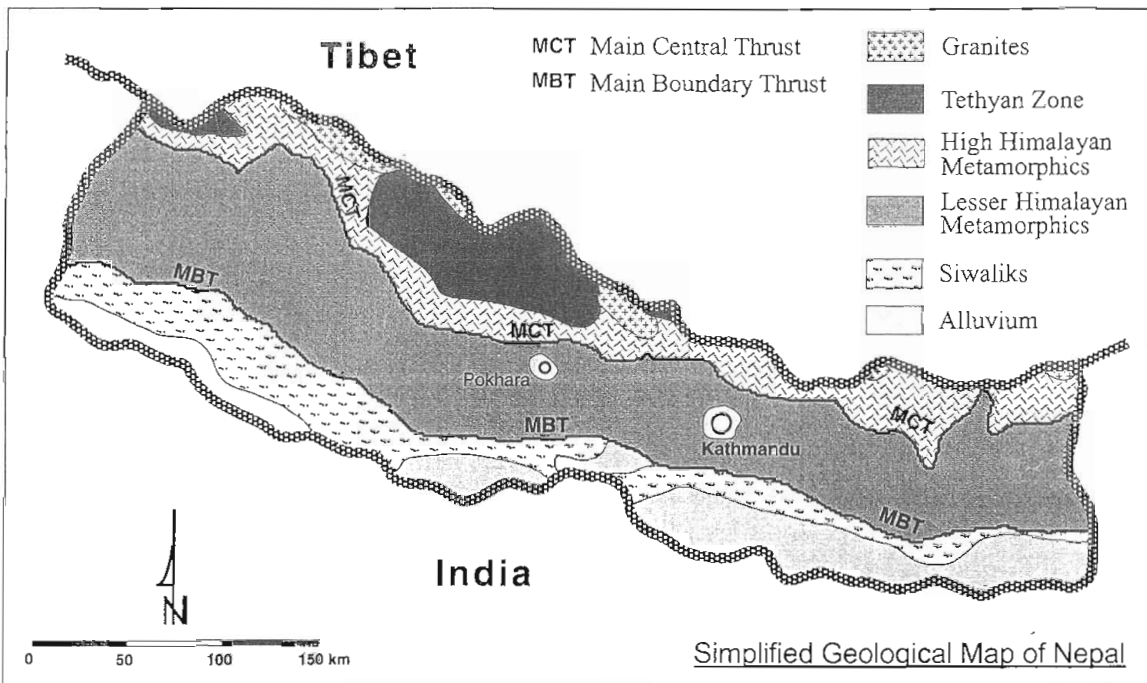
After discovering a few polished axes within a stratified context during the survey in the Dang valley I was convinced that people of the Neolithic period must have also occupied the Kathmandu valley. Although I started to carry out some prehistoric investigations in the Kathmandu valley the search was soon given up, as the continuous tilling of the terraced fields must have destroyed any signs of early settlements.

II. Geographical data of the Dang-Deokhuri area

1. Geography

Nepal, a small country of 147,000 sqkm, lies between the 80th and 88th longitudinal degree and between the 27th and 30th latitudinal degree. It is a landlocked, mountainous country with only a narrow strip of flat land in the south, the Terai. The mountains, the highest in the world, rise to more than 8000 m, forming an enormous barrier between India and Northeast Asia.

The hills of the Siwalik range form the lowest, southernmost range of mountains of the Himalaya (Fig.4). They rise up to about 1000 m or slightly more. Their deposits, made up of fluvial molasse sediments, are only moderately consolidated and weather easily, particularly the upper, younger part of the se-



Source: Mineral Resources Map of Nepal, UN Publication, 1993

Karto-Atelier 2000

Fig. 4. Map of Nepal with major geological units indicated and with the Main Boundary Thrust (MBT), separating the Siwaliks from the Lesser Himalayan rocks.

quence. The hills, therefore, form steep, brittle slopes with numerous landslides. The steep and brittle nature of the slopes do not lend themselves to agriculture, for which reason they are the least cultivated and the least disturbed belt between the plains and the snow-covered range of the High Himalayas. They are still covered with relatively dense forests (Pl.202/1).¹

The rivers draining the Siwaliks, and steeply dissecting them, have cut their valleys, – often with sets of terraces, – into the axial centres of the anticlines and synclines, thus running mainly east-west along the strike of the mountains. In order to reach their base in the plains they cut their courses at certain places southwards against the strike of the range and here form narrow, steep, V-shaped valleys before they enter the Terai plains. The flat Terai is part of the wide, alluvial Indo-Gangetic Plain.

The Siwalik Hills form the youngest orogenic belt of the Himalayas and were folded only in Early Pleistocene times. They consist of molasse sediments of sandstones, mudstones and conglomerates which have been derived from the rising Himalayas.

Where they emerge into the plains the rivers have often, but not everywhere, formed well-pronounced sets of terraces.

Besides these river-cut valleys, within the Siwalik hills there exist a number of wide, so-called Dun valleys, which have not been formed by river action, but by tectonic activities during the folding and faulting of the Siwalik Mountains. Into these basins thick amounts of alluvial sediments have been deposited by the rivers and also washed down from the surrounding hills as lateral deposits and fans in various phases of aggradation. Helped by continuing crustal movements and differential uplift, these alluvial deposits have filled the Dun valleys and have caused the formation of sets of higher and lower terraces in the valleys.

Best examples of such valleys in Nepal, and the focus of this prehistoric survey, are the Dang and the Deokhuri Duns in the Siwalik Hills in Western Nepal (Fig.5). The largest of the Dun valleys, the Chitwan valley in south central Nepal, has still to be surveyed. But occasional observations have verified the assumption that prehistoric sites are to be found in Chitwan, too, for example on the high terrace surface of Ramnagar, north of Narayangath, where a few choppers and coresctapers were found.

The search for prehistoric occupation places was carried out not only in these Dun valleys but also on the river terraces within the Siwalik hills in the Dang-Deokhuri area.

2. Climate

Nepal is a country with enormous physiographic contrasts, from the plains in the south with elevations of less than 150 metres to the highest mountains of the world (Mt. Everest with 8848 m height). The tremendous differences in height had a major impact on climate, vegetation and environment, causing vast variations in temperature and rainfall in so small a country. Rainfall varies from less than 200 mm in the highland desert of Mustang and Tibet to highest rainfalls of 4700 mm in the central mountains northwest of Pokhara. Temperatures, too, vary greatly with annual minimums of less than 0 degrees in the high mountains to summer maximums of more than 39 degrees in the Terai near Nepalganj. Such contrasts give rise to enormous differences in the vegetational cover, from sub-tropical forests in the southern plains to arctic conditions in the snow-covered mountains and desert vegetation on the highland plateaus.

¹ All photos are also scanned on a CD, included in volume II. They are listed according to their plate number and their photo number.

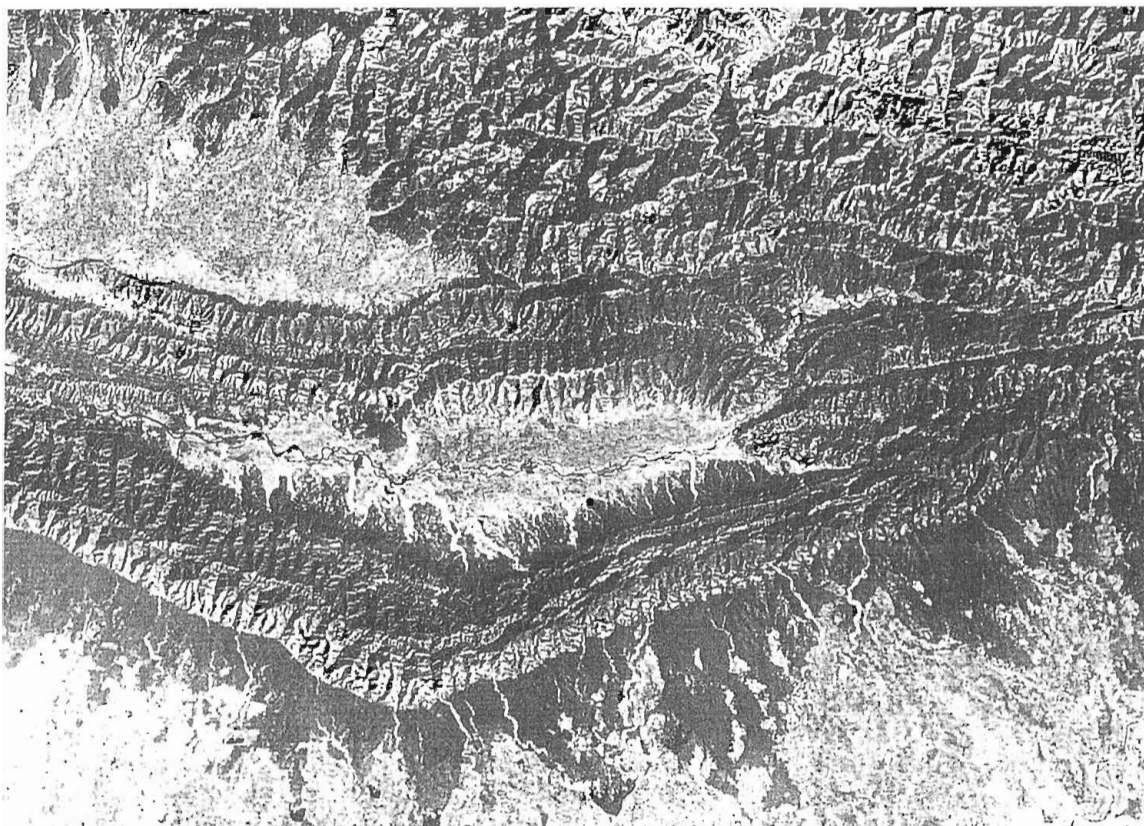


Fig. 5. Landsat image of the Surai Khola area (at right) and the two Dun valleys of Dang (at upper left) and Deokhuri (at centre) (after Corvinus & Rimal 2001).

The surveyed area of Dang-Deokhuri in the foothills of the Himalayas lies in a rainfall area of mean annual precipitation of 1600-2000 mm (Icimod GIS data, 1996). Tulsipur in the Dang Dun valley, at a height of 663 metres, received an annual average rainfall of 1700 mm between 1961 and 1980 (Panday 1987) and had temperatures between a summer maximum of 35°C to a winter minimum of 7°C. Icimod GIS data (1996) shows mean July temperatures of 27-30°C and mean January temperatures of 12-15°C. Night temperatures in winter in Dang, however, can go down occasionally to zero degree. Compared with this Kathmandu at a height of 1340 m has a mean annual rainfall of 1400 mm and temperatures range from minimum 2 degrees in winter to maximum 30 degrees in summer; while Namche Bazar at the foot of Mt. Everest at a height of 3880 m has a mean rainfall of 900 mm and temperatures between minus 8 degrees to maximum 16 degrees in summer.

The mean annual rainfall (mm) and minimum and maximum temperature (degree celsius) is given in Table 1.

Tab. 1: Mean annual rainfall (in mm) and minimum and maximum temperature (degree celsius) at various heights.

	Height	Rainfall	Minimum	Maximum
Terai (Nepalganj)	150 m	1263 mm	9	39
Terai (Bhairawa)	105 m	1580 mm	8	37
Dang Dun (Tulsipur)	663 m	1706 mm	7	35
Midland (Pokhara)	820 m	3365 mm	7	29
(Kachmandu)	1340 m	1400 mm	2	30
High Himalaya:				
(Tshyangboche)	3830 m	988 mm	—	—
(Namche Bazar)	3880 m	—	-8	16

(after data from Panday 1987 and Shrestha 1989)

3. Vegetation

The fertile plains of Nepal, called the Terai, were once covered by tropical deciduous forests, dominated by Sal (*Shorea robusta*) and associated with *Terminalia tomentosa*, *Lagerstroemia parviflora* and with a Khait-Sisau riverine forest (*Acacia catechu* and *Dalbergia sissoo*) together with tropical elephant grasses along the river sides. Tropical evergreen forests are not present (Shrestha 1989).

The part of the Terai, which is situated directly at the foot of the mountains, is called the Bhabar zone. This is the narrow belt of less fertile soil which consists of coarse alluvial debris of porous sands and gravels which, however, allowed the growth of thick forests. The Bhabar zone was once the legendary belt of virgin jungle of Sal forest with a great wealth of wild life. Now the virgin jungle has almost disappeared, except for a few restricted areas, and the wild life is almost extinct except where it is preserved in reserves.

The Terai plains beyond the narrow Bhabar zone is now heavily cultivated by people who have moved down from the overpopulated mountains in the last 50 years and have cut down the existing forests. The soil is fertile and is used for the cultivation of rice, wheat and maize and for cash crops of sugarcane, tobacco, jute, oil seeds etc. Large forest tracts are rare and trees are crippled for fodder. The only large trees left are Simal trees the wood of which is not useful. In recent years the plantation of Sal and Sisau is being encouraged, but lacks care and maintenance. If the population is not educated to plant trees or made aware that by saving trees they are saving their own environment, the last forests will soon disappear and we can only dream of the rich natural environment with their wealth of resources in which our prehistoric ancestors have lived.

The Siwaliks are much less populated due to the craggy nature of the hills and due to the poor soils which are less fertile and rather porous. For this reason they are still quite forested, and a few remnants of virgin forest still exist in isolated areas in deep gullies. Yet, even the Siwalik forests are being thinned out by the indiscriminate cutting of trees by the people of the neighbouring Terai. The principal forest type was once a sub-tropical deciduous forest. The lower part of the hills were covered by forests of Sal *Shorea robusta* in association with *Terminalia tomentosa*, *Bauhinia vablii* and *Phoenix humilis* while the hill tops were covered by Chir pine (*Pinus roxburghii*) forests. But now most hills of Dang Deokhuri are only covered by shrub vegetation.

The Dun valleys within the Siwalik mountains, too, were once covered with forests of Sal and *Terminalia tomentosa*, of which nothing is left except occasional strips of straggly Sal woods along the valley margins.

Only very recently some afforestation is taking place. The fertile soils of the Dun valleys are extensively cultivated now by rice, wheat, maize, but due to the deforestation of the flanking hills, the denudation of the soils, especially of the higher surfaces, is rapid. Along the valley margins, on the „shoulder“ between the hill slopes and the valley surface the erosion of the older fertile valley alluvium is so tremendous, that it has destroyed the area turning it into a typical badland topography (Pl.243/1). A few Sal trees struggle to survive, but have little chance. The continuous fodder-cutting of the trees and the yearly setting of fires in order to burn the dry grass, destroys also the young Sal saplings. It is a sad picture and the situation appears quite hopeless, as the population is still not aware of the necessity of planting vegetation, if only for the roots to hold the soil. Deforestation and grazing have left the surfaces completely blank, vulnerable and bare of any vegetation, so that the yearly heavy rains cut deep, vertical ravines into the soft, unconsolidated alluvium. Whatever efforts had been made in the last decade by the government for preservation and reforestation are now endangered again through the Maoist uprising. Vigilance to protect the forests is diminished out of fear, and bribery, and cutting of trees is worse than before.

4. Population

In 1997 the population of Nepal was 22.3 million, (the recent census of 2001 is 23.2 million). It increases frighteningly with an annual rate of 2.66. In 1960 the population was 9 million, in 1981 more than 15 million, with an average density of 102 people per square kilometer. A recent census showed that 45 % of the population are children under 14 years of age.

Such population increase has affected dramatically the natural balance between environment and man. The destruction of the environment is inevitable: in 50 years time there will not be enough land for the estimated 44 million people, if the population continues to grow at the same rate.

Some 50 to 60 years ago the virgin forests of the Terai and the Siwaliks were still intact and people shunned those areas because of malaria. After the eradication of malaria the expanding hill population moved into the Terai in search of new land to cultivate. The virgin forests have disappeared. Hand in hand with the increasing population and increasing deforestation a drastic increase in erosion, especially in the Dang and Deokhuri valleys has created a desertic landscape of badlands which washed away much of the fertile surfaces. This has happened only in the last 50-60 years. The story of an old farmer at Dongpur in Dang is an example of the dramatic change in landscape. We were examining the Dongpur badlands with the sensational feature of a huge block of sandstone perched on an almost 20m high column of alluvial silt, which was preserved only because of the sandstone block lying on top of it (Pl.243/2). All the surrounding alluvial silts of the terrace was eroded away. He told us, that as a child he was sitting on the big block while his goats were grazing all around him on the then still intact terrace surface. The block is unapproachable now. That means that 50 years ago the terrace surface was still more or less intact and that the erosional destruction has happened only in the last half century.

The original population of the Dun valleys of Dang Deokhuri and the Terai are the Tharus. They belong to the Tibeto-Nepali groups, like the Gurung, Thamang, Magar, Sherpa, Rai etc. The Tharus, however, do not have the same physical appearances as the just mentioned groups and have less pronounced mongoloid features. Shrivastava (1958, 133) says that „the Tharus are a Mongoloid people, or predominantly so, who have successfully assimilated non-Mongoloid physical features as well“. That states it very well. According to Bista (1980, 118) the Tharus are probably one of the oldest groups to inhabit the Terai and the Duns. „The traditional territory of the Tharus is called the Tharuwan or Tharwot. It consists of the

forested land along the southern base of the Shiva-lekh (Siwalik) mountain range". The Tharus are by tradition peasant farmers. There seem to be various stories about the origin of the Tharus. They themselves believe that they are descendants of the Rajputs from Rajputana in India dating to the time of the Islamic invasion.

In the last 50 years the Tharu population has been infiltrated and replaced increasingly by Indo-Nepalese groups of Brahmins, Khas and Chhetris from the hills, who bought the best land from the Tharus. According to Bista (1980, 119) „most of the Tharus in Dang-Deokhuri have been greatly exploited by ruthless *zamindars*, (wealthy landlords), landlords and revenue agents.“ Many Tharus had to sell their land, being forced to it by poverty and debts, and are now exploited as labourers by the new landowners. The Tharus are fine, honest, hard-working, cheerful and quite artistic people. There seem to be many different sub groups of Tharus. In Dang and Deokhuri they distinguish themselves by their dresses. The Dang Tharu women have short, white lungis, while the Deokhuri women wear wide, long, beautiful skirts in the fashion of the Rajasthani women, which makes their movements very graceful. Tharu women in Deokhuri are a lovely picture with their colourful flowing skirts and their erect, statuesque movements when carrying their burden of water vessels on their heads.

Both groups, the original Tharus and the new groups, live in separate villages, or at least in different parts of a village. Tharu villages look very different from the villages of any other group. When entering a Tharu village one is struck by its well orientated lay-out. Most houses are orientated North-South or East-West at right angles to each other (see photo 26 in T. Hagen 1980). They have low, one-storied long-houses with thatched roofs (Pl.202/2). Some of the houses are very long indeed, up to 20 m. The walls are of bamboo-lattice work and are plastered with mud from the inside and the outside. Their artistic nature expresses itself in interesting decorations of mudreliefs of animals and people on the outside house walls. People and animals live under the same roof. They are well organised inside, with kitchen and sleeping quarters separate. Large storage jars, made of mud and often artfully decorated, standing on legged pedestals, separate the living quarters from the animal stalls. They are interesting, cozy houses. My first impression, while entering a Tharu village, was of having stepped back in time to the Neolithic. It was an intuitive impression, but has never left me, that the Tharus had links with the last prehistoric population of Neolithic origin of the Dang-Deokhuri area.

Though they do not know anything about polished stone axes, which are found in the valleys, the women still produce shallow bowls of hand-made pottery (Pl.202/3), apart from their wheel-made pots. The Deokhuri valley is known for the fine pottery, the finest and thinnest in the country. They are made by a special potter community, the Kumars. The village Lamahi, which is developing into the „capital“ of the Deokhuri valley, is the centre of this pottery making (Pl.203/1). One often sees groups of potters, carrying large bundles of their ware over the hill tracks to the north and into the Terai, wearing their particularly colourful skirts.

There are many interesting avenues for research in Dang-Deokhuri: following up the discoveries of the oldest cultural remains of prehistoric times; seeking the origin of this special pottery making, and tracing the origins of the Tharus themselves, who are the oldest inhabitants of the Dun valleys. Can there be a link to the Neolithic people? ¹⁴C dates obtained from some Neolithic sites in Dang are very young indeed.

III. Geological and Stratigraphical Observations

Before describing the alluvial sediments of the Dun valleys a short description of the Siwalik geology and the formation of the Dun valleys is necessary.

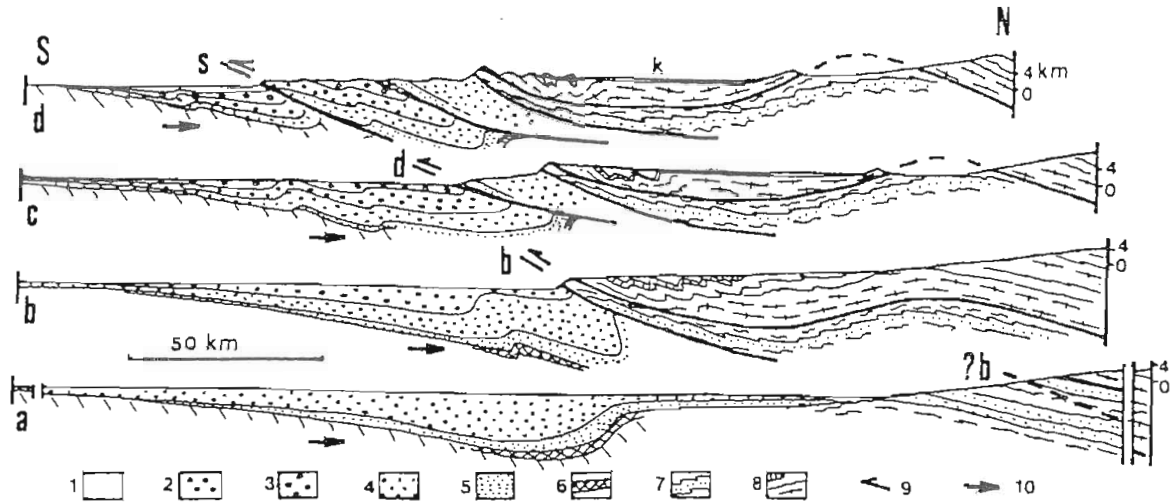
1. The geology of the Siwaliks and the forming of the intermontane Dun valleys and their geomorphological features

The Siwalik Hills form the youngest orogenic belt of the Himalayas and were folded during the last phase of the Himalayan mountain building process. They consist of up to 6000 m thick molasse deposits of sandstones, mudstones and conglomerates which have been derived from the rising mountains and have been deposited during Later Miocene to Pleistocene times into the foredeep in front of the Himalayas before they were uplifted. They became uplifted and folded and fractured only in Early Pleistocene times to form the Siwalik foothills. Older rocks of the Lesser Himalayas were thrust by the Main Boundary Thrust (MBT) over the fractured Siwalik sediments. These tectonic activities which gave rise to the Siwaliks, are characterised by the movements of a sequence of north-dipping thrust sheets which have been emplaced successively from north to south. They also led in the area under study to the formation of two intermontane valleys, so called Dun valleys, the Dang and the Deokhuri. According to Mugnier et al. (1994) and Mascle et al. (1986) the monoclinical structure of the hanging walls along the thrusts were responsible for the formation of troughs to the south of the hanging walls (Fig.6). The Dun valleys are a result of this activity; they are not normal river valleys formed by the cutting activities of rivers.

After their tectonic formation they began to be filled by Quaternary alluvial sediments of fluvial and lacustrine character. Stratigraphical data and ages of the alluvial fill were not available previously, and the present investigations yielded the first preliminary results on the ages and the stratigraphy of the Dun valley alluvium (Corvinus 1995).

The two Dun valleys are geographically separated from each other as well as from the Terai plains by two ranges of Siwalik hills (Fig.7), a southern belt which separates the Deokhuri Dun valley from the Terai and a northern belt which separates the southern Deokhuri valley from the northern Dang Dun in a more or less NW-SE direction. North of the Siwalik range, beyond the MBT, which forms the boundary between the Siwaliks and the higher Himalayas, follow the Lesser Himalayan metasedimentary rocks.

The wide Dang Dun valley with a length of 50 km and a maximum width of 17 km has an average elevation of about 650 m a.m.s.l. in the centre. But as the valley floor is tilted it has an elevation of about 600 m in the south at the Babai River and an average elevation of 750 m along its northern border, north of Gorahi and Tulsipur. The equally 50 km long Deokhuri Dun valley with a maximum width of 10 km has a considerably lower elevation of an average of 250 to 280 m a.m.s.l. in the centre, while beyond the southern Siwalik belt the Terai starts with elevations of 150 m and lower (Fig.8), for example south of Surai Naka.



1 : Gangetic Quaternary and (k) Plio-Quaternary of the intra-Himalayan basins (Kathmandu, Kashmir); 2 : upper Siwaliks, Plio-Quaternary, conglomerates and sands (< 5 MA); 3 : middle Siwaliks, Mio-Pliocene sandstones, pelites and argillites (10 to 5 MA); 4 : lower Siwaliks, Miocene sandstones and pelites; 5 : Darhamsala and Murrees; Oligo-Miocene fine sandstones; 6 : volcanics of possible Upper Paleozoic age and Precambrian of the Indian shield; 7 : midlands sequences, schists, quartzites and marble mainly of Upper Precambrian age, Upper Paleozoic and Middle Eocene levels are present; 8 : high Himalayan sequences, Upper Precambrian to (here) Lower Paleozoic; 9 : active thrust; 10 : motion of the Indian shield; a : during sedimentation of the lower Siwaliks (= 15 MA), possible beginning of motion of the MBT (?b); b : during sedimentation of middle Siwaliks (between 10 and 15 MA), motion of the MBT (b); c : during sedimentation of the upper Siwaliks (between 5 and 1 MA), motion of the Dun thrust (d); d : present day configuration, motion of Siwaliks thrust (s). The thrust front is the place in which the major part of the shortening occurs, as suggested by the sketch, the active boundary should, however migrate to the south.

Fig. 6. Evolutionary sketch of the Siwaliks (after Mascle & Herail 1982).

Both valleys are drained by a major river which flows east-west along the strike or axis of the Dun valleys: the small Babai River in Dang, which does not extend beyond the MBT, and the larger Rapti River in Deokhuri, which reaches far into the inner Himalaya.

Their drainage patterns differ, however, sharply from each other. They are influenced, each in different degrees, by young tectonic movements. While the Rapti River runs in a wide, braiding bed through the centre of the valley, thereby reflecting stability of the valley floor, the Babai River in Dang flows in a more or less western direction along the very south of the wide valley, and all tributaries, except the Tui Khola, flow southwards across the entire Dun valley to join the Babai River. It reflects uplifting of the northern part of the valley by rather recent tectonic movements along its northern border at the Main Boundary Thrust. This is also observed by Yamanaka & Yagi (1984) who report that the mode of the crustal movements control the distribution pattern of the terraces in northern Dang. These movements have affected the geomorphological characteristics of both valleys, resulting in differences of morphology and sedimentology.

The Tui valley, the only southern tributary of the Babai River, runs parallel to the Babai, before it suddenly turns northeast, leaving the Siwalik hills and joining the Babai River. It has an elevation of an average of 600 m like the southern Dang valley. It is only 18 km in length, but has a width of 2 km through most of its length. The small Tui River itself with its low water regime is an underfit stream in its wide valley and does not explain the extensive and thick alluvium of the valley.

Map of Dang–Deukhuri area, W-Nepal

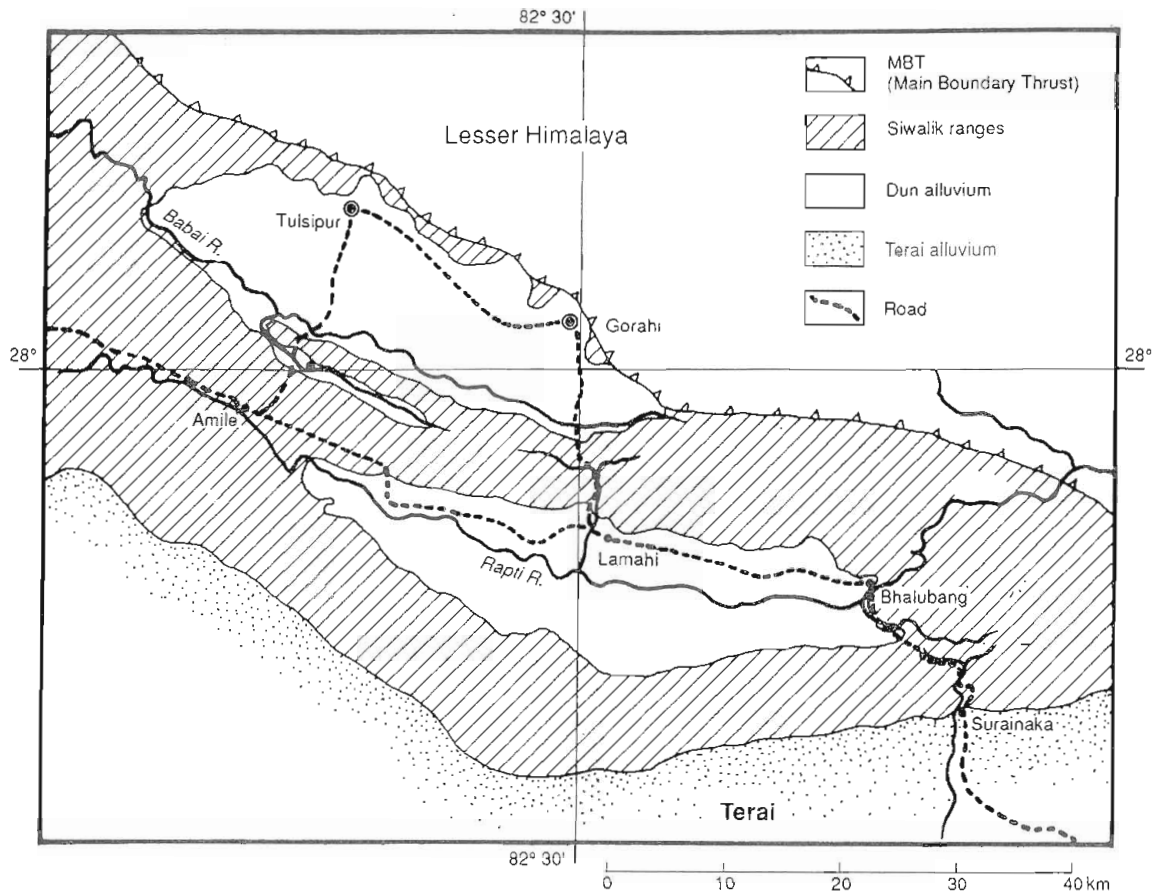


Fig. 7. Map of the Dang- and Deukhuri Dun valleys within the Siwaliks, bordered in the south by the plains of the Terai and in the north by the Main Boundary Thrust (MBT).

The source area of the Tui River in the east has a wide, trough-shaped valley, which seems to be an older, superimposed valley by a former larger stream. The recent small Tui has cut its insignificant bed into this wide valley.

To the east of the source of the Tui River lies the source of the small Mashot River which runs eastwards to join the westward flowing Arjun River. The Mashot and Arjun Rivers jointly turn southwards and from here on becomes the Arjun River (Fig.9). They have entrenched their V-shaped bed deeply into the Siwalik rocks, forming a set of 60-90 m high river terraces, covered by red soils, before reaching base level in the Deukhuri valley where it joins the Rapti River.

Comparing the drainage patterns of the Babai in Dang and the Rapti in Deukhuri there are striking differences. The Babai River is a very short stream and drains only the Dang valley itself. The hills directly to the east of the Dang valley are not drained by the Babai River, as one would expect, but by tributary streams of the Arjun River. The Rapti River of Deukhuri has a much longer drainage and comes from far inside the Lesser Himalayas. This also explains the difference in the bedload of both streams. While the

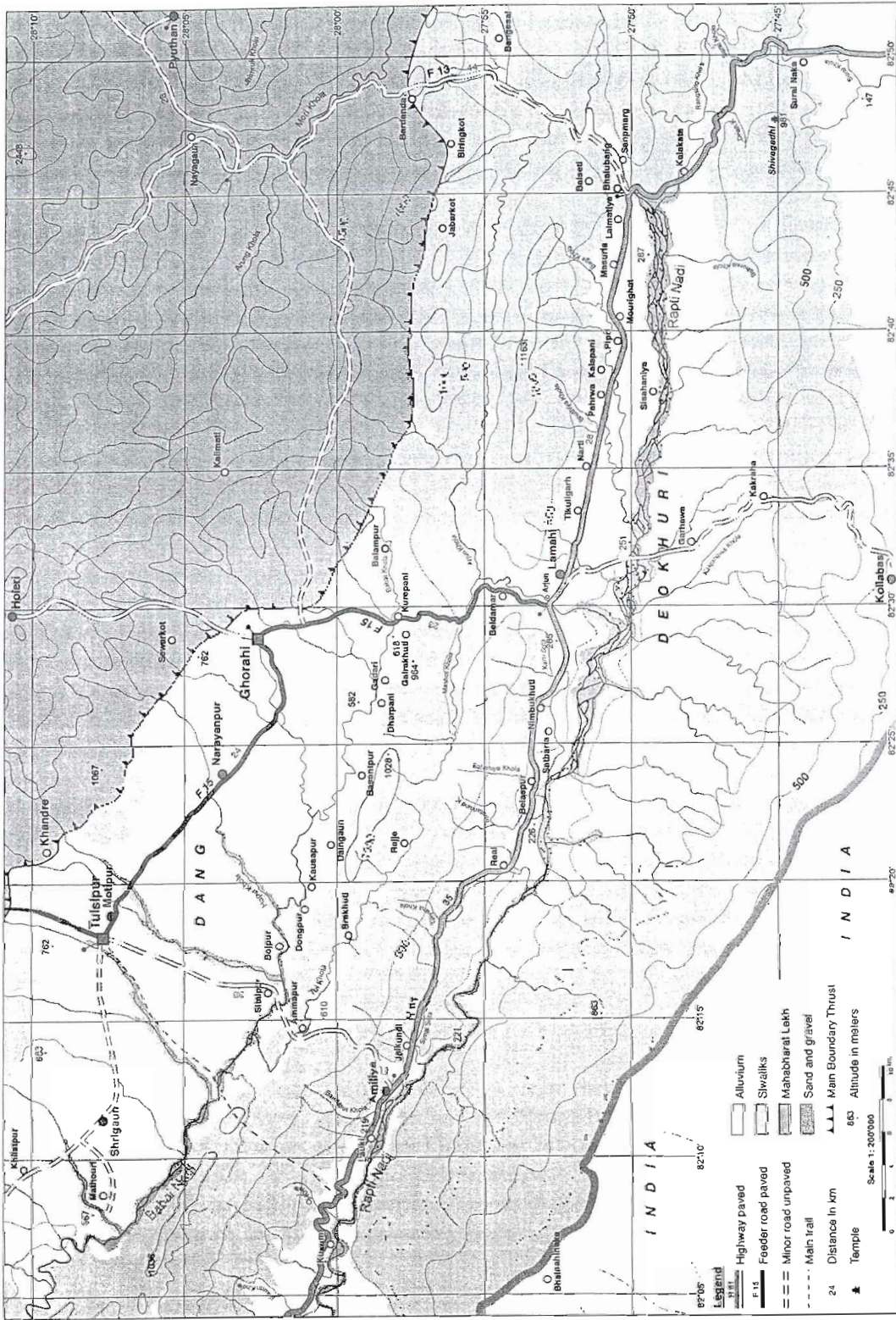


Fig. 8. General map of Dang-Deokhuri area, based on the older (better) topographical Survey (between 1950 and 1960).

Babai only carries a load of debris derived from the softer Siwalik rocks, the Rapti carries a differentiated load of rocks of Siwalik origin as well as hard rocks from the Lesser Himalayas.

The Babai River has other special features. At the western end of the Dang valley the Babai cuts suddenly through a gorge to join the Malai Khola, at a considerably deeper level. It is possible that the Malai Khola has captured the Babai River and that the Babai River was originally a tributary of the Rapti River, draining the Dang valley through the Tui valley and further through the Mashot and Arjun River southwards into the Deokhuri valley. The Babai River was captured later by the Malai Khola through the Babai gorge west of Babarapur, west of Mathouri (see Fig.8 at the NW corner of the map).

This would explain the wide, superimposed Tui valley and would also explain why the Tui River, as it is now, appears to be such an underfit stream.

Uplifting movements may have been the cause of the cutting off the possible former exit of the Tui to the south. It may also have caused the Dang and Tui valleys to be filled with lacustrine deposits of the Babai Formation before the river capture by the Malai Khola took place, draining the Dang valley through the Babai gorge west of Babarapur in a westerly direction. Renewed blocking after the capture may have been the reason for the aggradation of the swampy, clayey deposits of the Sitalpur Formation in Dang and Tui in the later Pleistocene (see chapter III.2.).

Another interesting feature observed in the Tui valley is that at many places in the upper drainage area a thick, well-rounded quartzite cobble-boulder gravel forms the base of the alluvium in the valley. The present small size of the stream and the low regime of the Tui would be unable to move the sediments of this volume. Nor could it have deposited such a well-sorted and even imbricated cobble gravel so close to its source. The question then arises as to what is the source of such unrelated, well-rounded quartzite cobbles. They could only have come from far beyond the Main Boundary Thrust. Another explanation for these quartzite cobble deposits would be outcrops of Boulder Conglomerate beds of the Upper Siwaliks below the alluvium of the Tui valley. At a few places conglomerate outcrops could be detected, but usually not of such cobble-boulder size. Everywhere else the geology of the Tui valley points to rocks of the Lower Siwaliks, where such conglomerates are absent or extremely rare.

The area just east of the Deokhuri valley has been mapped geologically (Fig.10), during the author's palaeontological investigations (Corvinus & Rimal 2001). But the western Dang area and the Tui area has not been mapped geologically in any detail and it is therefore too early to come to any conclusions concerning the origin of the basal cobble gravel. It is an intriguing question, as the basal cobble gravel in Tui has been extensively used by early prehistoric man for tool-making. The Siwalik area east of the Tui valley at the Arjun and Mashot Khola has been surveyed geologically by the author but it does not contain Upper Siwalik Boulder Conglomerates. It is very necessary for an understanding of both the Quaternary geology and the prehistory, to geologically map the area of western Dang, the Tui and western Deokhuri.

2. The Geology and Stratigraphy of the Dang, Tui and Deokhuri Dun Valleys

Quaternary geological data is extremely sparse in Nepal. Very little published data (except that of Yamanaka & Yagi, 1984) is available on the stratigraphy of the alluvium of the wide Dun valleys, the river terrace systems of the streams in the hills, and the alluvial fans emerging from the Himalayas into the Terai.

Such studies are, however, absolutely necessary for an understanding of the stratigraphy of the sediments in which the cultural remains have been found, and for the assessment of the palaeoenvironment, and the age of the sites.

Most of the sites in Nepal, discovered during this project, have their stratigraphical position in the Quaternary sediments of the Dun valleys.

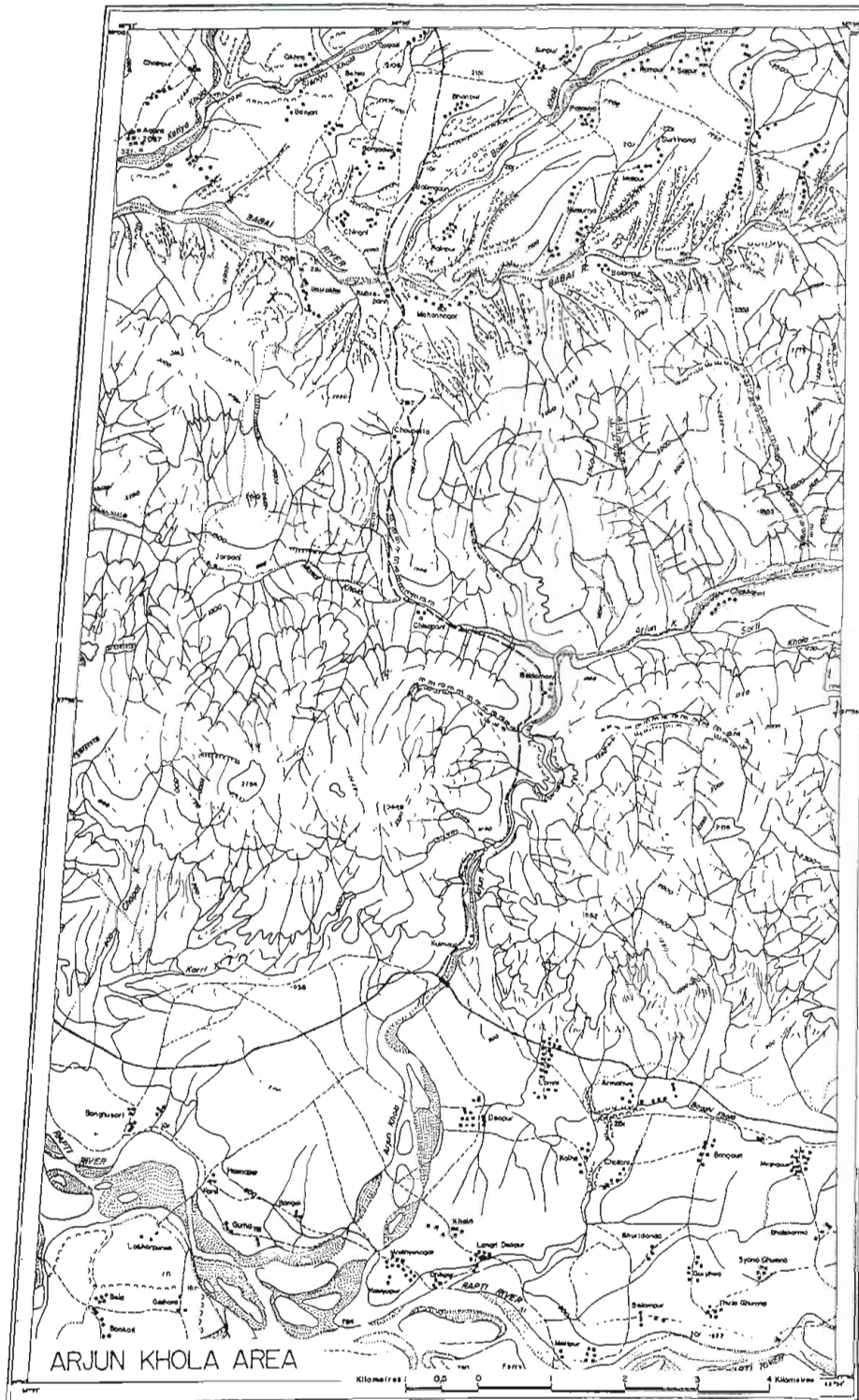


Fig. 9. Map of the Arjun and Mashot rivers, cutting their narrow valleys into the Siwaliks and draining into the Deokhuri Dun valley, at Lamahi.

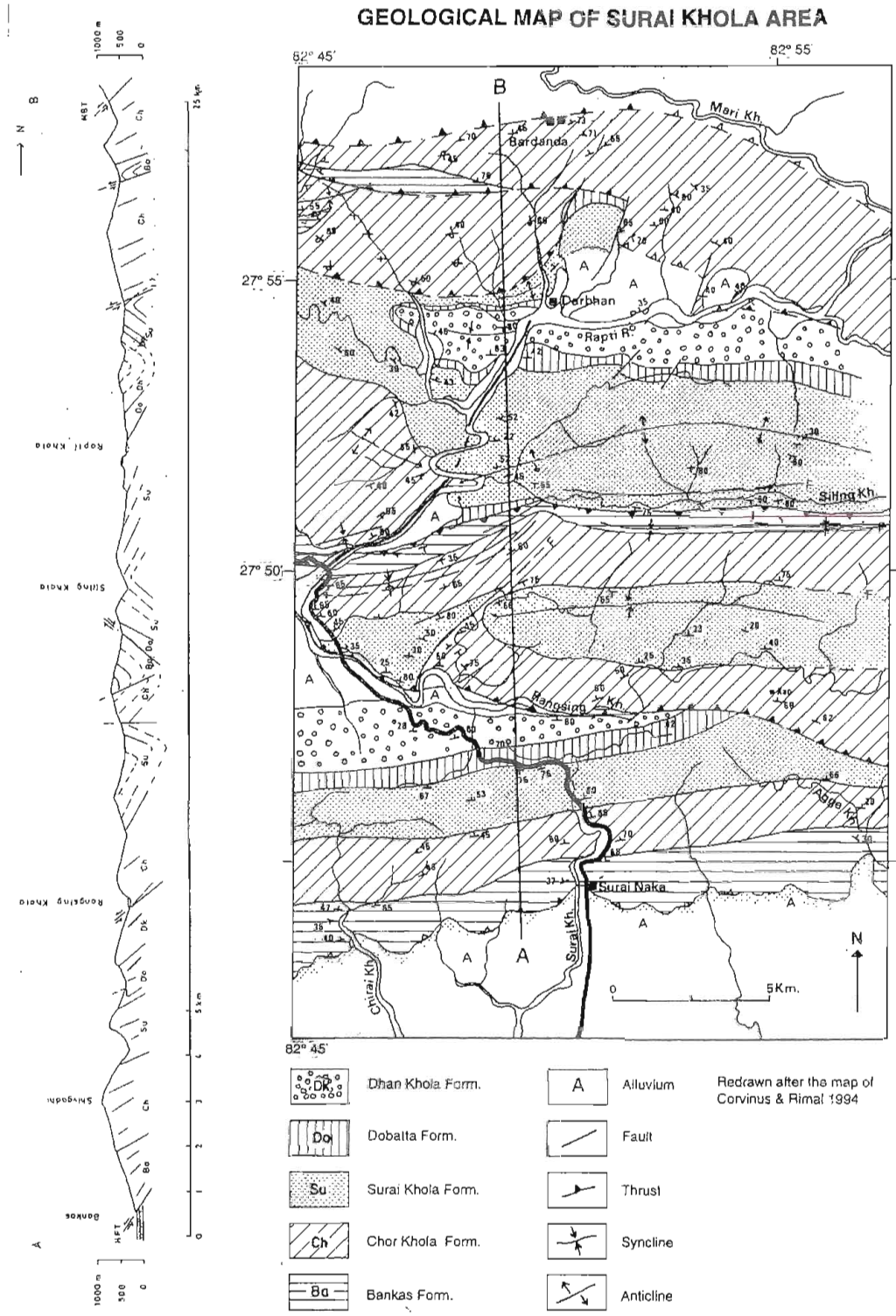


Fig. 10. Geological map of the Surai Khola area and north of it upto the Main Boundary Thrust (MBT) (after Corvinus & Rimal 2001).

The alluvial deposits of the Dun valleys have therefore been studied in greater detail along the southern margin of the Dang valley, in the Tui valley and in the Deokhuri valley where sites have been found. After careful study they have been divided by this author into three major formations: the older Babai Formation, called after the Babai River, along which the deposits are well exposed, the Gidhiniya Formation, called after the Gidhiniya village in the Tui valley, where these deposits have formed particularly well, and the younger Sitalpur Formation, called after Sitalpur village in the Dang valley at the type site of the Formation. These deposits form the Pleistocene alluvial filling of the Dun valleys (Fig.11,12). The three formations are best observed in the Dang and the Tui valley and will, therefore, be described first.¹

2.1. The Dang Dun valley and the description of the Babai, Gidhiniya and Sitalpur Formations

The Dang and the Tui valley are actually part of the same basin, but will be described separately.

The Dun valleys were once filled with thick Quaternary alluvial deposits. If one enters the Dang valley from the south by the Lamahi-Gorahi road, a first glimpse into the valley is quite an unforgettable view (Pl.203/2). It is a textbook example of a valley that was once filled to the rim by alluvial deposits, and the first impression is that of a vast lake which must have once occupied the valley. However, recent strong erosion has dissected the alluvium to such an extent that a desert-like badland topography has developed (see Pl.243/1), thus exposing all the alluvial sediments for geological studies.

The Dang Dun valley is the northern Dun valley of the two Dun valleys in the Dang-Deokhuri area (Fig.7). It is bordered in the north by remnants of Siwalik hills, which are separated from the higher mountains of the Mahabharat ranges by the Main Boundary Thrust (MBT). To the south the Dang Dun is separated from the Deokhuri Dun by a range of Siwalik hills with maximum elevations of 1000 m above sea level.

Due to active movements continuing along the MBT and to differential uplift in the north, the Babai River (which drains the Dang valley), flows along the very southern border of the valley at an elevation of about 650 m. All the main tributaries come from the north, flowing southwestwards to the Babai River (see also Chapter III.1).

The terraces along the northern margin of the Dang Dun valley have been described by Yamanaka & Yagi (1984). Although they have no bearing on the archaeological sites found along the southern margin of Dang Dun, this study has contributed to our understanding of the Dun valley formation. They record six terrace levels in the north, of which only on the three upper terraces a red soil has developed. They attain heights between 50 and 80 m above the present river level.

The described terraces along the northern margin are much better preserved and less dissected than those in the south, due to the extreme southward shifting of the Babai River. The terraces along the southern margin are therefore highly dissected by recent erosion and form only a narrow belt in the south. It is these southern, dissected terraces which yielded a wealth of prehistoric sites and have been studied in greater detail in the Dang valley.

¹ A few terms, which are of Indian or Nepali origin are used in this monograph, for example: Khola: a stream of a size larger than a gully, but smaller than a river and often (but not always) carries water only during the rainy season. Nala: a small gully, carrying water only in the rainy season. Kankar: calcium concretions, in small form of pellets or in the form of root casts. Murrum: soft, highly weathered bedrock, described as „saprolite“ (in Thomas, 1994, p.22).

Generalised Columnar Section of Quaternary Deposits of Dang and Tui Valleys

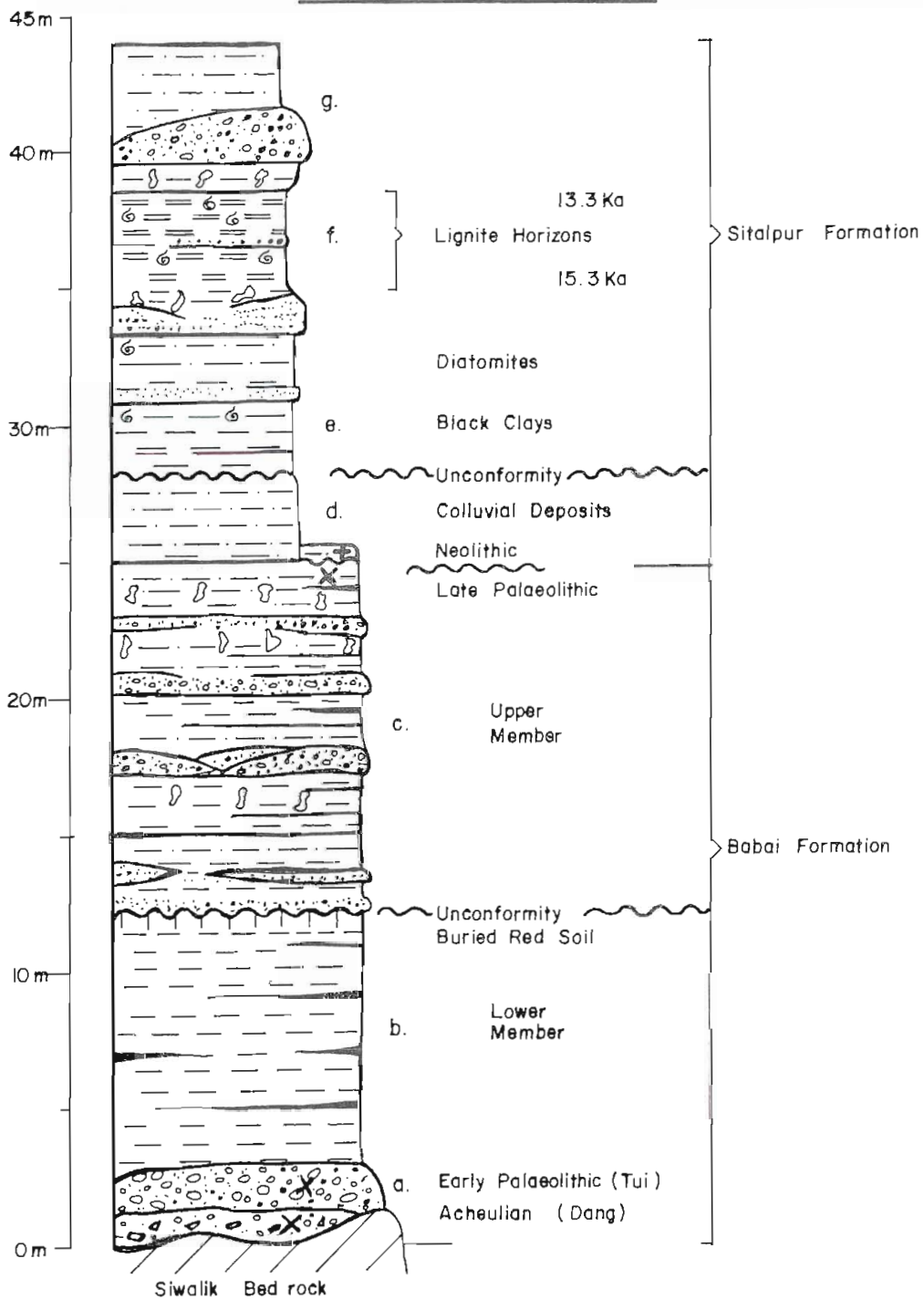


Fig. 11. Columnar section of the Quaternary deposits in the Dun valleys.

Schematic Profile through Dun Valley Terraces.

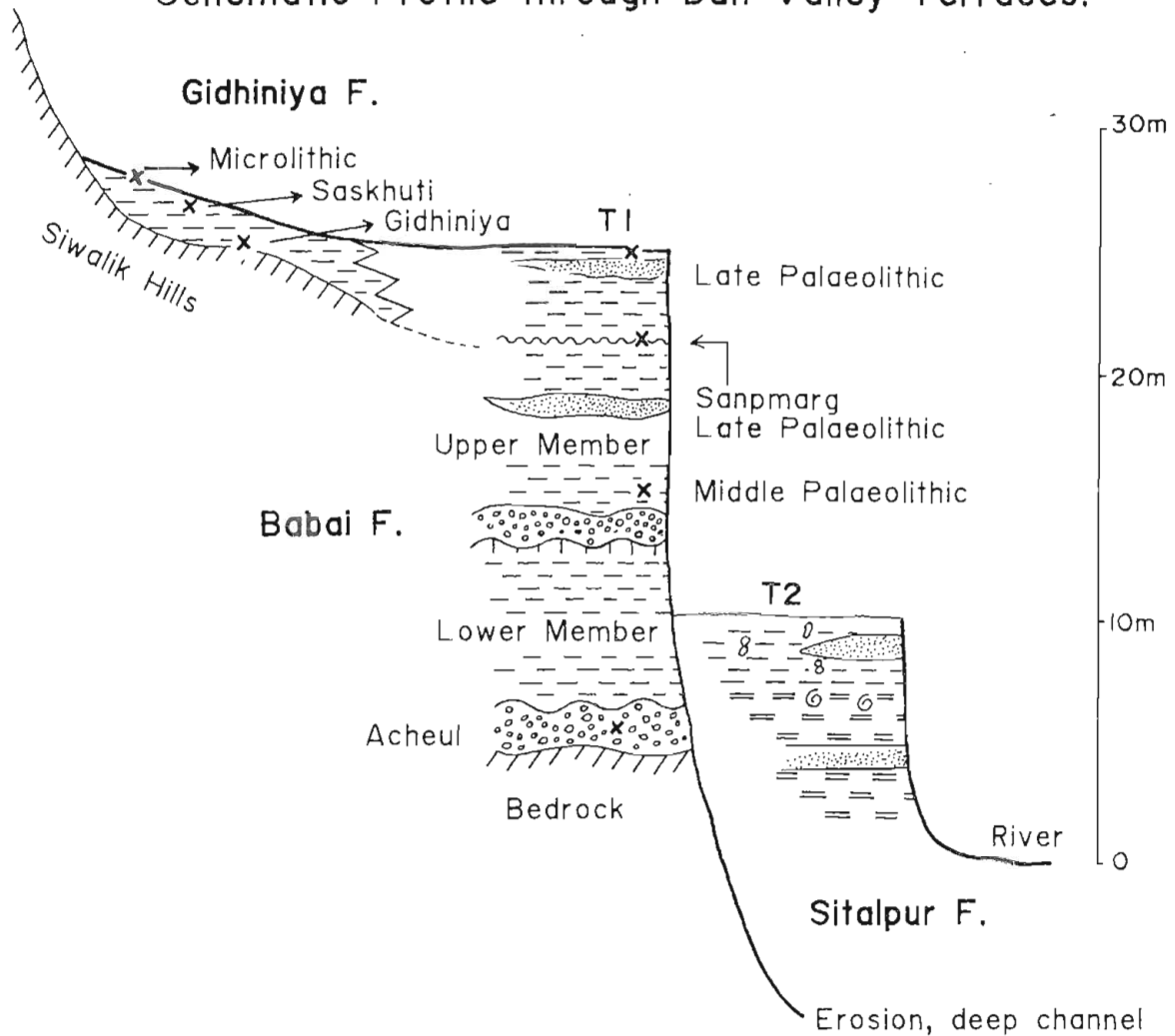


Fig. 12. Schematic profile through the Dun valley terraces and their Quaternary deposits.

The heavy dissection into deep badlands is a very recent, man-induced phenomenon. The slopes of the hills and their base, were once densely covered with forests. Even the 1:50,000 toposheets of the area, which date from the 1950's and early 1960's describe these slopes as being covered by „fairly dense, mixed jungle“ or „open mixed jungle“. Today these slopes have only open scrub, and the foot of the hills are completely denuded.

The higher terraces along the southern slope consist of deposits of the Babai Formation. They do not reach heights of more than 40 m above river level and are only present as dissected remnants of the formerly extensive surfaces. A red weathered soil has developed on these older terraces, but in most cases has been eroded away. It was during the period of the formation of these terraces that prehistoric occupation of various cultures took place. This is evidenced by artefacts on recent erosion surfaces and slopes, having been washed out at many places from the alluvial deposits.

Above the surfaces of the higher terraces, on the slopes of the adjacent hills, deposits of the Gidhiniya Formation have formed colluvial fans or hillwash deposits at the base of the hills and small basins on the slopes. At many places these deposits are also associated with prehistoric occupations (Fig.12).

The lower, more recent 10 m terraces are made up of the deposits of the Sicalpur Formation and form the wide, flat expanse of the main part of the valley which is extensively cultivated. Thus far they have not yielded any cultural remains.

Fig.13 shows several schematic cross-sections through the terraces near Daingaon village on the south margin of the Dang Dun and through Brakhuti and Gidhiniya in the Tui valley.

2.1.1. The Babai Formation

The deposits of the Babai Formation (Fig.11 and 12) are the oldest deposits of the alluvial fill of the Dang valley and formed a once extensive terrace surface varying between 25 and 40 m a.m.r.l. with gradients of about 8 degrees. They have undergone heavy dissection and are existent only in remnants. These thick successions of stratified silts and clays are of fluvial and lacustrine origin. They constitute a phase of extensive alluvial aggradation in the Dang Dun valley, as well as in the adjoining smaller Tui valley, and form a very recognisable facies.

The deposits of the Babai Formation attain a maximum thickness of 30 m and overlie irregularly dissected Siwalik bedrock. They have been divided into a Lower and an Upper Member. In Dang the oldest horizon, overlying Siwalik bedrock, consists at places where dissection has reached bedrock, of a coarse rubble horizon filling hollows in the irregularly dissected bedrock (as at Gadari where handaxes made of quartzite have been found *in situ* in this rubble, Corvinus 1990, 1991). In the Tui valley the oldest deposit is a well-rounded quartzite cobble-boulder gravel which is exposed at many places above bedrock and contains an Early Palaeolithic industry. The environment must have been dry and barren, probably cold, accounting for the coarse accumulation of rubble and cobble-boulder gravel at the base of the alluvial fill. This was the time when Early Palaeolithic groups sporadically occupied the valleys as seen by the Gadari handaxes in Dang, and the Early Palaeolithic artefacts in the Tui valley (described in chapter V.2.1.1 and 2.1.2). These cultural materials would indicate at least a Middle Pleistocene age for the oldest deposits of the Babai Formation in Dang and Tui.

Overlying the coarse basal deposits are lacustrine argillaceous sediments of the Lower Member of the Babai Formation. They were laid down during the ponding-up of the Dun valleys, probably due to blocking of the draining rivers during tectonically unstable times, in later Middle Pleistocene or earlier Late Pleistocene times. The clays are mottled and are affected by pedogenetic processes, and at places a red, buried soil has developed on them. A warm, humid climate, akin to the recent warm monsoon climate, is envisaged for the time of the Lower Member.

Unconformably overlying the clays of the Lower Member are well-stratified fluvio-lacustrine, but mainly fluvial sediments of clays and overbank silts of the Upper Member of the Babai Formation. Intermittent events of fluvial activity, in the form of gravel channel lenses, are seen intercalated with the clays and silts. The upper silts show horizons of tubular calcrete concretions, which must have formed under arid conditions during a cooler and drier climate, influenced by the cooling effect of the last global glacial event. Colluvial screes of lateral coarse gravel, coming down from the neighbouring Siwalik hills during such dry times, are common and intercalate with the upper fluvio-lacustrine deposits.

The sediments of the Babai Formation in Dang and Tui are of considerable thickness and have filled the valleys to the rim (see Pl.243/1 and Pl.203/2). The basins were literally choked with these sediments. It seems, (as described in chapter III.1, p.17) that the drainage of the Dang and the Tui valleys was blocked off by tectonic movements of post-Siwalik age, thus inducing the rivers to fill the valleys.

The deposits of the Babai Formation are quite unconsolidated and therefore easily erodible. The strong erosional phase of the last 50 years, resulting from overpopulation and heavy deforestation, has dissected the alluvium into a typical badland topography, often down to the original bedrock, and thus laying bare, and exposing, occupation places contained within the Babai Beds. Prehistoric sites could thus be recorded at many places in the Dang and Tui valleys. They are mostly connected, in one way or another, with the Upper Member of the Babai Formation (Corvinus 1985a and b, 1990, 1991, 1994).

Red duricrust has developed on the surface of the deposits of the Babai Formation and on the marginal, colluvial fan deposits of the Gidhiniya Formation during a period of stable environment. In the Dang valley not many of them have withstood the strong erosion of recent times. The deeply weathered red soils abundantly encountered in the Tui valley and in the Deokhuri Dun valley, are thus rather rare in the Dang valley.

The fortunate discovery of a small collection of handaxes in a basal rubble above bedrock in the lowermost part of the Babai Formation in the Dang valley, indicates Acheulian occupation at the very beginning of the aggradation of the Babai Beds. This discovery enables us to establish a lower boundary for the deposits of the Babai Formation: the basal rubble horizon with the Acheulian tools was deposited during the Early Palaeolithic, somewhere in the Middle Pleistocene, if not earlier. Numerous discoveries of Late Palaeolithic industries in the upper part of the Upper Babai Formation establishes the upper boundary. This confines the succession of the Babai Formation provisionally between the periods in which Early to Late Palaeolithic occupations occurred, i.e. between the later Early Pleistocene (or early Middle Pleistocene) and the later Late Pleistocene. We will later look at the dates we have obtained by the TL and OSL methods at a number of Palaeolithic sites.

2.1.2. The Gidhiniya Formation

The deposits of the Upper Member of the Babai Formation grade along the hill flanks and on saddles on the hill slopes into fan-like colluvial hillwash deposits, the Gidhiniya Formation, which are washed down from the hills with rather steep gradients of about 16 degrees (Fig.13 and Pl.244/1,2). These fan deposits consist entirely of homogeneous, yellow to reddish silts, and are unstratified and without apparent structure (Pl.244/1). Their morphology and their distribution pattern indicate that they are hillwash deposits of fine-grained detritus, covering small depressions on the hill slopes above the alluvial terraces. This detritus must have derived from the weathering of the mudstones of the Lower Siwaliks of which the hills in the surveyed area are composed (Pl.244/1,2). These mudstones weather easily and decompose into their original fine-grained silt. The detritus accumulates on the weathered slopes during arid periods within the Pleistocene, when the slopes were bare of vegetation and thus vulnerable. It may be assumed that after a long arid period when the climate again became milder and moister this accumulated detritus was washed down by gentle transport into small depressions and basins on the slopes. No coarser material gets transported. These colluvial silts will be described in more detail wherever they are associated with prehistoric cultural material. They are particularly abundant in the Tui valley near Gidhiniya village, which gave the formation its name, and along the southern border of the Dang valley, where the source of the Lower Siwalik mudstones is available as the parent rock.

Colluvial sediments as hillwash has been described also in South Africa (Botha & Partridge 2000; Wintle et al. 1995), where undifferentiated, fine-textured hillslope deposits have been termed hillwash by Brink (1985) or pedisegment. Interesting there is the association of prehistoric cultural material with hillwash deposits: „Insight into the relatively gentle process of colluvial transport of fine detritus by sheetwash on footslopes is provided by the preservation of intact Middle Stone Age knapping floors, buried in sandy colluvium“ (Botha & Partridge 2000, 93). A similar situation is documented also in Nepal at the Gidhiniya site in the Tui valley and the Masuriya 4 site in the Deokhuri valley (see below).

Grain size analysis of several of these colluvial silts has shown that the majority of them, 50 % to 70 %, consist of silt, 8-10 % of clay and the rest of fine sand. They are quite similar to loess, but the distribution pattern on the slopes and the morphological and sedimentological features are not that of loess.

The colluvial silts of the Gidhiniya Formation are always deposited on the valley slopes, above the actual river valley. Further inwards, along the valley shoulder, they interfinger with the well-stratified fluvio-lacustrine clays, silts and sands of the terrace deposits of the Upper Member of the Babai Formation (Pl.244/1).

From careful observation of the evidence, these colluvial deposits are more or less contemporaneous with the upper part of the Upper Member of the Babai Formation. A number of Late Palaeolithic and microlithic sites are connected with the Gidhiniya Formation (Fig.12) (see also Pl.205/3, Ph.16-Sc² and Pl.245/2).



Fig. 13. Schematic cross-sections through Brakhuti and Gidhiniya (Tui valley) and Daingaon (Dang valley), based on the data from the columnar section. a, b. and c. deposits of the Babai Formation, a. being the basal part with Early Palaeolithic artefacts at Brakhuti W (after Corvinus 1995a).

2.1.3. The Sitalpur Formation

Towards the end of the Pleistocene, the rivers were able to cut through their barriers and have deeply incised their beds through their older deposits reaching far below the modern river level, as drillings have revealed. After this phase of deep incision renewed aggradation of thick alluvial sediments sets in. The deposits of this formation are called the Sitalpur Formation after the type site at the village of Sitalpur in

² Those photos are not given in the plates of volume II, but are only shown as scanned (-Sc) photos on the CD (see list of photos on CD p. 380-83).

Dang. The central part of the Dang valley, north of the Babai river, and the inner part of the Tui valley are filled with these young deposits. They form the younger, flat, undissected and extensively cultivated, fertile terraces at a height of about 10 to 12 m above river level.

They consist of black, mollusc-rich clays, lignites and diatomaceous clays in the central part, which indicate stagnant pool environment, and calcareous silts, sands and occasional gravel lenses of fluvio-lacustrine character in the lower and upper parts (Fig.11).

Recently two ^{14}C dates (Sarkar 1992, pers.comm.) have been obtained from the lignite/clay profile of the Sitalpur section on the Babai River, south of Tulsipur. The top sample revealed an age of $13,270 \pm 19$ BP (BS 1008), 1.8 m below the surface of the section (5 m below terrace surface). The lower sample, taken 3.3 m below the surface of the section (6.5 m below terrace surface), has been dated to $15,320 \pm 280$ BP (BS 1009). The lignites contain an abundance of gastropod and bivalve shells, as well as plenty of organic plant material (Fig.14, see also Fig.121).

The ^{14}C dates indicate a terminal Pleistocene age for the Sitalpur Beds and the lignites point to a phase of amelioration of the climate during the later part of the last glacial. Such lignites and diatomites are also found extensively in the inner part of the Tui valley.

These Late Pleistocene ^{14}C dates of the lignites from the Sitalpur cliff correspond quite well with the Late Pleistocene ages obtained by Yamanaka and Yagi (1984) from gastropod shells ($16,420 \pm 450$ BP) some 20 km west of Sitalpur, probably from similar terrace deposits. From where their „humic silt“ ($21,410 \pm 870$ BP) comes is not clear.

Below and above the lignites the sediments consist of lacustrine clays and silts with calcretisation. The silts below the lignites show tubular kankar horizons, the silts above the 13 ka upper lignite show pellety kankar formation. This indicates more arid conditions before 15 ka and after 13 ka, and could be correlated with the younger Dryas.

Red soils are never associated with the Sitalpur beds.

The black clays and lignites, wherever they are cut and exposed by the river, form the lowest recognisable deposits in the Dun valleys. A Canadian team, while drilling to explore for oil and gas in Dang, revealed that alluvial sands and gravels below the black clays and lignites fill deeply cut ancient channels in the Dang and Tui valleys below the recent river level. It confirmed the assumption that prior to the deposition of the Sitalpur Beds a phase of heavy valley dissection had taken place. This was probably induced by tectonic instability in the later Pleistocene, i.e. opening up of the gorge of the Babai River west of Marhouri (see chapter III.1.).

The ^{14}C dates have determined the time of the ponding and swamp-formation as having taken place during the terminal part of the Pleistocene. The deposits of the older Babai Formation therefore belong to the earlier periods of the Pleistocene, before the last deep incision of the valleys and prior to the deposition of the Sitalpur Beds. They would therefore be assumed to belong to ages earlier than the terminal Pleistocene.

No prehistoric sites have been recorded so far from the Sitalpur Beds and their terraces.

All Palaeolithic occupations in the Dang valley are found only in association with the deposits of the Babai and Gidhiniya Formations. The deep incisions resulting from the erosion have made it possible to survey the various horizons and to relate the recovered sites with their stratigraphic levels. At numerous places assemblages of a flake-chopper-corescraper industry, described later as the Brakhuri industry, have been located. These sites always derive from the upper silts of the Upper Member of the Babai Formation and from the colluvial hillwash deposits of the Gidhiniya Formation.

Prehistoric occupation seemed to have been concentrated along the foot of the hills on the southern border of the Dang valley. The Lower Member is sterile, except for cultural material at the very base; at the commencement of the Dun infilling, having yielded an Acheulian assemblage at the site of Gadari in Dang.

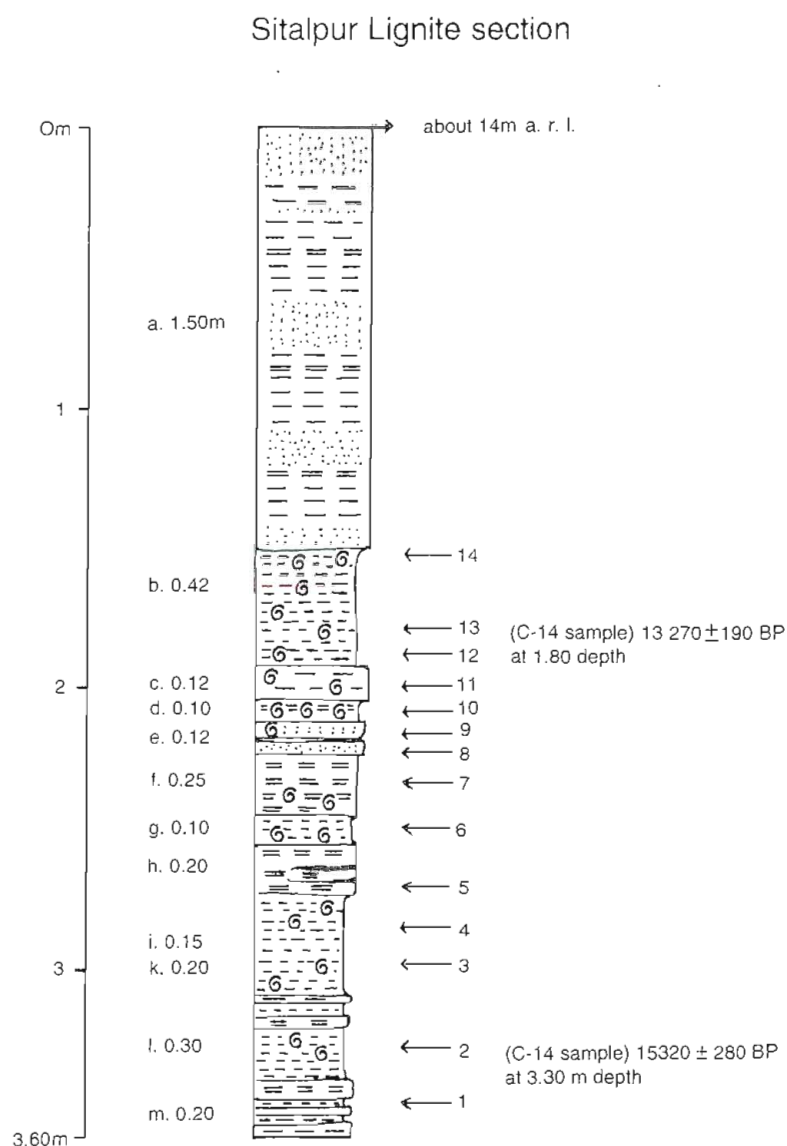


Fig. 14. Profile of the cliff at Sitalpur, Dang, on the Babai river, with deposits of the Sitalpur Formation.

2.2. The Tui valley

The Tui River is the only southern tributary of the Babai River in the Dang valley. It has an elevation of 600 to 620 m a.m.s.l., similar to the southern part of the Dang valley (Fig.15).

The sedimentation of the alluvial filling of the Tui valley, is a smaller replica of the Dang sedimentation and reflects the same events.

A high terrace extends on both sides of the lower inner part of the valley, reaching up to 25 m above the Tui river level. The deposits consist of the fluvio-lacustrine clay/silt successions of the Babai Formati-

on. They once formed an extensive surface, before the recent erosion of the last 50, or so, years dissected and partly destroyed them. Along the margin of the valley and in the small side-nallas, the flanks of the hills and the small saddles higher on the hills are covered, like in southern Dang, with colluvial hillwash deposits of unstratified yellow to reddish silts of the Gidhiniya Formation (Pl.244/1,2). A red soil is seen on the older deposits, wherever they have remained undisturbed.

The basal part of the clay/silt sequence of the Babai Beds in the Tui valley consists at many places of a very well sorted and rounded quartzite cobble gravel which always overlies Siwalik bedrock, for example at Brakhuti W (Fig.13). The cobbles are almost entirely made up of quartzite and not of Siwalik sandstone rocks. The only probable source of such well-rounded quartzite cobbles is either from far beyond the MBT (but the question is then through what drainage!) or from outcrops of Upper Siwalik rocks of the Boulder Conglomerate below the alluvium. A number of steeply dipping, E-W striking conglomerate beds of possibly Upper Siwalik age were encountered along the southern border of the valley below the alluvium. The southern and northern hill ranges, separating the Tui valley from the Dang and Deokhuri basins, are, however, made up of Lower Siwalik mudstones and claystones. A fault or thrust, running in E-W direction, probably along the axis of a syncline, has been encountered along the southern margin of the Tui valley below the Quaternary alluvium, thrusting Lower Siwalik rocks against conglomerates and soft sandstones. To the south of the fault, at the foot of the hills at Raniapur S, highly calcified fossil bones (a rib, long bones etc., but no cranial bones) were found eroding out from a purple claystone of the Lower Siwalik rocks in a gully. The fault runs all along the southernmost margin of the Tui valley (actually along the foot of the southern hill range). At several places, (for example at Raniapur, Brakhuti, Sakhuti) one can see the juxtaposition of Upper Siwalik sandstones and Lower Siwalik rocks.

This observation has a bearing on the origin of the basal quartzite cobble gravels of the Tui valley. It is highly probable that the well-rounded cobbles of the basal gravel of the Tui valley alluvium are derived from these conglomeratic outcrops along the southern range (see chapter III.1.). The alluvial cobble gravels always form the lowest and oldest deposit in the Tui valley. The gravel has yielded at several places an interesting assemblage of huge Clacton-like flakes and cores, of a Lower Palaeolithic industry, such as has not been found anywhere else in Nepal.

Weathering surfaces of red soils are found in the Tui valley mainly as remnants on the colluvial fan deposits on the slopes, where they have not been destroyed by the recent erosion.

The lowest alluvial level at Tui is the widespread 10-12 m terrace which is inset into the 20 to 25m terrace of the Babai Beds and forms the flat, central valley surface which is extensively cultivated (Fig.13). It comprises fluvial sediments and swamp deposits of the Sitalpur Formation with sands, sandy silts and kankarised silts. Black clays with abundant molluscs and numerous lignite horizons, similar to those in Dang near Sitalpur and most probably of the same age, are also widespread in the central and lowest part of the valley. They are intercalated with the sands and kankarised silts. As in Dang, these deposits reach below river level, pointing to a now buried, deeply incised older river channel pre-dating the aggradation of the Sitalpur Beds.

Prehistoric sites in the Tui valley are abundant.

As in the Dang valley, a number of prehistoric occupation sites are embedded in the deposits of the Babai Formation in the Tui valley. The oldest assemblage is that of a large flake-core industry of apparently Early Palaeolithic origin, embedded in the basal cobble gravel at Brakhuti W and at Simalkhuti and Rajje (Fig.16). The majority of sites have their position, like in Dang, in the upper part of the Upper Member of the Babai Formation and in the Gidhiniya Formation. They consist of flake-chopper-corescraper assemblages of the Brakhuti industry. The type site of this industry, called Brakhuti W, is situated in the Tui valley, west of the village of Brakhuti (Fig.13a,15,16). Of this industry there are an abundant number of occupation sites in similar stratigraphic positions in the valley. At Gidhiniya, a site with an assemblage of a slightly different facies of the Brakhuti industry was found on an erosional

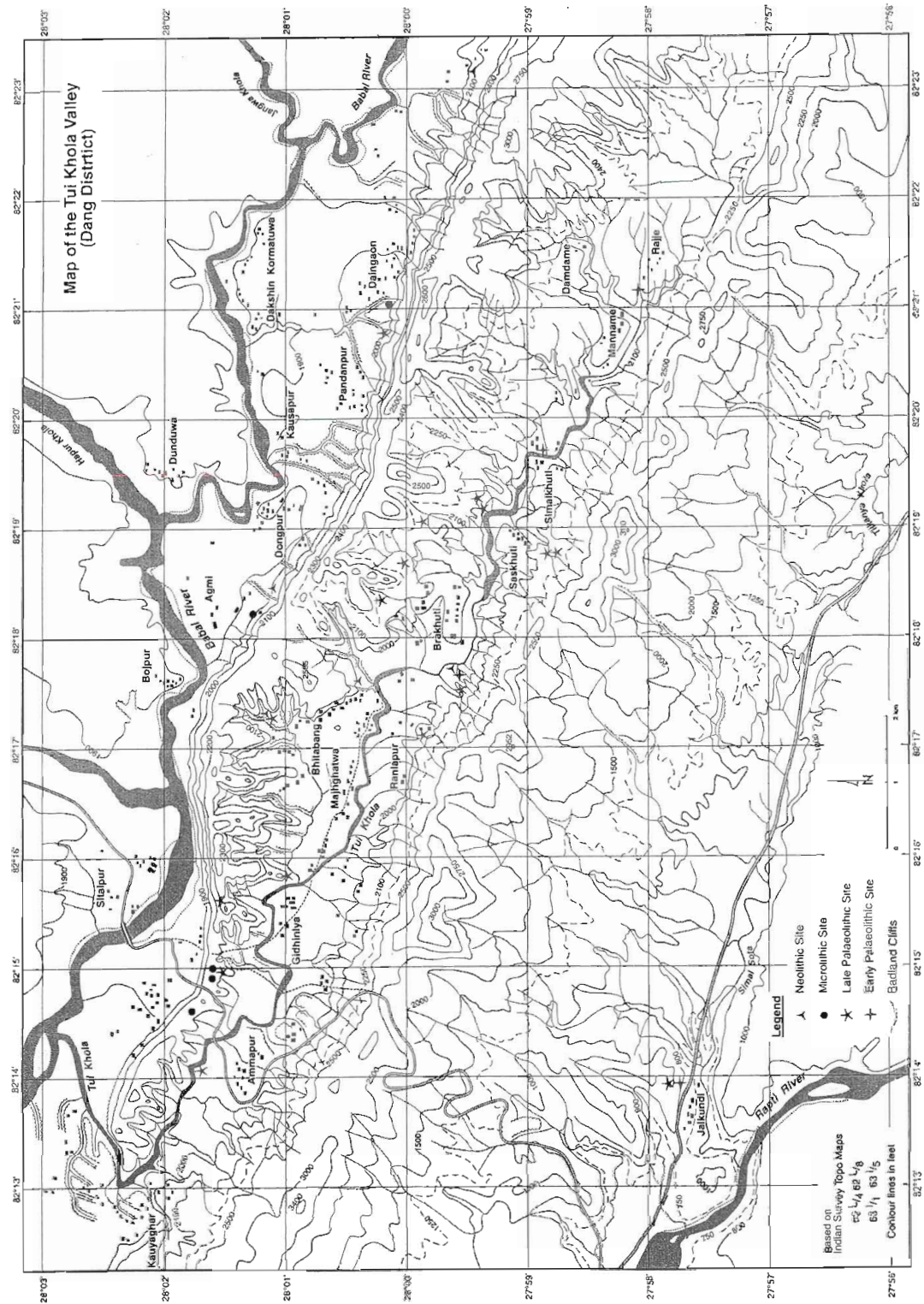


Fig. 15. Map of the Tui valley, based on the 1 inch/1 mile topo-maps, with prehistoric sites indicated.

terrace of bedrock which was overlain by the reddish-yellow colluvial silts of the Gidhiniya Formation (Fig.13b).

A microlithic industry is embedded in the upper level of the colluvial silty hillwash fan deposits north-east of Ammapur (Fig.15). Neolithic remains are also present, contained in an ashy grey soil topping the 25 m terrace at Brakhuri and Bhitabang, although these have been almost entirely destroyed by erosion.

As in Dang, no prehistoric remains were found in the Sitalput Beds.

2.3. The Deokhuri Dun valley

The Deokhuri Dun, which is situated south of the Dang basin and separated from it by a range of Siwalik hills, has been formed, like the Dang valley, as an intermontane, tectonic basin. It is bordered in the north and south by ranges of Siwalik hills, the southern belt separating it from the Terai plains (Fig.7 and 5).

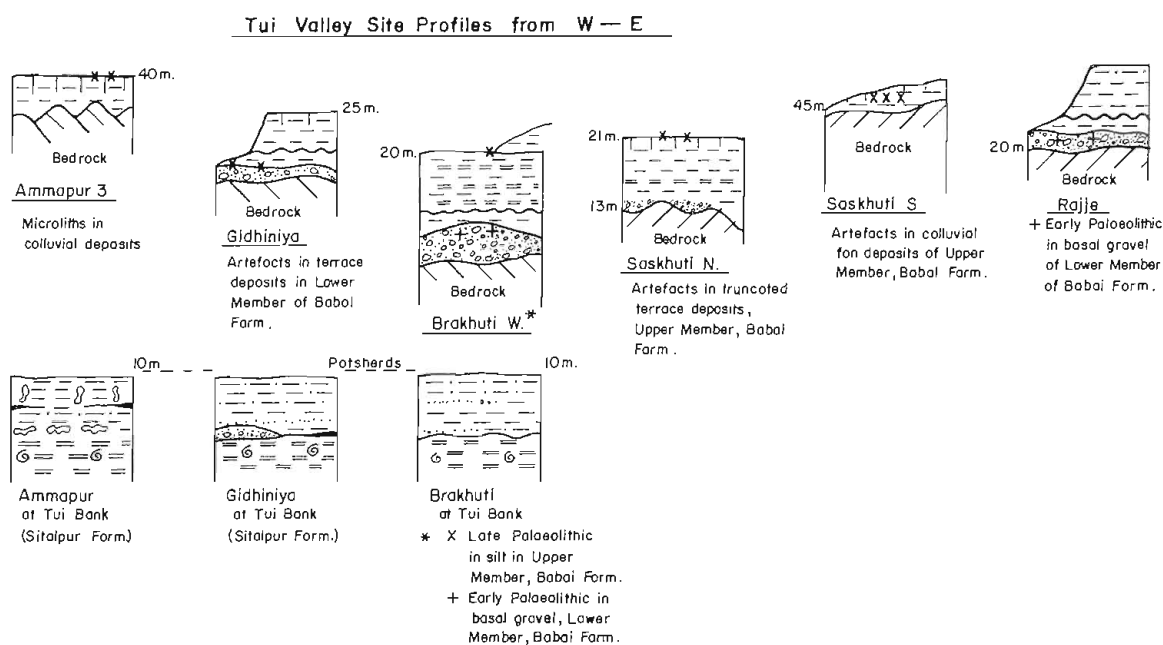


Fig. 16. Comparative profiles of major sites in the Tui valley. The upper row shows profiles of the upper T1 terrace, the lower row are profiles of the lower T2 terrace.

Its elevation is considerably lower (350 m lower) than the Dang Dun basin, averaging in height 250 m above sea level. The Siwalik range in the south has elevations of a maximum of 1,000 m, while the Terai plains near the mountain foot averages heights of 120 m above sea level.

The Deokhuri Dun valley is more depleted of its older original alluvial fillings than the Dang valley. The Rapti River which drains this valley, flows westwards through the centre of the valley and has filled

the central part of the valley with recent alluvium, forming the flat, lower Holocene terrace surface of about 10 m a.r.l.. This is devoid of prehistoric remains, like in Dang. But unlike in the Dang and Tui-valleys lignites and black clays have so far not been encountered below the young alluvium. However, this may be due to the fact that downcutting of the Rapti River is less deep in the Deokhuri valley than in the Dang valley and that, in fact, this river is at present in a stage of aggradation. Secondly, the young alluvial deposits have not been examined in any detail.

Above the wide Holocene surface of the central part of the Deokhuri Dun valley, which is extensively cultivated, remnants of a succession of alluvial sediments reveal the presence of older terrace deposits in the valley. These can be correlated to the deposits of the Babai Formation and are referred to as the Deokhuri facies of the Babai Formation.

Good exposures are seen in the central Deokhuri valley along the road near Nimbukhuti and Sarbaria (Pl.204/1) where they consist of clays, yellow silts, sands and intercalated gravel lenses and are predominantly fluvial and only partly lacustrine at the base. They are not covered by red soils, only by slightly rubified soils. This may be due to truncation of the uppermost surfaces by erosion.

The deposits at Nimbukhuti and Sarbaria are made up of two units, correlatable with the Lower and Upper Member of the Babai Formation of the Dang and Tui valleys. The older, lower one is of a compact, mottled silty clay of lacustrine character, containing iron-manganese pellets. It has a truncated, pedogenetically affected reddish surface, similar to the Lower Member of the Babai Formation in Dang/Tui. Unconformably overlying it with a sharp, erosional contact is the upper fluvial unit with yellow, calcareous silts containing well-developed tubular calcrete concretions, intercalated with fluvial pebble-cobble gravel lenses. The uppermost part consists predominantly of gravel with intermittent silts, which also show calcretisation. The surface is only slightly rubified. The upper, fluvial unit of the succession, extending up to the top of the 25 m terrace is probably of Late Pleistocene age and relates to the Upper Member of the Babai Formation. The upper calcrete horizon in the upper unit indicating rather arid conditions almost certainly belongs to the last glacial. The lower mottled silt with its rubified surface would indicate more humid conditions during a longer period of tectonic stability (maybe stage 5), of the last interglacial.

Deep red soils showing incipient ferricretisation, at numerous places overlie the deposits of the older terraces. They are seen in the extreme east of the Deokhuri valley on the high terraces near Bhalubang, Sanpmarg (Fig.8) and Lalatiya, where the Rapti River emerges from the Siwalik hills and at Arjun (Pl.204/2). They are also present in the extreme west, where the Rapti River leaves the Deokhuri Dun and has formed well-developed high terraces (at Oj, Saunri), as well as along the southern valley border, south of Lamahi (Kakraha, Garhwa, Fig.8).

The terrace deposits over which such red oxisols have developed, consist of fluvial sediments with little or no lacustrine intercalations. In the lower part they expose thick cobble and bouldery gravels, partly cemented by calcium carbonate. These appear to have been laid down as flush- or delta deposits by the streams when entering the base level of the Dun valley, caused by accentuated climatic changes or more probably controlled by tectonic causes. They are particularly evident at the entrance of the larger streams into the Dun valley eg. of the Rapti River in the east at Sanpmarg (Fig.123 and 124), on the Arjun River from the northern hills at the site of Arjun 3 (Fig.160) and particularly along the tributary streams joining the Rapti from the north at the extreme western end of Deokhuri at Saunri, Oj, etc. (Fig.159). Overbank silts with gravel- and sand lenses make up the upper part of the terrace deposits. From all of them flake-corescraper assemblages could be recorded.

The lower unit of lacustrine clays is seen most clearly in the central part of the Deokhuri valley at Sarbaria and Nimbukhuti (Pl.204/1). They are absent in the western area of Oj and Saunri and in the eastern area of Sanpmarg and Bhalubang, where the lower part of the succession consists of thick cobble gravels.

Occurrences of buried red soils are recorded, too. They have been correlated with each other (Fig.160). At Jalkundi in west-Deokhuri, a red soil is unconformably overlain by calcareous silts with calcrete con-

cretions, while at Oj, west of Jalkundi, a buried red soil is overlain by unkankarized silts and gravels, which in their turn have developed another deep-red oxisol on top of the whole succession. At Sanpmarg in east-Deokhuri a buried palaeosol, developed over yellow silts and gravel, is a red duricrust, slightly calcified due to the retention of carbonate. The buried soil contains a chopper industry.

Fine-grained colluvial fan deposits of silts of the Gidhiniya Formation are found along the very foot of the northern hill flanks, at higher levels than the terraces. They consist of homogeneous silts without apparent stratification, derived from the weathering of the mudstones of the Siwalik rocks of the surrounding hills. They, too, have formed a deep-red oxisol over their surfaces, wherever they have been preserved in niches of the hill flanks, for example at Lalmatiya (Pl.245/1), Masuriya, Pipri, Parhwa. They contain sites of flake-chopper-corescraper assemblages at the mentioned localities.

The various red top soils and palaeosols evident in the Deokhuri valley point to a series of land stabilisations and red soil formation of differing antiquity. The deeply weathered and ferricretised red oxisols, covering the colluvial silt fans on the hill flanks at many places (for example at Masuriya and Lalmatiya) must have a considerable antiquity, greater than those covering the alluvial terraces, though they seem at first sight relatable. The assumedly Middle Palaeolithic industry at Masuriya, embedded in the red soil capping the Gidhiniya Formation at Masuriya, points to its antiquity. The red top soils covering the alluvial terraces (Oj, Arjun, Sanpmarg, Bhatarkund) may be of an interstadial humid phase within the last glacial. These have developed over mottled, weathered silts and clays of the Upper Member of the Babai Formation (Deokhuri facies), or may have developed only from the end of the Pleistocene onwards with the amelioration in climate.

The buried red palaeosol seen at Sanpmarg with an end-chopper assemblage embedded in it has been dated preliminarily by OSL sampling. Two dates sandwich this horizon between 43 and 34 ka years. The red, buried soils at Nimbukhuri, Jalkundi and Oj/Saunri, on the other hand, may have a greater antiquity and may belong to an earlier time of stabilisation within the Late Pleistocene, maybe of a stage 5 time. The deposits below the buried palaeosols may reach down into the Middle Pleistocene. At Jalkundi a few weathered bifaces are connected with a fluvial gravel below the buried red soil (Fig.160).

Distinction must also be made between original *in situ* red soils and redeposited red soil sediments. Such deep-red soil sediments can be seen at various places in the Deokhuri valley, washed down from *in situ* soils to lower levels (as for example at Masuria 3 and Bhatarkund).

Prehistoric sites in the Deokhuri valley have been located in the badlands of the older alluvium, in their original sedimentary contexts. They have also been encountered on and in the red soil surfaces of the colluvial slopewash deposits along the northern border of the Deokhuri valley (as in Lalmatiya and Masuriya). Along the southern border only a short survey has been carried out, south of Lamahi, in the area of Garhwa and Kakraha (see Fig.8). Here too, the older terrace surfaces yielded scattered sites of flake-corescraper assemblages, eroded out apparently from the upper levels of the older terrace alluvium.

The majority of the numerous sites in the Deokhuri valley belong to a flake-corescraper industry, akin to the Brakhuti industry of the Tui valley. The sites of this industry are embedded in the uppermost level of the alluvial deposits of the older terraces and in the colluvial slopewash deposits along the hill slopes. Apart from these sites two microlithic sites were recovered from the very top of the alluvial/colluvial silts at Bhatarkund and Lamahi.

The site of Arjun 3 (Pl.204/2), the only typical Middle Palaeolithic assemblage in the surveyed areas, deserves special attention. It consists of a blade-flake industry with levallois elements having been found *in situ* at the base of a silt overbank deposit, 8 m below the red soil surface of the 30 m terrace of the Arjun river. Heavy erosion has exposed the artefact-bearing horizon. The site is, based on its stratigraphic level, of greater antiquity than the majority of the other sites in the Deokhuri valley, apart from the few bifaces from Jalkundi. These latter artefacts, found in a basal gravel, are also evidence of Early Palaeolithic occupation in the early phases of the Deokhuri valley alluvium.

Since the erosion in the Deokhuri Dun does not reach as deep into the alluvial strata as in Dang, the lower parts of the oldest terrace alluvium are usually not exposed except at the Arjun 3 site at the river. With the exception of the small locality of Jalkundi it is difficult to assess whether, as in Dang and Tui, basal deposits of quartzite cobbles, containing Early Palaeolithic artefacts exist above bedrock along the old channel of the Rapti River. The thick basal gravels at Sanpmarg, Arjun and Oj have so far not yielded any artefacts.

2.4. Comparisons of the two Dun valleys

The alluvial deposits of the Deokhuri valley are of somewhat different sedimentary character than those of the Dang and Tui valleys, and therefore have been referred to as the Deokhuri facies of the Babai Formation. The primary filling of the Dang and Tui valleys was by fluvio-lacustrine deposits of the Babai Formation. During the period that the Lower Member of the Babai Formation was deposited, after the basal phase of the rubble or gravel, the lacustrine sediments predominate over the fluvial ones. This indicates an environment of lakes and ponds during a time of tectonic stability, with occasional fluvial influxes (mainly from lateral nala contributions from the hills). At places remnants of a buried red palaeosol overlying the Lower Member can be observed, like at Balampur, Kurepani, Ranighora, Gadari in Dang valley (Fig.64). During the time of the Upper Member of the Babai Formation the fluvial character of sediments predominates with quickly changing lithologies of silts, sands and gravels. The once existent red top soils are mostly removed by erosion. This two-fold feature of a Lower and Upper Member of the deposits is also seen in the Deokhuri valley, but less apparent and more complicated. It can best be seen in the centre at the Nimbukhuri-Satbaria cliffs (Pl.204/1). The western and the eastern ends of the Deokhuri valley show much heavier fluvial activity by the presence of coarse conglomerates and gravels, especially in the lower part, pointing to the fact that the Rapti river is a larger and more active river than the Babai and the Tui rivers, shedding its heavier load when reaching the base level.

The younger Sitalpur Formation in Dang and Tui show sandy, silty sediments of fluvial origin with intermittent periods of pronounced swamp and pond environment. However, in the Deokhuri valley the deposits of the young, cultivated terraces which form the wide, central part of the Dun are unknown, as they are neither exposed, nor have they been surveyed. The Rapti river in the Deokhuri valley is, as compared with the Babai river in Dang, a mature river which at present is aggrading a heavy sedimentary load in its braiding channel.

3. The geology of the terraces in normal, non-tectonic river valleys

The rivers flowing through the Siwalik belt have incised their valleys steeply into the Siwalik mountains, as a result of neotectonic activities and have developed terrace benches along their courses at certain places. Such terraces are found mainly in two situations: either 1) along the E-W strike-orientated valleys within the Siwalik ranges, or 2) at the point where the rivers emerge from the mountains into the Tetai plain or into the Dun valleys.

3.1. Terraces within the Siwaliks

Most of the rivers, draining the Siwalik mountains, run in E-W directions along the strike of the Siwalik ranges in steeply incised, narrow valleys. They have formed at many places a set of very high terraces,

up to 90 m a.t.l. along their course, indicating strong incision, due to continued uplift of the Siwaliks. Such terraces consist of river-cut rock benches incised into the underlying Siwalik bedrock during uplift. They were subsequently covered with fluvial cobble gravels, sands and silts at heights exceeding 60 m a.t.l., and have invariably a red soil developed on their surfaces. Examples of such terraces are the 70-90 m terraces of the Mashor and the 60 m terraces of the Arjun rivers (Fig.9 and 164). These have been surveyed and were found to contain artefacts with sites consisting of a crude flake industry in association with choppers and corescrapers eg. near Beldamar. Similar terraces have also been surveyed in the E-W striking Siwalik belt west of the Deokhuri valley, where the Rapri River has formed high (ca. 50 m) terraces, which all have deep red soils developed on their surfaces and which all contain assemblages of the flake-corescraper industry.

Terraces are found also, though rarely, along the narrow S-N orientated gorges where the rivers cut their courses through the E-W striking Siwalik ranges. Here they form, in fact, deep and V-shaped valleys, and are still in the process of downcutting to the base level of the plains. On entering the plains they suddenly shed their heavy loads, causing thick fluvial aggradations at the foot of the mountains. In the plains the rivers form wide, braiding beds without any down-cutting and without any terraces. It is only in areas where the mountains are still actively rising, that terraces, also described under V.2.4., are formed.

3.2. Terraces of rivers emerging into the Terai plain

The terraces of the Rato River in Mahottari District in Eastern Nepal are an example of such terrace formation. Here, a set of high terraces (with red soil formation) and low terraces (with no red soils) have formed near the village of Patu, where the Rato River leaves the Siwalik Hills (Fig.3) and enters the Terai plain. The high, red terraces range in height from 60 to 90 m above river level around Patu village, while the lower, young terraces have elevations of 10 m, 15-20 m and 40-45 m above river level, around Gauridanda (see also Fig.170).

The terrace deposits unconformably overlie the uppermost Siwalik sediments of yellow-brown, coarse sandstones and pebble-cobble conglomerates which are south-dipping in the south and north-dipping in the north, forming a gentle anticline below the terrace deposits. Further north at the village of Patu the terrace deposits rest unconformably on northern dipping Upper Siwalik fossiliferous sandstones. Directly south of Patu, below the terrace deposits, a thrust fault thrusts these sandstones over uppermost Siwalik conglomerates.

The low terraces are young, Holocene in age and no prehistoric occupational sites are encountered.

The high terraces, on the other hand, have yielded in the vicinity of the village of Patu a number of prehistoric sites of a unique culture which is special to this region. The author has named this industry the Patu industry from the type site near the village of Patu. It consists of a Mesolithic industry of adzes, unifaces and sumatraliths with Hoabinhian affinities in association with choppers and corescrapers.

River terraces of this type at the very foot of the Himalayas are seen at a number of places where larger rivers emerge from the Siwaliks and where uplifting movements are still active. They are, however, usually quite forested and therefore difficult to survey for prehistoric sites.

One other place must be mentioned where terraces were formed under similar circumstances, near the villages of Chabeni and Satpati in the Nawal Parasi District in Lumbini Zone in Central Nepal. At the emergence of the large Narayani River into the Terai, some 7 km NW of Tribhenighar, a wide expanse of a low terrace has developed along the foot of the Siwalik hills. A Mesolithic site, called the Chabeni site, was discovered on the edge of the terrace. It is an open air site, which, although it contains adzes and unifaces, is unlike those from Patu.

In the same neighbourhood another site, called the Satpati site, was discovered but not in connection with any terraces. It is a most unusual and important discovery of handaxes of the Early Palaeolithic, found in a unique position *in situ* in folded sandstones of Upper Siwalik age, uplifted in the latest Himalayan tectonic upheaval which formed the southernmost hills of the Siwaliks. The geology of the Satpati site will be described separately (chapter V.2.3) as it has a completely different geological history from all the other sites in Nepal, and has no connection with the Dun valley alluvium nor the terrace deposits.

IV. The Prehistoric sites, their location and geological context

So far 98 localities have been located during the survey in the Dang-Deokhuri area, and 5 site complexes (with 30 localities) outside Dang-Deokhuri. All sites are open air sites, and the majority of them are in stratified context in the sediments. The location of sites can be divided into three categories, according to their geological context: sites situated in the Dun valley alluvium; sites located on and in higher river terraces in the Siwalik Hills, and at the foot of the Siwaliks; sites connected with the Upper Siwalik deposits.

1. Sites situated in the Dun valleys

The majority of the discovered prehistoric sites are situated in the alluvial Dun basins of the Dang, Tui and Deokhuri valleys. Regional maps show the distribution of the sites in both Dun valleys and the Tui valley. The map (Fig.8) helps to locate the areas of the various regional maps within the Dang and Deokhuri valleys. The occupation sites all come from definite stratigraphic horizons within the Dun valley deposits.

The sites could be detected due to exposure by the heavy erosion, caused by the extreme deforestation in the fertile Dun valleys and the bordering Siwalik hills. Deep, box-type gullies and badland formation, especially along the southern margin of the Dang Dun, has dissected the soft alluvial sediments, so that only remnants of the former extensive terraces and fan-like surfaces are left. The cultural remains embedded in the alluvium were washed out from the strata and were redeposited on the slopes, in the gullies and on the lower surfaces. Thus the original sites become destroyed and will disappear in time.

The majority of the sites in the Dang and the Tui valleys belong to the flake-chopper-corescraper assemblages of the Late Palaeolithic Brakhuti industry. They weather out from the upper silts of the Upper Member of the Babai Formation and from the Gidhiniya Formation. Rich sites of this industry are the Gadari flake site in the Dang valley and the Brakhuti W site and the Saskhuti sites in the Tui valley. Older sites like Gidhiniya in the Tui valley, Sanpmarg in the Deokhuri valley and the Middle Palaeolithic site of Arjun 3 in the Deokhuri valley derive from within certain lower lying levels of the alluvium. The oldest, that of Acheulian handaxes at Gadari in Dang, comes from the base of the Babai Formation.

The sites in the Dang valley are recorded only along the southern margin of the valley, along the left bank of the Babai river, i.e. in the narrow belt of Quaternary sedimentation between the river and the hills (Fig.2). The heavy erosion and downcutting by the river has exposed almost all of the deposits of the Babai Formation and thus exposed the embedded sites as well. North of the Babai River one encounters only the younger deposits of the Sitalpur Formation, while the northern margin of the Dang valley has not been surveyed.

All recovered palaeolithic sites in the Dang valley are embedded in the alluvial deposits of the Babai Formation and the hillwash silts of the Gidhiniya Formation. The most important site complex is at Gadari, next to Dharpani (Fig.8) where a sequence of three occupations are encountered in the strata (Fig.64).

A handaxe assemblage derives from the very base of the Babai succession close to the river, while at the top of the succession in the upper silt of the Upper Member a flake-chopper-corescraper industry is embedded. Remnants of a Neolithic occupation were found in the same area, situated in a grey soil on the very surface of the Babai terrace deposits. Similar to the Gadari flake industry and in similar stratigraphic context are the sites at Gadari E and Gadari SE, at Gaitakhuri and Mohannagat, all east of the Gadari site complex. At the Ranighora river site, which is only a few kilometers east of the Gadari site, Early Palaeolithic artefacts (including a biface) are associated with a basal quartzite cobble gravel, overlying bedrock. To the west of the Gadari site complex a number of small localities, for example Dharpani, Dolgaon and Basantapur W, were found within the upper silt of the Upper Babai Formation as well. A number of sites (Basantapur SW, Ranighora S and Ranighora SW) are occupations close to the hill slopes and are associated with the colluvial hillwash deposits of the Gidhiniya Formation. It is interesting to note that even the sites within the Upper Babai Beds are usually not very close to the river, but are situated somewhat away from the river towards the hills, suggesting occupations avoiding the close vicinity of the river. In fact they are often encountered close to the boundary towards the Gidhiniya Formation (for example Gairakhuri and Basantapur W). The same is the case in the Tui valley.

Small microlithic localities are present near Daingaon, Dongput and Agmi at the very hill shoulder on the surface of and within the colluvial silts. No palaeolithic findings were made in the deposits of the Lower Member of the Babai Beds between the basal gravels and the upper silts of the Upper Member.

In the Deokhuri valley the situation is somehow different. Sites close to the river are only found in the east, where the Rapti River enters the Deokhuri valley, and in the very west, where the river leaves the valley. In the Dun valley itself the river flows in the centre, bordered only by its recent to sub-recent low terrace. Only close to the foot of the Siwalik hills are remnants of the older alluvial deposits encountered, while most of the valley is filled with recent and redeposited young alluvium, which is devoid of prehistoric cultural material. All recovered sites are thus associated only with the older deposits, i.e. those of the Babai and Gidhiniya Formations, mostly from the northern and eastern margin of the valley.

Sites within the Babai Formation are found mostly embedded in the upper silts of the Upper Member, for example at Lape and Bhalubang in the eastern part of the valley or at Pipri and Parhwa N, east of Lamahi (Fig. 2). Others have their position further within the older strata of the Babai Formation, for example the site of Sanpmarg in the very eastern part of the valley, where the occupation is embedded in a buried palaeosol. Another site is that of the Middle Palaeolithic occupation of Arjun 3 (at the entrance of the Arjun River into the central Deokhuri valley), buried beneath a thick, alluvial silt layer (Fig. 160). One locality, that of Jalkundi in the westernmost part of the Deokhuri valley, yielded a few Early Palaeolithic artefacts in a basal cobble gravel on the right bank of the Rapti River.

Sites are also found within the colluvial hillwash deposits of the Gidhiniya Formation. Such hillwash silts are encountered only along the northern slopes of the Deokhuri valley where the hills consist of Lower Siwalik fine-grained rocks of mud- and siltstones which provide the parent material for the colluvial silts. Sites embedded in these silts are for example Lalmaniya, Masutiya and Morighat in the eastern Deokhuri valley and are always situated away from the river at the foot of the hills.

In the southern part of the Deokhuri Dun valley, only the area south of Lamahi has been surveyed (Fig. 2). Here, the southern mountain range consists of Upper Siwalik coarse-grained rocks, particularly of conglomerates, devoid of any mud- and siltstones which provided the source material for the colluvial deposits in the north. Thus, no hillwash silts are encountered in the investigated area along the southern margin of the valley. Here, the sites of Gathwa and Kakraha are associated with the upper part of the older terrace alluvium, belonging to the Upper Babai Beds.

Two of the three important microlithic sites come from the Deokhuri valley: Bhatarkund in the western valley and Lamahi near the Arjun River confluence. Bhatarkund is situated on the surface of the older alluvial terraces and Lamahi is embedded in colluvial silt fan remnants.

The Tui valley, being part of the Dang Dun basin, is particularly rich in sites. The type site of the Brakhuti industry is situated on the left side of the Tui river, west of the village of Brakhuti. It is the most important site complex in the Tui valley, as it has recorded a sequence of occupations. Besides being the type site for the Brakhuti industry which has its position in the upper silt of the Upper Babai Formation, it has recorded an Early Palaeolithic artefact assemblage in the basal gravels. It has also yielded Neolithic remains in a subrecent grey soil.

Upstream of this site complex are various other localities connected with the Brakhuti industry: Brakhuti NN and SE which also derive from the same stratigraphic level in the Upper Babai Formation, while a number of smaller localities (Brakhuti NE, NW and S) derive from colluvial silts at the hill flanks. The Saskhuti S sites which also belong to the Brakhuti industry are embedded within a hillwash fan of the Gidhiniya Formation at the very foot of the hills. Downstream of Brakhuti, on the left bank, are the sites of Raniapur, again similar to the Brakhuti industry. While the Raniapur S1 locality is associated with a silt of the Upper Babai Beds, the Raniapur S2 and S3 sites were embedded in the colluvial silts right at the foot of the hills, in a very similar situation as the Saskhuti S sites. The site of Gidhiniya, further downstream on the right bank of the Tui River, has a stratigraphically different association, situated on an elevated terrace knoll and buried by colluvial silts.

One of the most important microlithic site complexes comes from the Tui valley, north of Ammapur, where several localities were found eroding out from the top part of the colluvial silts which here cover the slopes of the hills.

The map (Fig.15) shows the distribution of the recorded sites in the Tui valley. The majority of them belong to the Brakhuti industry and derive either from within the upper part of the fluvio-lacustrine deposits of the Upper Babai Formation from yellow silts, or from the reddish, homogenous silts of the colluvial hillwash fans of the Gidhiniya Formation on the slopes and the foot of the hills. The oldest cultural material of an Early Palaeolithic assemblage is connected with the basal gravel of the Tui valley above bedrock, for example at Brakhuti W, at Simalkhuti and Rajje. As in Dang, the intermediate horizons of the Babai Formation, that is between the basal gravel of the Lower Member and the upper silts of the Upper Member, have not yielded any artefact-bearing horizons.

The columnar section shown in Figure 11 and the comparative profiles (Fig.16, 64, 160) of the three valleys give an indication of the position of the most important sites in their stratigraphic contexts.

The stratigraphy of each site will be described separately along with the description of the cultural material in chapter V.2.

2. Sites on high river terraces

The sites in the river valleys in the Siwaliks were discovered during a systematic search of the terraces of the rivers which cut through the Siwaliks and enter either the Dun valleys or the Terai Plain. Especially the older, high terrace levels which have developed red oxi-soils on their surfaces were examined. These terraces have yielded occupation sites of the chopper-corescraper-flake assemblage of the Brakhuti industry, all embedded in the red soil at the top of the terraces, for example on the high terraces of the Mashot and Arjun rivers (Fig.2 and 9).

In the deeply entrenched Mashot valley the six recorded localities (the 92 m site and the Mashot 1, 2, 3 and 4 sites and the small locality at the Mashot/Arjun confluence) are all connected with the red soils of

the terraces. In the narrow Arjun valley the two recorded localities of Beldamar 1 and 2 are also situated on the high 60 m red terrace surface and derive from the upper level of the terrace deposits.

The five site complexes on the Rapti River west of Deokhuri, Tap Kund, Jalkundi, Lauki, Oj and Saunri, were recovered also from the higher 50 to 60 m terraces and were embedded in the red soils. These sites are situated in the narrow valley of the Rapti River where it cuts through the Siwaliks to reach the Terai plains. They are located on extensive terraces on the northern bank of the Rapti River, where tributaries from the north join the river. The Oj and Saunri sites are the largest and consist of site complexes, each with several localities distributed over their extensive surfaces.

Though deforestation here is not as severe as in the Dun valleys, erosion causes the break-up of the edges of the terraces and sheet-wash effects the top soils. The erosion is mainly triggered by the prevailing habit of setting fire to the forests in the dry, hot season in order to allow new grass to grow. This habit burns the undergrowth and thus destroys the stabilisation of the soil by the thick root-network of the undergrowth. The terraces, thus, become denuded, together with the covering soil. The artefacts often lie as residual stones on stilts of soil of up to 20 cm in height, indicating the rapid rate of soil wash. Especially the river terraces along the Rapti River west of the Deokhuri Dun, like Saunri, Oj and Lauki (Fig.2) are extensively deforested and denuded, and the major portion of the red soil cover is washed away.

At almost all these high terraces occupation sites could be recorded, but they are in most of the cases disturbed by the erosion. In recent years an attempt of reforestation and fencing-off these areas has been beneficial for a new vegetation cover to re-introduce itself on the terrace tops, hiding the sites.

The richest site complex connected with such high river terraces is that of the Mesolithic Patu industry in eastern Nepal (Pl.205/1). It is situated on high, forest-covered terraces of a river emerging from the mountains into the Terai. Denudation of the forest soil, covering the fluvial terrace deposits, caused by deforestation, exposed the occupation site and left a thick scatter of artefacts on the denuded surface.

Artefacts were rarely found on the very top of the terraces, but on denuded surfaces or washed down on the slopes. By plotting the artefacts into a contour map according to their secondary location one can deduce the original level from which they have derived. It was therefore very fortunate, and this must be pointed out with particular emphasis, that no previous survey or collection had been made by any collector, and that the sites were virgin areas, so that the artefacts were lying where nature and erosion has left them, without any major human disturbance. Thus it was possible in most cases to locate the original sites by the concentration of eroded-out artefacts on the slopes.

All the above mentioned sites derive from the alluvial deposits of the Duns or from the river terraces and are post-Siwalik in age, that means they belong to the time after the folding and uplifting of the Siwalik mountains and after the formation of the Dun valleys.

3. Sites in the Upper Siwaliks

Only in two other cases were artefacts recorded in a much older context than in the post-Siwalik Dun valley alluvium. Acheulian handaxes were found embedded within folded deposits of the uppermost Siwalik Group at the Satpati Hill and were uplifted together with the strata in which they were embedded. This is a unique situation and is discussed in detail later (chapter V.2.2). In another case a few rolled possibly man-made cobble tools have been found in connection with a conglomerate bed of the Upper Siwalik Boulder Conglomerate (described in chapter V.2.2).

The geographical and geological contexts of the prehistoric finds have provided the first insight into the chronological interpretation. Tables 17, 18 and 19 describe the chronological sequence and stratigraphical associations and summarize the data of the recorded sites in the three main geographical settings: in the Dun valleys, on the high river terraces and in the Siwaliks. These will be discussed in more detail in chapter VI.

V. The Cultural Material of the Prehistoric Sites

1. The artefact types and terms used, and description of the raw material

Before describing the cultural material in detail the terms used for the tool- and artefact types and for the manufacture of the tool complexes must be explained. Since in many ways the artefacts, and also the various manufacturing techniques, are quite different from those from India and from Southeast Asia, some terms are new or have a different meaning than they do elsewhere.

First of all the term „pebble tool“ will be abandoned here. Most scholars use this term for large, heavy-duty tools like „choppets“ and „chopping tools“. The term „pebble“ is, – in the geological usage, – a small stone of a size smaller than 2.5 cm. From such small-sized stone cores one cannot manufacture large choppers. The correct term of the stone cotes used for making „pebble tools“ is „cobble“, which has a size of 2.5 to 25 cm. That is the size of the cores from which choppers and other heavy, large tools were made. Therefore they should actually be called „cobble tools“. This is the term I will use henceforth, and which should be adopted worldwide.

Although the terms chopper (for unifacial chopper) and chopping tool (for bifacial chopper) are the commonly used terms, I prefer to use the terms „unifacial chopper“ and „bifacial chopper“, as both are choppers, and as it is immediately apparent whether they are unifacial or bifacial. The unifacial character of the majority of the cobble tools is a dominant factor in the cultural material of Nepal, and this should be clearly indicated.

The earliest tool types recorded from Nepal are handaxes, bifacial tools made on cobbles or large flakes of quartzite. They belong in type and technique to the Indian Acheulian tradition, and no special description is necessary here. In chapter VIII.3, while comparing the Early Palaeolithic with East- and Southeast Asia, however, the so-called handaxes or handaxe-like cobble tools from Southeast Asia, will be given particular attention.

The cobble tools in Nepal comprise unifacial and bifacial choppers, corescrapers, sumatraliths, uniface and other, atypical cobble tools. Most of the cobble tools are unifacially made, leaving one side entirely of cortex. Unifaces and corescrapers are always unifacially trimmed, while sumatraliths are occasionally also partly bifacial. Choppers are both unifacially or bifacially trimmed.

A table introducing the types of large tools described in this monograph is included before the plates in volume II.

Special mention must be made about the corescrapers. This is a new tool type for Nepal. Corescrapers are not core scrapers, i.e. not scrapers in the usual sense, but are heavy-duty tools, always unifacially worked from a large, oblong cobble, with a vertical, or almost vertical, lateral working edge. It is a typical tool type from the Late Palaeolithic in Nepal, and will be described and illustrated in more detail in the next chapter.

An explanation has to be given about uniface and sumatraliths. A uniface is „half a biface“ in Forestiers description (Forestier, 2000, p.533), i.e. a tool which is unifacially trimmed over a part or over the entire surface of one face, while the other face is a flat cortical surface. He calls this type of trimming the „phénomène unifaceal hoabinhien“. Forestier does not make a distinction between uniface and sumatralith. The original sumatralith, however, is a flat-based, more or less high-backed, steeply and unifacially trimmed tool of oval to elongate or squarish shape, as described from many Hoabinhian sites, such as those figured in Ha van Tan (1997), van Heekeren and Knuth (1967), who call such high-backed sumatraliths „high-domed horsehoof“, or in Nishimura (1994). In this monograph a distinction is made between uniface (in Forestiers term) and sumatraliths. Sumatraliths in Nepal are flat-based, high-backed, steep-edged tools which are unifacially trimmed (over part or all of the upper high-backed face), while the flat, lower face is of cortex or a split cobble face, as described in the Brakhuti industry, at Gidhiniya and Patu.

The cultural material has been described chronologically, from older to younger, from the Acheulian to the Neolithic.

The Acheulian at the site of Gadari in Dang and at the Satpati site, includes bifacial tools comprising handaxes, cleavers, picks, and flakes, all of which show no new or special features when compared with the Acheulian tools from the Indian subcontinent. They belong to the Early Palaeolithic.

No new terms are used here for the Middle Palaeolithic site of Arjun 3 site in the Deokhuri valley. It includes a levallois element of prepared, discoidal cores and flakes detached from them, as well as a blade element.

Special mention must be made of the Brakhuti industry, and the older Gidhiniya facies of the Brakhuti industry (described in detail under the Tui valley material). It is a new type of a Late Palaeolithic industry and is particular to Nepal. Its type site is the Brakhuti West Site in the Tui valley, where it has been studied in detail. The tools are made using a special stone knapping technique and incorporate the new cobble tool types of corescrapers, besides unifaceal and bifacial choppers, uniface, sumatralith-like tools and flakes of a particular and simple technique, which will be described in chapter V.2.1. Suffice to say here, that this industry is the most common and abundant industry in the Dang-Deokhuri area, with slight variations amongst the sites.

The microlithic industries of the Dang-Tui-Deokhuri valleys, have, with variations, affinities with microlithic industries of the Indian subcontinent. New tool types and terms are, thus, not introduced.

Special mention, however, must be made of the terms and tool types introduced for the Mesolithic Patu industry of Eastern Nepal, which is quite separate and differs from anything found in the Dang-Deokhuri area. It is a Mesolithic assemblage of macrolithic type with no microlithic element. New tool types are introduced, especially various kinds of adzes, which are described in detail in the Patu chapter. The adzes have no counterpart in western Nepal, and so far, in India.

A short description of terms, used in this monograph, will be given below.

A **Split flake** is longitudinally split along its axis, either intentionally or unintentionally during the process of detachment from the core.

A **Snapped flake** is a flake which is snapped vertically to the long axis of the flake. This is mainly intentional, or by usage.

An „**Orange**“ flake is one which retains cortex along one side of the dorsal face of the flake, like the rind of an orange. It is a manufacturing flake.

A **Flake with cortex opposite the platform** shows cortex on the distal end of the flake. It has in most cases also a cortex platform. It is usually a rejuvenation flake of a unifaceal cobble tool, particularly of a corescraper, with its rejuvenated or reshaped edge.

A **Rejuvenation flake** is a flake detached from a cobble tool, to reshape it, and a part of the cobble tool edge is often seen at one side.

A Utilised flake is a flake with no definite retouch, but with slight utilisation marks. Wear analysis has not been done.

Stepretouch at the dorsal side of the platform edge means that the flake, which in all these cases has a cortex platform, has a particular kind of stepretouch at the edge of the platform on the dorsal face. It is the same kind of stepretouch found on choppers, sumatraliths and corescrapers. Such flakes are rejuvenation flakes of large cobble tools.

Uni-directional, two-directional, multidirectional dorsal face is a description of the dorsal face of the flakes, in order to show the kind of detachment from the core, and from what type of core. Uni-directional means that the flake was detached from a core, which had previous flakes detached from the same platform on the core as the flake itself. Most of these flakes have a cortex platform. Such flakes would be normal for the manufacture of unifacial cobble tools. „Two-directional“ means that the core from which the flake was detached was a double-platform core, with two platforms opposite each other. Such flakes, as well as those with a multidirectional dorsal face, are not necessarily manufacturing flakes, but were flakes removed also for other reasons, for example for utilisation.

The striking platform is always called just platform.

The major raw material used in all industries, except for the microlithic industry, is quartzite, which is available everywhere in the river beds. But there is one raw material which deserves special mention. It is a very soft, very fragile, finely laminated material which I have called „tuffacious“ or „tuff“, as it looks like tuff, though it is by no means a tuff. It is a sedimentary rock of extremely fine lamination and seems to derive from the Siwalik rocks, but the original strata has not been located yet. It is found as subangular cobbles in the older river gravels, like in the Arjun and Babai rivers. It is a porous, fine-grained rock, made up of fine quartz grains, with many porous interstices which must have once been filled with some mineral which has now disappeared. It seems to have been leached and weathered after the tool was manufactured. It is now so soft that it would be impossible to trim it; it breaks away with the slightest use and one can scratch its surface easily. This means that when prehistoric people used and trimmed the material it was unweathered and hard and well suitable for specially fine trimming. At some sites, like at the Gairakhuti site, it was a specially favoured raw material. Prehistoric people obtained this raw material from the river gravels available to them and it must have been a hard and fine, conchoidally splintering rock then. It is a strange material and no geologist so far has been able to describe to me how this rock could have changed its consistency to such an extent from the time of its manufacture, thousands of years ago, to now. This material is not anywhere else encountered (see appendix II).

Appendix I gives a sedimentological description of this rock by two colleagues together with the author's comments.

Quartzite is, however, the most common raw material in all the Nepal assemblages, even to some extent in the microlithic industry. The larger river beds in the Siwaliks carry abundant quantities of quartzite pebbles and cobbles. The rocks of the Lower and Middle Siwalik Group itself have no quartzite outcrops, only sandstones and claystones. Even the hard, calcareous sandstone of the Lower Siwalik Group is not suitable for tool manufacture. But the so-called Boulder Conglomerates of the Upper Siwalik Group carry large bodies of cobble-boulder conglomerates in which quartzite is a major component, having been brought down from the inner Himalayas. Wherever such Boulder Conglomerates are exposed in the Siwalik range the rivers carry abundant quartzite cobbles. This is particularly the case for the Deokhuri valley, where the southern range of the Siwaliks consist of Upper Siwalik Boulder Conglomerates. Besides which, the Rapti River, draining the Deokhuri valley, has its source area beyond the Main Boundary Thrust in the inner Himalayas where quartzite rocks are available as well.

The rivers that drain the Dang and Tui valleys only flow through the Siwaliks and have their source areas in the Siwaliks. Quartzite cobbles in the recent river beds of the Babai and Tui rivers are relatively rare and could only be derived from outcrops of Boulder Conglomerates of the Upper Siwalik Group. The re-

cent Babai River in the Dang valley does not carry quartzite cobbles, and the surrounding hills consist only of Lower and Middle Siwaliks which have no quartzitic rocks. Yet, prehistoric man in the Dang valley has used predominantly quartzitic raw material. Since this material is not available in the hills it must have been collected from the then existing river beds. In Early Palaeolithic times the basal gravels, seen for example at Ranighora, have quartzite cobbles as a component, and Early Palaeolithic hominids, like those of the Gadari handaxe site, thus had no difficulty in obtaining this material from the then existing river beds.

However, the Upper Babai Beds have no gravels with quartzite raw material and yet, the people of the Brakhuti industry of the Late Palaeolithic in the Dang valley have used this material abundantly. Where they brought it from is not clear, but the lack of availability of quartzite may have been the reason why „tuff“ is such a preferred raw material for them in the Dang valley sites (32 % at Gaitakhuti, 17 % at the Gadari Flake Site). This material must have derived from the Lower or Middle Siwaliks and must have been available in the river beds, as it is even today, though now always in leached form.

In the Tui valley the situation is somewhat different. There are thick quartzite cobble gravels even in the recent river bed, derived from exposures of the basal gravels of the alluvium. The question of the rather enigmatic source of these well-rounded quartzite cobbles is discussed in chapter III.2.1. in the Tui valley description, and in IV.2.1.1. under Raniapur and Brakhuti W boulder gravel.

In the Deokhuri valley the situation is again different. The Rapti river has always carried in its bed-load a heavy quartzite component, because the Rapti has its source area beyond the Siwaliks. Besides this, the southern tributaries of the Rapti river in the Dun valley have their sources in the Upper Siwalik Boulder Conglomerates, and their beds are loaded with large quartzite cobbles, so that quartzite was available at all times for prehistoric man in the Deokhuri valley.

Other raw materials used are chert and quartz, though only to a small extent in the Brakhuti industry, and to a larger extent in the microlithic industry. Quartz and chert nodules are not easily available in the river beds and could have been brought only from beyond the Main Boundary Thrust from the inner Himalayas. Chalcedony, a raw material so abundantly used in the Indian microlithic, is here used only to a very small extent, as it is not available in the rivers. In India it is the volcanic Deccan Trap rocks in Central India which furnished this material abundantly and it was traded far to the south and to the north, and even into the Himalayas (1-2 % in the microlithic industries in Nepal).

Comparing the diagrams of the raw material of the various sites (see below) will give an idea of the differences in raw material use.

The good raw material available in the surveyed areas has influenced the quality of the tool manufacturing. The fine, conchoidal fracture of the quartzites used, for example in the Middle Palaeolithic Arjun industry, is seen in the good quality of the flaking technique of the prepared cores and flakes of Arjun. It seems that these people took great care in choosing quartzite cobbles of particular fine quality. At Patu, on the other hand, quartzite of another kind was preferred, which had cleavage planes and which fractured in a particular way, which the Patu people needed and preferred for their particular slicing method.

Regarding the technologies used in the various periods they will be described and discussed in detail in chapter V.2. during the analysis of the cultural material.

2. The description and analysis of the cultural material, area-wise

2.1. Western Nepal, the Dang-Deokhuri Dun valleys

2.1.1. Sites in the Tui valley

The Tui valley is a small tributary valley of the Dang valley, but belongs geologically to the Dang Dun and exhibits the same stratigraphical features as the Dang Dun, only on a smaller scale, and is therefore used as a model area for the understanding of the Dun valley alluviation in the Dang-Deokhuri area. Its stratigraphical and geological features have been described in chapter III.2. The Tui River is the only southern tributary of the Babai River in Dang. It runs parallel to the latter, before it turns suddenly northeast, west of Ammapur (Fig.15), and then leaves the Siwaliks before joining the Babai River. It has a mean elevation of about 600 m, like the southern Dang valley, and is only 18 km in length but has a considerable width of about 2 km throughout most of its length.

In the Tui valley, so far 13 localities of prehistoric settlements have been found. All of them are connected with the higher alluvial terraces and colluvial hillwash deposits, and none are linked with the low 10 m terrace, except pottery sites of **subrecent origin** at Majhgharwa and Raniapur/Bhirabang. The majority of localities are associated with the marginal colluvial slope wash deposits of silts of the Gidhiniya Formation. Recent strong erosion which has dissected the Quaternary strata has exposed the sites. A comparative table of the schematic section through the most important sites is given in Fig.16.

The sites will be described in their geographical distribution, from west to east, heading upstream. The first large and important site complex is that of a microlithic assemblage at Ammapur, which will be described in greater detail below, after which a few smaller localities in the vicinity of Ammapur are recorded, some of which seem to belong to the microlithic Ammapur complex, whereas some others, namely the more western ones, do not.

The Ammapur sites

North of the Tui River, above the village of Ammapur (Fig.17), which lies at a mean height of 580 m.a.s.l., several localities were recorded in January 1989, all of which belong to a microlithic industry consisting of artefacts made of chert, chalcedony and quartz, and larger flakes and tools made of quartzite. They appear to be eroding out from the upper levels of the red-to-yellow colluvial silt belonging to the Gidhiniya Formation, which covers at many places the foot of the northern flank of the Siwalik hills, there forming deeply dissected fan surfaces at heights of 620 m a.m.s.l., and even more, i.e. 40 m and more above river level. These reddish-yellow silts are the product of the weathering of the Lower Siwalik mudstones, which form the rocks of the surrounding hills, and have been washed out as colluvial mudflows or slope wash (see description of these deposits in III.2.1.2.). There are many such silt remnants not only around Ammapur but in the whole of the Tui valley, both on the slopes and on saddles in the surrounding Siwalik hills above the valley. They are certainly not of fluvial nature, and can only be explained by colluvial slope wash processes (Pl.205/2, see also Pl.244/1). They lie on exposed and dissected bedrock, as seen well in this photo.

As described in chapter III.2.1.2., such deposition must have occurred only after a long period of very arid and cool climatic conditions, conducive to little or no vegetation, during which the weathered silt material from the Siwalik mudstones accumulated on the slopes, and washed down gently to be deposited as small fans in basins and saddles on the hillslopes. Such conditions could have only occurred in the last glacial period, towards the end of a maximal cold phase (perhaps after 18 ka BP). The artefacts found within the very top part of these silts therefore belong most probably to the end phase of the colluvial deposition at the beginning of an amelioration phase during the terminal Pleistocene.

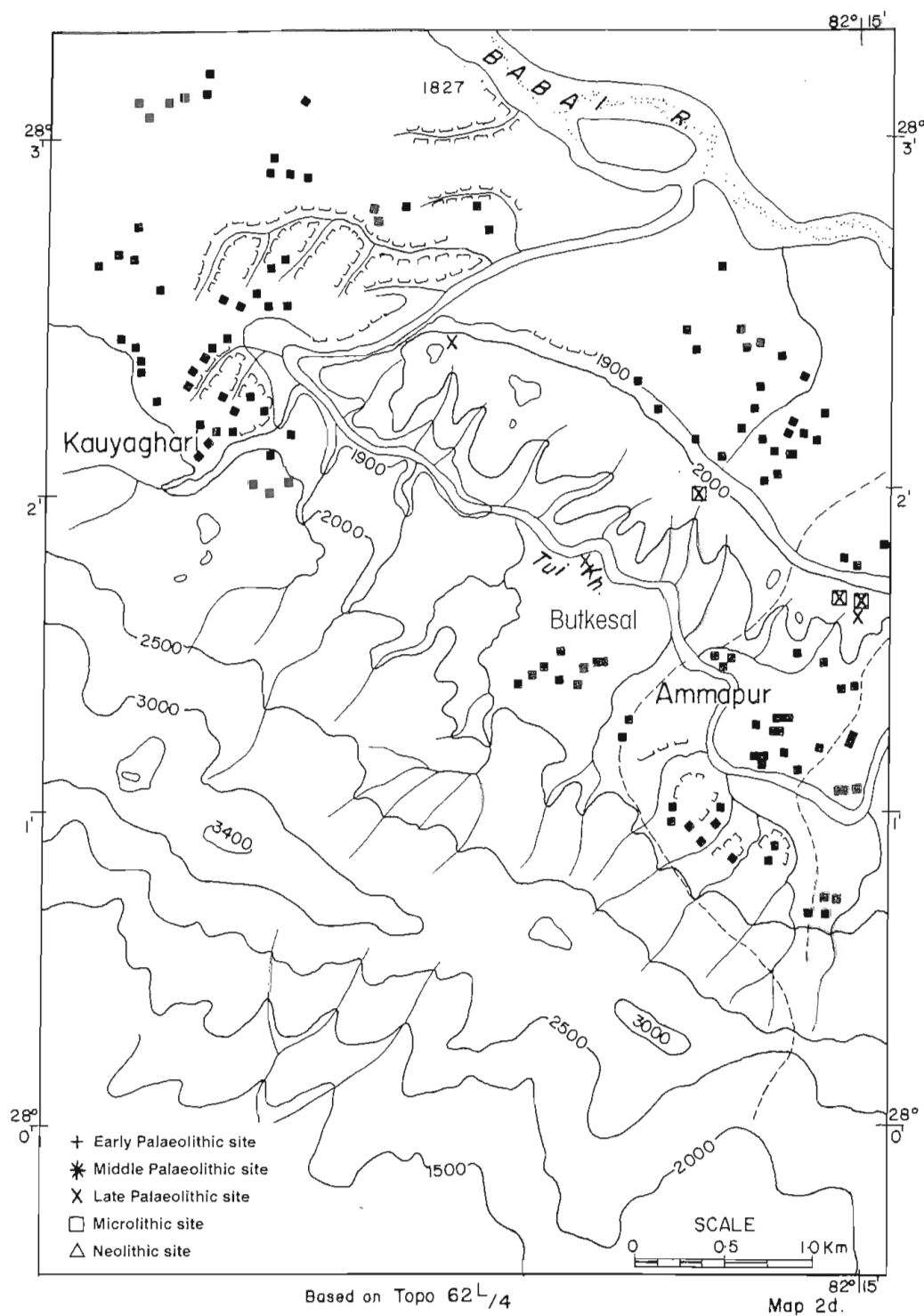


Fig. 17. Regional map 2d, of the Tui valley at Ammapur and the confluence with the Babai river. The legend is valid for all regional maps.

The silt deposits of the sites of Ammapur, situated at a height of about 615 metres (just above contour line 2000' and below the hill, peaking at 2100'), have been dissected and cut by small erosion gullies into several silt remnants, all containing artefacts. The artefacts are enriched in the gullies into which they have been washed from the silt.

Ammapur 1 is only a thin remnant of the silt overlying bedrock, with a few quartzite flakes of Brakhuti type (see below) having weathered out from the silt. The locality Ammapur 2 is a neighbouring silt remnant on which a few light-red potsherds are found on top of the silt.

Ammapur 3 is the western-most locality of the Ammapur complex (Pl.205/3) where, in shallow bedrock gullies once covered by the silt, a concentration of mainly microlithic artefacts of quartzite, chert and quartz is found. The artefacts comprise small flakes, chips, some cores and a few corescrapers, which occur together with numerous unbroken and broken cobbles and pebbles of quartzite and chert. A selective collection was made but the artefact concentration was left untouched, so that the correct place for an excavation could be chosen for future work (if the artefacts have not been destroyed by erosion). A few weathered light-red potsherds are found there, too, on bedrock.

The artefact level on the surface of the rocky ridge is a lag deposit, being the residue of the washed away silt in which the artefacts were embedded. The lag level is 0.50 to 1.50 m higher than the truncated surface of the silt. That means that much silt has been already washed away. The artefacts are also lying at the silt/rock boundary and have eroded out from the silt towards the small erosion gullies. The thickness of the silt varies enormously. The rock level below the silt was very dissected before the aggradation of the silt. The rocks of the Lower Siwaliks, which form the bedrock, dip almost vertically and have weathered into steep ridges of more resistant sandstones and deeply entrenched gullies of the less resistant mudstones (Pl.205/3). This dissected, rugged bedrock terrain was covered by the colluvial silt; eg. the silts in the bedrock gullies are 5 to 8 m thick, while above the sandstone ridges they are only 1 to 2 m thick. The silt on the sandstone ridges is almost completely gone, leaving the artefacts on the bedrock as residue. Judging by the situation at the neighbouring site of Ammapur 4, where the silt cover is still more intact, the artefacts had their level in the uppermost part of the silt.

Ammapur 4 is another site, situated some 100 m to the west of the site complex of Ammapur 1 to 3. It is embedded in the same yellow colluvial silts, 35 to 40 m above the Tui River. Many artefacts are eroding out from the upper part of the silt, some 0.30 m below the silt surface. The silt at the Ammapur 4 site is of varying thickness, between 2 m to a maximum of 8 m, which overlies deeply dissected bedrock (Pl.16-Sc). The abundant artefacts here consist of small flakes, chips and cores of quartzite, chert, quartz and the light „tuffaceous“ material, and contain a large microlithic element. A selective collection has been made from the washed-out artefacts. Each time I visited the site a new collection was made in order to save the artefacts from being washed away down the gullies.

The Ammapur silts belong to the colluvial hillslope deposits of the Gidhiniya Formation which once covered all the slopes above Ammapur. Now there are only remnants of these formerly widespread fans (Pl.205/2,3, see also Pl.244/1).

The Ammapur artefact assemblage. The Ammapur artefact assemblage is predominantly a microlithic one, almost all specimens having been fashioned from small nodules of chert, chalcedony or quartz. Associated with the microliths are larger tools and flakes, all made of quartzite. The selective collection comprises a total of 201 artefacts: 4 quartzite flakes from Ammapur 1, 105 mainly microlithic artefacts from Ammapur 3, 92 mainly microlithic artefacts from Ammapur 4, and light-red pottery sherds from Ammapur 2. The collections made in later years are not included in the statistical analysis.

The microlithic assemblage includes a variety of microlithic tools, such as: backed lunates, some of them very well made with fine retouch at the back (Pl.1/1,2,6 and Pl.1/3,4,5);

naturally backed lunates, the blunt back being unretouched;
 backed bladelets and flakes (Pl.1/7,8), the back is either retouched or is naturally blunt;
 thumbnail-scrapers (Pl.1/9-12 and Pl.69/3), with fine retouch on the dorsal face along a convex edge;
 end-retouched microliths with fine retouch at the distal end (Pl.1/18). They were made from cortical chunks or flake-like pieces or on flakes;
 side-retouched pieces, where a thin retouch was executed on one lateral side (Pl.1/19)) without a blunted back on the opposite side;
 geometrical tools of trapezoidal or rectangular shape with a sharp distal edge (Pl.1/13-15);
 utilised flakes of geometric shape, (Pl.68/3,4, Pl.1/16);
 non-microlithic, but small scrapers; including a fine side-cum-end scraper (Pl.1/17) and an end-scraper on a blade-flake;
 utilised bladelets (Pl.68/5).

Lunates and thumbnail-scrapers are more common than others. The bladelets have often a natural blunt back opposite the sharp edge. The backing retouch on the lunates is sometimes not very well executed, but the retouch on the thumbnail-scrapers is in some cases very well done (Pl.1/9-12). End- and side-retouched microlithic tools are more common at Ammapur 4 than at Ammapur 3. A few fine geometric tools (Pl.1/13-15, Pl.68/3,4) are present, but geometric, non-retouched flakes are less common at Ammapur than at the other two microlithic sites of Lamahi and Bhatarkund 1. Small scrapers are rare, but a number of bladelets were used (Pl.68/5). Larger scrapers made of quartzite are also present.

The majority of the microlithic cores are discoidal, mostly unifacial ones (Pl.68/2, Pl.1/20 and Pl.2/1,2,3), but some are also either cylindrical single-platform cores (Pl.68/1) or else are polyhedral cores with several platforms at right angles to each other (Pl.1/21). The discoidal cores are mainly unifacial or almost unifacial, with the lower face of the small chert or chalcedony pebble being left with cortex, while microlithic flakes have been removed radially from the upper face; or they are half-unifacial, which a few microliths having also been removed from the lower face.

The majority (49 %) of microlithic flakes of Ammapur 3 and 4 have a cortical platform (Fig.18), while 20 % have plain platforms and only 15 % are prepared. The vast majority of the flakes (81 %) have no cortex on their dorsal faces (Fig.19). The blade/bladelet element (with 14 %) is more common than at the other two microlithic sites, while split and snapped flakes are rare (1 % and 7.5 % respectively) (Fig.20). Step-retouch at the platform edge are rather frequent (41.5 %) (Fig.20). The dorsal scars stem in the majority of cases (40.5 %) from flake detachments from the same platform on the core as the flake itself, indicating single-platform cores, though multidirectional scars are also relatively abundant (31 %), while radial flaking is rare (only 5.5 %) (Fig.21). The quantitative characteristics are shown in Figures 23-25. The platform angle of a majority (65.5 %) of flakes have angles smaller than 110 degrees (Fig.22), which is typical of all three sites. Most (60.5 %) are smaller than 3 cm (Fig.23). The breadth/length graph has its peak at 0.7, with 10.5 % of flakes having a ratio less than 0.5, indicating a rare blade element (Fig.24), though these are more common than at the other two sites. The thickness/breadth graph has its peak at 0.3, with 67 % of flakes having a ratio less than 0.4 (Fig.25), being thinner, very similar to the other two sites.

The larger quartzite flakes have cortex platforms and step-retouch at their platform edges, and their dorsal faces seem to be well prepared on the core (Pl.67/3, Pl.66/4, Pl.67/1 and Pl.67/2). They are typologically quite similar to the flakes of the Brakhati assemblage (see later), which have step-retouch at the platform edge and cortex opposite the platform, marking them out as corescraper-rejuvenation flakes (Pl.67/2). There are also a few typical „orange“ flakes and one of the utilised flakes has a fine gloss at its used, but unretouched distal edge. It is the only one of its kind (no gloss has been found so far on any of the tools), though this waste flake indicates that gloss-bearing tools must have been present. One flake is a fine point (Pl.69/7), but similar examples are rare. A number of the larger quartzite flakes have been uti-

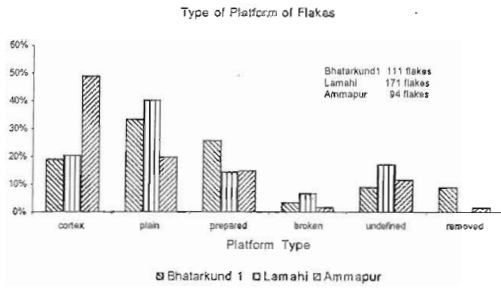


Fig. 18. Type of platform of microlithic flakes.

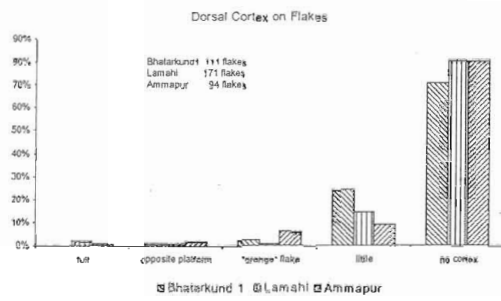


Fig. 19. Cortex on dorsal face of microlithic flakes.

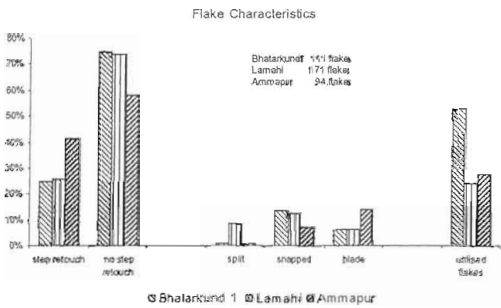


Fig. 20. Characteristics of microlithic flakes.

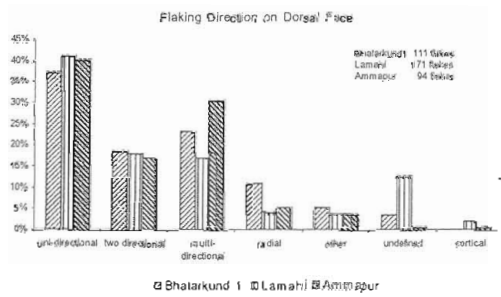


Fig. 21. Type of dorsal scars of microlithic flakes.

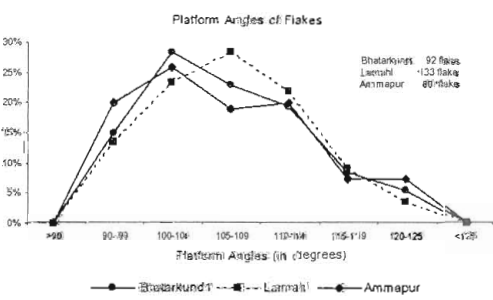


Fig. 22. Angle of platform of microlithic flakes.

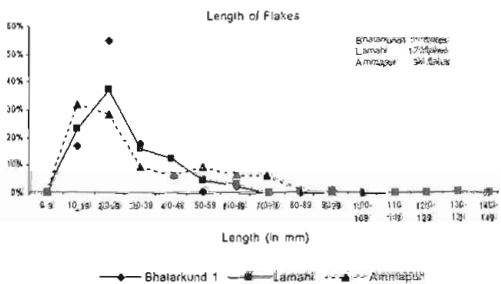


Fig. 23. Size of microlithic flakes.

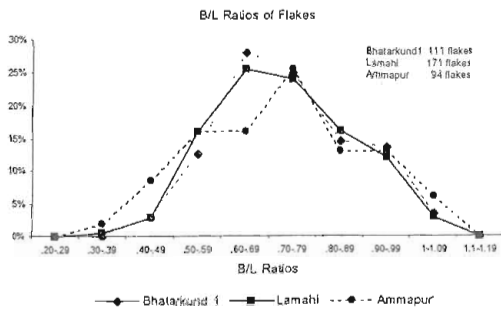


Fig. 24. Breadth/length ratios of microlithic flakes.

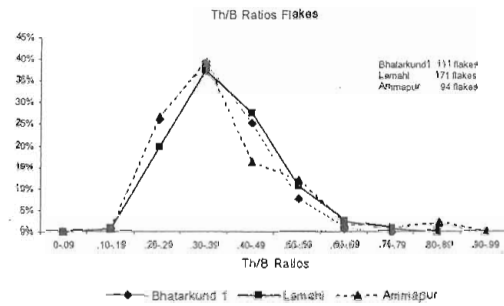


Fig. 25. Thickness/breadth ratios of microlithic flakes.

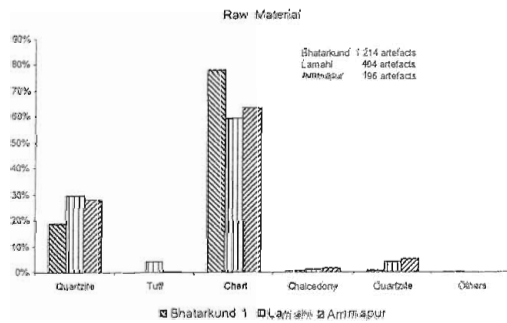


Fig. 26. Raw material of microlithic artefacts.

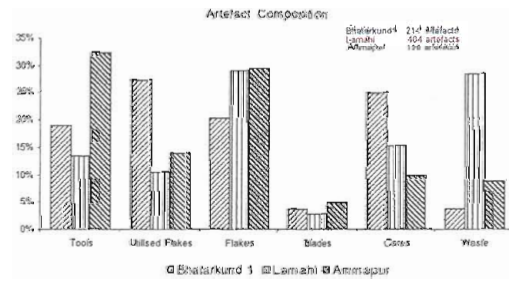


Fig. 27. Artefact composition of microlithic artefacts.

lised (Pl.67/3, Pl.66/4). True blades of a larger size are not present, except a few blade-flakes, utilised as scrapers (Pl.66/2,3).

The few quartzite flakes from locality Ammapur 1 are not microlithic. One is a corescraper-rejuvenation flake, with cortex opposite the cortical platform. Another flake is actually a well-prepared levallois flake with a prepared platform and radial dorsal scars. This flake seems to be the only one of its kind at Ammapur, while at the Lamahi and Bhararkund microlithic sites a definite levallois element is apparent.

The large heavy duty tools, made of quartzite, include: unifacial choppers, either oval (Pl.68/7) or round (Pl.69/2); a large unifacial side-chopper (Pl.65/1); and ovate unifaces (Pl.69/1 and Pl.68/6) with well-made steeply retouched edges around the circumference; and large scrapers with convex working edges (Pl.67/4). One especially interesting implement is a bifacial tool made of coarse white quartzite (Pl.65/2) with a bifacial knife-like right edge, which is well used, while the opposite side is blunt, so as to give the tool a knife-like shape, and with a fine oblique transversal adze-like edge, which is likewise well used. This is the only tool of its kind in the Tui valley. It is somewhat abraded and looks older than the rest of the tools. Two small corescrapers, ranging in size from 60 to 90 mm, have both two lateral steep edges opposite each other. A flat discoidal tool, made on a split cobble, appears not to belong to this assemblage either, but seems to be older. It is quite weathered and rounded, has no secondary trim-

ming and has a well-worn jagged edge around the circumference. It is still unclear whether the larger quartzite flakes and the heavy duty tools belong, as a different tool requirement, to the microlithic assemblage or not. We can only say that they were found in definite association with the microliths on the surface, where they have eroded out from the silt. There are also two grinding stones of cylindrical shape in the collection with a ground or striated grinding surface. One (Pl.66/1) has, besides the smoothed grinding surface, another surface with heavy, elongate pitting marks and another with fine, point-like pitting marks. Both ends seem to have been used for pounding.

The raw material consists of a variety of colourful cherts (63.5 %), while quartzite is still quite prominent (28.5 %). „Tuff“, which is a rather dominant material in the Brakhuti industry, is very negligible in the microlithic assemblages. At Ammapur it accounts for only 0.5 % (Fig.26).

The artefact composition is shown in Fig.27. Since it is a selective collection, the percentages show a high value for tools and utilised flakes (Table 2), and a low value for waste. The percentage of unutilised, unretouched flakes is high, too, as they were collected for the purpose of understanding the manufacturing processes.

The classification of tools, utilised flakes and cores from Ammapur 3 and 4 is given in Table 2 (the non-utilised flakes are not included).

Summary of the Ammapur artefacts. The Ammapur assemblage is a microlithic industry, albeit with a macrolithic element. The microliths, predominantly made of chert, comprise thumbnail-scrapers, backed lunates and other backed pieces, some geometric forms and bladelets. The microlithic cores include discoidal cores, which is the prominent core type at Ammapur, cylindrical one-platform cores and polyhedral cores with several platforms at right angles to each other. The assemblage includes also heavy duty cobble tools: oval and round unifacial end-choppers, a side-chopper, ovate uniface, cotescrapers, round scrapers and a knife-cum-adze. There are also a few grinding stones with striations and pitting marks. These heavy duty tools are, however, much less frequent at the Ammapur 4 site than at Ammapur 3, where they were found together with the microliths. The question whether they belong with the microlithic tools, but for a different activity, is yet unsolved. At the two other microlithic sites, in the Deokhuri valley, no large tools were found in direct association with the microlithic assemblages (see there), none at Bhatarkund, and only a few at Lamahi, but not in direct connection with the microlithic tools.

The Ammapur 3 site is almost exhausted now due to the heavy erosion. But Ammapur 4 yields every time one visits the site artefacts that have newly eroded out. Most have been collected to save them from being completely washed away.

Tab. 2: Classification of tools, utilised flakes and cores from Ammapur 3 and 4.

Microlithic tools and utilised blades	Ammapur 3	Ammapur 4
12 backed lunates	7	5
4 naturally backed lunates	2	2
8 backed bladelets/flakes	2	6
10 thumbnail-scrapers	7	3
8 end-retouched microliths	2	6
4 side-retouched microliths	-	4
3 geometric microlithic tools	3	-
4 geometric utilised flakes	2	2
6 scrapers (non-microlithic)	3	-
9 utilised bladelets	9	-
6 other bladelets	3	3
1 point (non-microlithic)	1	-
	41	31

Microlithic cores		
7 discoidal, cores (mostly unifacial)	1	6
4 polyhedral cores with several platforms at right angles	3	1
1 single-platform, cylindrical	1	-
2 two-platform cores at right angles	2	-
7 irreg. cores/core fragments	2	5
	9	12
Heavy duty tools		
4 Unifacial choppers		
2 round	2	-
1 oval	1	-
1 side-choppers	1	-
2 unifaces	2	-
2 corescrapers	-	2
1 large scrapers	1	-
1 bifacial knife-adze	1	-
1 discoids	-	1
2 grinding stones	2	-
17 larger flakes, utilised	11	6
	21	9

Of the total of 123 artefacts from Ammapur 3 and Ammapur 4, 102 are tools and 21 are cores.

After the statistical analysis of the artefacts collected up to 1994, all the larger eroded artefacts have been saved and collected in 1998, 1999 and 2001, but have not yet been catalogued. It is evident, however, that the number of utilised microlithic tools, mainly of lunates and thumbnail-scrapers, has thereby been augmented considerably.

Numerous smaller localities and even smaller „activity spots“ could be recorded around Ammapur, but never in the young alluvial lower terrace of the Sitalpur Formation or on its surface. They are always connected with the colluvial high-level silt deposits on the hillslopes.

Ammapur 5 is one such example, where in the years 1998/99 a small microlithic „spot“ eroded out from a small remnant of a colluvial silt deposit (Ph.17-Sc) on the Siwalik slope north of Ammapur (Fig.17). One year later no other artefacts had eroded out at the site, and a small pit, dug into the silt, ensured that nothing more was in fact present, and that it had only been a minor activity spot with only small microlithic flakes and chips, and one fine, backed blade or lunate.

Other small localities include Ammapur NW in a remnant of a high-level silt fan (Pl.206/1 and 205/2), containing just a few microlithic chips, which were collected from the silt slopes, having derived from the silt. This silt remnant is situated in a saddle at a height of 620 m, on the hill ridge between the Tui and the Dang valleys, and is the highest of the hillslope silts around Ammapur. The hills surrounding the saddle are just above 670 m high. This silt has a definite rubification horizon on its surface, now almost eroded away.

Another small locality is Dakhna SW 1, a little flaking spot with crude, non-microlithic artefacts that lie on the rock surface in a small saddle on the hill crest just east of the mouth of the Tui River. The silt that once existed on it was probably washed away. The small, rather undiagnostic assemblage is one of a number of such hill-crest localities in the Tui valley, where obviously some activity was carried out,

away from the camp. There are numerous such small localities which can be seen in the dry season, when the grass has wilted away. They are, in some cases connected with remnants of the high-level silts, or in others are lying on the rocky weathered surface of the hill slopes and saddles.

The next complex of sites in the Tui valley upstream are the Gidhiniya sites (Fig.28).

The Gidhiniya sites

A number of localities were recorded north and east of Gidhiniya village. The largest is the Gidhiniya site on the northern bank of the Tui River east of the Gidhiniya village, while northwest of the main site, in a shallow saddle in the hills, is a small locality called Gidhiniya Pass. The sites were discovered in February 1984 (Corvinus 1985).

Above the Tui River to the north and northeast of Gidhiniya, the hillslopes and the foot of the Siwalik hills were once covered, up to 30 m a.m.r.l. and above, by the conspicuous yellow- to reddish-yellow unstratified high-level silts of colluvial origin of the Gidhiniya Formation (Pl.246). This constitutes, in fact, the type site of the Gidhiniya Formation. Now erosion has dissected these silts to a great degree, creating a badland topography and exposing the underlying bedrock.

The Gidhiniya site is located on a promontory 16.50 m above the Tui River (Pl.206/2) on a rocky surface of a cobble-pebble rubble, which has been weathered *in situ* from the underlying Siwalik sandstones. These sandstones have weathered into several parallel ridges, leaving between them the washed away mudstone layers as small basins of *murrum*¹ (see term described in chapter V.1.). Many artefacts, all made from quartzite, not from Siwalik sandstone, were found amongst the weathered Siwalik cobbles. The site must have been a factory site or workshop, and man must have brought the quartzite cobbles up to the site (Pl.207/1). Almost all quartzite cobbles have been chipped or worked. There is an abundance of waste flakes, chips and other debris, and also, though fewer in number, of tools. The majority of artefacts are fresh, but a certain number are weathered, indicating that the latter have been eroding out a considerably long time ago. There is no doubt that the site was once covered completely by the yellow colluvial silt of the Gidhiniya Formation. In 1984, when the site was discovered, only remnants of it were seen, covering part of the site (Pl.245/2). Now, after more than 15 years, the surface of the silt cover has receded down the slope by the yearly sheetwash erosion.

From the Gidhiniya site one has a fine bird's eye view to the south over the Tui valley and its lower lying terraces (Pl.207/1). It is certainly a suitable place for occupation. Behind the site is a rock shelter, in the form of a natural chamber, which now is used as a shrine by the villagers.

The site on the promontory is 25 m long and 10 m wide and slopes down at both ends to the east and west. On the side facing the river, Siwalik sandstones crop out below the site, but at both eastern and western ends the bedrock slopes down and is overlain by yellow silt (Fig.29 and Fig.30).

The artefact locality on the Gidhiniya Pass, at a height of about 660 to 670 m, i.e. about 80 to 90 m above the Tui River and 1 km up the hill (Fig.28), belong culturally to the Gidhiniya site. A yellow colluvial high-level silt of the Gidhiniya Formation once filled a small, shallow basin just below the pass. Only remnants of this silt can be seen now (Pl.207/2). The surrounding Siwalik hills consist of Lower Siwalik sandstones dipping gently to the south, and of thick intercalated yellow and ochre clay- and siltstones, which are the source of the reworked colluvial silt (Pl.207/3). The site was protected till recently by the vegetation on the hills. But the hilltops are deforested and bare now, so that the colluvial silt has rapidly eroded away, and with it the artefacts. The artefacts are derived *in situ* from the lower part of the silt and weather out from it, so that many are lying as residue on the underlying bedrock or, enriched, in

¹ Such *murrum* is specially developed within the easily weathering siltstones intercalated between the harder sandstones (see Fig.29).

the small erosion gullies. In a few years time all the silt will be washed away by erosion, and the artefacts will be scattered on the bedrock with no connection any longer with the sediment in which they once were embedded.

The Gidhiniya sites are of special interest for two reasons: Firstly because the colluvial silt has here filled up, in the form of a slopewash deposit, a shallow basin high up above the actual river valley. The silt is identical with the silts which have accumulated everywhere as high-level colluvial silts in the Tui valley and its side valleys. It seems beyond doubt, given this situation, that all these high-level yellow/ocher silts in the Tui valley and in the southern Dang valley have the same origin, i.e. as weathering debris from the Lower Siwalik siltstones, laid down as colluvial slopewash.

The second reason is that this site shows us that one has to be very careful when assessing the age and provenance of artefacts found on bedrock in hilly terrain where erosion is very strong and may have washed away the original sediment in which the artefacts were embedded. In this regard I may record a fine levallois core, unconnected with any site, which I found in December 1999 a few hundred metres west of the Gidhiniya site, on an exposed bedrock surface between badland hillocks of the colluvial silts. It must have derived from within the silt, which near the discovery location is about 5 m thick (Pl.208/1, the tool was found near the hammer).

The site of the Gidhiniya Pass is a small one and must have been occupied by a small band of people who camped below the pass in the safe confines of the basin, which maybe was used as a hunting place above the base camp at the Gidhiniya site on the Tui River. The small collection of artefacts made from this locality (an *in situ* flake and 24 surface artefacts) is quite similar to the artefacts from the Gidhiniya site. Of special interest are the few uniface (Pl.71/5) and scrapers, and a ground stone point (Pl.71/2) similar to the ground stone points at the main Gidhniya site. The artefacts of the small Gidhiniya Pass site seems to derive from the lower part of the silt itself, not from the top or from below the silt. There are no artefacts on the surface of the silt or on the bedrock surface further away from the site, except those close to the silt block which eroded out from the silt and lie on the bedrock, having been washed down the slope (see Pl.207/3, where the man sits). Most of the artefacts are fresh to very fresh, and only a few are weathered from having been exposed longer after being washed out from the silt.

The Gidhiniya artefact assemblage. The industry of the Gidhiniya assemblage is mainly a cobble tool industry, with large tools of choppers, corescrapers, sumatraliths, polyhedrons and uniface, along with a few scrapers and utilised flakes associated with unutilised flakes and other waste. The artefact composition of the assemblage is shown in Fig.31. The surface collection consists mainly of flakes, of which the majority (90 %) are waste flakes with no apparent use. There are almost no cores. In the collection are only 5 cores. The flakes, of all sizes and rather ill-shaped, seem to be mainly manufacturing flakes and rejuvenation flakes of the large cobble tools. The raw material of the Gidhiniya assemblage is quartzite, besides a low percentage of chert and „ruff“ (Fig.32).

The tools consist of unifacial choppers, corescrapers and polyhedrons, all made on round or oblong cobbles by unifacial flaking. The most typical tools in Gidhiniya are unifacial, round choppers with a convex cortical lower face, such as artefact No.1² (Pl.2/5). No. 33 and 34 (Pl.69/5,6) are miniature forms of this type, which is a very special feature of Gidhniya. Other chopper forms have semicircular convex, unifacial edges or edges 3/4 the way around the circumference or have lateral convex edges. Choppers with a bifacial edge are rare. There are, however, no side-choppers nor end-choppers.

The corescrapers have a characteristic steep working edge above a flat base of cortex, with angles of more than 80 or 90 degrees, made by steep, unifacial stepretouch from the cortex base. The edges are normally either straight or convex and semicircular. Some have not only one but two lateral edges (Pl.3/2).

² Numbers of artefacts have mostly been given for those artefacts which have a special importance or which have not been drawn or photographed.

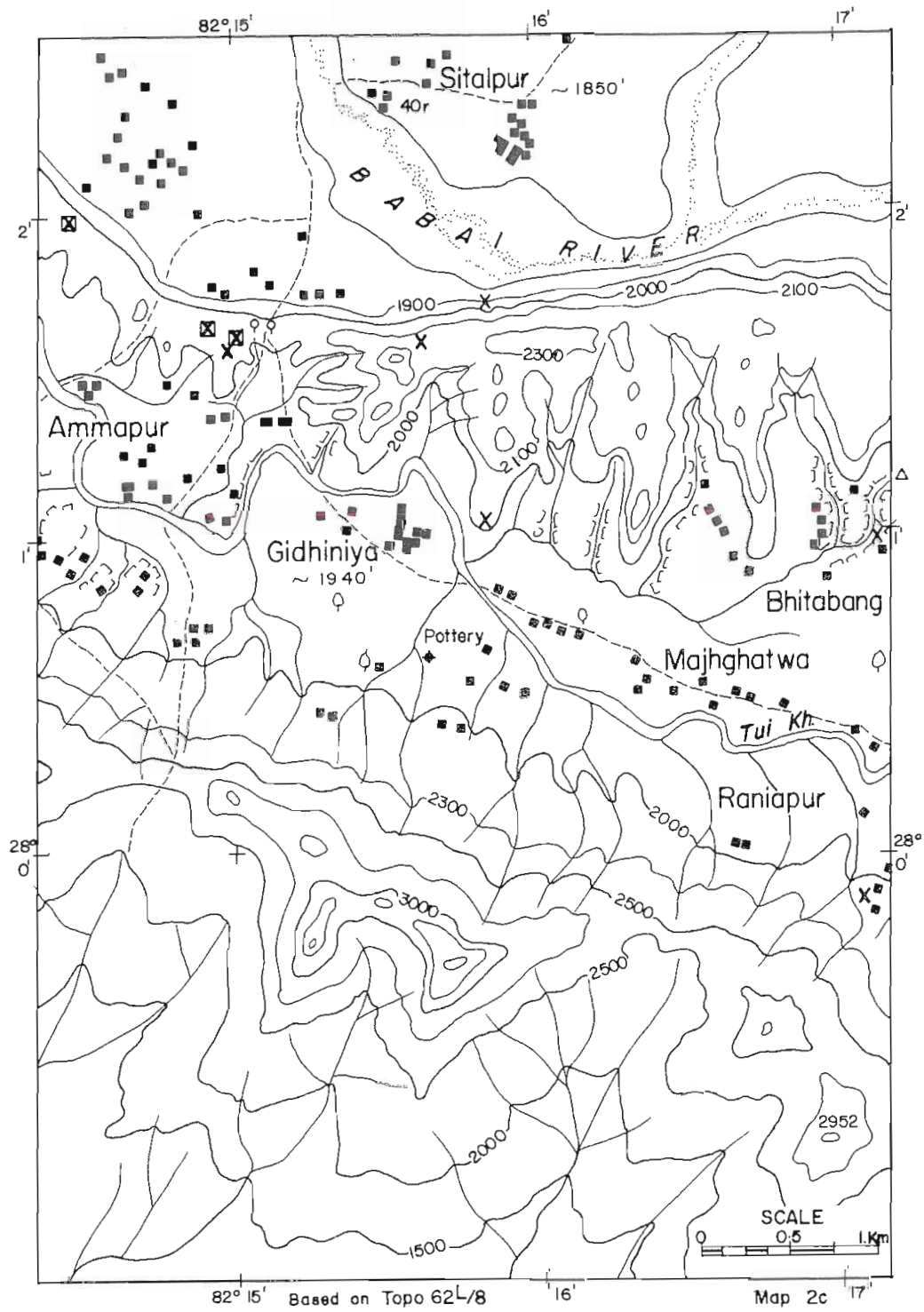


Fig. 28. Regional map 2c of Gidhiniya area (legend see Fig. 17).

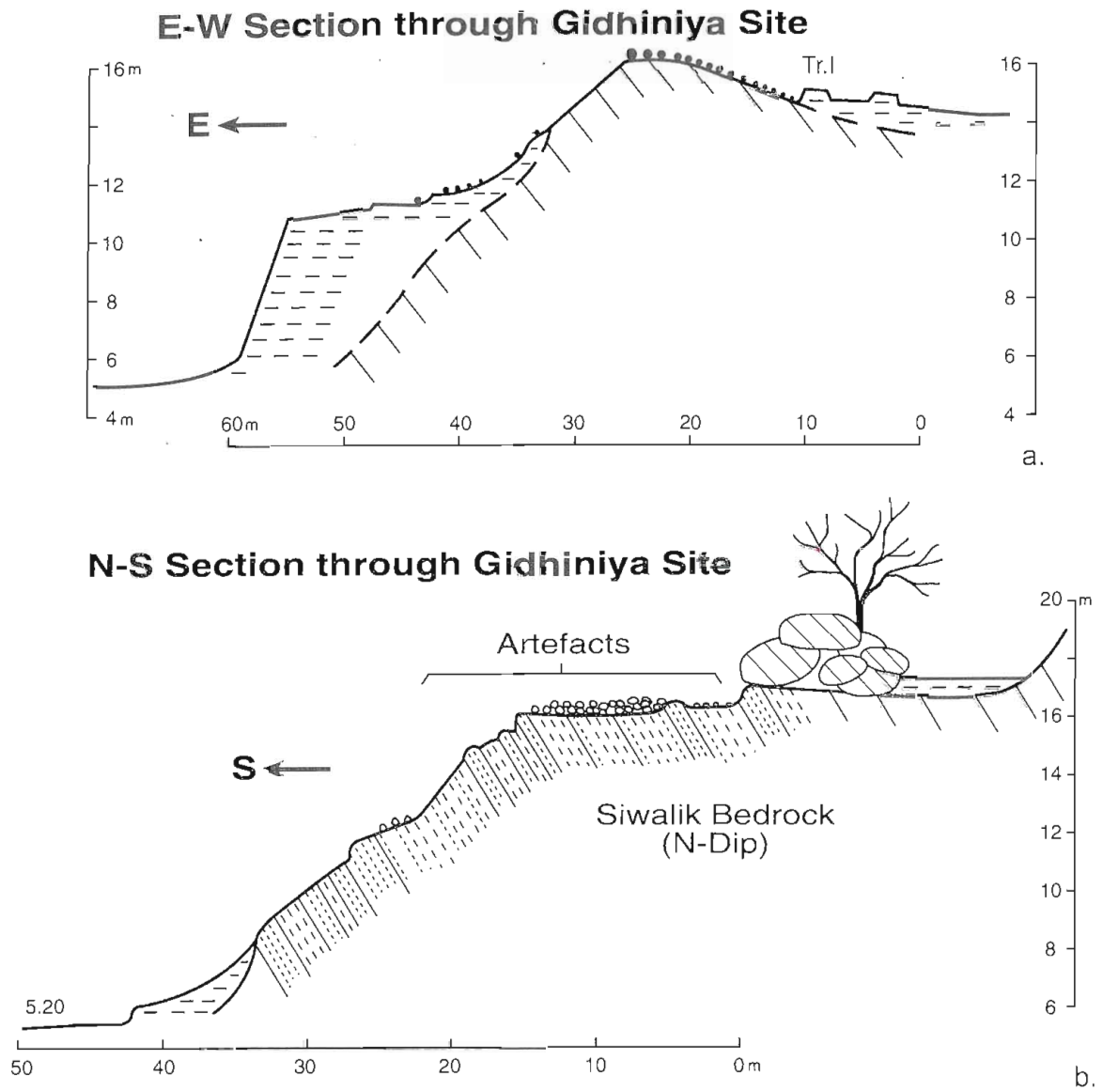


Fig. 29 a,b. Gidhiniya site sections, N-S section and E-W section.

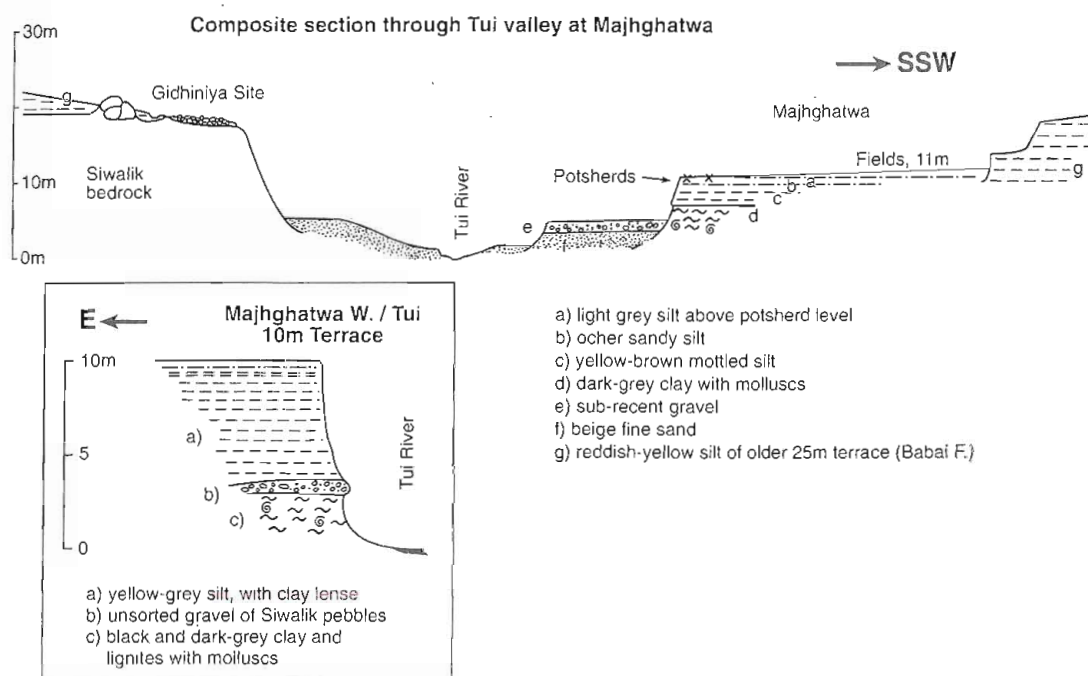


Fig. 30. Majhghatwa section with Gidhiniya at left.

A particularly fine specimen is a rectangular corescraper, only one lateral edge of which is trimmed by fine, shallow, unifacial scars, to form a steep, straight edge (Pl.2/4). It is made on a flat rectangular cobble of the light, „tuffaceous“ material, so commonly used in Dang and Deokhuri. Corescrapers are not a very characteristic tool type at Gidhiniya. They are, apart from the classical type seen in Pl.2/4, a rather heterogeneous tool category. What they have in common is a steep, lateral working edge.

A very interesting feature of the cobble tools of Gidhiniya is that a considerable number of them are high-backed and completely flat-based, like sumatraliths. Most of them are described as corescrapers, as they do not have the regular oval or round form, or the all-round steep trimming of a sumatralith, but otherwise they do resemble sumatraliths. A few, though, are sumatraliths in the Southeast Asian fashion (Pl.70/4 and 5). The base is usually a flat cortex surface (Pl.70/4), but often it is the surface of a split cobble (Pl.70/5 and Pl.3/1,3), and sometimes it is also a flake face. These high-backed, flat-based, mostly round tools bear comparison with similar sumatralith-like tools from some caves in Vietnam. Tool No.78 is the finest specimen (Pl.70/4), and is very much like the typical oval sumatralith of Sumatra and mainland Southeast Asia, while No. 31 is a fine specimen of a round, steeply trimmed sumatralith. Of particular interest are very small round sumatralith-like tools 45 to 50 mm in diameter, which are made in the same fashion as the large flat-based ones, only in a miniature size (Pl.3/1,3), just as there are miniature choppers.

A few tools are polyhedrons. They are round cobble tools with blunt edges of more than 90 degrees all around the circumference. Such tools are found in India, though in an Early Palaeolithic context. One has extremely battered edges, having been used probably as a hammer.

There are only a few scrapers. No.38 (Pl.70/1) was made on a flake with the platform removed, having a steeply retouched convex scraper edge at its distal end. No. 74 (Pl.70/2) is an end flake with a fine convex distal working edge. No. 157 is a unifacial end-scraper on a split cobble, with a steep, convex distal edge. At cutting III at Gidhiniya, there is a fine, but broken scraper made on a flake (No.4) *in situ* in the silt just above the gravel. It has a unifacial retouch at the distal convex edge. At the Gidhiniya Pass

W). They have predominantly cortex platforms (50.5 % in Fig.37). A total of 65.5 % of the flakes have no cortex apart from the platform cortex (Fig.38); 59 % exhibit the characteristic stepretouch on the platform edge of the dorsal face (Fig.39), such as flakes 18 and 17 (Pl.3/5 and 4/1) and flake 40 and 42 (Pl.71/4 and 72/1) (this is a characteristic feature amongst most of the flake assemblages in the Dang area and particularly at Brakhuti W). The flakes are not well shaped, except for a few oval flakes with radial and multidirectional dorsal faces (Fig.40), such as those illustrated in Pl.3/4,5 and Pl.4/2,3, and flakes with unidirectional scars (Pl.70/3, Pl.72/1, Pl.71/4). There are a few well-made points and pointed flakes with unidirectional trimming (Pl.71/8,4 and Pl.4/1,2). Blade-flakes are rare; two of the four are made of chert (Pl.69/4). Apart from point No. 17 and 24 (Pl.4/1,2), the latter having a retouch on its ventral face, none of the flakes are retouched, except for the stepretouch at the platform edge which is done on the core prior to the flake detachment. Interesting is the flake in Pl.4/3, which broke into two pieces, maybe during manufacture, since the breakage is not fresh, and both pieces were found close together.

Only a few flakes (9 % in Fig.31) seem to have been utilised (Pl.4/1,2,3, Pl.70/3 and Pl.71/4,6,8) at their points or distal ends, and others on their concave or convex sides. But the vast majority of flakes is rather crude and ill-shaped. The collection of flakes is a selective one, and therefore does not reflect the true nature of the flake assemblage as a whole.

There are only five undiagnostic cores in the collected assemblage.

The two small cylindrical ground stone points from the Gidhiniya main site (Pl.71/1,3) and one from the Gidhiniya Pass site (Pl.71/2) give pause for reflection. Such stone points are unknown from other sites of this period. At first sight, the artefacts of both sites seem to be of the same age and type. The three unifaces, however, are unique to the Gidhiniya Pass site. There are no unifaces at the main site, but the scrapers and the flake assemblage resemble each other. There does not seem to be much difference in age between the two assemblages, the Gidhiniya Pass locality from within the colluvial silt and the Gidhiniya main site somewhat earlier, from below the colluvial silt, just prior to being covered by the silt.

In order to clarify the provenance and actual horizon of the cultural material of the Gidhiniya main site, a small-scale cutting was carried out. The reason why such a cutting was necessary was that it was not clear whether the artefacts had their original position on the rubble horizon underneath the formerly covering silts or whether they derived from within the silt and were left as residuals on the rubble surface after the fine silt had been washed away by erosion.

The bulk of the artefacts were lying on the rubble horizon above the bedrock on the promontory where no covering silt is now seen. A great many artefacts were also seen to have been washed down from the actual site onto the steep slope to the east where there was no silt left. But on the gentle western slope the covering silt was still in existence when I first arrived, while 15 years later much of the silt was gone.

At first, in January 1989, a small test scraping of 0.25m was done (Pl.208/2) where a corescraper had been found at the base of the covering silt on the rubble horizon. But since this was not enough proof of a horizon below the silt, a year later a few more small test cuttings were done, cuttings I, II and III (Ph.27-Sc). It was seen that the artefact horizon thins out to the west. At cutting I (Fig.41) the section shows the artefact horizon to be on the rubble horizon, covered by a thin remnant of the yellow silt. Below the rubble-artefact horizon is the very weathered murrum of the Siwalik rocks, seen at B. There are 13 artefacts in C/1 and 40 artefacts in B/1 associated with the rubble horizon.

Cutting II, which was put down into a small silt hillock a few metres away from the exposed rubble horizon to the northwest, revealed nothing except a broken quartzite pebble at 0.42 m below the silt. No stones or artefacts were found in the completely unstratified silt. At 0.42 m below surface some Siwalik pebbles and cobbles belonging to the rubble horizon begin to appear. The artefact level has thinned out here. Siwalik sandstone rock belonging to the Siwalik outcrops measured in the N-S section (Fig.29) is met with at a depth of 0.75 m. The lower part of the colluvial silt contains small black iron-manganese pellets, the upper part not. There are no calcrete pellets in the silt.

Cutting III was done again nearer to the exposed rubble horizon, where there is only a very thin silt cover left. Here, a total of 59 surface artefacts were collected from amongst the rubble (Fig.42), while the subsurface level yielded only 15 artefacts. A few centimetres (5-6 cm) below the surface the Siwalik bedrock began with steeply dipping calcareous shales in the southern part, a fossil bed of trace fossils in the centre and weathered murrum of weathered Siwalik siltstone in the northern part. Some 8 artefacts were plotted from this bedrock surface (Fig.42).

What we see from these small test cuttings is that the artefact horizon exposed on the rubble/bedrock surface on the promontory continues on the gentle slope to the west below the covering silt of the Gidhiniya Formation and then thins out. It seems therefore probable that the colluvial silt once covered the whole site, if only thinly, and was eroded away only recently. The artefact horizon, therefore, is older than the colluvial silt at the Gidhiniya site. But how much older is difficult to say.

These silts are particularly conspicuous in a side valley immediately to the northeast of the main Gidhiniya site (Pl.246) and at the Gidhiniya Pass site (Pl.207/3). They are a continuation of the silts covering the Gidhiniya site. The Gidhiniya Formation has been described in chapter III.2.1.2. as being hillwash deposits formed during dry periods and laid down during the beginning of somewhat moister periods, maybe at the beginning of stage 3 or the end of stage 2 of the last glacial event. The Gidhiniya main site, then, would belong to a period just prior to these stages, after a prolonged period of dryness and weathering of the bedrock at Gidhiniya.

One particularly noteworthy observation is that the high-level colluvial silts of the Gidhiniya Formation contain at many places, and within different stratigraphic levels, cultural material of different cultural periods. We have seen that at Ammapur the microlithic sites are associated with the uppermost horizon of the silt fans. At the Gidhiniya site, the artefact horizon is buried under the colluvial silt. At the small Gidhiniya Pass site, high up above the Tui valley in a hill saddle, the artefacts have been eroding out from within the lower part of the colluvial silt. At the site of Saskhuti S (see later), the artefact horizon is contained in a definite occupation horizon within the colluvial silt fan. The same silts have covered the hillslopes and lower foot areas of the Siwalik slopes almost everywhere in the Tui valley, and almost everywhere they are artefact-bearing. In all these instances, prehistoric material is associated with the colluvial silts – either microlithic cultures from the top part, or Late Palaeolithic assemblages of the Brakhuti industry within the silt, or even below the silt in the case of the Gidhiniya assemblage.

Summary of Gidhiniya artefacts. Gidhiniya is a cobble-tool industry with choppers, corescrapers, sumatraliths and rare elements of scrapers and unifaces.

A total of 85 % of the collected artefacts are made of quartzite and 11 % of chert (Fig.32). The flakes are predominantly waste flakes, i.e. manufacturing and rejuvenation flakes. They show, as typical features, cortex platforms and a characteristic stepretouch at the platform edge on the dorsal face. Shapes are not standardized, though a few pointed and oval-shaped flakes are present. Few flakes have been utilised. There is no levallois-prepared core element present. The flakes show that most flake production was done by detaching them from a cortical platform (Fig.37). This is also indicated by their having a high percentage of unidirectional trimming scars on their dorsal faces (Fig.40). There is almost no prepared/faceted platform present, or any blade element (Fig.37 and 39). That a stepretouch at the platform edge of the dorsal face is so abundant (Fig.39) (about 50 %, which is almost as high as at the Brakhuti W site) is significant. It will be described in more detail during the description of the Brakhuti industry. The majority of the flakes have no cortex on their dorsal face apart from the cortex platform (Fig.38). The presence of flakes with cortex opposite the platform and of flakes with lateral cortex in the form of so-called „orange“ flakes (Fig.38) is significant, too, and has to do with the special manufacturing technique employed in the Brakhuti industry and described below.

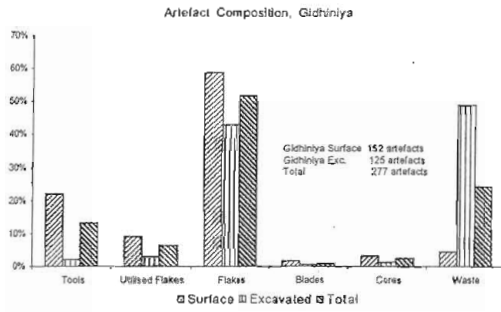


Fig. 31. Artefact composition of the Gidhniya site.

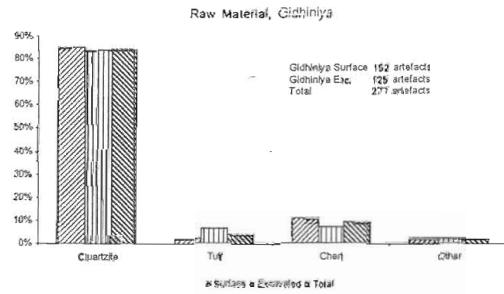


Fig. 32. Raw material of the Gidhniya assemblage.

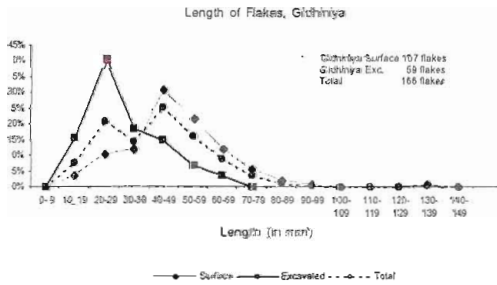


Fig. 33. Size of Gidhniya flakes.

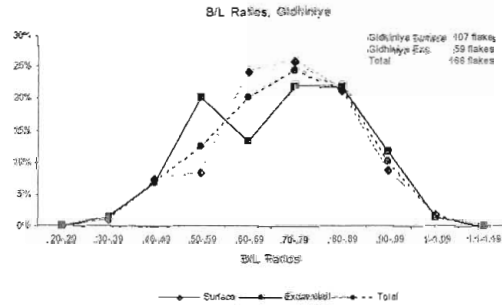


Fig. 34. Breadth/length ratios of Gidhniya flakes.

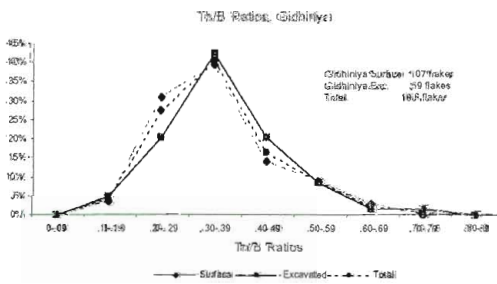


Fig. 35. Thickness/breadth ratios

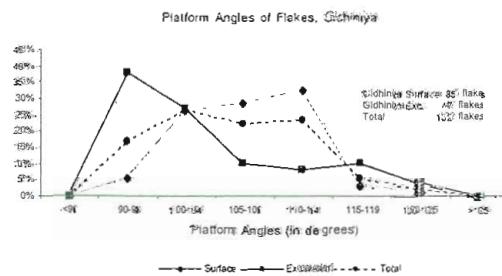


Fig. 36. Angle of platform of Gidhniya flakes.

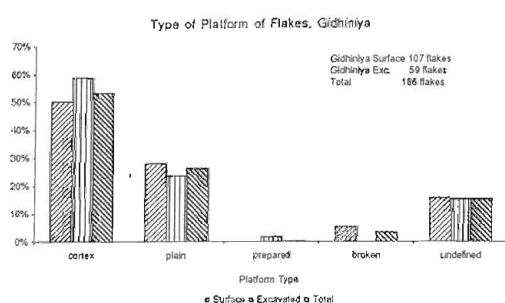


Fig. 37. Type of platform of Gidhniya flakes.

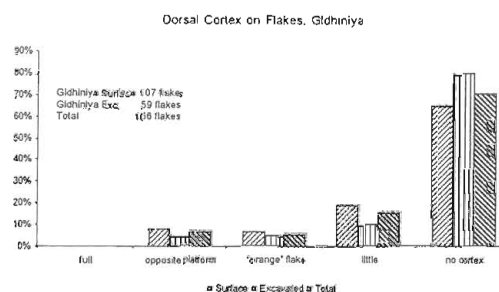


Fig. 38. Cortex on dorsal face of Gidhniya flakes.

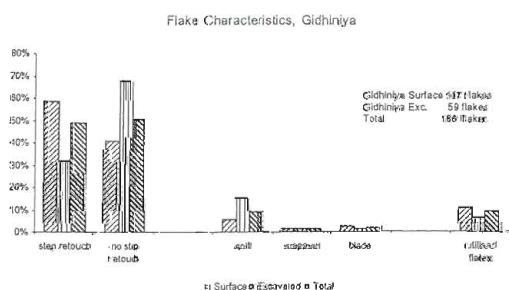


Fig. 39. Characteristics of Gidhniya flakes.

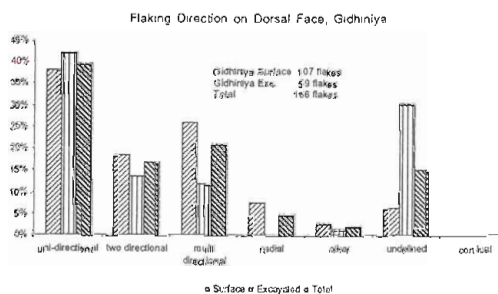


Fig. 40. Type of dorsal scars on Gidhniya flakes.

What is interesting in the diagram of the artefact composition (Fig.31) is the great difference between tools and waste in the surface and excavation categories, pointing to the very selective nature of the surface collection. Surface collections are always selective: the tools and the interesting flakes will be collected, while the uninteresting flakes and other waste will be left at the site. A selective collection will reveal the types of tools at a site and certain flake characteristics, indicative of certain manufacturing techniques, but it will distort the overall nature of the camp- or factory-site. The surface collection shows a much greater tool to waste ratio than the excavated sample (Fig.31); multidirectional and radial flaking scars as opposed to undefinable and unidirectional scars are more abundant in the surface category than in the excavation sample (Fig.40); stepretouch at the platform edge represents a higher percentage in the selective collection than the no-stepretouch category (Fig.39); platform angles have a much more definite peak in the excavated category than the widely varying angles in the surface collection. The excavated sample, on the other hand, though very small at Gidhniya, illustrates a more realistic picture of the assemblage.

The Gidhniya assemblage could be described as a not very sophisticated assemblage, having been fashioned from unprepared cores and cobbles by initial hard hammer percussion and then by soft hammer trimming. The flakes with stepretouch at the platform edge would indicate rejuvenation processes of the large cobble tools of choppers and corescrapers, which constitute the major types of tools at the site.

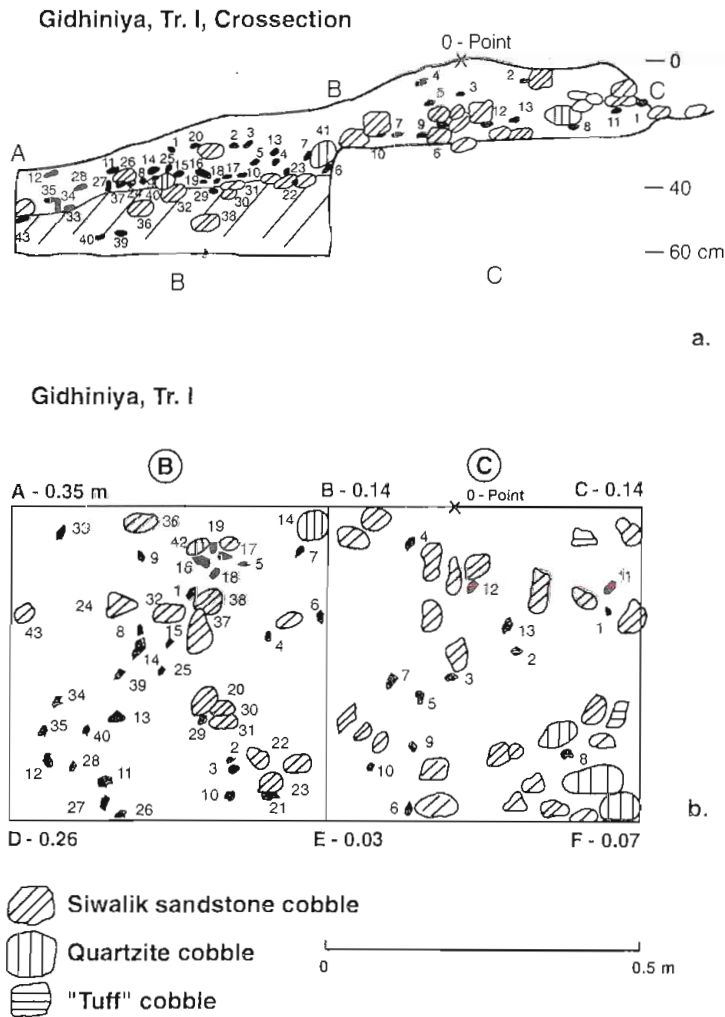


Fig. 41a,b. Gidhiniya site, test cutting I plotting.

Between Majhghatwa and Bhitabang

East of the Gidhiniya site, the central part of the Tui valley is covered by the young low 10-15 m terrace, a wide, flat expanse of cultivated fields belonging to the village of Majhghatwa, which is situated on these flats and extends from just east of Gidhiniya to south of Bhitabang (Fig.15 and Fig.28).

This young terrace has not yielded any prehistoric remains. However, the top 0.5m layer of grey, clayey and ashy soil (Fig.30) in the western part of Majhghatwa village is filled with broken potsherds of a wheel-made kind. They seem to be the remains of a former potter's village of the Tharu community that once lived on this terrace. Together with the potsherds, are found some grinding stones and querns. The potsherd layer is about 0.40 m below the surface of the fields and is overlain by recent yellow flood deposits on the surface of the terrace which here is 10-12 m a.r.l. One handmade bowl, in four pieces, has also been recovered. The present population does not know anything about a pottery site.

South of Majhghatwa village, going towards the southern range of hills, one crosses the well-exposed clays, mottled silts and gravels of the Babai Formation which forms the dissected 20-22 m terrace surface.

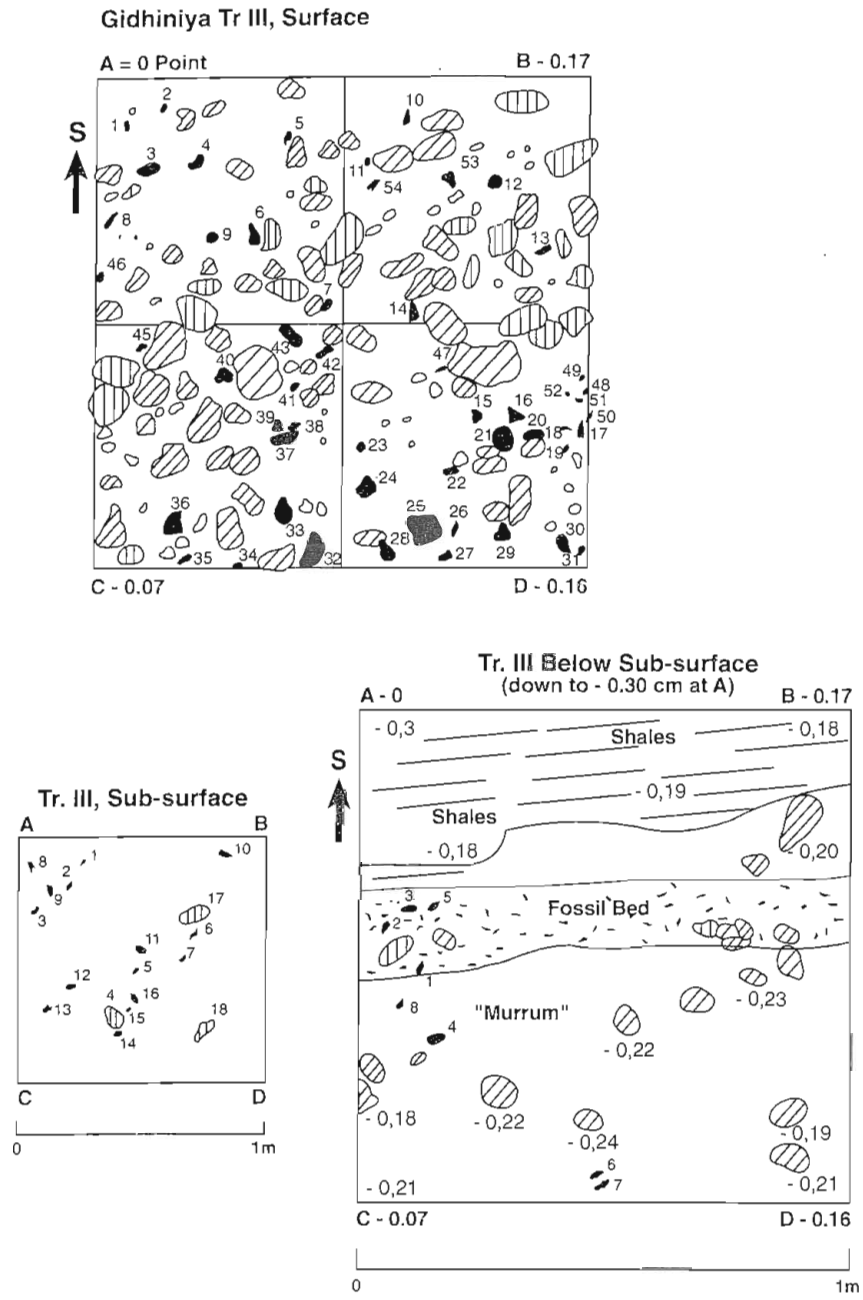


Fig. 42. Gidhiniya site, test cutting III plotting.

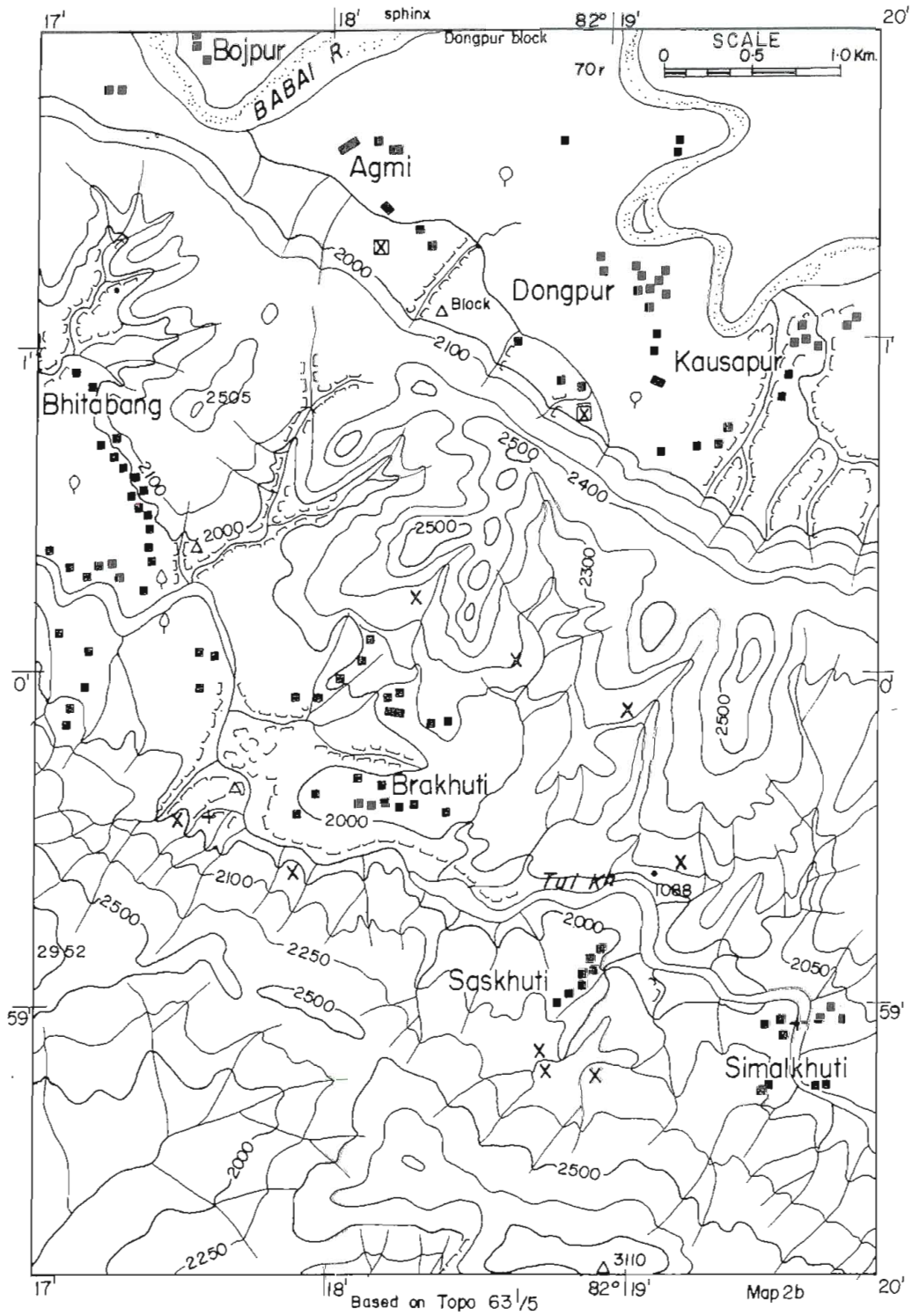


Fig. 43. Regional map 2b, of the Tui valley around Brakhuti (legend see Fig. 17).

South of it, at the foot of the hills, the slopes are covered again by the colluvial reddish silt of the Gidhiniya Formation. The silt has only a thickness of 1.5-2 m at a level of about 25-30 m a. r.l., and overlies bedrock. A small flaking site of quartzite artefacts of the Brakhuti type was encountered here (Majhghatwa SW) in March 1999. The artefacts were lying on bedrock below the colluvial silt, and must have had their original location below the silt.

On the northern margin of the valley between Gidhiniya and Bhitabang, along the foot of the bordering hills, reddish colluvial silts of quite considerable thickness are seen everywhere abutting against the hills in the side valleys near Bhitabang (compare Pl.246). They are interfingering with the alluvium of the Upper Babai Formation, which forms the higher terrace of up to 25 m a.r.l. The colluvial silts in the side valleys are deeply dissected and form steep badland ravines. Scattered stone artefacts of flakes and occasional corescrapers and choppers are found on the surface, probably having eroded out from the silts.

North and northwest of Bhitabang village, (Fig.28 and 43) towards the pass over the hills to the Dang valley, the light-yellow silts and clays of the Upper Babai Formation are exposed everywhere, reaching deep into the side valleys and interfingering with the colluvial silts on the slopes. At locality Bhitabang NE, a fine fragment of a celt (Pl.4/4), made from laminated mudstone, was collected from the colluvial silt on the surface of a gully, along with a pointed scraper (Pl.4/5). Nearby a few quartzite flakes have eroded out from the colluvial silt. The high-level colluvial silts attain varying thicknesses of 2 m to sometimes more than 4 m.

Higher up towards the pass, Lower Siwalik rocks underlie the colluvial silt. There, at Bhitabang NE, a few Lower Siwalik fossil bones have eroded out from the weathered sandstone: a fragmented horncore, ruminant teeth and limb bones.

In the overlying yellowish-red colluvial silt, a few chert flakes and cores were found in the gullies, washed out from the silt together with a fine grinding stone.

Up at Bhitabang Pass itself, between the Dang and Tui valleys, there is a small locality with a round unifacial chopper of the Gidhiniya type and flakes of quartzite and chert, a few of which were collected. These specimens exhibit the same features as the cultural material eroding out from the silt further below, displaying cortex platforms and stepretouch at the platform edge, and they seem to belong to the same people who were responsible for the widespread flake-corescraper assemblages of the Brakhuti industry (described below). But here, at the pass, the artefacts are not associated with any silt deposit but lie directly on bedrock, overlooking both valleys, those of Dang to the north and Tui to the south. It is impossible to say now whether the artefacts were once covered by colluvial silt.

Artefact localities are also found along the southern Tui valley margin at Raniapur (Fig.28 and 43). Raniapur village on the map of Fig.28 continues to the east into the western part of the map of Fig.43. The prehistoric sites are indicated in the map of Fig.28. Raniapur SW is a small locality of artefact-bearing yellowish-red silt overlying rather thick fluvial cobble gravel (Fig.44), which seems to be the reworking of Siwalik conglomerate beds below the infill of the valley (see also Fig.46). Raniapur S1, is a small locality on bedrock (Fig.45), with quartzite flakes and cobble tools. Only a small sample was collected in 1989: a few flakes with cortex platforms and stepflaking at their edge and cortex opposite the platform (Pl.72/2), along with a unifacial corescraper with fine retouch at the steep edge.

The artefacts lie on bedrock, but the site was once covered by a yellow silt of the Upper Babai Beds. It is not certain whether the artefacts have come from within the silt or from below the silt. But to judge by other sites with similar artefacts and in a similar setting, they must have derived from the upper part of the Upper Babai silts.

Closeby, at Raniapur S2, another small artefact locality, presented an interesting situation (Fig.46). A basal quartzite cobble gravel unconformably overlies bedrock, which consists here of Upper Siwalik conglomerates and white soft sandstones (Fig.46 and Pl.208/3, the gravel is seen in the middle ground, the silt above it in the background). The gravel is overlain by a reddish-yellow silt, which is heavily dissected

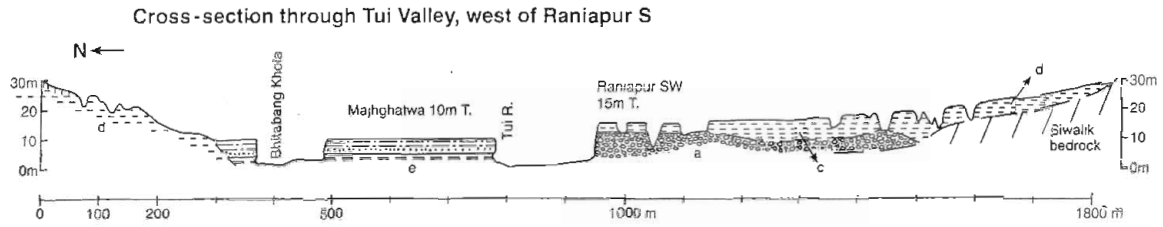


Fig. 44. Cross-section through Tui valley at Raniapur

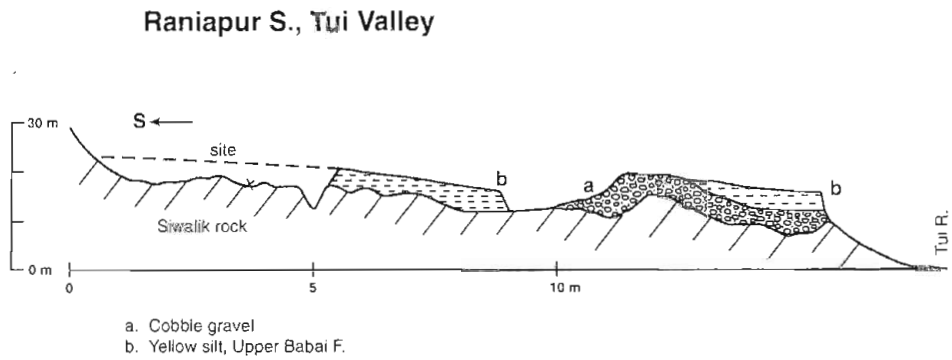


Fig. 45. Cross-section at Raniapur S site.

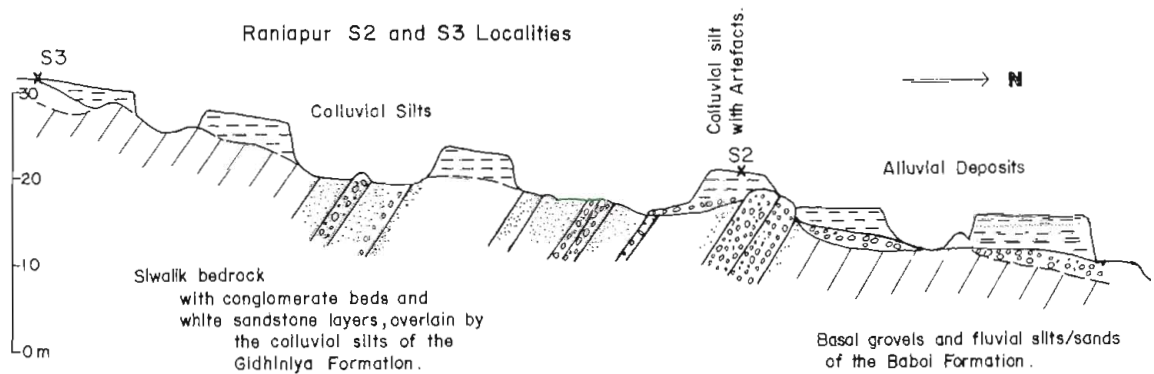


Fig. 46. Cross-section through Raniapur S2 and S3 localities.

and contains quartzite artefacts similar to those of the Raniapur S, Gidhiniya and Brakhuti W sites. In 1991 and 1994 a few quartzite flakes and scrapers and a round unifacial corescraper were collected. The reddish silt, seen in Pl.208/3, belongs to the colluvial slopewash silts. These grade towards the river into the alluvial deposits of the Babai Beds, seen at the right in Fig.46 and in Pl.208/3.

The geological history here is unusually interesting. The basal fluvial quartzite cobble gravel, which has been exposed by erosion at many places above bedrock in the Tui valley, is described in detail in the section dealing with Brakhuti W. The quartzite cobbles and pebbles of the gravel derive originally, most probably, from the Upper Siwalik Boulder Conglomerate, which together with steeply dipping Upper Siwalik sandstones form the bedrock at Raniapur (Fig.46 and Ph.29-Sc); the Siwalik Boulder Conglomerate is seen exposed at left in Ph.29-Sc, and the basal gravel is seen in the upper middle ground at the right, the latter in turn being overlain by the reddish-yellow silt containing the artefacts. The geological situation is described in chapter III.2.2. dealing with the Tui valley.

Unconformably overlying the reworked cobble gravel are the stratified yellow silts and grey clayey silts of the Upper Beds of the Babai Formation, which forms the heavily dissected 15-20 m terrace, while closer to the hills they grade into or interfinger with the colluvial reddish silts, some of which have remnants of red soil covering the top.

A small flaking spot with an abundance of artefacts, called Raniapur S3, was recorded in March 1999, some 100 to 150 m S40°W of Raniapur S2, at the very edge of the colluvial silt, where it abuts against the hillside, as indicated in the left part of Fig.46. The flakes here are *in situ* in the reddish silt, which overlies Upper Siwalik sandstones of the „salt & pepper“ facies (Pl.209/1). The silt, though only 1m thick at the artefact site, becomes very thick, up to 8 m, just less than 100 m north in a badland gully (Pl.209/2), which shows how dissected the bedrock must have been at the time the colluvial silts were deposited. In this photo, the way in which the stratified alluvial deposits of the Upper Babai Beds (in the background) abut against the colluvial silts (in the foreground) is seen in good effect.

Northeast of Raniapur and southeast of Bhitabang, north of the Tui river, at Raniapur NE, (Fig.43), a site with an abundance of wheel-made pottery was discovered on the surface of a flat expanse of the 20 m terrace of the Babai Beds, overlying Lower Siwalik rocks. The terrace surface has developed into a red soil. A recent crude shrine of Kul Deota is in the centre of it, and is still visited by the people, but farmers say that the pottery does not come from the recent population. At places the surface is simply covered with broken sherds of mainly wheel-made pottery. But at the edges of the terrace very weathered sherds of cord-marked pottery erode out from the grey „Plaggen“ soil above the silt. Some quartzite flakes and a lump of copper are also in evidence here. It is a mixed site, disturbed by cultivation and by heavy erosion. The pottery site covers a surface of 50x50 m.

Lower down, towards the river, the terrace breaks up into badlands and exposes the stratified yellow silts of the Babai Beds that form the 20 m terrace. North of this locality, a small side valley joins the Tui valley, which, like all the side valleys of the Tui basin, is filled with colluvial slopewash silts. How quickly the silts are washed away by the heavy erosion is seen by the young trees, which stand on stilts of silt of up to 1.5 m, exposing their roots. It is only the network of roots which prevents the silt from being washed away completely (Ph.32-Sc).

On 23rd March 1991 I was given an interesting small painted clay figurine by a shepherd boy, Gehendra Karki (Pl.247), which he claims to have found at a place above the Tui riverbank. He showed me the place. It is situated on the 15 m terrace which ends with a precipitous cliff facing south and west towards the Tui River. The terrace is covered with recently planted saal trees. On the surface disintegrating bricks of ancient, flat type are seen, which are not used anymore. The bricks are either 5x15x20 cm or 5x17x23 cm in size. Nothing else was found, no pottery of any kind or any other artefacts. But a brick structure of some kind must have been situated once at this cliff above the river, and the clay figurine may have been associated with it. But it may also be older. The figurine is 7 cm in height, and is made of

6 round clay balls joined together in the form of a female body which displays a large belly, legs, arms and a head. All pieces are painted red and black in spiral patterns. The back is rather flat, but is also painted similarly. Nothing of this kind is known from any other site. It could be a small female deity or a toy, the former being rather more likely.

The Brakhuti W sites

Further to the east along the Tui River, one of the most important site complexes was discovered in February 1990, important not only for the Tui valley, but for the entire Dang-Deokhuri area. These are the Brakhuti West (Brakhuti W) sites, so called because of their location west of the village of Brakhuti on the left side of the Tui River (Fig.43).

The Brakhuti W site is of such major importance because it has yielded a sequence of cultural units superimposed upon each other in the strata: an Early Palaeolithic site at the base, a Late Palaeolithic occupation in the upper part, and Neolithic remains at the top. These will be described below in their chronological order. Another significant fact is that the site has yielded the richest artefact assemblage in the Dang-Tui area, in the form of a Late Palaeolithic flake industry in association with large cobble tools of choppers and corescrapers. It is regarded as the type site of this industry, called the Brakhuti industry (after the village), and therefore will be described in greater detail. Though it is a very rich site, no excavation could be carried out, except for one test cutting, to verify the horizon of the artefact level in the strata.

The stratigraphical sequence, as seen in the cross section of the Tui valley at Brakhuti W (Fig.47 and Fig.48), shows a succession of lacustrine and fluvial deposits of the older alluvium of the Babai Formation (a, b and c in Fig.48), forming the higher terrace levels at 17 to 25 m, while the younger 10 m terrace is formed by the fluvial alluvium of the Sitalpur Formation (e).

The Babai Formation has as its oldest unit large fluvial lenses of basal channel gravels (a in Fig.48), consisting of well-sorted and well-rounded quartzite cobbles and boulders, called the Brakhuti boulder gravel, in which an Early Palaeolithic assemblage of large flakes and cores is embedded. It overlies the Siwalik bedrock. The gravels are overlain, with a break in time, by stratified alluvial clays, silts and sandy silts of lacustrine and fluvial character (b and c) of the Babai Formation. The Lower Member of the Babai Formation, consisting of compacted reddish clays (b) of lacustrine character, is not seen everywhere. The Upper Member of the Babai Beds, consisting of fluvial clayey silts and sandy silts (c) make up the top of the 20 to 25 m terrace. At the hill sides they grade into the unstratified, colluvial reddish-yellow silts (d) of the Gidhiniya Formation, which exists at Brakhuti W only as small fan remnants. The rich Brakhuti flake site is embedded in the upper silts of the Upper Member of the Babai Beds, at the very place near the shoulder of the hill where these silts interfinger with the colluvial silts of the Gidhiniya deposits.

The younger alluvium of the Sitalpur Formation consists of lower dark grey clays and upper light grey sands and silts, both forming the inner 10 m flatlands (e in Fig.48).

The remains of a small Neolithic occupation horizon are encountered in a grey „Plaggen“ soil, that covers the Upper Babai Beds at the 17 m terrace level.

The Brakhuti W Boulder Gravel. As at Raniapur S, a basal cobble gravel overlies in large lenses the bedrock of Upper Siwalik sandstones and conglomerates at Brakhuti W (Pl.210/1). The components of the gravel derive most probably from the Siwalik conglomerates (see chapter III.2.2).

Wherever the basal quartzite gravel is exposed in the Brakhuti W area, it shows the same well-rounded, sorted and often imbricated feature as the gravel of the type site and is everywhere artefact-bearing. It was laid down as a thick, extremely well-sorted gravel sheet of imbricated cobbles in the riverbed by the ancient Tui River. Four localities are recorded here, Bouldergravel S, Bouldergravel NE, Bouldergravel NW and Bouldergravel E.

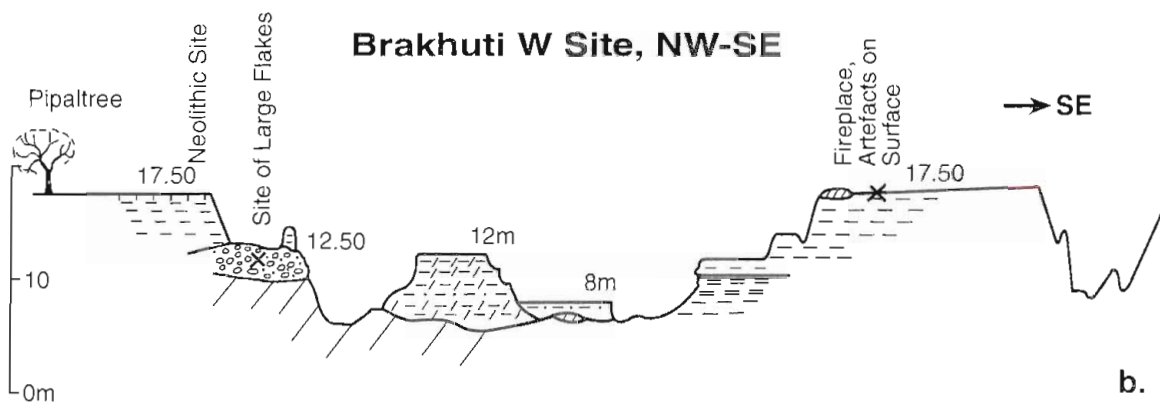
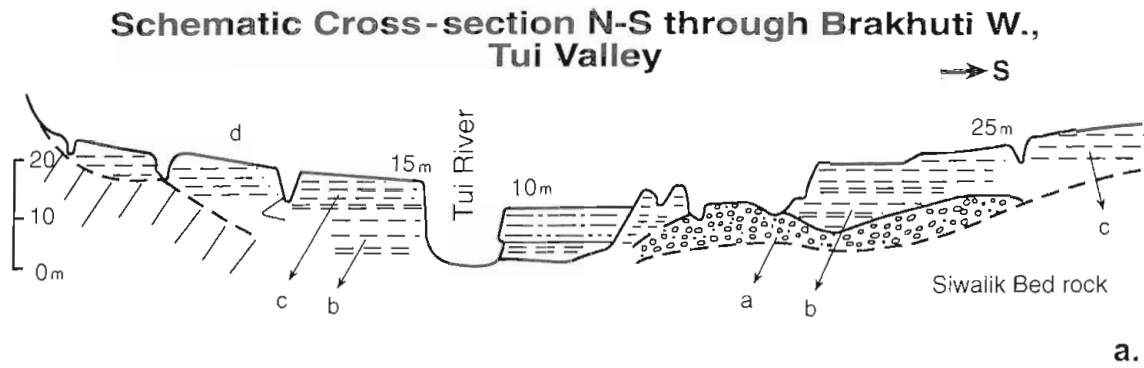


Fig. 47a,b. Schematic cross profiles through the Tui valley at Brakhuti.

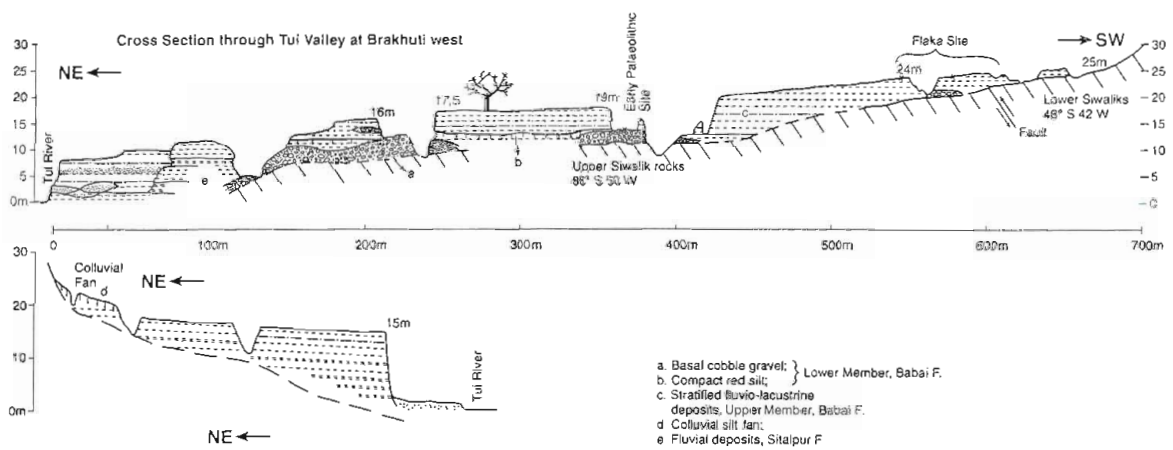


Fig. 48. Cross-section through the Tui valley at the Brakhuti W site; the lower profile is a NE continuation of the upper one.

Palaeolithic man probably made use of these cobble sheets as a factory site: the large quartzite cobbles furnished him with the raw material for his manufacture of large flakes, cores and large tools, which are older than all the other assemblages of the Tui river valley.

The most interesting of these gravel exposures is locality „Bouldergravel S“ (Pl.210/2, Pl.211/1,2 and Ph.38-Sc). At this site we see the exposed gravel below a small remnant of the overlying silt, the composites of which are washed down the steep slope over the underlying bedrock. In Pl.210/2 this same gravel sheet can be seen exposed below the overlying thick silt. The gravel at this place is not more than 1 m in thickness. Amongst the well-rounded cobbles and boulders (all of quartzite) are numerous very large cores and large flakes *in situ* (Pl.211/1,2). Pl. 211/2 depicts a few of the large artefacts from this site. Almost all artefacts consist of large primary manufacturing debris and virtually no tools.

Another locality on the northwest side of the whole area is „Bouldergravel NW“ (Pl.211/3), where a 2-3m thick gravel layer is exposed below the covering silt, with huge flakes and cores amongst the cobbles. A third locality in the same Brakhuti area is „Bouldergravel NE“ at a northeastern exposure of the gravel (Pl.210/1). There the gravel sheet is very extensive but less rich in artefacts, and is overlain by the thick fluvial silts (centre left in the section Fig.48).

Here mention must be made of the large imbricated gravel sheets observed in the Tui riverbed upstream from Brakhuti: at Simalkhuti and west of Saskhuri (Pl.212/1), both of which also yielded a few Early Palaeolithic artefacts: for example, a huge core of a size of 400 mm (Ph.41-Sc). These imbricated gravel sheets can not have been a load transport of the small, recent Tui River from far away, but are an exposure of the basal cobble-boulder gravel of the Lower Babai Formation, having been laid down by a much larger, active stream, after being reworked from Siwalik conglomerate outcrops. They invariably underlie the fluvial clay-silt deposits of all the rest of the Babai Beds, as seen at the cliff in the background in Pl.212/1. The clay-silt deposits got eroded away by the Holocene erosion, and cliffs of them can be seen adjoining the river bank. The exposed gravel sheets are of interest in the context of the discussion about the environmental changes that occurred in the Tui valley which follows the description of the artefacts. They are very extensive and can be observed from Raniapur all the way upstream to the recent source area of the Tui River, near Rajje and beyond, where they always form the coarse basal gravel deposit overlying bedrock in the riverbed, and are always artefact-bearing.

Description of the Boulder Gravel cultural material. The artefacts consist of huge flakes and cores, the likes of which have not been encountered elsewhere in Nepal. Their sizes average between 100 and 200 mm, the largest of the collection being a flake, 233 mm in length, the largest artefact measured in the field being a core, 400 mm in size. Most of the cores are unprepared and rather crude, with only a few very large flake scars. Many of the flakes are huge, having wide, plain platform angles of roughly 120 degrees, and only one or a few large primary flake scars on the dorsal face, and no secondary trimming (Pl.98/1a,b; Pl.94/3). A few are, however, rather well-made, their dorsal faces having large primary scars, struck multidirectionally (Pl.97/2) from unprepared cores. There is no secondary flaking on most of the flakes, except in rare cases (Pl.96/1,2), and probably Nos.1,2 (Pl.98/1a,b). Many of the large flakes retain cortex on their dorsal face (Pl.93/2; Pl.94/3), and the end-flake in Pl.97/1 retains, apart from the cortex platform, cortex opposite the platform, by which one can estimate the size of the core from which the flake was removed.

The cores are unprepared, and flakes were struck from cortex or from large flake scars; core b.gr.E/Nr.7 has two opposed platforms, one being a flake scar, and the other a split cobble face. There is one high-backed discoidal core of a size of 105 mm from Rajje (Pl.94/2), the only one of its kind. What is common, though, are alternate bifacial cores (Pl.211/1,2) an example of which is seen in the photo near the end of the hammer (it was left in the field). The artefacts were too heavy, and it was impossible to carry many of them back to the camp, which was more than one hour away from the site on foot.

There are nine tools amongst the selected sample. The finest is a large uniface (Pl.92) with primary and secondary flakes around the entire circumference. No.2 of b.gr. NW is a large, well-made end-scrapers made on a flake with a broad, convex distal edge, almost like a cleaver (Pl.95). Another scraper is displaying a bifacially trimmed edge. A particularly well-conceived tool is the unfinished biface shown in Pl.93/1a, b, which is interesting in having been made from a large Kombewa flake, and having a bifacially trimmed, slightly zigzag edge along one side. A pointed tool manufactured from an end-flake was utilised on the left lateral side up to the point (Pl.94/1).

Judging by the nature of the artefacts, amongst which there are very few tools, one can conclude that the boulder gravel exposures were used by Early Palaeolithic man as quarry and factory sites, where they fashioned their tool kit, leaving the large cores and flakes behind as waste. The majority of flakes are quite fresh and have not been transported. They must have been manufactured at this place and have only recently been exposed by erosion.

Brakhuti is not the only site of large Early Palaeolithic artefacts in basal cobble gravels in the Tui valley. Further upstream, at Simalkhuti and at Rajje, two other localities bearing similar artefacts in similar basal gravels were found (Pl.94/3, Pl.94/2, Pl.97/3), and will be described later.

This assemblage is typologically the oldest in the Tui valley. Although there are no true bifaces in it, it is suggested here, that it belongs to the Early Palaeolithic period: the unfinished biface on a Kombewa flake, the fine unifacial ovate and the three large well-made end-scrapers seem to point in this direction, along with the alternate bifacial cores and the large flakes exhibiting wide platform angles.

Besides the typological indications, the stratigraphical position of the assemblage in the oldest alluvial deposit of the valley points as well to at least an early Mid-Pleistocene age. And it may not be a coincidence that the handaxe site of Gadari is situated east of Brakhuti W, over the next range of hills, barely 15 km away, on the southern slope of the Dang Valley, in a similar stratigraphic position.

There seems to have been a long break of human settlement after the Early Palaeolithic occupation. We cannot assess with certainty the time of this occupation. But given the association of the artefact assemblage with a deposit of strong fluvial activity, we can assume that it must have coincided with a period of high stream velocity, when the Tui River was able, unlike today, to move such huge bodies of gravel.

Presumably not only the climate, being different from today's, was responsible for this change in river activity, but also environmental and geological features. A much larger stream was flowing through the valley, much larger than today's trickle of water in the Tui River. One could envisage a wetter climate and also a more forceful passage of the stream through the valley, which was able to carry and redistribute a heavy load of coarse boulder gravels. But this may have been possible only when the geomorphological structure of the valley, influenced or caused by tectonic movements, was different. This is described in chapter III.2.2.

It is suggested here, therefore, that during the time of the Early Palaeolithic occupation, which may have occurred in the last Interglacial but one, in stage 7, and most probably even earlier, a larger, more active river (via the Mashot and the upper Arjun Rivers) flowed through the valley from a source area much further east than today and that later tectonic movements cut off the former source and reduced the Tui River to its insignificant role today. Early Palaeolithic man had an abundance of raw material available, in an environment of an active perennially flowing river with plenty of water for his own sustenance and that of the animals he hunted.

An interesting comparison can be drawn to a new site in southern India, namely Isampur, in the Hunsgi valley in Karnatak. This site, recently excavated (Paddayya et al. 1999; Petraglia et al. 1999; Paddayya et al. 2000 and 2002) is a limestone quarry and factory site, where from silicious limestone slabs huge cores and flakes of similar nature as those described from the Brakhuti boulder gravel were manufactured *in situ*. A small number of bifaces, too, are recorded, but not particularly well-made ones, presumably only the discarded ones. The Isampur quarry site has provisionally been dated to 0.5 to 0.6 m.y. (Paddayya et al.

2000), while recent ESR dating on herbivorous teeth associated with the artefacts yielded a tentative age of 1.27 ± 0.17 m.y (Paddayya et al. 2002), though this seems rather early. It is, however, not unteasonable to consider an age between 0.5 and 0.7 m.y. for the Early Palaeolithic material of the Tui valley basal boulder gravel and for the Gadari Acheulian in the basal deposit in the Dang valley as well.

The Brakhuti W Flake Site, its stratigraphy and technology. The site complex of Brakhuti West was first discovered on February 24th, 1990. It consists of several cultural units, superimposed upon each other in the sediments west of Brakhuti village, on the left (southern) side of the Tui River. The first sign of prehistoric occupation was a flat, polished stone axe, associated with cord-marked potsherds in a grey topsoil dissected by badland erosion. This location will be discussed later, the assemblages of the Brakhuti complex being described in chronological order.

The Early Palaeolithic artefact-bearing basal gravel at Brakhuti W is unconformably overlain by the stratified silts and clays of the Babai Formation. After a probably rather long break in sedimentation, the uneven surface of the gravel was covered by the later deposits of the Babai Formation, which have filled the entire Tui valley with lacustrine and fluvial stratified clays and silts and, intercalated in the Upper Member of the Babai Beds, by occasional coarse flash-flood gravels. They grade at the slopes of the hills into the colluvial silts of the Gidhiniya Formation.

After a long gap prehistoric man began living again in the Tui valley, occupying sites along the foot of the hills during the last phases of the deposition of the Babai Beds, given that their cultural remains have been found in the top part of these sediments, where they were recently exposed by the strong erosion.

One of the richest and most extensive artefact sites was discovered in February 1990 at Brakhuti W, west-southwest of the village of Brakhuti (Fig.43) on the south bank of the Tui River, close to the foot of the hills, where it was recently exposed by the strong erosion (Fig.48 and Pl.248/1). The site is embedded in the upper part of the alluvial silt (Pl.213/1) near the shoulder between the alluvial stratified silts and the colluvial silt, though it is extremely difficult at this place to distinguish between the two. Below the flake site, about 150 m to the north (left in Pl.248/1; see also Fig.48), the alluvial silt overlies the cobble-boulder gravel (which contains the Early Palaeolithic industry with its huge flakes). A thin layer of quartzite cobbles is exposed below the flake site itself (Fig.48), amongst which two large cotes and two large flakes were recorded.

Artefacts from the Brakhuti W site emerge from the silt at the erosional edge in big quantities (in fact, in the hundreds), and are being washed down from their original horizon into the gullies, where they are getting redistributed and buried in the reworked alluvium in the gullies (Pl.213/2). A substantial collection was made here from the slopes, in order to salvage the washed-down artefacts, before they disappear and are washed away altogether. No artefacts could be found on the very surface of the silt terrace, but many *in situ* artefacts were seen protruding from the silt at the edge just below the surface.

The occupation site, embedded in the silt, must have been an extensive one and must have measured roughly 80 m from southeast to northwest, artefacts being seen eroding out from the silt along the southeastern and southern edge of the badland gullies below the actual site. How far it extends in northeastern direction is difficult to estimate, since the silt surface is unbroken. To the southwest the site extends for about 100 m over dissected silt up to the foot of the Siwalik Hills.

A small pit of 1x1 m was cut at this place to locate the actual horizon. This cutting was made near the edge (seen in Pl.213/1, where the man stands). The pit was dug 0.40 m deep into the silt, which did not show any structure or stratification, but did yield small calcrete pellets and manganese stainings. The occupation horizon was encountered at a depth of 0.35-0.40 m.

Judging by the large amount of washed-out artefacts, it seems that the occupation horizon had once been a workshop.

Bedrock was encountered 2.25 m below this horizon in the gullies. It was covered by a thin layer of the basal cobble-boulder gravel, which thins out to the south.

The stratigraphy at the flake site of Brakhuti W is thus from top to bottom (the surface of the silt terrace is 25 m a.m.t.l.):

2.25 m of yellow silts of the Babai Formation, with the flake site embedded in it 0.40m below the surface;

///^ unconformity,

a thin layer of approximately 0.20 m of cobble-boulder gravel, with two large cores and a few large flakes exposed; it is the southernmost edge of the basal cobble-gravel, which thins out to the south;

///^ unconformity;

the bedrock of Upper Siwalik micaceous sandstones.

The bedrock below the central part of the flake site is about 22.50 m a.m.t.l. But 30 m north of the flake site the bedrock has dipped down to 18.50 m a.m.t.l., as could be seen in an erosional gully, while about 150 m north, at the Early Palaeolithic site, bedrock is at about 12 m a.m.t.l. (Fig.48), indicating that a phase of incision irregularly dissected the bedrock floor before the infilling of the alluvium of the Babai Beds.

The artefact horizon of the Brakhuti W Flake Site is encountered within the upper part of the silt, some 40-45 cm below the recent surface. But it is most probable that the uppermost part of the silt of the Babai Formation has been truncated by sheetwash erosion for about 1-2 metre. A red soil must have once covered the entire older terrace surface before the recent strong erosional phase. No red soil is left at the site. According to A. Bronger (pers.comm. and report) the red soil was formed in a tropical-to-subtropical, humid-hot monsoonal climate. The formation of such red soils must have taken at least 5,000 years, but it could have taken longer (up to 40,000 years). We suggest that the red soil was formed after the end of the Pleistocene and that the yellow silts below it belong to a cooler and drier climate of the last glacial. The artefacts from this silt must therefore have a minimum age of 10,000 years but could be as old as a few tens of thousands of years, belonging to the later part of the last glacial. Recent OSL dates analysed by Kadereit (see Appendix II) has yielded a provisional age of ca. 24 ka for the silt of the Gadari Flake site, which belongs to the same industry, and which would tally well with the stratigraphic observations.

The collection made at the Brakhuti W Flake Site comprises 555 larger artefacts from the surface and slope and 164 small waste pieces from the edge-cutting, consisting almost entirely of very small waste and only of a few tools. These small waste chips of between 10 and 20 mm are not found on the erosional slopes, because they are washed away each season by the rains. Small waste of this kind definitely suggests that the artefact horizon was a workshop. A larger excavation would help to clarify this question.

About 100 m to the southwest of the actual flake site, and right at the foot of the hills, the covering silt is eroded away and bare bedrock is exposed. Here at locality Brakhuti WW, which is an extension of the Brakhuti W Flake Site, the artefacts lie directly on bedrock, with remnants of the red colluvial silt next to it. The locality was obviously once covered by a thin coat of the red silt, the artefacts being residual remnants from below the eroded silt. This situation indicates that the Upper Member of the Babai Formation and the Gidhiniya Formation are contemporaneous with each other and grade into each other at the foot of the hillslope, both containing artefacts of the same industry.

The Gidhiniya site and the Brakhuti W Flake Site are related to each other, but with a stratigraphical difference: the Gidhiniya site is situated below the red colluvial silt, and the Brakhuti W Flake Site, in the upper part of the Upper Babai Beds.

Fig.49 presents a tentative geological and cultural scenario in the Tui valley at Brakhuti West, with the Atjun 3 site and the Sanpmarg site from the Deokhuri valley included for the insight they offer:

The Brakhuti W Flake Site is seen within the upper part of the alluvial silt at c4), at a height of 25 m a.r.l., below which the bedrock lies at 22 m a.r.l. together with a remnant of the boulder gravel. The silt above the site is being washed away to some extent by young sheetwash erosion: the red soil, which once covered the surface, is completely eroded away. At d) artefacts of the Gidhiniya type lie on the bedrock at 25 m a.r.l., covered by the now quickly receding colluvial silt of the Gidhiniya Formation. The colluvial silt interfingers with the Upper Babai silts and is, therefore, contemporaneous with the Upper Member of the Babai Beds. At c2) the bedrock level is at 18 m a.r.l. and at a) it is encountered at 12 m a.r.l., with the Early Palaeolithic boulder gravel overlying bedrock. We will discuss this scenario in more detail in chapter VI.1., in the chronological interpretation.

The Brakhuti W Industry. The surface collection of the Brakhuti W Flake Site consists of 263 artefacts, and that of the test pit of 173 artefacts and 34 natural chips, altogether the largest collection from Tui. It is a selective collection. Not all washed-down artefacts were collected, but care was taken to collect the typical artefacts and those which display the characteristics of the manufacturing process. The artefacts resemble in technique and composition those of the other sites in the Tui valley (Gidhiniya, Saskhuti S and N, Brakhuti N and NE, Raniapur etc.) and also display similarities with the Gadari Flake Site assemblage in the Dang valley and several sites in the Deokhuri valley. The unique manufacturing technique and the special significance of the artefact- and tool-composition warranted the decision to give the collection an indicative name. Hence it is called the Brakhuti industry, the Brakhuti W Flake Site being its type site. The artefacts of the Saskhuti S and N sites and the Brakhuti NN and NE sites are described alongside with the Brakhuti W Flake Site, inasmuch as they are almost identical in their composition and their manufacturing technique. The Gidhiniya artefacts, being older, differ to a certain degree.

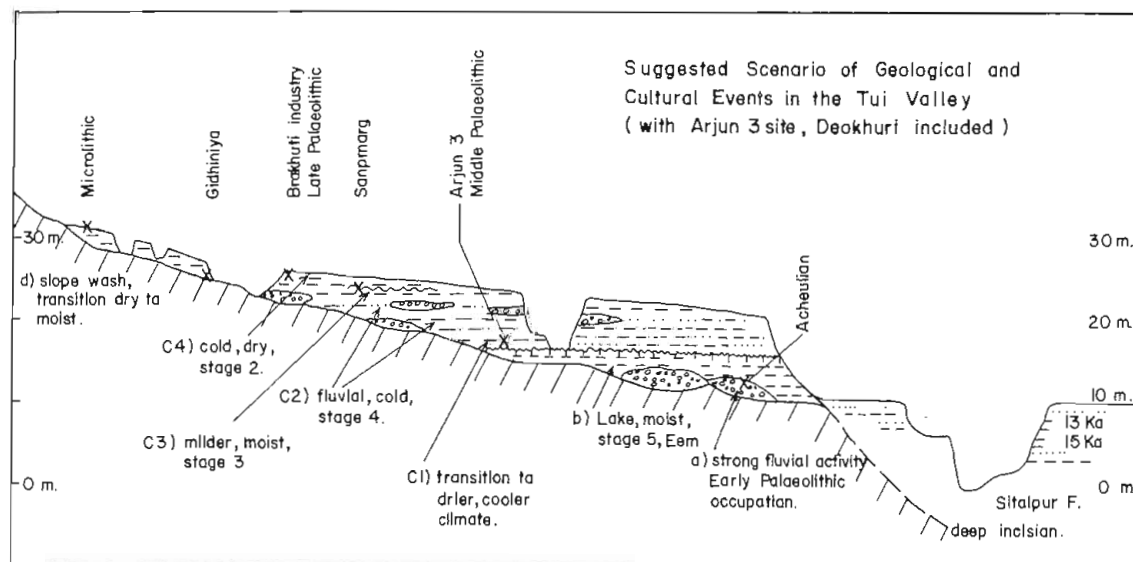


Fig. 49. The probable scenario of geological and cultural events in the Tui valley.

Tab. 3: Tool composition of the Brakhuti W Flake Site, surface.

Tool Type	Number of Tools	%
Side-chopper	2	5.5
End-chopper	—	—
Round chopper	1	2.7
Corescraper	15	41.7
Sumatralith	3	8.3
Uniface	2	5.5
Discoïd	1	2.7
Chopper/core	2	5.5
Total (cobble tools)	26	71.9
Side-scraper	1	2.7
End-scraper	1	2.7
Other scraper	4	11.1
Total (scrapers)	6	16.5
Rerouched piece	1	2.7
Grinder	2	5.5
Cylindrical stone	1	2.7
Total (other tools)	4	10.9
Total no. of tools	36	99.3
Utilised flakes	16	

This table of tools shows that cobble tools make up the majority (72 %) of the tools and 13.6 % of the collected material (Fig.50). Amongst the tools it is the corescraper which is the favorite type of tool, it being always found as the characteristic tool of this industry. Besides it, there are unifacial choppers and sumatraliths, a few scrapers and a uniface. Altogether 6 % of the 263 surface flakes have been utilised (Fig.50). Almost all tools and artefacts (86 %) are made from quartzite (Fig.51).

The corescraper is the most common tool type (16 specimens at Brakhuti W, 15 from the surface and one from the trench; 2 from Brakhuti NN; 1 from Brakhuti NE, 2 from Saskhuri S and 4 from Saskhuri S). Corescrapers are made on flat-based, elongate, rather angular cobbles. From the flat cortical base, the steep, unifacial, usually vertical edge was trimmed upwards. The edge of a true corescraper is well trimmed, with fine secondary retouch, and is usually well-defined and straight, as illustrated in Pl.73/1, Pl.73/3 and Pl.74/2, or at the Saskhuri sites (Pl.74/1). Sometimes the edge is convex and sometimes slightly concave from prolonged use (Pl.73/2 and Pl.88/2). On occasion the straight lateral edge merges into a similarly steep or slightly less steep distal edge (Pl.72/4, Pl.72/3, and at Saskhuri S, Pl.74/1). Sometimes there are two parallel lateral edges on opposite sides as in Pl.73/1 and Pl.74/2, which has half a lateral edge opposite the long lateral edge (the latter is a particularly interesting piece, made on a lovely green quartzite cobble and having a hump-backed upper face). At Saskhuri N No.4 and 1 (Pl.75/1) have two parallel well-retouched lateral edges, though the latter tool could sooner be called a uniface, as the edge goes around the entire circumference. Some corescrapers were utilised extensively and therefore were resharpened and reduced in cross section, such as is shown in Pl.72/4 and Pl.73/3. The corescraper is evidently the most useful and characteristic tool of the Brakhuti industry; it is a „Leitartefakt“, a type artefact, of the industry.

At times the distinction between a corescraper and a chopper is not easy to make. There are transitional pieces, difficult to categorize. For example, the specimen No.1 at Saskhuti N (Pl.75/1), a double corescraper, could be termed a uniface as well, as it has an edge along the entire circumference, both sides being very steep, as in corescrapers, while both ends are shallow with 60 degrees.

Choppers are not common but nevertheless characteristic. They are unilaterally trimmed and are either round unifacial choppers, similar to the Gidhiniya choppers, or else oval, rectangular or irregular side-choppers. There are a total of 13 specimens (3 at Brakhuti W (and 2 choppers/cores), 1 at Brakhuti NN, 3 at Brakhuti NE and 4 at the Saskhuti sites).

The round unifacial choppers have a lower convex face of cortex, while the upper face is trimmed over the entire face for example, at Brakhuti W (Pl.74/3 and Pl.75/2) and at Saskhuti (Pl.88/3). They are rather rare in Brakhuti and Saskhuti, while in Gidhiniya such round unifacial choppers are the common type.

Side-choppers are also rare. No.43 at Brakhuti W (Pl.76/1) is an oval unifacial chopper, the lower face being entirely cortical and the upper face being a flat split face. It has fine trimming around almost the entire circumference, and resembles a uniface. Pl.77/1a, b shows a side-chopper on a split cobble with one lateral side well trimmed. This tool could alternatively be described as a sumatralith, given its flat lower face and the flat cortex in the centre of the upper face. Pl.78/1 illustrates a fine double side-chopper, though this particular one is transitional to a corescraper with two unifacial straight edges, one being steep (85 degrees), the other more shallow as in a chopper (both are well used). There are a number of small choppers with short, but well-retouched edges of 70°. A typical unifacial side-chopper with a concave lateral edge of 70° from Saskhuti is shown in Pl.90/2, while another one (Pl.78/2) is a fine, rather unique side-chopper, made on a large cortex flake and displaying a very big bulb of percussion. It is a well-shaped rectangular tool with the lower face being of cortex, while the upper face is the trimmed ventral flake surface with its heavy bulb at the oblique right corner. It has a straight 80° edge on the left side, while the opposite edge is also trimmed but has not been excessively used. The apex is unused, but the butt, next to the bulb, has a sharp utilised edge. This tool could as easily be termed a uniface, but since the long left lateral edge is the main working edge, it is classified as a unifacial side-chopper.

The unifacial choppers at Brakhuti W are not a very standardized group amongst the unifacial cobble tools in the Tui valleys, and are transitional to sumatraliths and unifactes. In this respect the assemblage of Gidhiniya differs from the Brakhuti W site, having as its „Leitform“ the round unifacial chopper, and the corescraper is less pronounced.

Alongside these choppers there are round or oval unifacial steep-edged tools, which have been classified as sumatraliths or sumatralith-like. They are made on flat-based cobbles. The very flat lower cortical base is left entirely untrimmed, while the upper face is trimmed all around, so that a steep edge rises from the base around most or all of the circumference (Pl.79/1 and 2). They are also found at Saskhuti (Pl.91) and at Gidhiniya (Pl.70/4). The typical sumatralith is high-backed, (as in Pl.79/1 and Pl.79/2 at Brakhuti and at Gidhiniya (Pl.70/4 and 5), but there are others which are less high-backed and less steep, but still cannot be classified otherwise (Pl.91). These are interesting tools and have similarities with the Hoabinhian type of flat-based high-backed sumatraliths of Southeast Asia.

Typical unifactes, too, belong to the tool kit of the Brakhuti industry. They are trimmed only on the upper face, usually all around the circumference. They are flat tools, the lower, untrimmed face being either of flat cortex or a split face, or even a ventral flake face, and their circumferential edge is not steep, but shallow. Two fine unifacial tools at Brakhuti W, are No.9 (Pl.80/1) and No.111. Both are typical flat unifactes with a shallow edge of 65-70° all around the circumference and a slightly convex lower cortical face. The above-described side-chopper at Saskhuti S (Pl.78/2) could also be classified as a uniface.

Sumatraliths, unifactes and unifacial choppers with an edge all around the circumference are all related to each other.

Scrapers are rare and are not a typical tool group. Pl.80/2 shows an end-scrapers on an oval-shaped slice and Pl.76/3 an end-scrapers made on a flake, while Pl.76/2 illustrates a small rectangular scraper on a flat pebble with a denticulate edge, and No.171 is a heavy unifacial scraper, made on a flat cobble with a convex edge. The finest specimen is No.212 (Pl.80/5), a well-used pointed scraper made on a flake, with fine secondary retouch at the left side.

The typical tools of the Brakhuti industry in the Tui valley are a variety of heavy-duty cobble tools of corescrapers, choppers, uniface and sumatraliths, all uniaxially trimmed. They are a highly versatile group of tools and are transitional in type to each other, and seem to reflect a wide range of heavy work. For example the tool shown in Pl.76/1, described as a side-chopper could as well be classified as a uniface, or the tool illustrated in Pl.80/1, classified as a uniface, could also be called a sumatralith, though it is not as high-backed as a typical sumatralith. It is evident that the analyst views each tool group from a different angle than the prehistoric user. Lacking the knowledge of the exact function of each tool type, we can only classify them according to their shape and their working edges.

There are variations between the sites belonging to the Brakhuti industry. The Brakhuti W Flake Site has the greatest variety (probably due to the fact that this is the largest collection); Gidhiniya's typical type of tool is the round uniaxial, convex-bottomed chopper; while the more common types of tools of the Brakhuti and Saskhuti sites are the sumatralith-type ones and the straight-sided steep corescrapers.

The flakes of the Brakhuti industry have been subjected to a detailed analysis in order to understand the special manufacturing technique of the stone-knapping processes of this industry. The description of the Brakhuti W flakes is valid also for the other related sites of Brakhuti and Saskhuti.

There are no characteristic cores, and indeed only five specimens could be classified as cores (2 %) (Fig.50). They are ill-defined, with in some instances cores having later been used as choppers, such as the core-cum-chopper shown in Pl.81/1, and a few others which have usemarks at an edge. There may be doubts in some readers' minds that the corescrapers are actually cores and not tools. But it was with this possibility in mind that the analysis of the corescrapers, and especially of their edges, was particularly thorough. The conclusion is that the steep, straight-edged corescrapers with a definite edge retouch, and often with heavy usemarks, are certainly tools and were not utilised as cores.

The flakes (207 flakes) form, at 79 %, the largest component of the collection of the Brakhuti W site.

Flakes have predominantly cortex platforms (81 %), 8 % have plain platforms, and only 1 % have some preparation of the platform (Fig.52).

A total of 58 % of the flakes have a characteristic stepflaking or stepretouch at their platform edges on the dorsal face (Fig.54). The stepretouch resembles the retouch on the corescrapers and choppers, and it is possible, therefore, that most of the flakes with such a platform retouch are rejuvenation flakes deriving from the resharpening of the cobble tools. Still, it is difficult to decide whether some of the flakes were meant to be detached for a certain use, or whether they are all waste products from the manufacture of the uniaxial cobble tools. The fact that 81 % of the flakes have cortex platforms seems to suggest that they were detached from the cortical rim of the uniaxial edges of the cobble tools. Few flakes (only 8 %) seem to have been utilised (Fig.54). They are not different in shape and technique from the rest, and the utilisation marks are faint, (see in Pl.84/4,5 and Pl.85/1-6 from Brakhuti, and a few from the Saskhuti S site, Pl.89/1-3, Pl.90/1). The observation that a considerable number of flakes have cortex opposite the platform at their distal end (Fig.53), (as in the case shown in Pl.80/3,4 and Pl.81/2) is interesting, too, and points up the fact that they were detached from uniaxial cobble tools, especially from the typical corescrapers. Similar flakes can be found at the Raniaput site (Pl.72/2) and Gidhiniya (Pl.70/3).

In this respect it is also worth noting the high percentage (52 %) of flakes with unidirectional flaking scars on the dorsal face (Fig.55), which indicates that the detachment pattern of previous flakes was in the majority of cases in the same direction as the detachment of the flake itself—in other words, from a cortical

base of a unifacial tool unidirectionally upwards. This in turn would indicate a resharpening and reshaping of the edge of a unifacial cobble tool.

It could be argued that the stepretouch at the dorsal platform edge of the flakes may have been executed to reduce the thickness of the flakes, if the flakes were intentional products. But on the other hand where are the cores? The corescrapers and the other large unifacial cobble tools are too well-defined classes of tools, with well-utilised edges, to call them cores.

A small number of flakes do exhibit, however, a well-defined shape and prepared secondary trimming, (Pl.85/1,2, Pl.82/5 and Pl.84/4) and particularly the pointed scraper No. 212 (Pl.80/5). These flakes seem to be incidental rather than intentional. In the absence of prepared cores this is to be expected. All the smaller flakes are certainly waste.

The average size of all flakes from Brakhuti W is between 30 and 60 mm.: 6 % are smaller than 30 mm and 15 % larger than 70 mm, while the majority of 79 % are medium-sized (Fig.56). The B/L ratios of the flakes (Fig.58) show a definite tendency towards medium, rather squatish-to-oval flakes, at a ratio of 0.6, while the majority (85 %) of Th/B ratios (Fig.57) fall between medium ratios of 0.2 and 0.5, i.e. flakes whose thickness is between 1/4 to 1/2 of their width.

The platform angles of flakes have an average of 100-110°, with a maximum of 31 % at 105-109° (Fig.59). Altogether 63 % have platforms smaller than 110°.

There is no blade element apparent in the Brakhuti industry apart from a few blade-like pieces (Pl.85/6).

The flakes have thus very characteristic features and seem to be predominantly manufacturing waste from cobble tool production.

An analysis of the probable manufacturing processes of the production of cobble tools of corescrapers and choppers, as an outcome of the study of the flakes, is given below.

Most of the collected flakes (one needs to keep in mind that the collection is a selective one!) seem to have been detached from the edges of the unifacial corescrapers and choppers, because many of them display the same stepretouch on their platform edge as is seen on the working edges of the corescrapers. There are flakes which have definite utilisation marks at their platform edge, and so must have been detached from extensively utilised corescraper edges. The flakes with corescraper usemarks and corescraper edge retouch (specially marked in the catalogue) make up 25 % of all collected flakes.

A good example of such flakes with utilisation marks at the platform edge is the thick flake at Saskhuti S (Pl.82/1) and a few others, which have been detached from a corescraper with two edges at right angles. The flakes themselves are of no use. They show utilisation marks on the remnants of the two corescraper edges at right angles to each other, having been detached to reduce or to rejuvenate the corescrapers (Pl.82/3), while the flake in Pl.82/4, a waste flake with heavy step-trimming at the platform edge, was struck from a heavily utilised chopper edge as a rejuvenation flake.

The flakes can tell us much, too, about the way the corescrapers were produced. All cobble tools have a considerable amount of cortex left on their surface, and one can deduce from it the original form of the cobble used. The favoured cobble was an oblong-to-round, somewhat flat cobble with rounded corners, almost always of quartzite (see Fig.51). The first detachments were primary cortex flakes struck from one of the rounded corners (called in our analysis first-stage flakes). They are cortex flakes. None have been included in the selected collection, as they exhibit only cortex.

Such cortex flake scars can be seen, however, on the second-stage flakes, where a large part of the dorsal face consists of cortex apart from one or two flake scars removed from the same platform as the flake itself (Pl.82/2, Pl.83/1 and Pl.83/2). These second-stage flakes produce a shallow edge of about 70 degrees on the corescraper-to-be. The so-called „orange“ flakes belong to this category of second-stage flakes.

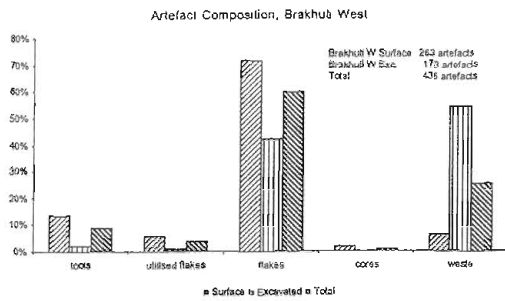


Fig. 50. Artefact composition of Brakhu W site.

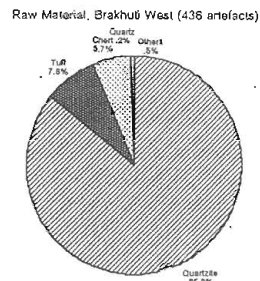


Fig. 51. Raw material of the Brakhu W artefacts.

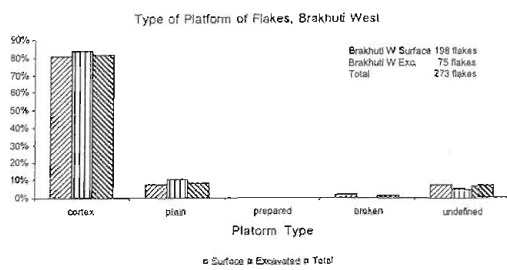


Fig. 52. Type of platform of Brakhu flakes.

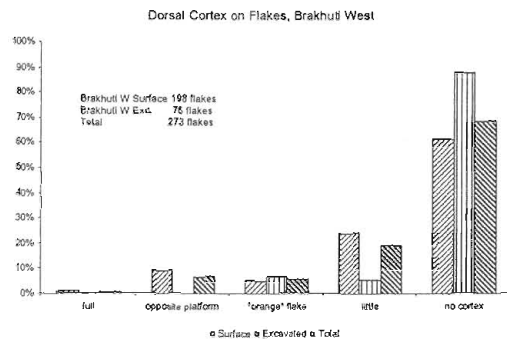


Fig. 53. Cortex of dorsal face of Brakhu W flakes.

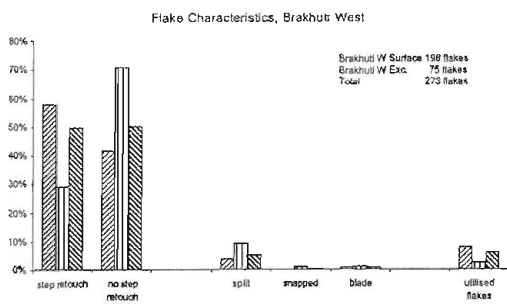


Fig. 54. Characteristics of Brakhu W flakes.

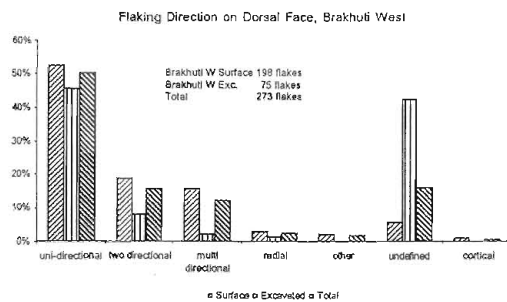


Fig. 55. Flaking direction on dorsal face of Brakhu W flakes.

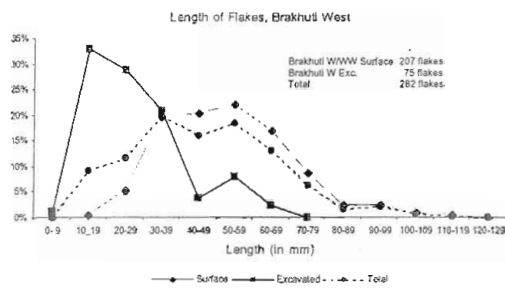


Fig. 56. Size of Brakhuti W flakes.

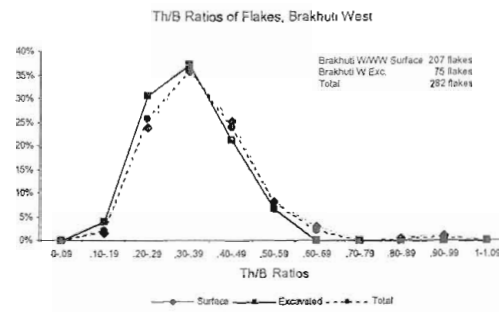


Fig. 57. Th/B ratios of Brakhuti W flakes.

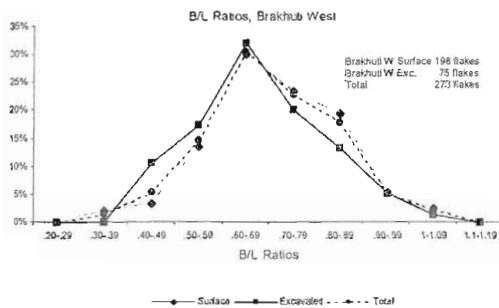


Fig. 58. B/L ratios of Brakhuti W flakes.

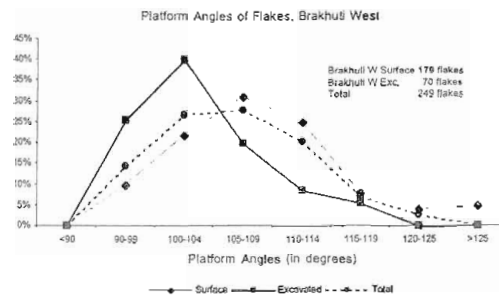


Fig. 59. Angle of platform of Brakhuti W flakes.

The subsequent goal was to produce a steep edge on the trimmed cobble. The third-stage flakes are small, shallow flakes or stepflakes, which produce the desired steep edge. There are only few such flakes left in the scatter on the slopes, as they are smaller than 15 mm, and therefore easily washed away and lost. But in the *in situ* cutting I, one finds many such very small chips and stepflakes, as seen in Pl.83/3,4, all 15 mm or less in length from the platform. These small flakes with abrupt distal ends, as in Pl.83/3, produce a steep, often 90° step-edge at the corescraper edge, which is usually not more than 15-20 mm high above the actual edge (one can see the deep step they produce at the corescraper edge). Above these step-flakes one can see the remains of the shallow scars of the second-stage flakes, with a 70° slope towards the edge (see the corescrapers from Brakhuti in Pl.72/4, Pl.74/2, Pl.73/3 and Pl.73/2) or from Saskatchewan S (Pl.74/1).

The fourth-stage flakes are flakes taken off from the corescraper edge, most probably in order to rejuvenate or resharpen the edge which may have become blunted by use. Such flakes are found in plentiful numbers. They are normally small in size, have cortex platforms and always display the typical step-touch at the platform edge (Pl.83/5), of small size, or of medium size of 30-40 mm (Pl.83/7,8,9,10) or sometimes larger (40-50 mm) (Pl.83/6 and Pl.82/3).

When not only the edge but the whole corescraper was reshaped, large fifth-stage flakes were removed. They usually have cortex opposite the cortex platform, indicating that the entire width of the co-

rescraper has been rejuvenated, thereby reducing the breadth of the tool. In addition, they show stepretouch at the platform edge, indicating that an entire portion of the chopper/corescraper edge had been removed. We find, in fact, many such reduced, narrow corescrapers (Pl.74/1 and Pl.73/3 and Pl.72/4). Afterwards the process of steepening the edge with small third-stage flakes starts all over again.

Typical examples of such fifth-stage flakes are seen in Pl.84/1,2; or in Pl.80/3,4 and Pl.81/2 (flakes with cortex opposite the platform); and „orange“ flakes (Pl.81/3 and Pl.82/2); and flakes which remove parts of two corescraper edges at right angles to each other (Pl.84/3). And in extreme cases a whole corner of the tool is removed, which is indicated by the thickness of the flake, such as in Pl.82/1, mentioned before.

The same production process can be seen at the sites in the Mashot valley (just east of the Tui valley beyond the watershed), which possess similar corescrapers and very similar types of flakes, tiny third-stage flakes and fourth-stage flakes (Pl.100/2 and Pl.99/2), second-stage flakes (Pl.88/1), and fifth-stage flakes with cortex opposite the cortex platform and stepretouch from the removed corescraper edge as in Pl.99/3.

One can, of course, argue here that the whole reduction and manufacturing process was aimed at producing small flake tools, and that the corescrapers are cores, especially in the light of the fact that many of the corescrapers are reduced to quite narrow tools. On the other hand, the corescrapers display in most cases such definite utilisation marks, with the lateral edge being often reduced to a narrow, concave edge, that in my mind – after analysing them for years, and even experimenting on their usage – they are heavy wood-working tools and not cores. Besides that, the fourth-stage flakes show only in rare cases signs of utilisation.

Brakhuti W.I. In 1991 a small cutting, Brak.W.I, was made into the edge of the Brakhuti W Flake Site in order to find the actual horizon of the occupation floor (Fig.60).

The artefacts at this location are eroding out in profusion at the edge of the terrace surface where a gully deeply dissects the surface. Artefacts are found on the steep gully slopes but not on the surface of the terrace itself. A 1x1m cutting was put down here, with point B (at 25 m a.t.l.) as the 0-point. The first 25 cm were sterile, the sediment being of fine yellow-grey silt which contained a few very small brown calcareous pellets. An ant or earthworm burrow and several recent root casts have disturbed the layer.

The artefact level starts at 0.25 m below 0-point, at a level of 24.75 m a.m.r.l. The burrow which disturbs the level is 15 cm in diameter and its bottom is 47 cm below 0-point. The concentration of artefacts is between depths of 0.40-0.45 m below the surface (Fig.60).

From the small test cutting 220 artefacts and waste (173 artefacts and 47 whole or broken pebbles) have been plotted from levels between 0.25-0.40 m below 0-point. The actual level of the occupation horizon is 0.40-0.45m below 0-point (15 artefacts are found between 0.25 and 0.29 m; 49 between 0.30 and 0.39 m, 156 between 0.40 and 0.48 m), (see also Fig.60).

Altogether 55 % of the artefacts of cutting I (Fig.50) are complete waste (chips, flake-like pieces, chunks), and even 42 % of the flakes are nothing but small waste. There are only four tools: one chopper/core, one corescraper, an end-scraper, and a rough scraper made on a cobble fragment. Of the flakes only two were apparently utilised (1.4 %). Of the remaining flakes only a very few are in any sense well shaped (Pl.85/3,6); the rest are waste. This shows clearly the selective nature of the surface collection, namely its low percentage of waste. The diagram of the small test cutting (in Fig.50), on the other hand, reflects the actual composition of the artefacts, with the highest percentage being waste. It is indicative of a factory site of stone knapping. The raw material of all the collected artefacts is in the majority of cases (86 %) quartzite (Fig.51).

Fig.52 shows that a majority (84 %) of the small waste flakes, like the larger ones outside, have cortex platforms. They represent for the most part, the third-stage flakes of tool production.

The cutting, though only a small one, indicates that an occupation floor exists at a depth of 40 cm below the recent surface. To judge by the quantity of waste, and especially tiny waste, the site was a factory site. More cannot be said about the occupation at the moment due to the restricted nature of the cutting, but the latter has clarified the level of the actual horizon. A larger excavation needs to be carried out at this place.

The small artefacts from within the silt are quite weathered. When such small artefacts become exposed they weather quickly and disintegrate. Therefore the category comprising smallest waste (chips and tiny flakes), found *in situ*, is not found outside, only the larger and fresher artefacts.

The Brakbuti W site complex reveals an interesting situation. Below the artefact-bearing silt of 2.25m thickness, the southernmost edge of the cobble-boulder gravel bearing Early Palaeolithic artefacts are encountered above bedrock. Two industries of different ages and cultures chronologically here overlies each other, separated by a considerable time gap.

Thus in the recently eroded gully we see the old buried bedrock surface (exposed by recent erosion) overlain by the boulder gravel containing exposed Early Palaeolithic *in situ* flakes; and mixed on the surface with the older flakes are artefacts of the younger industry, washed down from their original horizon above it, giving a false first impression. Only careful examination of the stratigraphical and geological data in the field can reveal the true provenance and chronological order of the cultural material.

The Neolithic locality at Brakbuti W. About 300 m to the northeast of the Brakbuti W Flake Site remnants of a small Neolithic locality have weathered out from the edge of the flat 17.5m high terrace surface, east of a large pipal tree. Some polished axe fragments were found on 24th February 1990 and 6th April 1990 (Fig.61a,b) and a small cutting was put down at the edge in February 1991. A grey soil of not more than 15cm thickness is seen to be overlying the yellow alluvial silt of the Upper Babai Beds. From the grey soil fragments of two small polished axes together with very weathered pottery sherds decorated with cord markings were washed out into the gully, which cuts steeply into the terrace surface. A 1m area was scraped from the bare surface at the gully edge down to a depth of 15-20cm (Fig.61b). A few more potsherds were obtained, but nothing more. Some specks of charcoal are scattered in the grey soil but no horizon of occupation could be recorded. If an occupation was once present here, it has all been destroyed by erosion. Below the grey soil is the yellow alluvial silt of the Upper Member of the Babai Formation.

Layer a.: The top 10 cm consists of the grey „Plaggen“ soil, the surface being bare. It is contaminated by roots and bioturbation (by ants). The grey soil is a slightly humic, quite recent soil, formed under the influence of cultivation, the grazing of cattle and the slight vegetation during the monsoons. At a depth of 10 cm a few very weathered pottery sherds were found.

Layer b.: Layer a grades into layer b of light grey-to-yellow silt without noticeable structure, up to 15cm in depth, and contains roots and is disturbed by bioturbation.

Layer c.: Below 15 cm is the yellow alluvial Upper Babai silt, with roots, small, very weathered Siwalik sandstone pellets and bioturbation.

At cutting I (0.50 m by 0.50 m) at the side of the gully, nothing was found in the grey soil.

Cutting II (0.50 m by 0.50 m) was dug into the inner part of the small gully which cuts into the surface and exposed some pottery sherds and a small area of fire-baked red earth with specks of charcoal, which the gully has almost entirely destroyed. This may have been a fire-place. Only a few weathered sherds have been found to the right of the burnt earth, but nothing else. Some charcoal specks were collected which may possibly be contaminated, as they were close to the gully edge. They yielded a very young age of $1,540 \pm 90$ BP (BSIP No.BS 946, 1992).

Another cutting, III (0.80 by 0.50 m), was put down a few metres to the west, at the edge of the bare surface. In the first 10 cm (1st layer) only specks of charcoal in great numbers were encountered in the

western part. In the 2nd layer (10 to 20 cm), again only a few charcoal specks are present in the western part. In the 3rd layer (20 to 26 cm), there are many small specks of charcoal together with red- burnt pieces of earth. This seems to have been the floor, or what remains of it. No cultural material was encountered. Below this level is sterile yellow silt. Apart from the second axe fragment (outside), no stone artefacts were found either inside or outside the cutting. The pieces of pottery are so small and weathered that only on some of them could cord-marking be detected.

Further upstream in the Tui valley we encounter a number of other localities of the Brakhuti industry.

Brakhuti W, Neolithic Locality in Grey Soil

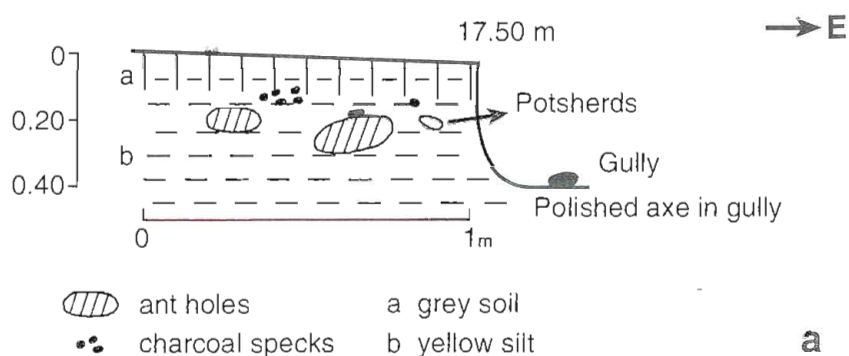


Fig. 61a. Brakhuti W Neolithic locality, profile.

Other sites near Brakhuti

Brakhuti S is situated on the south side of the Tui River, and south of Brakhuti village, between three small gullies that join the river from the south (Fig.43). Quartzite artefacts have eroded out from the reddish colluvial silts. No collection was made from here.

Brakhuti NW is a small artefact locality of the Brakhuti industry situated west of a narrow northern gully, north- northwest of Brakhuti village, where a few crude flakes have eroded out from the reddish silt. There is also a fire-place and scattered wheel-made pottery on the surface (including a whole shattered pot). Some cord-marked pottery seems to have come from the topmost part of the silt. There are no stone artefacts associated with the pottery. The stone artefacts seem to have come from a lower level. The fire-place is a red-baked eroded silt knob with no charcoal. No collection was made.

Brakhuti NN is a small flaking site where artefacts of quartzite, chert and „tuff“ of the Brakhuti industry have eroded out in a gully from a yellow-reddish alluvial silt 0.45 to 0.50 m below the surface of the higher terrace of the Babai Formation (Pl.213/3), in a very similar situation to the Brakhuti W Flake Site. East of it, at the foot of the hill, reddish, homogeneous silt of the Gidhiniya Formation overlies unconformably Lower Siwalik bedrock (Ph.47-Sc), looking over the colluvial silt westwards to the Brakhuti NN locality.

A sample of eight artefacts was taken, consisting of two corescrapers, a round unifacial chopper (Pl.75/2) and a few flakes that are consistent with the second-stage flakes of the Brakhuti industry. The site is situated north of Brakhuti village next to a large gully coming from the north, 50 m SE of the pipal tree.

Just a little to the west of this site is locality Brakhuti N/1, from where a corescraper-rejuvenation flake was taken.

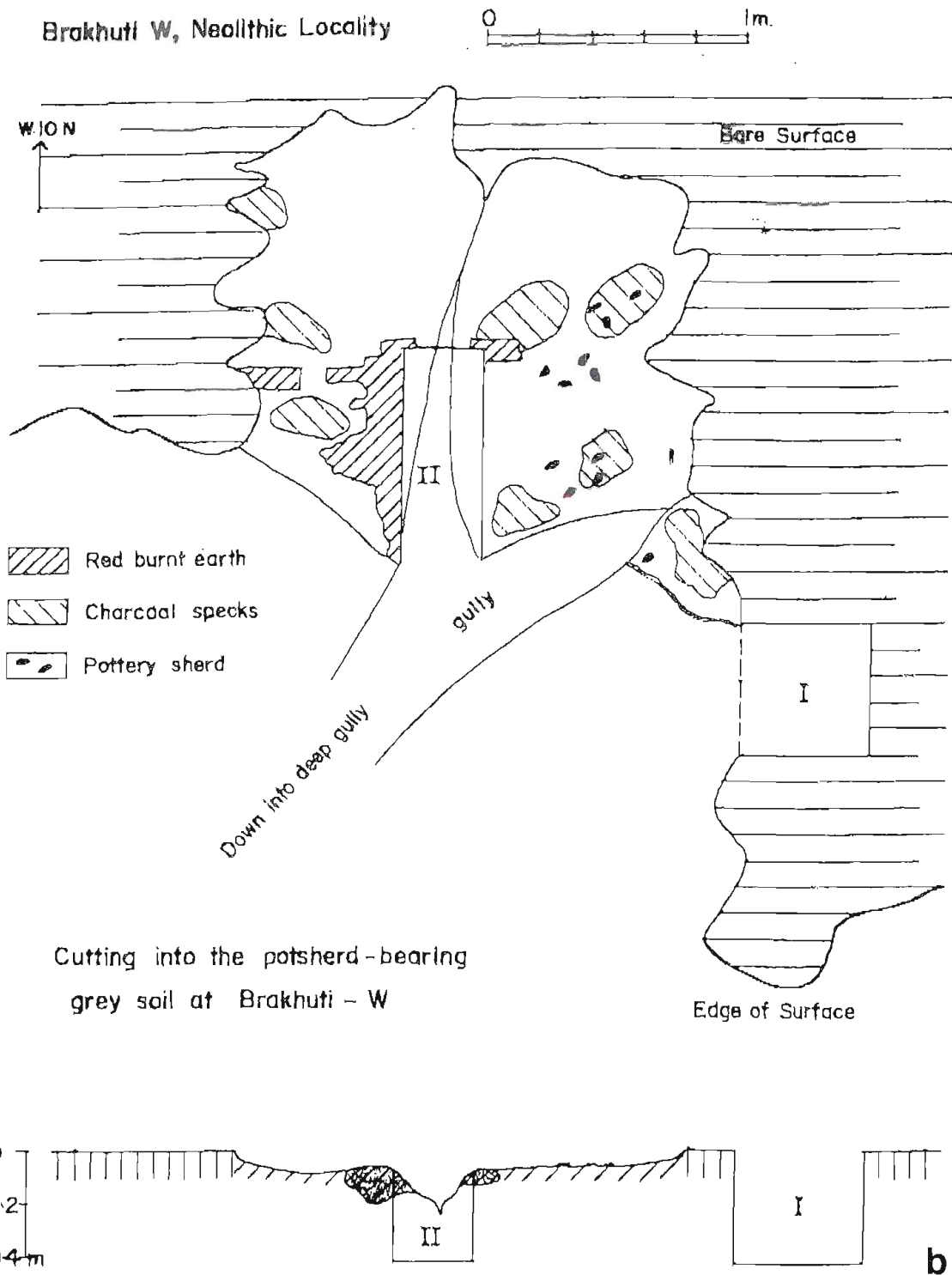


Fig. 61b. Brakhuti W Neolithic locality, plotting of the Neolithic locality.

Brakhuti NE. Some hundred metres further east, along the foot of the hills, there is another extensive, though sparse, scatter of artefacts. It is seen to be eroding out in shallow gullies from a thin, reddish colluvial silt covering Siwalik bedrock. A sample of artefacts was taken, comprising a reduced cotescraper (Pl.73/3), three choppers of which No.1 (Pl.78/1) is a fine, straight-edged side chopper and a few flakes, all in the Brakhuti industry fashion (included in the previous description). A number of large quartzite boulders also lie scattered on the surface, almost certainly brought up to the present location as manuports for intended work. One hundred metres to the east of this locality is a grass-covered surface on grey soil, from which many wheel-made pottery sherds have been washed out. A number of very large quartzite cobbles are scattered amongst the potsherds. The grey soil cover suggests occupation. Was it a potters' village or a burial ground?

Brakhuti SE site. This locality is east of the Brakhuti W site complex on the south side of the Tui River, where a few polished axes, made of „tuff“, were found at the edge of the 27m silt terrace of the Upper Babai Beds. The stratified Babai Beds reach up to this level to form the alluvial terrace. Pl.214/1 gives a view from the site to the north over the dissected yellow silts of the Babai Beds. South of it, on the hill sides, one encounters the reddish colluvial silts at a height of 35 m a.r.l. In Pl.214/1 two axes are still *in situ* in the yellow silt (at the mans feet).

From nearby this locality, looking north over the Tui valley (Pl.248/2) one can easily distinguish the interfingering of the well-stratified Upper Babai Beds (in the middle ground) and the reddish colluvial silts of the Gidhiniya Formation (in the foreground) at the foot of the hills.

The strong erosion will destroy the prehistoric sites in the near future. The photos will soon be the only documentation of the sites. For this reason the photos are of extreme importance.

The occupation of the people of the Brakhuti industry continues further upstream along the Tui valley, clustering around Saskhuti village to the north, south and east. The artefacts have been described previously in the analysis of the Brakhuti W site material.

The Saskhuti N sites

North-northeast of Saskhuti village (Fig.43) bedrock has been exposed on the north bank of the Tui River. It consists of Upper Siwalik pebbly sandstones, hard, calcareous „puddingstone“ lenses and mudstone layers, all forming hard ledges in the river itself. The bedrock was deeply dissected prior to the alluvial aggradation. A boulder gravel unconformably overlies bedrock 13 m above the river level. The boulder gravel in turn is overlain by reddish-yellow alluvial silt of the Upper Babai Beds up to the terrace surface at 21-22 m. Fig.62b presents the profile at the north bank. The river is at a level of 590 to 595 m. The terrace surface is a truncated one, and not much of the original red soil, covering it is left.

At the edge of the terrace lying nearest to the river, artefacts of quartzite have eroded out from a level 0.40m below the red surface of the alluvial silt at the Saskhuti N/1 locality. A small sample of artefacts was taken from this locality, comprising a round chopper, a bifacial core/chopper (Pl.86/1), 2 scrapers and a few flakes (Pl.89/4). Above the artefact horizon, a thin grey, humic soil has developed over the silt on the actual terrace surface (22.50 m).

A number of fire-places are seen at the 22m level, but they are either right on the surface of the red silt or in the grey soil, and so are not associated with the stone artefacts.

About 30 m further north is locality Saskhuti N/2, at the edge where the terrace is dissected by a gully. Here, too, a thin, grey soil cover has developed over the silt. At the very edge two fire-places can be seen both partly destroyed by the erosion. An iron arrowhead was lying next to one of them (Pl.214/2), and sparse, wheel-made pottery is associated with it. The iron arrowhead is the only one of its kind so far found, and its antiquity is not clear, i.e. whether it belongs to historic times or to a protohistoric period. Future research should answer this question.

Stratigraphically lower down in the section, on the gully slope, stone artefacts are eroding out from the silt, situated some 0.50m below the surface. It would be worthwhile to carry out a small excavation there to establish the connection between the arrowhead/fire-place horizon from the surface with the stone artefact horizon below it in the silt.

A small sample of these artefacts was taken from the Sask.N/2 locality, comprising four corescrapers, (Pl.75/1), a cylindrical stone used as a hammer, and a sample of 19 flakes and three waste pieces. They all seem to belong typologically to the Brakhuti industry.

The Saskhuti S and SE flake sites

The Saskhuti S Site is a rich flaking site situated south of Saskhuti village at the very shoulder of the hill on a truncated surface of the red colluvial slopewash deposits of the Gidhiniya Formation, where the latter abuts against the slopes of Siwalik rocks. The elevation of the site is 40-50 m above river level. The silt overlies irregularly dissected bedrock and has a thickness of about 2.50 m above bedrock. The artefacts of the site are scattered over an area of about 50 by 50 m. The red surface slopes considerably, with a gradient of about 10 degrees, away from the hill slopes, while the bedrock beneath the red soil has a similar gradient (Fig.62a). The silt is very dissected and at places completely eroded, leaving bare bedrock between the areas of silt (Pl.214/3). Artefacts are scattered on the bedrock as residual remnants from the silt.

It is obvious that the artefacts have their original horizon at a definite level within the silt of the Gidhiniya Formation. The silt at Saskhuti S is truncated by erosion into several steps, the original surface being a bare, rather steeply inclined surface, so that the sheet erosion progressed in a more or less stepwise way. On one of the steps, the artefact level is seen as a rich occupation floor, being exposed by erosion at about 2 m above bedrock and 0.50 m below the average level of the red silt surface (Pl.215/1).

Many artefacts are eroding out from this level and are scattered in the small erosion gullies. They consist mostly of waste flakes and chips and chunks. A selected collection of artefacts, most of them from *in*

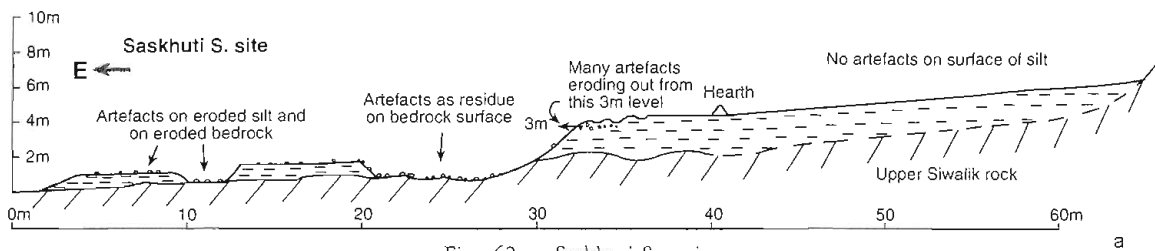


Fig. 62a. Saskhuti-S section.

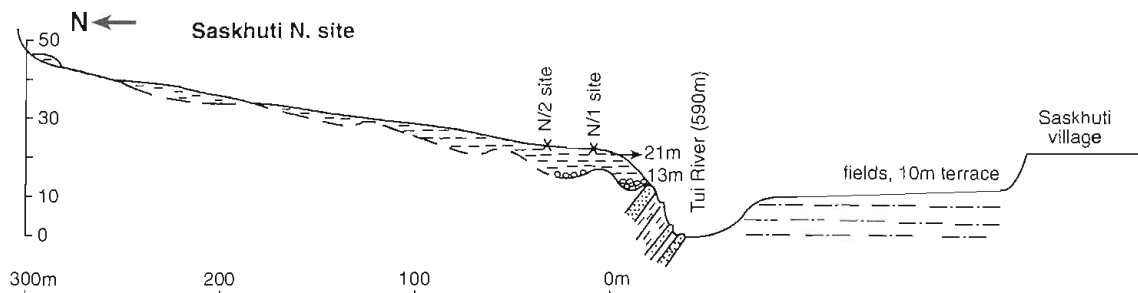


Fig. 62b. Saskhuti-N profile.

situ in the silt, was made at this spot. Altogether a sample of 38 artefacts was collected, including 2 cores-crappers (Pl.74/1 and Pl.88/2), 3 choppers (a side-chopper, Pl.90/2 and a round chopper, Pl.88/3), 1 uniface made on a side-flake (Pl.78/2) and a few utilised flakes (Pl.89/1,5 and Pl.90/1), 2 cores (one of them a large, fine radial core of a size of 200 mm (Pl.87), and 25 waste flakes, amongst them fifth-stage rejuvenation flakes (Pl.82/1 and Pl.84/3), described above under Brakhuti W. This rich site was in all probability a camp-cum-factory site.

Ten metres west of this exposure a large fire-place can be seen on a surface of the red silt. It is on a higher level than the artefact level, and there are no stone artefacts nor any pottery connected with it. Some charcoal was collected from it, but it was too near the surface to yield any reliable date. Some 13 m south of the first large fire-place is another one on the same level. Four more fire-places have been counted north of the site between it and the first Siwalik conglomerate ridge, less than 100 m away. They must belong to a considerably more recent period than the stone artefacts. No artefacts are connected with them.

No artefacts are found on the red surface west of the exposed artefact horizon at the eroded edge, up towards the hill (see Pl.214/3), indicating that the artefacts are confined to a horizon approximately 0.50 m below the recent colluvial surface. Since sheetwash erosion has played a considerable role in the overall erosion, it is probable that the original silt fan surface was slightly higher than today and that the artefact horizon was perhaps 1m below the original surface.

Some of the artefacts are extremely fresh, having recently been eroded out from the silt. Others, which have been exposed for some time, are weathered.

About 50 m north of the main flaking site, separated by a deep, 50 m wide gully, additional artefacts (locality Sask.S/2) have eroded out from the same silt level as at the main site. It is part of the same site and seems to be a small flaking spot connected with the main site. Since the time of occupation, erosion has separated the two localities from each other in the form of a deep gully. Six flakes were taken as a sample, four struck from the same core.

Further east, along the foot of the hills, on the southern margin of the Tui valley, passing through the dissected badlands, one encounters a number of smaller and larger flaking places, which all belong typologically to the same cultural period as the Brakhuti industry. One such locality is located E20N from the Saskhuti S site, across the next eastern gully on a large exposed colluvial silt surface of the Gidhniya Formation. Many stone artefacts (of the Brakhuti type) lie scattered on the surface, having eroded out from the dissected silt. The silt above bedrock is not more than 2 m in thickness, and, as at Saskhuti S, the artefacts, scattered on the bare bedrock, are residual remnants from the eroded silt. No sample was taken.

The Saskhuti SE Site: A little further east, where the reddish-yellow silt surface of the Gidhniya Formation breaks up into badlands, one encounters a flaking spot with stone artefacts and haematite pebbles. This locality, about 500 m S35E from the southernmost house of Saskhuti village, is again very rich. The artefacts derive from the upper part of the silt, having been washed down onto the lower surface, where a cobble conglomerate of Upper Siwalik bedrock is exposed, so that the impression is as if the artefacts derive from the conglomerate. However, the conglomerate was not exposed at the time of occupation but was covered by the silts of the Babai Formation.

A small sample of artefacts was collected, the finest of them being a unifacial sumatralith-like tool (Pl.91) and a few flakes (Pl.89/2 and Pl.90/3). The artefacts belong again to the Brakhuti industry.

Comparative remarks on the Saskhuti sites

The artefact assemblages of all the Saskhuti sites are similar in type and technique to the Brakhuti industry. The most important features of the Saskhuti sites have already been described in connection with the Brakhuti W Flake Site, but a short description of the special features of the tools is necessary.

Narrow, flat, flat-based and straight-edged corescrapers are common (Pl.75/1). In Saskhuti S, No.10 (Pl.74/1) is an especially large, 195 mm-long specimen with fine retouch along the working edge, its end rounded off by two large, shallow flakes. Pl.88/2 shows a steep corescraper made from „tuff“, with a concave vertical working edge. Pl.90/2 depicts a good example of a slightly concave side-chopper, the working edge of which was used extensively, while No.34 (Pl.88/3) is a round unifacial chopper, similar to the Gidhinya choppers. One well-shaped and unique tool at Saskhuti S is the large rectangular parallel-sided tool No.11 (Pl.78/2), made on a large cortex flake with an enormous cortical bulb of percussion. It is described already under the Brakhuti assemblage. It is a special tool and nothing similar to it has been found so far anywhere else.

Other interesting pieces include two sumatralith-type tools. One (Pl.91) is made on a split flat cobble, from which a steep, round edge was formed by unifacial trimming from the flat lower surface around most of the circumference. Only the cortical back (which fits comfortably into the hand when holding the tool) has been left untouched. It is not as high-backed as a typical sumatralith, such as No.78 of Gidhinya or No. 45 and 198 of Brakhuti W., but it is similar in its semi-height to sumatralith No. 197 (Pl.79/2) of Brakhuti W, though the latter has a perfectly round shape.

Another special tool is the large radial core Sask.S/9, 200 mm in diameter (Pl.87/1a,b). It is quite weathered on its upper surface which had been exposed for a long time. It was made on a large flat cobble with a flat lower face, around which 8-10 large flakes have been removed, while the central flat cobble surface shows parallel striation and pitting marks, indicating that the cobble was used as an anvil prior to having been a core. On the upper, more rounded, cortical face 6-7 flakes were removed along part of the rim. It is almost an alternate-bifacial core, such as are found so commonly in the Early Palaeolithic in Africa. But this artefact is an isolated, single element of its kind in this context.

Interesting, too, is a thick corescraper-rejuvenation flake of the fifth stage of reduction (Pl.82/1), as described under the Brakhuti W assemblage, and the flake in Pl.84/3, which is made on „tuff“, removed from a corescraper, with two step-flaked edges at right angles to each other. Quite a number of flakes from the Saskhuti S and SE sites were utilised (Pl.89/1,2,3 and Pl.90/1,3).

On the whole, the tools and flakes conform to the previously described Brakhuti W industry, and the manufacturing technique is the same.

A majority (65.5 %) of the 58 flakes of the Saskhuti sites are of medium size (between 30-70 mm), slightly less than at Brakhuti. Platform angles vary between 100 and 115°, with a peak at 110° and 65 % being smaller than 110° – very similar to the flakes from the other sites of the Brakhuti industry. The B/L and Th/B ratios, too, are very similar to those at Brakhuti W. Altogether 69 % of the Saskhuti flakes have cortex platforms, somewhat less than at Brakhuti W, and 64 % of them have the characteristic step-retouch at the platform edge, which is quite consistent with flakes of the Brakhuti industry. The Saskhuti S site displays a higher proportion of multidirectional (17 %) and radial (15 %) flaking directions than the Brakhuti W site (12.5 % and 2.6 % respectively), indicating a somewhat more sophisticated flaking process, or, in other words, a higher amount of intentional flake production.

What is also interesting at Saskhuti N/1 is that a type of fine cherty quartzite was used to a greater extent (46 %). The artefacts Nos. 19-35 were all found together and were struck from the same chert core. Chert is present at Saskhuti S, too, but only in small quantities (4.5 %), as in Brakhuti (5.7 %), while the predominant material there is quartzite (88.5 %). This raw material is not present in the immediate vicinity of the site, at the foot of the hills. It is available only in the Tui river bed at some distance from the occupation site.

Rajje

The Tui valley was explored up to the source area, and a few further sites were recorded in the upper reaches.

A very important aim during the exploration of the upper reaches of Tui valley was the continued search for a basal cobble-boulder gravel, similar to that exposed below the Brakhuti W flake-bearing silts, where it contained an Early Palaeolithic workshop.

Several other exposures of similar large lenses of this basal boulder gravel can be seen – always directly overlying bedrock – and most of them, like the Brakhuti boulder gravel, bearing artefacts of the Early Palaeolithic: 1) east of Saskhuti in the riverbed; 2) at Simalkhuti (Fig.43) on the left bank of the Tui River, overlying bedrock 8-9 m above the river level, underlying the silts of the Babai Formation, and containing a number of palaeoliths (Pl.94/3); 3) a large lens of boulder gravel, exposed in the riverbed in the big N-bend before the village of Manname; 4) the boulder gravel west of Rajje, 20 m above river level, overlying bedrock. All these gravel sites yielded a few large flakes and cores.

The most important site besides the Brakhuti W boulder gravel, however, is the cobble-boulder gravel at Rajje (Fig.63), on the north bank of the Tui River, on the way up to the 30 m-high northern terrace of Rajje. The cobble-boulder gravel of Rajje has a thickness of about 1.50 m, and at places even thicker. It is exposed 20 m above river level, overlying Siwalik bedrock. It is overlain in turn by several metres of reddish-yellow silt. The silt has partly been washed away, so that only remnants of 1 to 2 m exist above the gravel (Pl.215/2,3 and Ph.56-Sc). It is a large expanse of boulder gravel still displaying its original imbrication (Ph.55-Sc). The cobble-boulder gravel contains many huge cores and large flakes (Pl.215/3), very similar to those of the Brakhuti W boulder gravel. Pl.215,3 shows one such core of a size of 300 mm together with another core and a number of large flakes, while another interesting large radial core lies nearby amongst very big cobbles and boulders (Ph.56-Sc) which must have served as the required raw material. Only a few artefacts from the Rajje site could be collected, since they are extremely large and too heavy to carry the long four hour walk on foot back to camp: a high-backed, discoidal core of 105 mm (Pl.94/2) and 2 large flakes of 138 and 103 mm (Pl.97/3).

Above the site, the Rajje terrace is a wide expanse of the older alluvium, 30 m a.r.l. or higher. The Tui River, which here flows along the extreme southern rim of its valley, has cut a gorge into bedrock of crushed Upper Siwalik sandstones (there is a fault running in southeast to northwestern direction along the entire southern margin of the valley, Lower Siwalik rocks to the north having been thrown against Upper Siwalik rocks to the south below the valley floor).

The little Tharu hamlet of Damdame, north of Rajje on the hill slope, is now abandoned, but it still belongs to the Tharu community, which is the ancient and original population of the Tui valley.

Summary remarks on the Tui valley

The Tui valley has provided us with a great wealth of occupational sites of the Early to the Late Palaeolithic, all in a stratigraphic context. The oldest cultural material is contained in a basal cobble gravel above bedrock and consists of large Clacton-like flakes and huge cores at several localities. Stratigraphically at the very top of the sequence of sediments a rich microlithic site is embedded in colluvial silts of the Gidhiniya Formation.

Apart from the large Early Palaeolithic flakes and cores from the basal cobble gravel and the microlithic industry of Ammapur, all the other assemblages in the Tui valley belong more or less, with variations, to the chopper-core-scrapers-flake assemblages of the Brakhuti industry. This is confirmed by their stratigraphic position in the upper part of the silts of the Upper Babai Formation and in, or below, the colluvial silts of the Gidhiniya Formation.

The Gidhiniya assemblage is an older facies of the Brakhuti industry and exhibits a greater variety (including in the choice of raw material) than the Brakhuti and Saskhuti sites, and is also stratigraphically older. The stone-knapping technique is, however, the same in all sites of the Brakhuti industry.

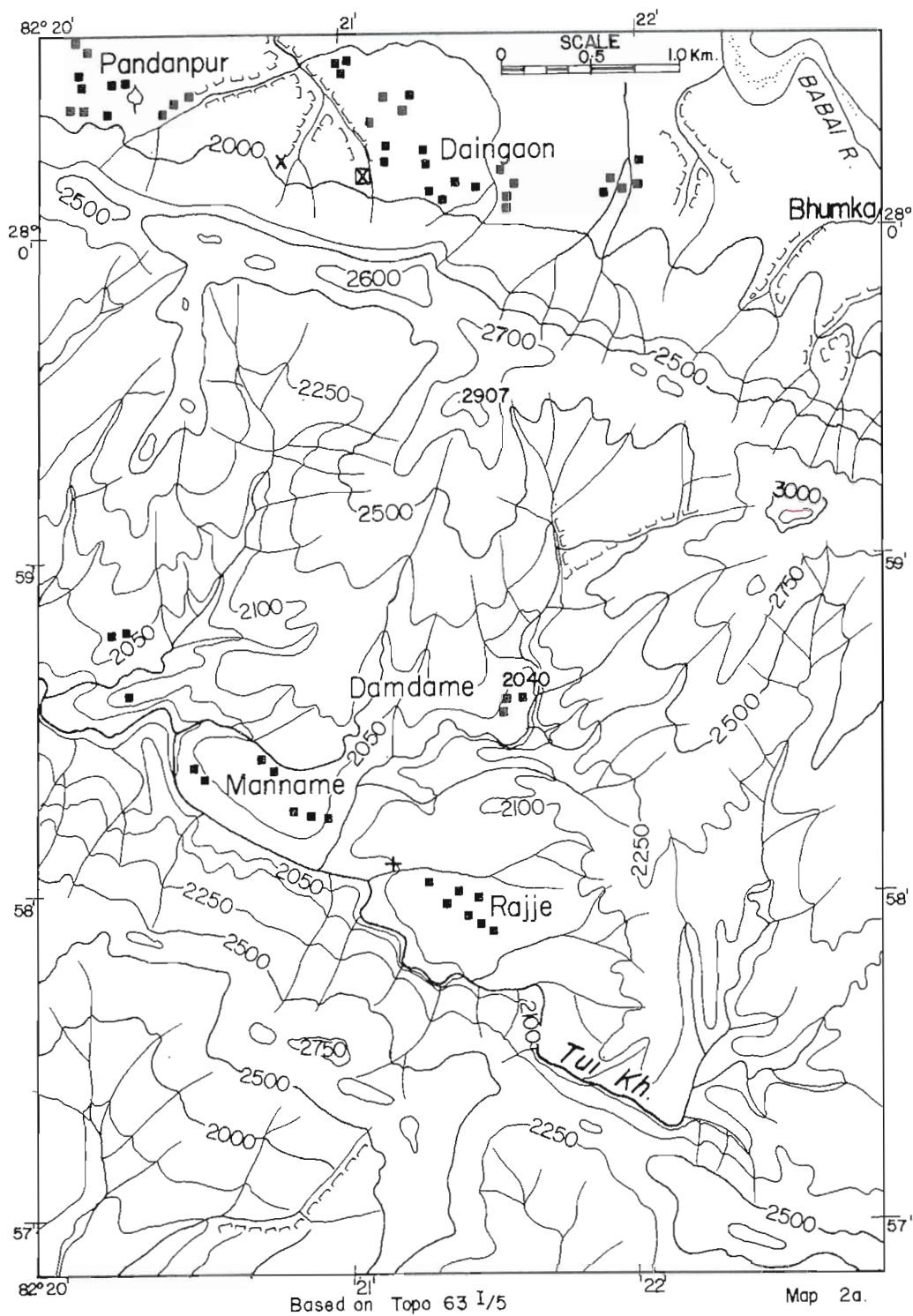


Fig. 63. Regional map 2a of the upper Tui valley (legend see Fig. 17).

The abundance of sites of the Brakhuti industry indicates a rather dense occupation of the valley. The stratigraphical evidence and the provisional OSL ages place this industry within the later Late Pleistocene, and in fact, within the coldest phase of the last glacial. This being the case, the environment must have been quite different from today, and the climate considerably colder and drier. The vegetation could not have been a subtropical one as it is now with dense saal forests (*Shorea robusta*). The tool kit, however, containing an abundance of heavy-duty tools, points to a forested environment, probably open forests of pines and other temperate conifers, though we have no direct evidence of this.

The fundamental explorations having been made in the past years by this author, it will be necessary to carry out excavations of some of the more important sites in the Tui valley, especially those of Gidhiniya, Brakhuti W and Saskhuti S. This future work will be important in order to save the sites from complete destruction by erosion.

2.1.2. Sites in the Dang Valley

The Dang Dun valley was surveyed only along the southern part of the valley between Mohannagar and Balampur in the east and between Gairakhuti and Sitalpur in the west (Fig.8), where the strong erosion has dissected the alluvial sediments into deep badlands and at places exposed the sediments down to bed-rock level. The geology and geomorphology has been described already in chapter III.2.1. The Babai River, draining the Dang valley and forming the base level, flows along the extreme south of the valley, thereby enhancing the erosional process thanks to the steep gradient of the lateral nalas flowing into it. The erosion is so strong that only remnants of the Quaternary deposits are left on the southern side of the valley (Pl.250/1). Artefact sites once embedded in the sediments, have been exposed and were discovered due to their abundant exposure on the slopes of the badlands, to where they were washed down from their original horizons in the deposits.

The sites will be described areawise from east to west, following the Babai River along its southern bank from Balampur/Mohannagar in the easternmost part via Kurepani on the Gorahi road to Sitalpur/Bojpur in the west, near the mouth of the Tui River. A comparative table of the schematic sections of the most important sites are given in Fig.64.

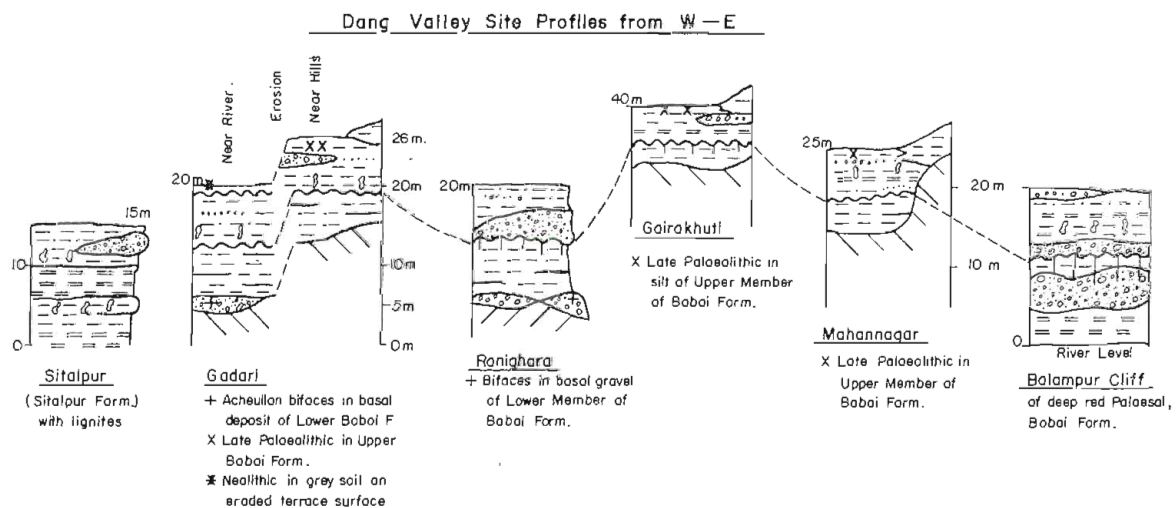


Fig. 64. Comparative table of profiles of sites in the Dang valley.

The Kurepani sites

The first sites, encountered in Dang in February 1984 after the initial discovery of the Lamahi microlithic site in January 1984, was a small complex of sites at Kurepani, just west of the Lamahi-Gorahi road, as one enters the Dang valley. This road is a branch of the main east-west highway of Nepal, connecting the latter with the Dang valley (Fig.65). The sites were found in the dissected badlands of yellow alluvial silts at the foot of the hills.

In April 1983 I had collected already a few quartzite specimens at Kurepani 1, which appeared to be crude artefacts, but I was not sure. Besides, I was busy recovering and saving the many fossil vertebrate bones from the Siwalik rocks during construction work of the new road, which was then in progress. It was only in February 1984, after finding the first definite microlithic site at Lamahi in the Deokhuri valley, that I acknowledged the presence of prehistoric populations in Nepal, in the Dang-Deokhuri valley and so started a detailed prehistoric survey on foot along the southern margin of the Dang valley. The Kurepani and Gairakhuti localities were the first ones which I recorded that same month. Later a number of further localities could be recorded, all belonging together, and all deriving from the upper part of the yellow alluvial silts. From locality Kurepani 1 again a number of artefacts were collected (Pl.101/1,2), the first one being a utilised flake-blade.

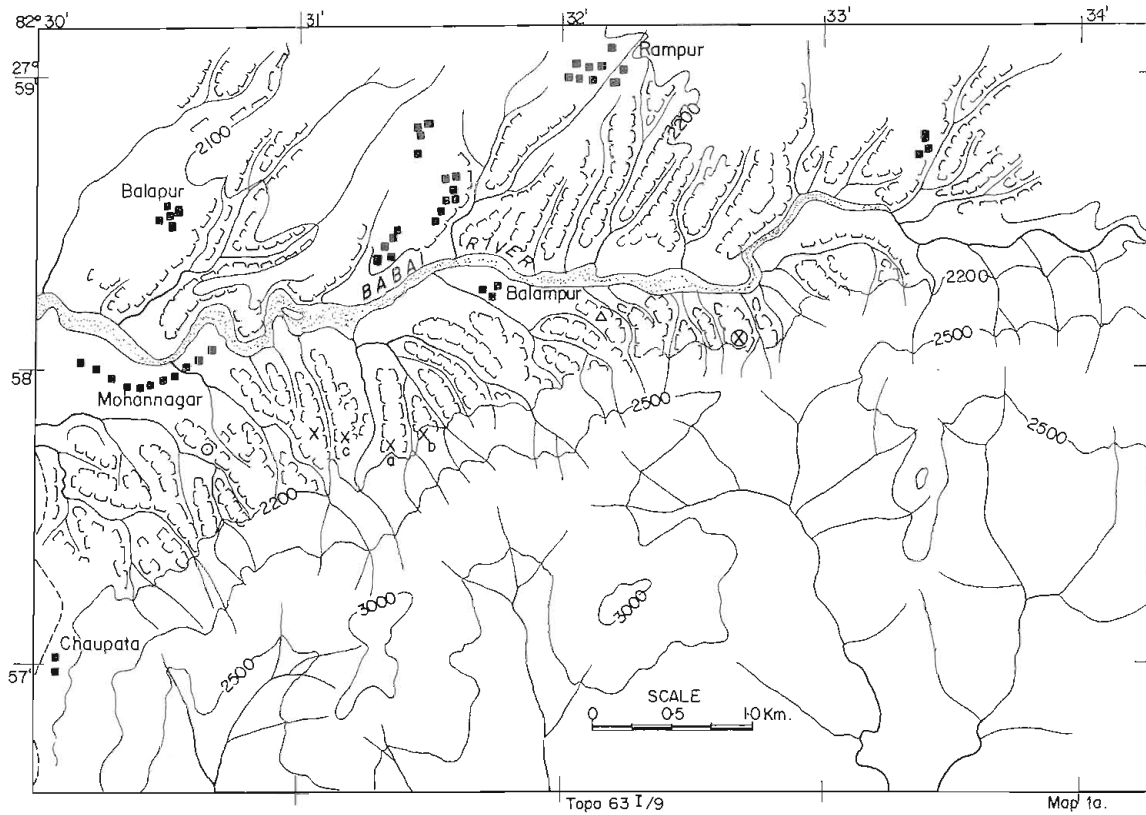


Fig. 65. Regional map 1a of the eastern Dang valley (legend see Fig. 17).

Some 100 m west of Kurepani 1 a few very small flakes of chert and a few quartzite flakes were recovered, a straight, well-made corescraper and a unifacial radial core from the silt overlying Siwalik bedrock. A little further west, at the eastern edge of a fairly large khola, erosion has cut steep vertical gorges up to

10 m in depth into the silt. Many artefacts were seen eroding out from the top part of the silt from a level of 20 to 30 cm below the surface (locality Kurepani 1a). A small collection of flakes and flake-like pieces made from chert, quartzite and „tuff“ was made (Pl.101/3,5).

Another small locality, called Kurepani 2, was located just east of locality 1a, exhibiting similar artefacts, from which only one flake was taken. Remnants of a few fire-places are seen there together with a few flakes made from „tuff“ on the surface nearby.

A third locality, Kurepani 3, is situated directly on the west side of the road to Gorahi, on the bare red surface of the silt, where a few flake artefacts were eroding out from about 20 to 30 cm below the silt surface at the edge of several badland gullies. Two circular hearths with baked rims, 85 cm apart from each other, were exposed by the heavy erosion (Fig.66). The light red, wearhated potsherds, scattered on the surface, can probably be related with the hearths. The hearths of Kurepani 3 have a diameter of 70 and 67 cm. Their rims consist of hard red clay on the outer side, while ash and charcoal are exposed on their inside. A few flakes of quartzite and „tuff“ are scattered in a small rain gully next to one of the hearths. These flakes are well made, from prepared cores.

Locality Kurepani 4 is a small artefact spot east of the road at Kurepani with a mixed surface scatter of a few microliths and quartzite flakes which do not belong to the western Kurepani site complex.

Along the river between Kurepani and Gairakhuti an approximately 20m-high cliff with a well-preserved red top soil covers the yellow silts of the river cliff at Kurepani 5. Bronger & Wichmann took soil samples from the red soil, down to 2.30 m below the surface on the eastern edge. Altogether 7 samples were taken. On the other side of the river, at Jinjami, they took another 7 samples from a 2.50 m profile of a red soil surface (Wichmann 1993).

In the section of the red soil profile of the Kurepani 5 locality a few quartzite and artefacts made from „tuff“ were seen to have eroded out from the upper part of the red soil (four pieces were taken), about 20 cm below its surface.

The Kurepani site complex is not of one cultural unit. The cultural material comes from at least six different localities. The artefacts consist of a few corescrapers from Kurepani 1, 1a and 2 and a few flakes of the Brakhuti type. But at Kurepani 1 there are also some finer elements, such as a few blade-flakes and a prepared discoidal core, as well as a microlithic element. Kurepani 1a and 3 have Brakhuti-type flakes but also younger-looking material of chert, including a fine end-scraper and a small well-retouched side-scraper made on a chunk. The few small quartzite flakes from Kurepani 3 are well-made, struck from prepared cores. The samples are, however, too small to merit more detailed analysis.

Before going west from the road along the southern margin of the Dang valley, let us look at the easternmost part of the Dang valley.

Sites in the eastern Dang valley

The Mohannagar localities. The eastern part of the southern Dang valley (Fig.65), east of Kurepani, was first surveyed in February 1989. Here the badlands along the southern border of the Dang valley are particularly extensive. They offer a textbook example of a badland topography (Pl.243/1): the deposits of the 25 to 30 m-high terrace level of the Babai Beds are dissected into a labyrinth of vertical gullies and terrace blocks, cut up to a depth of 18 m. The exposed deposits show well the stratified nature of the alluvial deposits of grey clays, yellow-to-beige silts and sandy silts together with intercalated lenses of gravel of the Babai Formation. The gravel is composed of cobbles and pebbles of sandstone transported as lateral influxes from the Siwalik sandstone rocks in the hills. Towards the hillside the gravel lenses become thicker and more extensive, while they decrease towards the valley, where, instead, clays intercalate increasingly with the silts.

The surface of this terrace, before it became so dissected, was a wide, flat expanse, rising from 640 m near the river to 670 m at the foot of the hills. It must have been occupied extensively by groups of people of the Late Palaeolithic and the Neolithic. Numerous smaller and larger localities are found distributed over the area southeast and east of Mohannagar.

About 1 km east-southeast of Mohannagar village artefacts are eroding out from the upper part of the saffron-yellow silts at the eroded edge of the terrace near the foot of the hills. The locality is called Mohannagar E(a). Only remnants of the uppermost silt are present, as recent erosion is very strong. The artefacts which have lain on the surface for some time exhibit a patina. Those which have freshly eroded out from the silt are unpatinated. Most artefacts are of the „tuff“ material, described in chapter V.1.: flakes, waste and corescrapers, similar to the Gairakhuri assemblage. One corescraper is of a special kind: a sumatralith-like high-backed tool with two steep retouched lateral edges and a very flat lower face. Small, delicate flakes, too, are found, made from the same „tuff“ material. The raw material of „tuff“, as it is seen now, is completely unsuitable for any flaking. A few artefacts are also made from quartzite, including a white, particularly fine kind of it. No association with pottery was observed here.

On the next eastern surface at the foot of the hills, at a place called Mohannagar E(b), the same phenomenon is seen: „tuff“ artefacts are eroding out from the alluvial silt of the Upper Babai Beds and are being washed down onto a gravel of cobbles and pebbles of Siwalik sandstone. The artefacts are again very weathered and patinated after long exposure, and fresh when they have recently derived from the sediment. Particularly interesting is a large, partly polished oval cobble of metamorphic rock, of which only the upper face is polished. The sides are used, and the lower face has calcrete adhering to it, indicating its origin from within the silt. The artefacts at this locality are not abundant, and constitute only a thin scatter on the surface. They do not seem to derive from a defined horizon of occupation, but are dispersed within a 20-30 cm thick horizon in the yellow silt.

A round, hard-baked red silt block of some 50 cm in diameter, probably a fire-place, is eroding out from the top level of the yellow silt in apparent association with the artefacts.

A sample of the surface artefacts was taken from this locality of Mohannagar E(b), since otherwise they would have been washed away after the next rainy season. A number of pieces of „tuff“ were also taken to furnish evidence of how they break up after exposure to erosion. The abundance of such „tuff“, worked and unworked, is a noteworthy feature at this locality. The pieces must have been brought to this place as manuports by man, because all the cobbles of the gravel underlying the silt which have been deposited by fluvial activity are of Siwalik sandstone. „Tuff“ cobbles of this kind have, however, been observed in the fluvial cobble gravels which are exposed along the Babai River cliffs near Kurepani and particularly at Balamput.

In March 1990 the Mohannagar localities were revisited but nothing more was collected. A number of new localities could be recorded. About 100 m to the southeast of our camp a very brittle fossil of a horn core of a bovid was found in a gully in the stratified silt, 5 m below the surface.

A few hundred metres southeast of the fossil locality another artefact locality, called Mohannagar SE, was recorded on the alluvial silt surface. A few very weathered artefacts of quartzite and „tuff“ erode out from the silt, where they interfinger with gravel lenses of cobbles and pebbles of Siwalik sandstone. It is not a rich locality, only a thin scatter of artefacts quite close to the hills. Further south towards the shoulder of the hill one encounters the reddish-yellow colluvial silts of the Gidhiniya Formation, which have a steeper gradient and abut against the hills some 15 metres higher than the 25-30 m terrace surface (Fig.66).

On the next, eastern-most silt surface, close to the hill slopes, a locality called Mohannagar E(c) exhibits a few almost destroyed fire-places and cord-marked pottery eroding out at the edge of the dissected silt. A sample of potsherds was taken from two small places, 1.50 m apart from each other, and 5 m east from the nearest fire-place.

palaeolithic period is outside the scope of this study. These pottery sites are recorded here as an important part of the ancient history of Dang. Future research should concentrate on these young periods of early pottery-making in an attempt to understand their relationship to the other, non-pottery sites in Dang, and their probable relationship to the pottery-making of the original population of the Dang-Deokhuri valleys, the Tharus.

The Balampur red cliff. North of the Mohannagar E localities, on the northern bank of the Babai River at Balampur village, the river has cut a steep cliff into the terrace deposits. The Balampur cliff is interesting for its exposure of a buried red soil within the fluvial deposits of 20 m thickness (Fig.67). The river here has an elevation of approximately 620 m, and the terrace rises 20 m above it. The buried deep-red soil is overlain, with a sharp contact, by a grey fluvial gravel, followed by a grey clay and yellow-grey silts, sandy silts and a topmost layer of gravel. The buried red horizon consists of a sediment of silt-to-clay size with a thin, yellow, leached horizon on top, just below the gravel contact. Below the red horizon is a layer of unsorted gravel in a red sand matrix which contains a conspicuous amount of angular „tuff“ cobbles. No artefacts were found at the cliff or on the terrace.

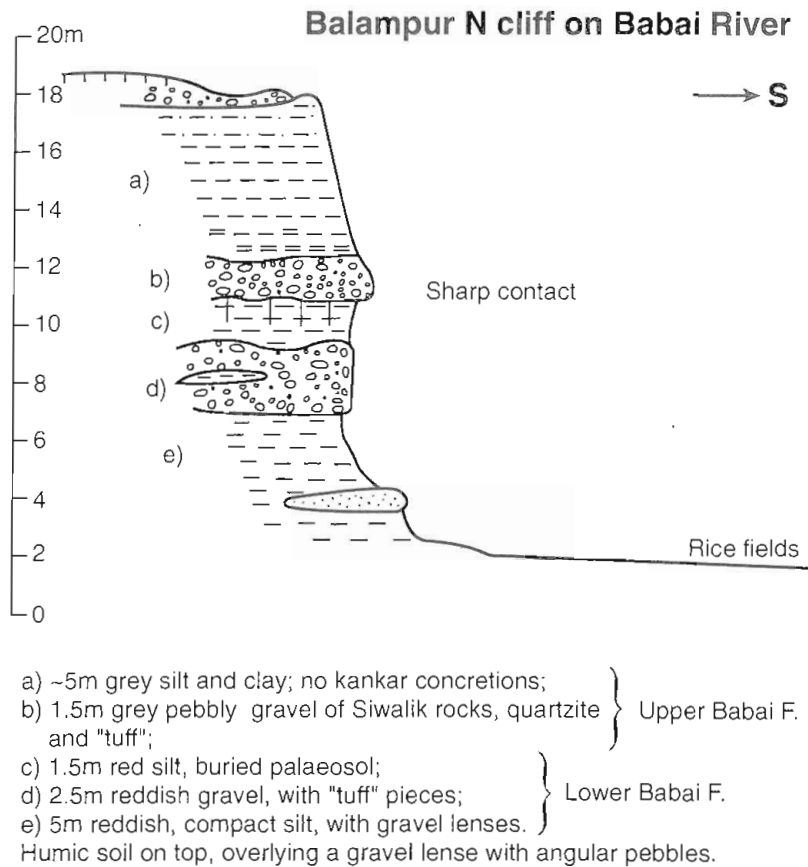


Fig. 67. Balampur North cliff section.

The Kurepani E cliff. The Babai River cliff near Mohannagar village, east of Kurepani, was measured and sampled for a soil profile in 1989 by Bronger & Wichmann. The cliff was re-sampled in 1990 by Tischner for TL dating (but the samples were lost by him): it rises 18m above the flood plain of rice fields. The lowest measured deposit is a 3 m-thick grey-brown clay, overlain by 2m of brown clayey silt and 5m of yellow-to-yellow-brown clay/silt and 4 m of reddish-brown silty clay. A 2m gravel bed follows and is covered by 2 m of red soil on top (Fig.68). There are no artefacts.

Another profile was taken at a red cliff east of Mohannagar. A buried red soil similar to that of the Balampur cliff can be seen here. It is 8m above the bed of a small stream and is exposed for 2m below younger deposits of gravel, sandy silts and silts with a clay lens (Fig.69). There are no artefacts.

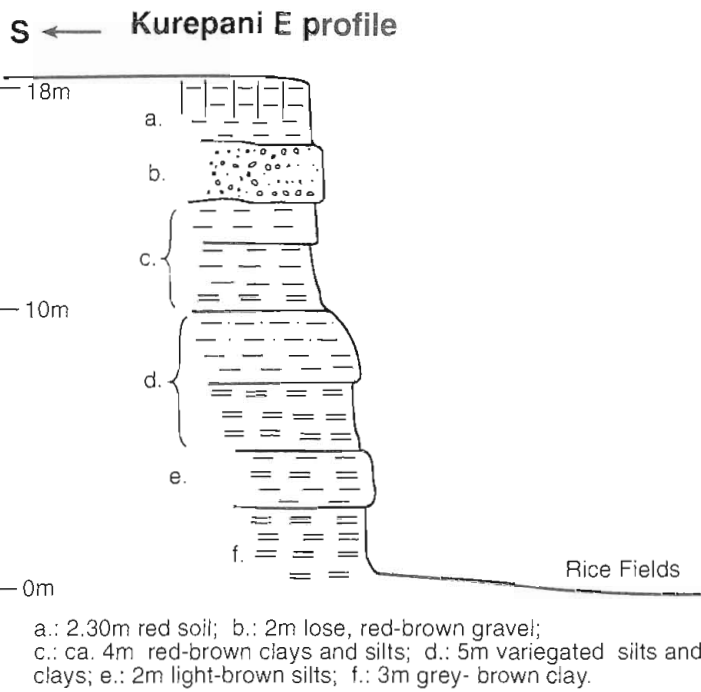


Fig. 68. Kurepani East section.

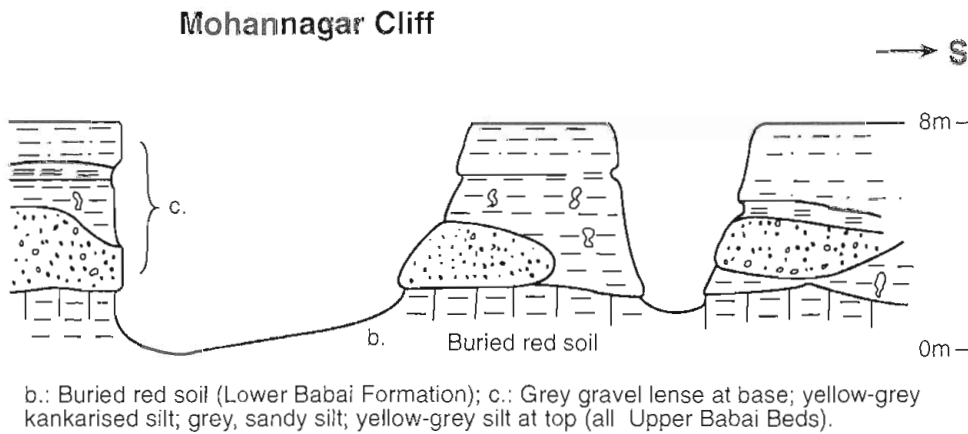


Fig. 69. Mohannagar cliff section below Mohannagar village.

Sites in the western Dang valley

Returning to the Gorahi road, we now turn west to begin our survey on foot along the southern rim of the Dang valley, and to penetrate into the badlands of the alluvial and colluvial deposits of the Babai and Gidhiniya Formations (Pl.243/1). This turned out to be a much more difficult undertaking than initially thought. These deposits are so dissected into deep gorges and gullies and labyrinthic badlands with vertical cliffs that one becomes easily lost in them. Not only finding one's place on the map was extremely difficult, but also relocating any of the discovered sites in the thousands of gullies was almost impossible. The only maps available at the time of survey were the old one-inch/one-mile topo maps of the 1950s and 1960s (and these only as photocopies!). They were accurate enough, but obviously it is impossible to show all the hundreds and thousands of dissected badland features. Without modern satellite-positioning equipment it was very difficult to pinpoint a site exactly. Therefore all site locations on the maps are necessarily approximate.

Secondly, the new topo maps of 1:25,000, finished only recently (between 1998 and 2000) for this area, are worse than the older maps. They do not show any details of particular geomorphological features the way the old maps did. I did not transfer the sites onto the new maps, because the badlands, in which all the discovered sites are situated, are not indicated at all. No site could be shown to any degree of accuracy in the new maps. All the regional maps drawn up for this book are based on the old one-inch/one-mile topo maps, with the badland features well indicated. The many intricate badland areas are indicated to some extent in the redrawn regional maps (see, for example, the map in Fig.65, based on the old topo map 63/I-9). All names of villages and rivers in the text, too, are given according to the spelling of names in the older maps, except in the case of new villages that have come up within the last 40 years.

With this introduction we will plunge into the badlands.

The above-described Kurepani sites are indicated in the regional map 1b (Fig.70). West of Kurepani, around the village of Gairakhuti, another complex of sites could be recorded, and were called the Gairakhuti sites. The erosion in the badlands around Gairakhuti has cut extremely deep gorges and gullies, exposing 9.60 to 10 m of alluvial silts and clays, often without reaching the bedrock below it. Climbing up and down these precipices, without knowing exactly where one was and where one would surface, was an almost unsurmountable task in itself. At other places the alluvial deposits above bedrock are only one to two metres thick. These features indicated an extremely dissected bedrock level below the alluvium (see Fig.71).

West of the Kurepani sites one reaches Gairakhuti village through the deeply dissected badlands, where a small locality (Gairakhuti S) was found east of the main Gairakhuti nala south of Gairakhuti village. Only two „ruff“ flakes (with stepflakes at the platform edge) were collected from a gully in the top part of the 4 m-thick yellow silt above bedrock. This small locality is not indicated on the map. A small locality of quartzite artefacts of flakes (Gairakhuti W) was found west of Gairakhuti village, just north of a small hillock of Siwalik rock, surrounded by alluvial silts. Only two flakes, made of quartzite, were taken from here: a cortex flake with two small dorsal scars at the platform and a simple flake with cortex platform.

The Gairakhuti SW Site. A very extensive site was discovered further inland in February 1988 (after a heavy rainstorm in the night, submerging our tents), called Gairakhuti SW, about 750 m to the west-southwest of the village (just south of the G of Gairakhuti in the map of Fig.70). The alluvium is heavily dissected into badlands (Pl.249/1). An extensive artefact scatter is seen eroding out from the top part of the yellow silt, indicating that an artefact horizon has been partly exposed here from a probable level of 60-90 cm below the recent silt surface. There is a main scatter on the gentle slope to the east of the silt surface, and another larger scatter to the south of the surface where erosion has broken up the silt into shallow gullies (Pl.216/1), exposing hundreds of artefacts from the occupation horizon in the silt, as seen in the photo. No artefacts are present on top of the silt surface.

At the site itself, the yellow silt is only a 1.50 m-thick layer above the exposed bedrock. Large amounts of the silt are washed away each year by the monsoon rains. The series of photos in Ph.58-61-c (Pl.216/1 and Pl.249/2) documents the site from 1989 to 1999. Pl.216/1 shows the site in 1989, when it was discovered, and the silt cover was still a continuous sheet with artefacts eroding out from it. Five years later (Ph.59-Sc) most artefacts lie exposed on the bedrock, with much of the silt gone; and in 1999, 10 years later (Ph.60-Sc), the artefact-bearing yellow silt is only a remnant of its former spread above bedrock, exposing the artefact-bearing horizon in the silt 10 cm above bedrock (Pl.249/2).

Erosion has also partly affected some fire-places that were situated in the top of the silt that contained charcoal, which by autumn 1994 had been almost entirely washed away. A ^{14}C analysis, done in Hannover (Labor number Hv 20176), from charcoal collected from the exposed fire-place, yielded an age of $1,080 \pm 45$ BP, with a calibrated age of AD 895-1,015. This very young age may be due to contamination from long exposure of the charcoal. No artefacts were found in association with the fire-place, nor were there any on the surface surrounding it. Ten other fire-places were seen in a radius of about 100 m, all without stone artefacts, and only one was associated with wheel-made pottery. These „fire-places“ probably have no human cause but are due rather to natural forest fires, which, at a later stage, burnt some large trees down to their roots, and so have nothing to do with the artefact horizon below in the silt.

Quite interesting are a number of large, partly broken-up cobbles and cobble fragments of quartzite, which may have belonged to a few stone circles. Also, two probable post holes could be seen towards the east, where the surface is breaking up through the erosion.

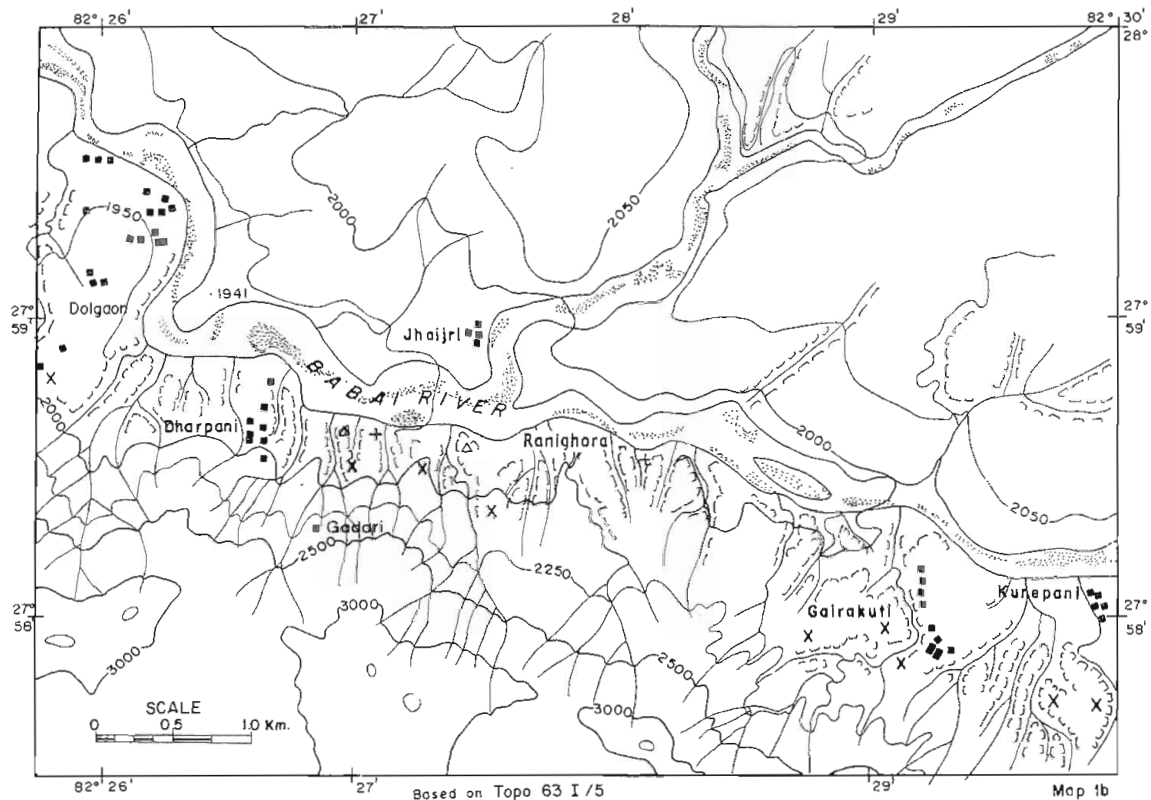


Fig. 70. Regional map 1b of Gaitakhuti and Gadari sites in the Dang valley (legend see Fig. 17).

blonski, to search for more fossils. We then found hundreds of fragments of mainly very small bones of mammals and reptiles, particularly of small mammals of species which had not been known from Nepal previously. The study of these unique fossils from the Lower Siwaliks will be published in a separate palaeontological publication. But as the site was discovered simultaneously with the prehistoric site, this important discovery should be mentioned here. At several other localities in the vicinity of Gairakhuti and Ranighora fossil finds were recorded during the 1998-99 survey from the Lower Siwalik rocks below the Quaternary in-filling.

The artefact scatter of the Gairakhuti SW site washed out from the silt at the southern fringe gives an immediate impression of having come from what must have been a factory site. There are no natural outcrops of gravel nearby and all the raw material (of a variety of quartzite, „tuff“ and chert, and one haematite pebble) must have been carried in by the occupants of the site. There are large, unworked quartzite boulders and cobbles, broken-up cobbles of quartzite and „tuff“, and a large number of waste, consisting of chunks and chips and undiagnostic flakes, together with artefacts of an identifiable nature, namely flakes, cores and tools.

Particularly striking is the large percentage of „tuffaceous“ raw material (see chapter V.1.) used at this place: not only flakes but also such heavy duty tools as corescrapers. They are very weathered and often so soft that they would be useless for any work today, although they still retain the sharp facets of the original trimming on the dorsal face. The original raw material, before weathering and leaching, was hard and perfect for tool manufacture.

Gairakhuti SW, description of artefacts. From this very rich site a selective collection of 68 artefacts, mostly flakes, was made in order to show the various raw materials used, while the rest were left on the surface as future demarcations for eventual excavations (though if not done soon, they will be gone). Amongst the artefacts there is a great amount of small, delicate waste debris of chips and thin flakes besides the larger flakes. The tools consist of corescrapers, a few choppers and a scraper. One microlith of chert amongst the 68 collected artefacts exhibits a rare microlithic element. Some calcified wooden branches have eroded out from the lower part of the silt, just above bedrock but are not associated with the occupation horizon. There is no pottery connected with the site. The artefact assemblage of the Gairakhuti SW site is to some extent similar to the Brakhuti industry from the Tui valley, although, compared with Brakhuti, the Gairakhuti site has a much higher percentage (32.5 %) of „tuff“ artefacts.

The tools at Gairakhuti SW are only few in number, seven corescrapers, two choppers, a side-scraper and a few utilised flakes.

The corescrapers are mostly made from „tuff“ (five of the seven collected ones). They all have a steep, straight, lateral unifacial edge trimmed from the flat cortex plane of a cobble. Three specimens (Pl.102/1) are high-backed pieces with half of the cortex left; they have square-to-trapezoid sections, with a steep, straight unifacially trimmed edge, the upper face having been trimmed by a few large primary flakes. This is the normal type of a corescraper. The tool (Pl.103/2) is made on a flat, split cobble of „tuff“. It has the characteristic steep, straight edge of a corescraper, but is so narrow that it seems to have broken during usage parallel to its edge along a cleavage plane. No.8 is a small corescraper-like tool with a steep, slightly convex edge from a split surface, and opposite another edge which is short, rounded and steep. It is triangular in section and shape. No. 10 (Pl.101/4) is a flat pushplane-like corescraper with a typical steep, lateral unifacial edge trimmed from a flat split surface and an incomplete second lateral edge opposite. Another fine corescraper is an isolated tool found slightly to the west of the main site. It retains much cortex, but one lateral side is trimmed into a steep, straight, well-fashioned edge. At right angles to it there is a short, distal unifacially trimmed edge.

The two choppers, No. 5 being of „tuff“ (Pl.103/1), are like corescrapers in shape, with straight, unifacial edges, but with less steep angles of only 70°. They are trimmed along one side while the rest is cortex. The edges are finely retouched like those of the corescrapers.

A side-scraper was made on a flat, split cobble and trimmed along two lateral sides: the left is steeply trimmed uniaxially, while the right is trimmed into a denticulate edge. This and the above specimens are all heavy duty cobble tools.

The statistical analysis of the 52 flakes of Gairakhuti SW shows following features: 58 % of the flakes have cortex platforms (Fig.72), less than at the Brakhuti industry, and 4 % have prepared platforms. Almost 10% of the flakes have cortex opposite the platform, and 4 % are „orange“ flakes (Fig.73). Only 37 % of them have stepretouch at the platform edge, for example, the flake in Pl.101/6, (Fig.74), in contrast to higher percentages of this feature in the assemblages of the Brakhuti W and Gadari flake sites.

The scars on the dorsal face show a rather high amount of multidirectional flaking scars (19 %) (Fig.75), higher than at Brakhuti and almost as high as at Gidhniya.

The length (L) of the flakes averages between 30 and 60 mm (77 %) showing medium size (Fig.76).

19 % are narrower than 0.5 (B/L ratios) and 60 % are thinner than 0.4 (Fig.77) (Th/B ratios).

69 % of platform angles are smaller than 110° (Fig.78), a figure comparable with the Brakhuti industry flakes.

There is no blade element. Most flakes are undiagnostic, though a few are well-fashioned, some pointed as the flake in Pl.103/5, though it was probably not utilised. Others (Pl.104/2 and Pl.105/2) are large, well-made flakes, the former having a utilised distal end and almost radial dorsal flaking, though no levallois-like preparation is present. No.53 (Pl.102/2) is an elongate flake with a convex, probably utilised distal edge. Only a few flakes show utilisation marks.

Flakes with cortex platforms and stepretouch are the most common ones (Pl.101/6, Pl. 103/3-4 and Pl.105/2). A few are corescraper-rejuvenation flakes, as the flake in Pl.103/4 which displays the step-flaked part of a corescraper edge on the dorsal face. A small number of flakes have cortex opposite the platform, having been seemingly removed from flat cobbles for the production of corescrapers (Pl.101/6 and Pl.105/2). There are also a number of „orange flakes“. All these features are also characteristic of flakes of the Brakhuti industry, though most of the flakes are made from „tuff“.

A large flake-cum-core is an isolated find in a gully in the northern badlands, close to the SW site. It was a huge Early Palaeolithic flake, very rounded, and was later trimmed with large primary flakes, bifacially on the left side, and with two vertical flakes on the right side of the dorsal face.

The raw material (Fig.79) is, compared with most other sites (apart from the microlithic sites), different in composition. Quartzite is used less exclusively (only 63 %) than at Brakhuti and Gidhniya (both 85 %), while „tuff“ has a correspondingly higher percentage (32,5 %). This is quite similar to the other large site in Dang, the Gadari flake site (with 45 % „tuff“ against 48 % quartzite).

The artefact collection is a selective sample and therefore does not reflect the true nature of the artefact composition (Fig.80), which shows the percentage of tools and utilised flakes being comparatively large (14.5 % and 12 % respectively), while undiagnostic waste flakes stand at 64.55 %. Cores account for only 6 %, and other waste (chunks and chips) for as low as 3 %.

The Ranighora area. Early Palaeolithic Sites: Following the Babai River west from Gairakhuti, half-way between Gairakhuti and Dharpani at Ranighora (Fig.70), the south bank exposes Lower Siwalik rocks of variegated clays and mudstones, overlain unconformably by a succession of silts and gravels of the Babai Formation. The upper part displays stratified clays and silts with intercalations of coarse fluvial and colluvial gravel lenses of Siwalik sandstone cobbles. The lower part, near the riverbank, exhibits a thick cobble-boulder gravel of fluvial character with well-rounded quartzite cobbles overlying, both bedrock and, at places, a basal red silt (Fig.81). A large, quite weathered quartzite core with a bifacial edge and five flakes removed from it, was found on the lower slope amongst other quartzite cobbles in February 1984.

On the slope of a gully slightly to the west along the river, a bifacial broken handaxe (Ranighora 1) (Pl.104/1) was found in February 1984 in association with quartzite cobbles deriving from the basal fluvial

al gravel of quartzite cobbles described above. It is a rounded biface, the first such Early Palaeolithic tool found in Dang. No other bifaces were found at that time. The tool was made on a flake, the proximal part of the tool having broken off. A rounded point was produced by secondary trimming.

Locality Opposite Jhajjri: A little further west, on the west side of the khola coming from the south, opposite Jhajjri village, a small sample of artefacts was collected in 1984: two cotescrapers of the Gidhiniya type, and a few flakes, one of which is a large, weathered bifacial flake or broken biface of Early Palaeolithic appearance. They occurred, between the river and the slopes descending from the upper terrace, amongst scattered cobbles of quartzite and Siwalik sandstone. It is a mixed surface sample from the first year of the survey.

A cross section of the cliff on the river opposite Jhajjri documents the alluvial deposits (Fig.82a). Above weathered Siwalik bedrock there is a lower red-brown clayey silt with calcareous pellets („pseudovergleit“, according to Bronger) which appears to be a palaeosol. It overlies pockets of a basal gravel. Above the red-brown silt, separated by an unconformity, a gravel of rather unsorted Siwalik sandstone cobbles forms a colluvial gravel deposit below stratified yellow silts and clays of the Upper Member of the Babai Formation. The deposits reach up to 20 m a.r.l. Some quartzite artefacts were found at the base of the lower clayey silt. At the river itself a subrecent grey silt overlying a dark clay has been deposited against the older cliff.

Later, in 1999, during the palaeontological survey with colleague Nina Jablonski to search in this area for further fossils in the Siwalik rocks underlying the Quaternary deposits, the Ranighora locality, where the first biface was found in 1984, was included again, in order to clarify the complicated stratigraphy (Fig.81). As seen in Fig.81 and Fig.71 at Gairakhuti, the bedrock under the alluvium is extremely undulating and dissected below the in-filling of the Babai Beds, so that it outcrops at various levels. On the bedrock lenses of gravel of quartzite cobbles are exposed at several places. The quartzite cobbles must have their origin from beyond the Main Boundary Thrust (MBT), or from outcrops of Upper Siwalik Boulder Conglomerate, which are, however, not present along the southern slopes of Dang (it is still unclear where these well-rounded quartzite cobbles of the basal gravel have come from). No such quartzite gravel is seen in the recent bed load of the Babai River.

The Ranighora River Site: The gravel lenses at Ranighora overlie bedrock at various levels (Fig.81) and is overlain in turn by the well-stratified beds of the Babai Formation (clearly seen in Pl.216/2), where gravel lenses are exposed at the base (in the left foreground) over variegated Siwalik clays, and are overlain (in the background), by a red silt of the Lower Babai Beds, followed by fluvial deposits of the Upper Babai Beds, which form the terrace surface. At one place near the riverbank, however, the bedrock reaches a height of 17 m and forms a flat small plateau, covered by a thin veneer of quartzite cobble gravel (Pl.216/3). On this small plateau, very rounded Early Palaeolithic artefacts were found amongst the cobbles of the gravel. Artefacts from this locality have found their way down the steep slope towards the river, and it was here that the first biface of 1984 was found.

The 33 artefacts collected on 1999 from this site are rolled and weathered, having been on the surface for a long time. It is, however, a mixed assemblage. A total of 25 rounded artefacts can be attributed to the Early Palaeolithic, while the rest seem to be of a much later period. The 17m-high surface was probably never, or only thinly, covered by the fluvial sediments, and must have been available for raw material for the Early Palaeolithic period as well as for later occupants.

Amongst the collected artefacts are mainly cores of the alternate bifacial type and flakes struck from them, the latter with plain platforms and no stepretouch at the platform edge. There is one steep-edged unifacial chopper and one unfinished oval biface. A fine sumatralith and a number of flakes with cortex platforms and stepflake scars, obviously belong to a much later period and conform more closely to the Brakhuti material.

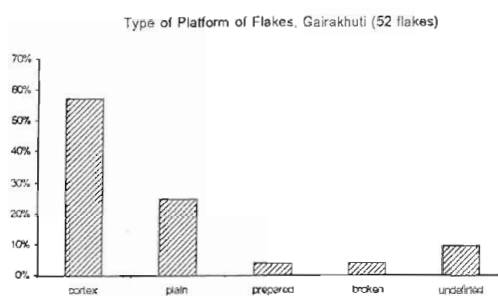


Fig. 72. Gairakhuti, type of platform of flakes.

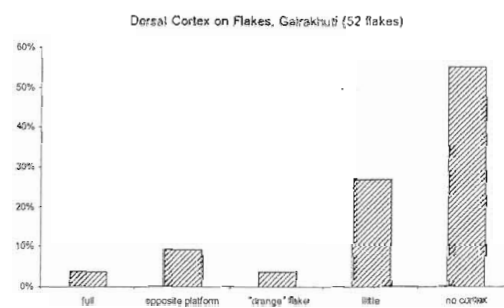


Fig. 73. Gairakhuti, dorsal cortex on flakes.

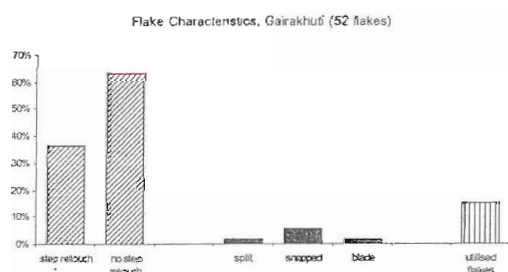


Fig. 74. Gairakhuti, characteristics of flakes.

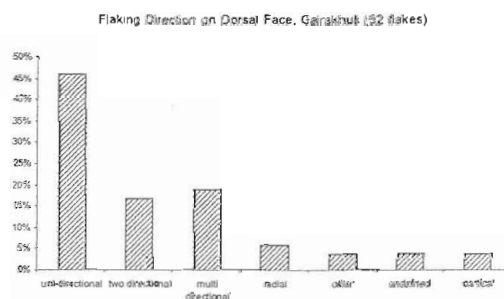


Fig. 75. Gairakhuti, dorsal scars on flakes.

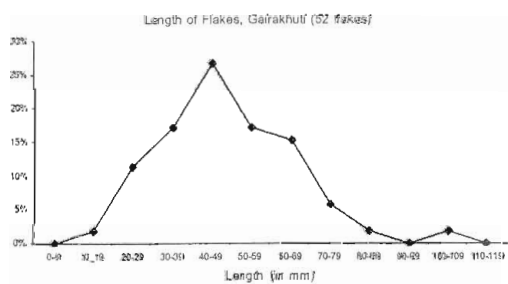


Fig. 76. Gairakhuti, size of flakes.

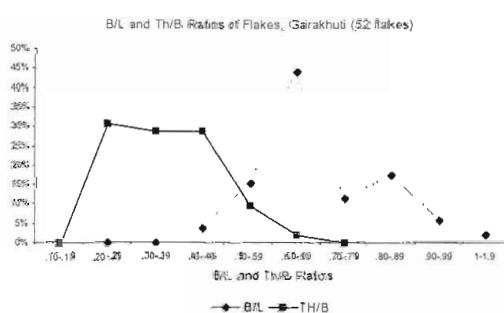


Fig. 77. Gairakhuti, B/L ratios of flakes together with Th/B ratios of flakes.

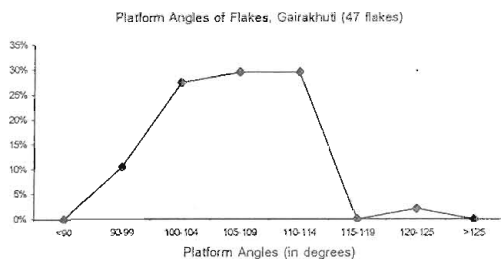


Fig. 78. Gairakhuti, angle of platform of flakes.

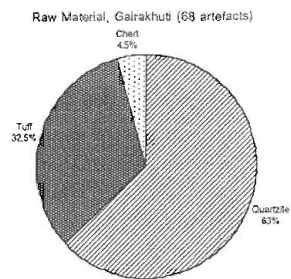


Fig. 79. Gairakhuti raw material of all artefacts.

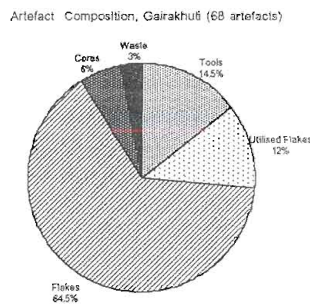


Fig. 80. Composition of Gairakhuti artefacts.

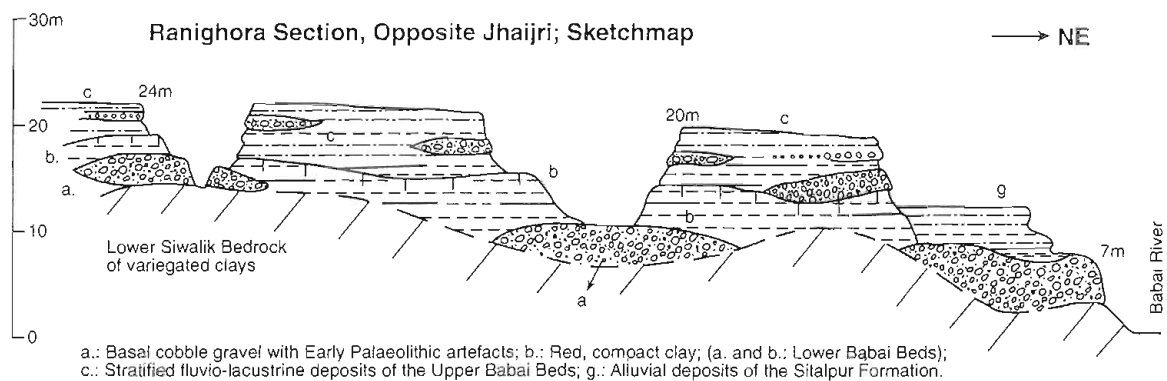


Fig. 81. Cross-section through Ranighora/opposite Jhajiri.

Profile Opposite Jhaijri, on the River

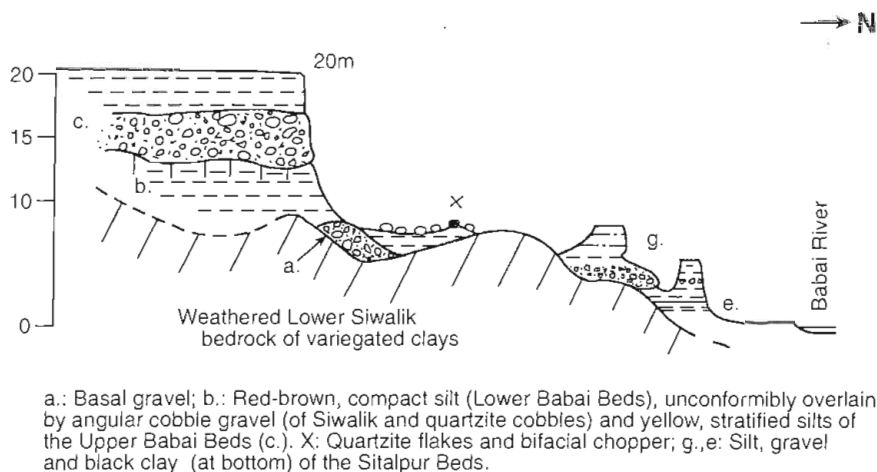


Fig. 82a. Profile opposite Jhaijri.

Gadari East Flake Site

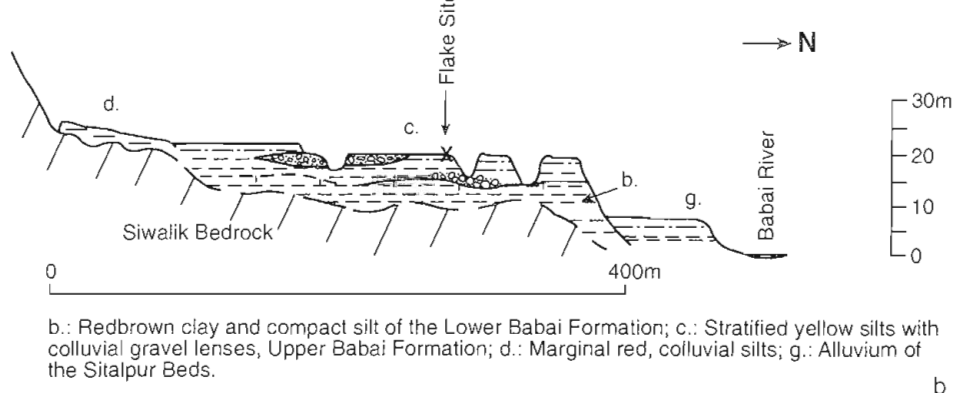


Fig. 82b. Section of the Gadari East flake site.

Late Palaeolithic Sites at Ranighora: Further inland from the river, away from the Early Palaeolithic site, a number of localities were recorded which derive from below the colluvial silt of the Gidhiniya Formation. These are the Ranighora SW and S sites.

The Ranighora SW and S Sites: The Ranighora SW site is situated on the southernmost margin of the yellow and red silt surface, away from the river and near to the hill slope (Fig.70) and must have once been covered by the red, colluvial silt. It is a flaking spot with artefacts made from quartzite, „tuff“ or chert, and exhibiting mainly crude flakes. These artefacts are scattered on the surface, having eroded out at the south edge of the silt terrace remnant, just west of the path coming from the hills. A sample was taken.

The small assemblage is a mixed sample. There are a few fine corescrapers (Pl.105/1,3) made from „tuff“, as at Gairakhuti, with fine retouch on their steep unifacial edges. No.2 is a very reduced corescraper (see cross section in Pl.105/3) and seems to have been used extensively. There are also some Brakhuti-type flakes made of „tuff“ and quartzite. They are very weathered, and must have been exposed for some

time on the surface. No.5, a corecraper-rejuvenation flake, has been utilised at the removed striking platform and displays fine bifacial retouch or usemarks. The „tuff“ flakes and the „tuff“ corecrapers resemble those of the nearby Gairakuthi SW site.

There are also a few small retouched chert artefacts, a fine thumbnail-scraper and a retouched flake with a concave edge. One intriguing fact is that small chert artefacts of microlithic character sometimes occur in association with the quartzitic Brakhuti flakes on the surface in Dang. There are, however, separate sites with such small artefacts on chert in Dang for example, at Daingaon, Dongpur and at Agmi, and the question is whether the above-mentioned chert artefacts have superficially mixed with the Brakhuti flakes or belong together with them as a special feature of the Brakhuti industry in Dang. The former is more probable.

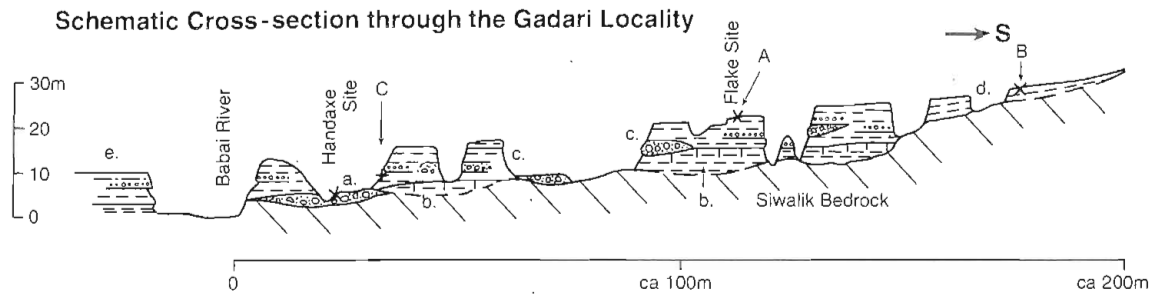
Close to the Ranighora SW site there is another larger site, Ranighora S, situated further south at the very bottom of the slope of the Siwalik hills, where the colluvial silts abut against the Siwalik rocks. Both Ranighora sites are indicated on the map in Fig.70 as one locality. An abundance of quartzite flakes are lying exposed on the rocky surface ledges at the foot of the hills, which once were covered by the colluvium, of which only small remnants are left. From this site one has an excellent view over the whole valley to the north and over the stratified alluvial Babai Beds (Pl.217/1). The artefact site is seen on the bare, light surface in the middle ground. The artefacts are very weathered and must have been exposed for a considerable time after erosion. A sample was taken. The artefacts all belong to the Brakhuti industry; they exhibit cortex platforms and usually stepflakes, and have either multidirectional or uni-directional flaking scars on their dorsal face, being well trimmed (Pl.106/1-4). They conform largely in appearance to those of the nearby Gadari Flake Site. The sample is very homogeneous in comparison with the Ranighora SW site.

At this same place, next to the prehistoric site, a rich fossil site of Lower Siwalik vertebrate fossil bones was discovered during the survey for prehistoric remains in February 1991. Reptile fossils of crocodiles and turtles along with mammalian fossils of rhinocerotidae, hippopotamidae, bovidae and *Deinotherium* have eroded out from two sandstone layers and an overlying clay layer (Pl.249/3). Behind the site in the photo, to the east, one can clearly see the interfingering of the colluvial silt (at right) and the alluvial deposits of the Babai Formation in the centre (this comes out only in a coloured photo). Nearby I found, in 1998, a locality with many fossil bones of one individual of *Deinotherium* sp. (teeth, tusk, tib and other fragments), which had eroded out from a Lower to Middle Siwalik claystone.

The entire area between Gairakuthi/Kurepani and Dharpani along the southern bank of the Babai River is rich in both small and large artefact localities. They have been exposed by the extremely heavy erosion and have been redistributed to some extent by the recent gully streams, which are dissecting the alluvium to such a great extent. Most of the localities are similar in appearance and technique with the Brakhuti industry, and are eroding out from the top part of the yellow alluvial silts of the Upper Member of the Babai Formation and the colluvial silts of the Gidhiniya Formation.

The Gadari site complex, general description

One of the most important and interesting prehistoric localities of Dang is the Gadari site complex at latitude 27°, 59'north and longitude 82°, 27'east, where three cultural assemblages are superimposed upon each other in the dissected alluvium of the Babai Formation within an area of a few hundred metres: a Lower Palaeolithic site of bifaces at the base, a Late Palaeolithic flake industry in the upper silts, and a Neolithic site on the surface (Fig.83). The Gadari site complex is situated on the south bank of the Babai River at the hamlet of Gadari, just east of Dharpani (Fig.70). The entire area between the river and the hills is dissected to such an extent that only remnants of the once extensive terrace of the alluvial Babai Beds can be seen (Pl.250/1).



a.: Basal rubble gravel with Acheulian bifaces; b.: Reddish, compact silt; Unconformity; c.: Yellow stratified silts, clays and gravel lenses with the Gadari Flake Site in the upper strata; d.: Marginal, colluvial silt fan. (a., b.: Lower Babai Formation; c.: Upper Babai Formation; d.: Gidhinya Formation; e.: Sitalpur Formation). A, B, C: OSL sample spots.

Fig. 83. Schematic cross profile over the Gadari site complex.

The extremely strong erosion has exposed near the riverbank a basal pebble-cobble rubble gravel overlying Siwalik bedrock. On the eroded surface a few handaxes and flakes and one cleaver were found on 1st March 1990 at a site, subsequently called the Gadari Handaxe Site. An *in situ* core was still cemented in the rubble (Pl.217/2 and 68-Sc), indicating that the original site of the bifaces was within the basal rubble. The rubble is overlying irregularly eroded Siwalik bedrock, and is in turn overlain by the silt and clay succession of the Babai Formation (Fig.84a,b). Most of the artefacts were found on the surface amongst the components of the eroded basal rubble gravel and have been exposed only due to the deep dissection of the alluvium (Ph.69-Sc). The silts and clays of the Babai Formation once formed an extensive 25-30 m terrace at Gadari, but the whole area is now extremely dissected into badlands, and the former covering silt has almost disappeared, exposing the basal rubble and bedrock.

The basal rubble which contains the Early Palaeolithic artefacts consists of subangular cobbles and pebbles of Siwalik sandstone, probably derived *in situ* from the weathered bedrock. It is cemented by a calcareous matrix of angular pebbly sand, also derived from the Siwalik rocks. There are no quartzite cobbles in the rubble itself. The rubble filled small, irregular bedrock basins, where the rocks bear well-marked water-cut rills, indicating scoring of the active river in its bedrock channel just prior to or contemporaneous with the habitation of the Early Palaeolithic people. Since the rubble does not contain any quartzite cobbles, the manufacturers of the handaxes must have used this material at another place and brought the artefacts to this site.

The discovery of handaxes in Dang came as something of a surprise, as handaxe-producing people rarely penetrate into mountain tracts and were not expected in the interior of the Himalayas, where they were separated by two mountain ranges of Siwalik hills from the plains. It is significant that in spite of the systematic and detailed survey during the 10 years which brought to light an abundance of younger industries, this was the first definite site of the Acheulian within the mountains in Nepal. That means that such sites are rare and that the people of the handaxe tradition were not frequent but sporadic occupants of the valley.

The first handaxe was found on 1st March 1990 on the surface above bedrock (Pl.217/3, where the man stands). Later other artefacts were found nearby on the surface of the rubble, for example a cleaver (Pl.218/1, where the man stands), and a well-made handaxe at a point where the overlying silt had just recently been washed away (Ph.69-Sc). The artefacts are not abundant and consist mainly of tools, apart from a few smaller flakes and a large core. It seems to have not been a stone/knapping site but rather a place where some other form of activity went on near the river.

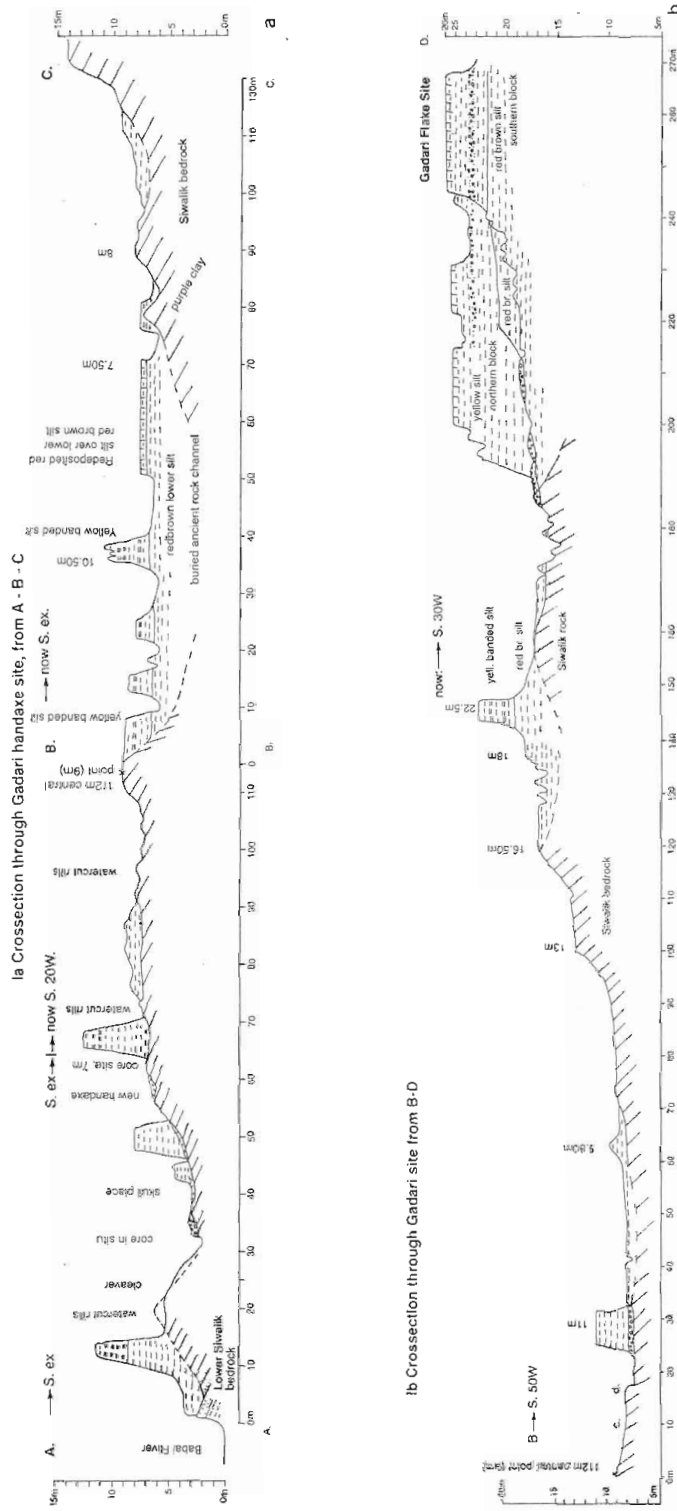


Fig. 84a, b Cross profiles through the Gadari handaxe site (from A-B-C, the handaxe site is at the left) and Gadari Flake site (from B-D), a. N-S, b. S50/W, then S30/W.

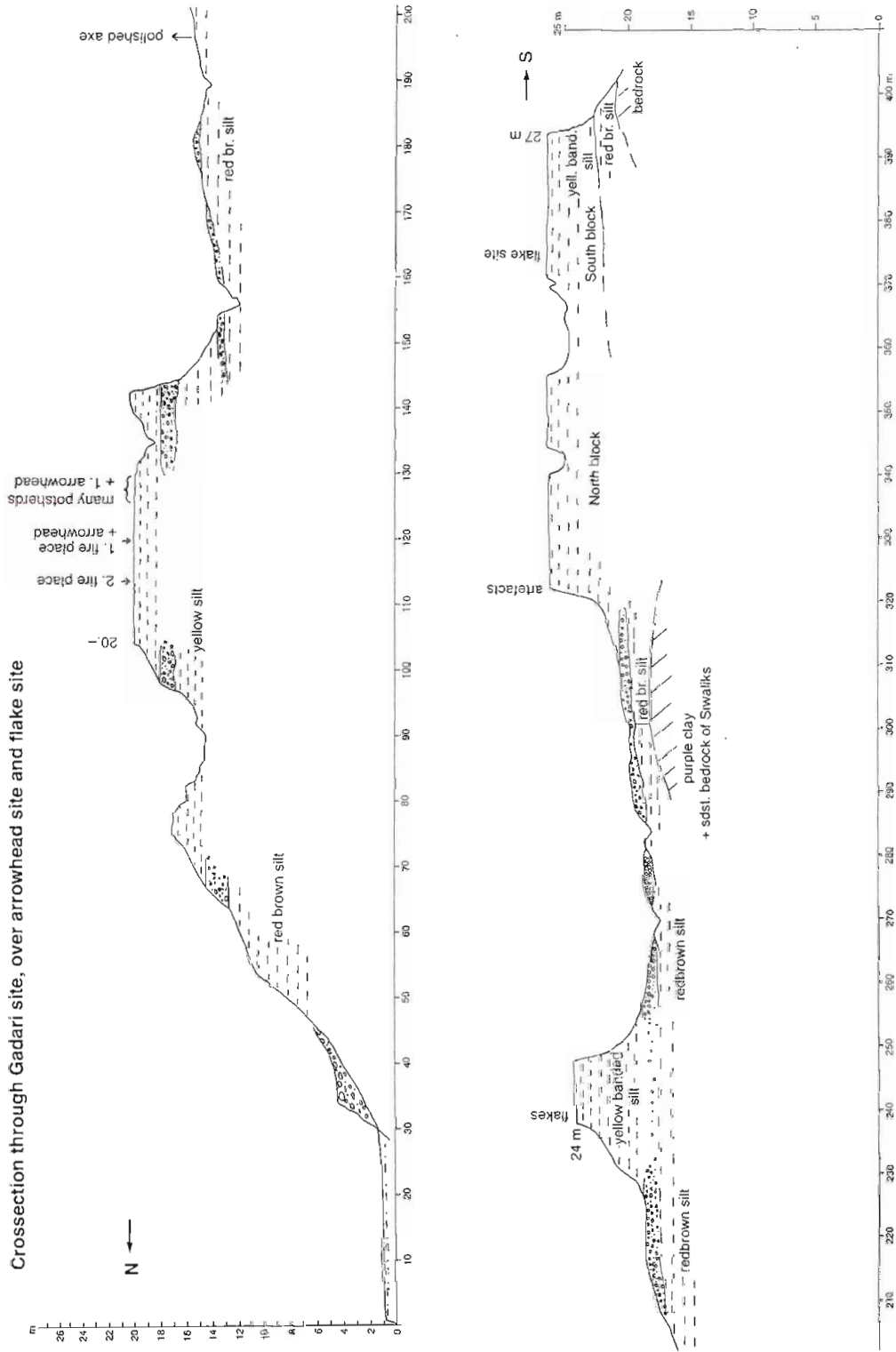


Fig. 85. Cross profile: over the Arrowhead Site (above) and the Flake Site (below).

E-W Crossection through Gadari handaxe site and arrowhead site

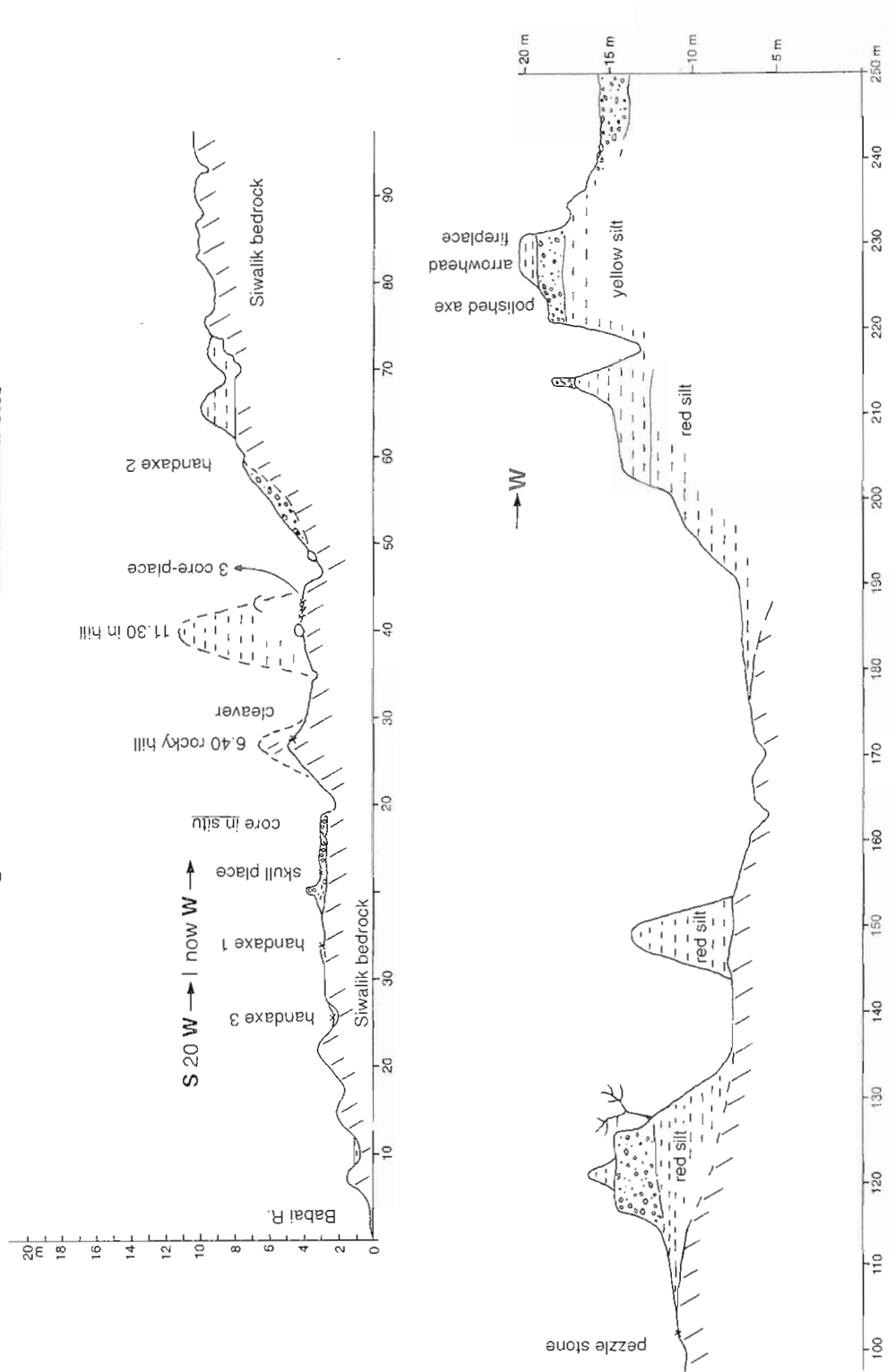


Fig. 86. E-W cross profile through the Gadari handaxe site (above) and the Arrowhead Site (below).

After probably a considerable gap in time the site was buried by the Babai Beds of lacustrine clays in the lower part and then, after an unconformity, by fluvial silts and gravels in the upper part.

About 300 m to the southwest of the biface site (Fig.84b) (cross section A-B-D) a larger remnant of the 25 m terrace of the Babai Formation alluvium can be seen (Pl.250/1), exposing yellow silts with intercalated lenses of gravel overlying older red-brown silts. The top part of the yellow silt is a compact 1.5m-thick mottled silt (Pl.218/2). Innumerable, rather crude artefacts of quartzite, some chert and even quartz are eroding out and are scattered on the slopes (Ph.73-Sc). A substantial collection was made from this site, discovered on 11th April 1990, and later called the *Gadaraï Flake Site*.

The artefacts derive from a level 10 to 15 cm below the recent surface of the silt (Pl.218/2). The *Gadaraï Flake Site* is situated 330 m south of the Babai River (Fig.70).

Two hundred metres to the west of the biface site, over dissected badlands, another prominent remnant of the 25m terrace of the Babai Formation deposits is found closer to the river (Ph.74-Sc). It consists of yellow silts with gravel lenses of the Upper Babai Formation above a red-brown clayey silt of the Lower Babai Formation overlying bedrock (Fig.85 and 86). On top of this hillock remnants of a Neolithic site, called the *Gadaraï Arrowhead Site*, were also encountered, in February 1991. The site is situated 120 m south of the Babai River bank and 210 m north of the *Gadaraï Flake Site*. The three sites form the corners of a triangle, the *Arrowhead Site* being 200 m west and north of the biface and the flake site respectively.

A few hundred metres to the east and southeast of the *Gadaraï* site complex several other flake sites present an assemblage similar to the *Gadaraï* flake site eroding out from several remnants of the terrace of the upper yellow silts of the Babai Formation, from levels of 0.45 to 0.50 m below the terrace surface. From a rich site, called *Gadaraï E*, a sample of 29 stone artefacts made from quartzite and green and red chert was taken.

In the neighbourhood of *Gadaraï E*, a few ground stones and fragments of polished celts were found on the surface. These tools, situated 1 km east of the *Arrowhead Site*, must have belonged to the people of the latter site.

East of the *Gadaraï E* site, the remnant of the neighbouring terrace surface exposes a deep-red clayey silt belonging to the Lower Member of the Babai Formation, from which the overlying yellow silt has partly eroded away. The red silt dips northwards below the yellow silts of the Upper Babai Beds. A hundred metres to the north of the red silt hillock, beyond a dry gully bed, another flake site, called *Gadaraï SE*, is encountered, where many artefacts of quartzite and also of „tuff“ (similar to those of the *Gairakhuti SW*), are eroding out from the edge of the upper yellow silt. It is a rich site. The assemblage is rather crude and resembles that of the *Gadaraï Flake Site*.

At this point some explanations about the complicated depositional features of the alluvial strata are in order. The entire area, a belt of about 450 m between the river and the slopes of the southern Siwalik hills, has been heavily dissected down to bedrock through the thick alluvium of the Babai Formation, and therefore provides insight into the stratigraphic complexities of the strata. It shows the complicated nature of fluvial cut-and-fill activities. Below the alluvium, the bedrock itself was dissected unevenly prior to the alluviation. During the alluviation itself cut-and-fill activities occurred, too, indicating that, apart from the larger phases of erosion and aggradation, the meandering river caused repeated cutting and re-filling on a smaller scale.

The alluvium consists in this area of yellow silts and sandy silts with intercalated lateral gravel lenses of cobbles and pebbles of Siwalik sandstone, which form the Upper Member of the Babai Formation. A thin, red-brown soil was usually developed on the upper yellow silt. Unconformably underlying it is the Lower Member represented by a red, homogeneous, clayey silt (Ph.75-Sc). The lower red silt is, however, not present everywhere. For example, at the *Gadaraï E* site the upper yellow silt of 4 m thickness, having a gravel lens of Siwalik sandstone cobbles at its base, rests unconformably on the homogeneous red silt. The latter

is well exposed on the eastern slope of the terrace remnant, where it is seen dipping northwards below the upper yellow silt. On its western slope, however, the red silt is no longer present, having been eroded away before the deposition of the Upper Member. The lower red silt is present again below the upper yellow silts and clays further east towards Gairakhuti. Towards the west, however, at the handaxe site, the red silt is absent and must have been eroded away completely, so that the basal rubble gravel containing the bifaces was unconformably overlain directly by the yellow silt of the Upper Member. The lower red silt is present again below the Upper Babai silts at the Gadari Flake Site and the Arrowhead Site.

Cut-and-fill episodes are common in fluvial and lacustrine environments, especially if they are affected by tectonic instability as well. They certainly complicate the understanding of the Quaternary history and the interpretation of the cultural remains embedded in them.

The Early Palaeolithic population who produced the bifaces at Gadari occupied the southern banks of the river at the end of the first extensive erosional phase and prior to the alluviation of the Babai Formation. After a long gap of time later groups of people, those of the Gadari Flake Site and of the other flake sites at Gadari E and Gadari SE, occupied the valley towards the end of the alluviation of the Upper Member. Finally, the people of the Arrowhead Site settled on the very top of the alluvial 25 m terrace, probably after the large erosional phase between the Babai and the Sitalpur Formations. They lived on the higher terrace surfaces near the river, that overlook the Dang valley northwards. These youngest sites are connected with a grey soil on the terrace surfaces.

The Gadari site complex is important because three cultural units separated by large time gaps between each unit were embedded in the alluvial sediments, and became exposed only thanks to the strong recent erosion. The Neolithic people of the Arrowhead Site lived and roamed on the then still intact 25m terrace surface of the Babai Formation, while the artefacts of the Gadari Flake Site were embedded beneath it in the Upper Babai Beds. Deeper still, at the very base of the alluvium, the remains of the Acheulian occupation lay buried under the entire succession of the Babai Formation.

The Gadari Handaxe Industry. This industry has been described in detail in „Quartär“ (Corvinus 1991). Early Palaeolithic sites in Nepal are rare. The discovery of handaxes at Gadari provides evidence of the earliest inhabitants in the Dang-Deokhuri area. Though the assemblage is small, numbering 31 artefacts, it testifies to the presence of Acheulian people in Nepal. It also points up the diversity of tool types. The artefacts collected are: 4 bifaces, 1 cleaver, 1 pick, 2 scrapers, 1 point, 1 discoid, 2 polyhedrons, 2 hammerstones, 7 cores and 9 flakes. They are all made from quartzite.

The bifacial tools were made from quartzite cobbles or large flakes by primary hard hammer trimming, and by finer secondary step-flaking to form the edges. One biface, No.1 (Pl.5/1a,b) the first one found in Nepal, is a small, pointed, oval handaxe with a length of 115 mm; it was made on a cobble by removing large primary flakes, resulting in a jagged bifacial edge and a rounded point. Some cortex is left on its upper face. Another handaxe, No.2 (Pl.6 and 7), is a fine flat biface, 145 mm in length, made on a flake. It was trimmed with large but shallow primary flakes and smaller secondary retouch, resulting in a straight, slightly sinuous edge. The apex is flat and shallow, like a chisel, made by the intersection of a large primary flake on the lower face and several smaller scars on the upper face. No.3 is an unfinished oval biface, 133 mm in length, made on a cobble (Pl.111 and 112/1). It is trimmed on the lower face by large flakes and a few shallow flakes at one lateral edge, while the other face retains much cortex apart from several large primary flake scars at the distal end. The finest handaxe is No.21 (Pl.114 and 115), which is a well-conceived oval tool, with a straight edge round the entire circumference and trimmed all over both faces, to produce a biface of classical shape. A large cleaver, No.5, (Pl.113) is a fine specimen, too, though it is rather rolled and abraded. It is made on a large side flake, with much cortex left on the upper face, though the latter was trimmed along its side to shape the right bifacial edge. The lower flake face is rimmed along both sides and the butt. The broad cleaver edge is heavily utilised, with large scars of utilisation on both faces.

A pick (Pl.116/1) is a rough, heavy tool, with large primary flake scars over its body, but the apex is worked into a pick point by a few small flakes. Pl.112/2 shows a convex scraper on a flake with utilisation marks on its cortical convex edge. The tool in Pl.116/2 is a pointed tool, made on an end-flake with a plain platform and its lateral left edge utilised. Noteworthy are a few polyhedral tools (Pl.117/1, Pl.118) which are trimmed all over, leaving only some cortex in places. They contain several rather blunt edges and may have been used as sling balls. Another interesting tool is a Kombewa flake (Pl.116/3, Pl.117/3b). Kombewa flakes are well known from Acheulian sites in Africa, and also in India. They are flakes with bulbs on both faces: the present flake was detached not from a core, but from another, larger flake, the bulb of which was retained on the dorsal face of the present flake and is seen on the upper right side of the dorsal face (Pl.116/3). The flake has no secondary trimming, but was utilised on its distal edge.

A number of larger and smaller flakes and cores make up the rest of the assemblage. One core was found *in situ*, embedded in the basal gravel (Pl.217/2).

The assemblage is not a large one, but it establishes beyond doubt the fact that Acheulian people not only reached the Himalayan mountains from the south, but also penetrated into them. The handaxe site of Gadari is situated beyond the second mountain range of the Siwaliks. The distance from the plains is 30 km as the crow flies. The easiest approach from the plains would be along the Rapti River from the West and then from Jalkundi village over a pass in the Siwalik hills into the Tui valley and thence over the next range into the Dang basin. It is possible that this was the route the Acheulian migrants took, because at Jalkundi itself there is a small Palaeolithic locality with a few rolled bifaces. These seem to derive from a quartzite cobble gravel overlying, Siwalik bedrock, as at Gadari (see Jalkundi site).

The Gadari Flake Site and its assemblage. After a long gap of time during which a tremendous change in the geology and environment took place in the valley and no people seem to have lived there, groups of much later Palaeolithic inhabitants occupied the Gadari area. These are the people who were responsible for the Gadari Flake Site, which belongs typologically to the Brakhuri industry.

This site is an important and extremely rich one, but has been destroyed almost completely by erosion. It will be described in greater detail. Artefacts of quartzite, chert and „tuff“ are eroding out in large quantities from the top part of the upper yellow silt of the 25 m terrace and are scattered on the slopes and floors of the adjacent gullies (Ph.73-Sc). The actual horizon is seen to be about 15-25/30 cm below the terrace surface level (Pl.218/2). Two small test cuttings were made into the terrace edge to verify this horizon, and the artefacts were plotted and collected (Fig.107 and 108). A selective collection of 114 artefacts was made from the edge of the surface and from the western slope, onto which the artefacts were washed down from the top. A charcoal sample was taken from just below the surface, though not from the artefact horizon itself. This gave an age of 2560 ± 130 BP (BS sample 944 of the Birbal Sahnii Institute of Palaeobotany, Lucknow, pers. comm. by Sarkar, 1992). The date is extremely young and it is probable that the charcoal was contaminated by its closeness to the surface. A second sample of charcoal specks was collected from a block of red-brown silt, which seems to have fallen down from the vertical cliff from a level 3m below the artefact horizon; it gave an age of 17270 ± 1120 BP (BS 945 of the same Institute).

Later, in 1995, a couple of samples were taken by G. A. Wagner (Heidelberg) from the Gadari area for optical stimulated luminescence (OSL) dating. One sample (A, HDS-297) was taken from the silt just below the artefact horizon itself, some 0.5 m below the top of the alluvial terrace, providing an age of 23.3 (4.1) ka (see appendix II). The altimeter reading from this place was 613 m a.s.l.

A second sample (B, HDS-298) was taken from the reddish colluvial silt of the Gidhiniya Formation on the slope to the Siwalik hills, some 300 m away to the south from the Gadari Flake Site, 0.6 m below the dissected surface, giving an age of 15.7 (2,1) ka, from which place a few artefacts were recorded.

A third sample (C, HDS-299) was taken at a depth of 1.70 m from the dissected yellow alluvial silt of the Upper Babai Formation, overlying unconformably the basal rubble/gravel layer which contains, near-

by, the handaxe locality. This provided an age of 42.4 (4.1) ka. The altimeter reading at this place was 595 m a.s.l., 18 m below the Gadari Flake Site.

These dates tally well with the recorded geological observations and the cultural configuration of the site complex. The Acheulian horizon is overlain after a considerable erosional time gap, not by the Lower Member of the Babai Formation but the Upper Member, which provided the OSL-age of ca. 40 ka (Sample C) 1.70 m below the top of the eroded surface. The Upper Member of the Babai Formation reaches thicknesses of more than 3 metres at other places. Sample B is situated some 0.2 m below the horizon of the Gadari Flake Site in the more solidified silt, the artefact horizon already being disturbed. There does not seem to be any doubt that the date does not tally with the cultural and geological record. This would place the Brakhti industry into the later part of the Late Pleistocene.

The top of the Gidhiniya Formation at Gadari, has a slightly younger age of 16 ka (sample B), and could be understood by the fact that erosional sheerwash has affected the terrace level of the upper part of the Upper Babai Formation. This is also discussed later. The top of the Babai Formation shows at several places, where erosion has left the surface intact, a red oxisol which here at Gadari is not present anymore. This is also discussed below.

The 114 artefacts collected are (Fig.96):

- 21 tools,
- 69 flakes,
- 6 flake-like pieces,
- 3 cores,
- 1 chip,
- 1 worked chunk,
- 12 chunks,
- 1 broken cobble.

The 21 tools of the Gadari flake site are all heavy-duty cobble tools (except one end-scraper, No.43):

- 10 corescrapers,
- 2 round, unifacial choppers,
- 1 bifacial tool,
- 2 anvils,
- 5 heavy scrapers made on cobbles,
- 1 end-scraper on flake.

Corescrapers are the most common tool type at the Gadari Flake Site. Nos.2 and 30 (Pl.119/2 and 120/2) are typical corescrapers. The former is a narrow tool; its lower face is of cortex, while its upper face is the split surface of a cobble from which a few primary flakes have been detached, and with a straight unifacial edge at the right side. No.30 is a very fine elongate corescraper of the type common to the Brakhti industry. It was made on an elongate square-sectioned cobble. Only one side was trimmed by a number of primary flakes, after which a straight unifacial edge was produced by fine regular stepretouch. No.31 is very similar to 30, and like it made on a flat, square-sectioned cobble. Only one side has been trimmed with fine stepretouch to form a straight, unifacial edge. The rest is cortex; part of the cortex opposite the edge has broken away.

The most interesting corescraper, No.1, is an elongate, hump-backed tool (Pl.119/1) with a trapezoidal section. It has two straight unifacial edges opposite each other and a slightly convex unifacial edge at the distal end, all on the same upper face. The base is a flat cortex surface, from which the longer, better-made, right edge has been struck (seen in the photo). The shorter edge has been trimmed from a large flake surface at right angles to the cortex base, and the distal edge is formed from a split cobble surface.

No.7 (Pl.120/1) is a round corescraper-cum-core, almost like a sumatralith, with three steep unifacial edges: two short used edges at right angles to each other, while opposite them is a rather zigzag unifacial

edge with stepretouch which appears to be the edge of a core. The lower face is of cortex. It is an interesting tool, rather polyhedral in character, not the usual corescraper.

One (No.3) is a double corescraper made from „tuff“. Another (No.32) is a high-backed corescraper-cum-core, not the usual type. The upper face is high-backed and triangular, forming a bifacial ridge. No.33 was once a true corescraper, from „tuff“, made on an angular cobble, but half of the tool has broken away, probably by use. No.35 (Pl.121/1a,b) is a round, high corescraper with a short, steep unifacial, slightly jagged edge of 85°, but with fine retouch. Except for three primary flakes and the stepretouch there is no other trimming, and the rest of the tool is cortex. It is an unusual type of corescraper.

Of the ten tools described as corescrapers six are typical corescrapers, three of which have only one lateral edge, representing the normal type; two have two lateral edges, one of which has an additional broad distal edge. The rest (Pl.120/1 and 121/1a,b) are unusual types.

Choppers are not common. One is a flat, round unifacial chopper on a flat cobble (Pl.122/1). The lower face consists entirely of flat cortex. The cortex extends at the butt from the lower face to the centre of the upper face. The edge goes three-quarter round the circumference: it forms a retouched, convex unifacial edge with an angle of 75°. Another is a round unifacial chopper or heavy scraper on a flat split cobble. The lower face consists of cortex. It has a concavo-convex edge of 67°, made by very fine unifacial retouch at the right side. A short chopping edge, blunted by battering marks, forms the distal end.

Heavy-duty scrapers are few in number. One is a heavy, round unifacial scraper on a split cobble. A jagged convex edge was unifacially fashioned along one side, while the opposite side is cortex. The edge has step-flakes and there is a tiny remnant of cortex left in the middle of the edge, which means that the cortex reached from the opposite side up over the upper face to this side and abutted against the split surface of the lower face. Another is a square scraper on a flat split „tuff“ cobble, with the lower face being of cortex and the upper face being the split surface. Only one short, straight edge has been made by four shallow flake scars and some retouch.

No.37 is a scraper on a flat cobble with shallow unifacial trimming and retouch along one side. No.56 is a side-scraper on a split cobble, with a convex lateral edge trimmed from the lower face and a battered edge at the distal end. No.5 is a unifacial tool, probably the broken half of a uniface rather than a scraper. The distal convex edge and one lateral edge are retouched. It is made from phyllite, which is rarely used for tool-manufacture in an area where quartzite is abundantly available.

No.43 (Pl.122/2) is a fine blade-like flake, made into an end-scraper. It is retouched near its platform, which was removed and trimmed with fine unifacial retouch to form a straight scraper edge. A short notched edge on the left side near the apex is produced by delicate retouch. It is not a true blade: more than half of the dorsal face consists of a natural surface.

The bifacial tool is a very rolled specimen. It does not belong to the Gadari Flake Site industry but to the biface site and must have been carried off from there recently. It is found below the flake site, on the bedrock surface. It is a cleaver-like tool with a cleaver edge, which is formed by the intersection of a cortex plane on the upper face and a large flake surface on the lower face. The butt is trimmed roughly by 2 x 3 large flake scars and the right side has a rather zigzag bifacial edge.

There are 2 anvils. One is a large, oval cobble of quartzite with a flat upper face which was ground, almost polished, and then pitted with many marks. Such pitting marks are also found on all other sides. The other is a similar anvil which was found on the surface slightly farther to the north, on the slope of the Arrowhead Site, and appears to belong to that site. It is smoothly ground on one face, with striations across the surface. The other face has pitting marks.

The Gadari flakes, 69 in all, conform well to those of the Brakhuti industry. The statistical data of the Gadari Flake Site has been compared with that of the Brakhuti W and Gidhiniya sites in Figures 97-105. The following statistics were compiled:

77 % of the flakes have a cortex platform (Fig.87), and only 8.5 % have a plain and 3 % have a prepared platform, similar to statistics of the Brakhuti W flakes (Fig.97).

71 % have no cortex apart from the cortex platform, 6 % have cortex opposite the platform, and another 6 % have cortex opposite and along one side (called „orange flakes“ (Fig.88) – again very similar to the Brakhuti flakes (Fig.98).

57 % of the Gadari flakes have stepretouch on the platform edge (Fig.89), more than those without such retouch (compare with the Brakhuti flakes Fig.99).

The flaking direction on the dorsal face (Fig.90) shows, with more than 50 %, a dominance of uni-directional scars, a trend typical of flakes in the Brakhuti industry (compare with Fig.100).

The size (length) of the Gadari flakes (Fig.91) shows a majority (74 %) of medium-sized flakes (30 to 69 mm), and only 13 % of sizes smaller than 30mm (similar to what obtains in the Brakhuti industry (Fig.101 and Fig.91).

The ratios descriptive of the shape of flakes—B/L (Fig.93) and Th/B (Fig.92) – are also comparable with those of the Brakhuti flakes (Fig.103 and 102).

The platform angle of the Gadari flakes (Fig.94) has a peak at 105-109 degrees, which conforms with the Brakhuti flakes (Fig.104 and Fig.94).

Flakes with cortex opposite the platform were apparently struck as tool-manufacturing flakes, from uniface corescrapers, as from corescraper No.30 (Pl.120/2a and 121/2b). The cortex opposite the platform on the flakes derives from the cortex on the upper face of the corescrapers during production. Of these flakes, two are particularly interesting. No.15 (Pl.126/4) was struck near the distal end of a corescraper which had a lateral edge and a distal edge at right angles to each other. Remnants of both these edges are seen on the flake near the platform and on the right side, while cortex is present at the right, extending from the platform to the distal end. Similarly, No. 19 is another corescraper-rejuvenation flake. It has stepretouch at the platform edge and on the left side, originating from the original corescraper edges, at right angles to each other. Two are „orange flakes“ (Pl.123/2,3), struck from the same corescraper, the first one having been struck from its left side and the other from its right side. Two flakes from the west slope are „orange flakes“ with cortex extending from the platform to opposite the platform. Most flakes have the typical stepretouch at the platform edge (Pl.124/2,3).

There are a number of well-made flakes (Pl.122/3, Pl.124/1-5, Pl.125/1,3,4 and Pl.126/2) with prior multidirectional flaking on the core. A few of the flakes were utilised, the finest being No. 9 (Pl.126/1), which has a utilised convex edge at the left side and No. 41 (Pl.125/3), an oval flake where both the lateral denticulate edges have been utilised. No. 11 (Pl.126/2) has a utilised concavo-convex edge; No. 14 (Pl.122/3) may have been utilised on its right side and No. 16 (Pl.125/2) on its jagged distal edge. Flakes 11 and 13 (Pl.126/2 and 3) were detached from the same „ruff“ core, though they do not fit together.

The flakes from the west-slope are quite undiagnostic. Only No. 6 was utilised, at the distal end, while the rest is waste. They were collected for the variety of raw material they exhibit: red, brown and greenish chert, quartz and all kinds of colourful quartzite.

The data on the raw material of the Gadari artefacts show an interesting feature, namely, contrary to other Brakhuti industry sites, a considerably higher percentage of „tuff“ (17 %) and chert (14 %) (Fig.95), whereas the main site of Brakhuti W has only 7,8 % of its artefacts on „tuff“ and those of Gidhiniya only 4 % (Fig.105a). This, however, compares rather well with the Gairakhuti site, which both is geographically close and has an even higher percentage of „tuff“ (32.5%).

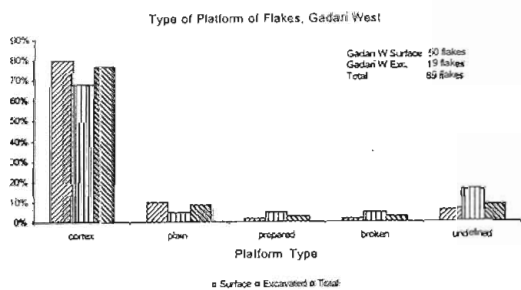


Fig. 87. Type of platform of Gadari flakes.

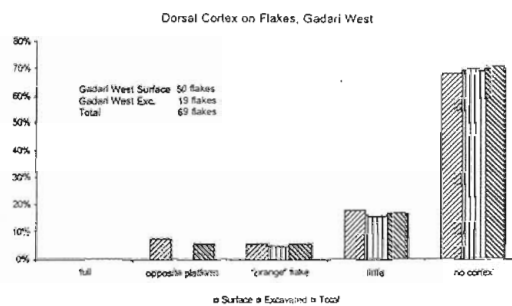


Fig. 88. Cortex on dorsal face of Gadari flakes.

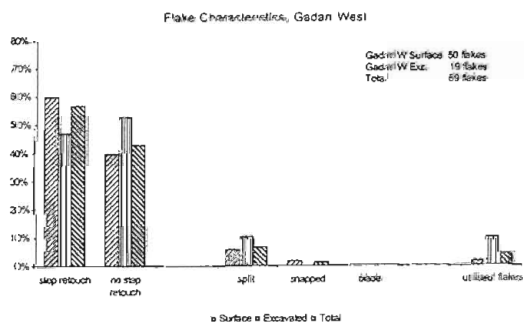


Fig. 89. Flake characteristics of Gadari flakes.

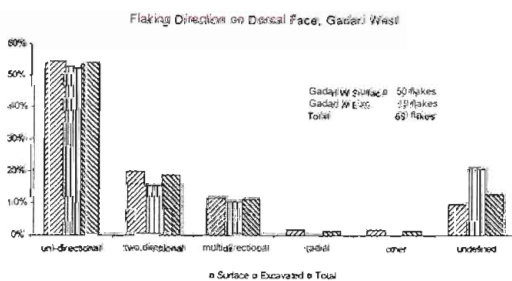


Fig. 90. Flaking direction on dorsal face of Gadari flakes.

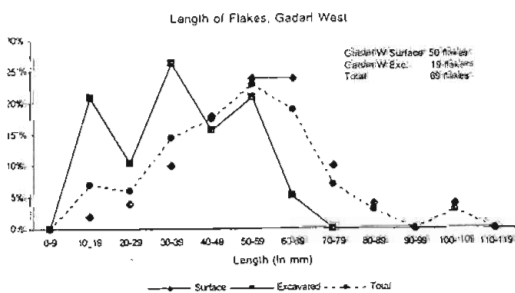


Fig. 91. Size of Gadari flakes.

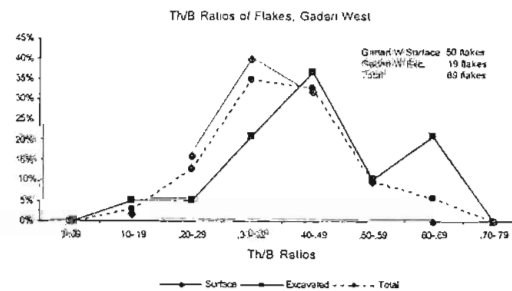


Fig. 92. Th/B ratios of Gadari flakes.

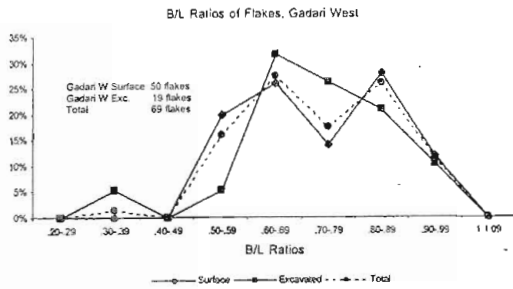


Fig. 93. B/L ratios of Gadari flakes.

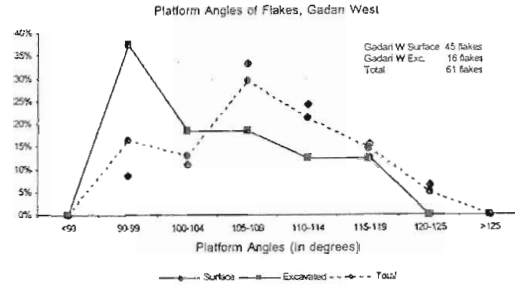


Fig. 94. Angle of platform of Gadari flakes.

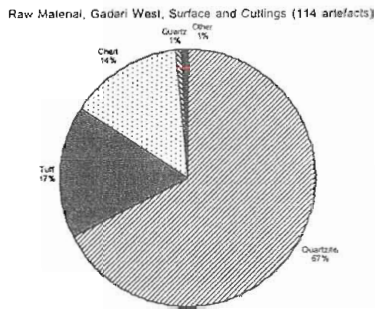


Fig. 95. Raw material of Gadari Flake Site.

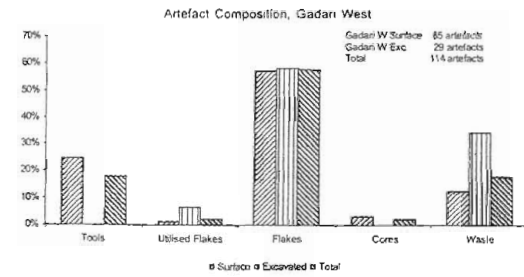


Fig. 96. Artefact composition of Gadari Flake Site.

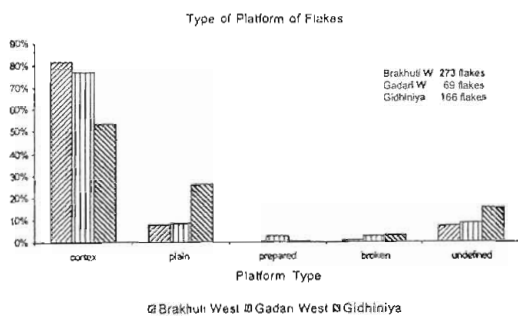


Fig. 97. Comparative chart of platform type of flakes of Brakhuti, Gadari and Gidhiniya.

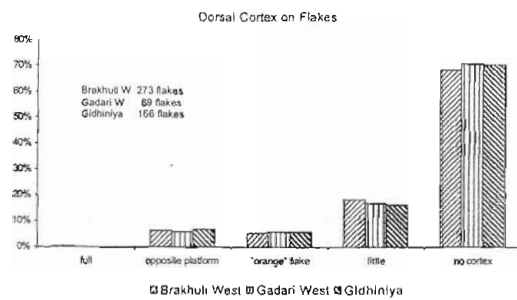


Fig. 98. Comparative chart of dorsal cortex of flakes of Brakhuti, Gadari and Gidhiniya.

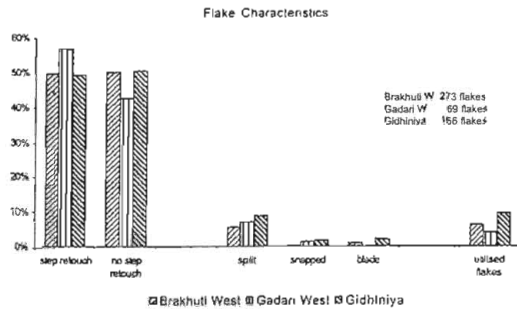


Fig. 99. Comparative chart of stepretouch on platform edge of flakes of Brakhuti, Gadari and Gidhiniya.

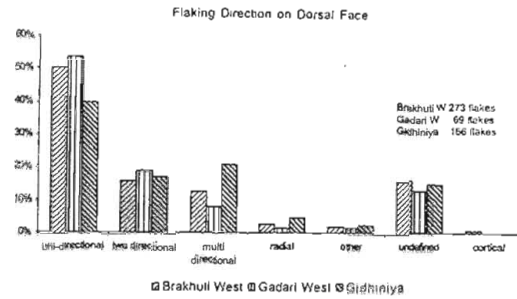


Fig. 100. Comparative chart of flaking direction.

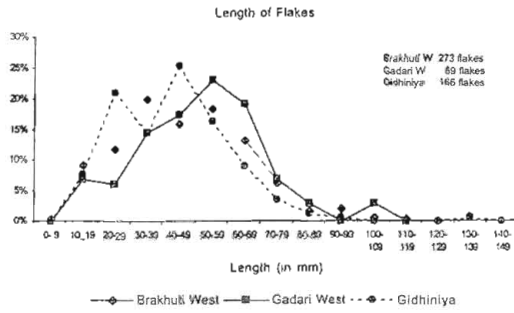


Fig. 101. Comparative chart of size of flakes.

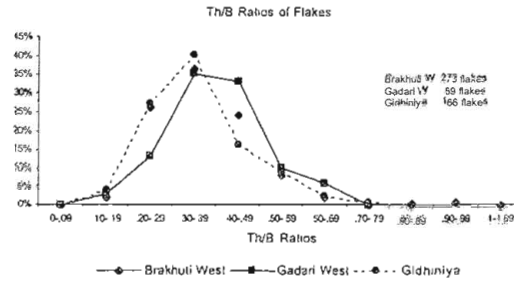


Fig. 102. Comparative chart of Th/B ratios.

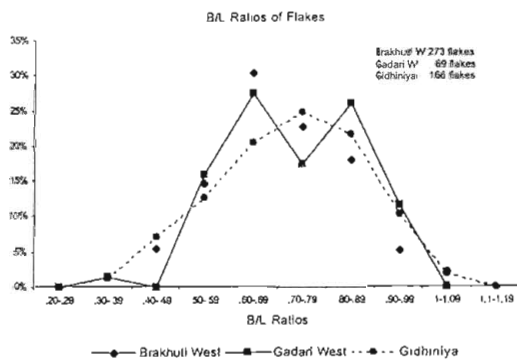


Fig. 103. Comparative chart of B/L ratios.

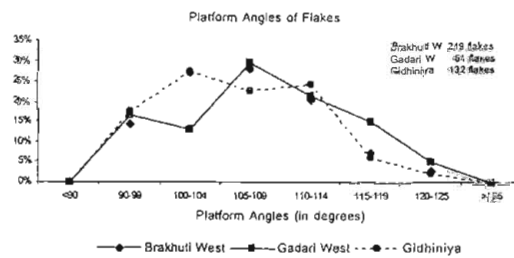


Fig. 104. Comparative chart of platform angles.

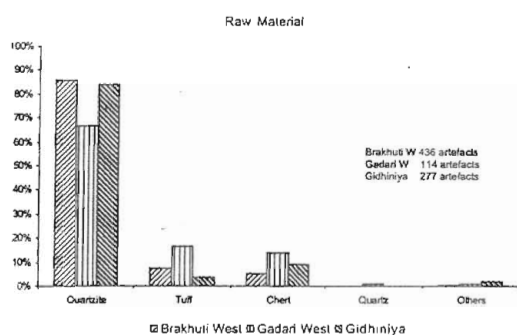


Fig. 105a. Comparative chart of raw material from Brakhuti W, Gadari and Gidhiniya.

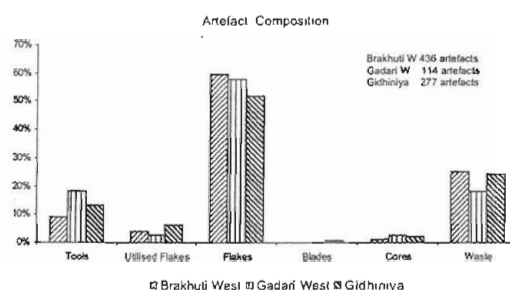


Fig. 105b. Comparative chart of artefact composition of Brakhuti W, Gadari and Gidhiniya.

The artefact composition (Fig.96) displays, as in other excavated sites (Gidhiniya, Fig.31), Brakhuti W (Fig.56), a discrepancy in the amount of tools and waste between the selective surface sample and the excavated sample. The comparison with Fig.105b, which summarizes all three sites, is distorted, as in this diagram the total of the artefacts at each site is considered.

The collection described here is a selective one. Most of the artefacts scattered on the slopes and below it on the gully surfaces consist of waste. Only the finer specimens were collected, in order to save them from being washed away completely. Most of the site has by now been destroyed by erosion. Only a small remnant of the original site on the silt terrace is left. Nothing can be done to save this site from complete erosional destruction, which is the reason why the description of the collected artefacts was done in more detail.

The abundance of the artefacts that have eroded out onto the slopes and lower surfaces indicates that the Gadari Flake Site once was an extensive and rich occupation site. The small number of tools in contrast to the abundance of waste points to the probability that the site was once a factory.

The technique displayed by the assemblage of the Gadari Flake Site is comparable to that of the Brakhuti industry. Flakes and tool types, especially the heavy-duty tools, are very similar. The stratigraphic level of the site, too, is comparable to that at the Brakhuti W site in the Tui valley. The Gadari flake assemblage can therefore be regarded as belonging to the same cultural unit as that of the Brakhuti industry in the Tui valley. Both sites seem to be factory-cum-camp sites of the same kind of people, once living in the Dang and Tui valleys. Both had the same tool requirements and their way of life must have been similar.

Two small cuttings were done in February 1991 into the surface of the terrace remnant of the Gadari Flake Site to clarify the level of the artefact horizon in the silt (Fig.106-108). The 15 artefacts in Tr.I come from levels 0.5 to 0.8 m below the surface. In Tr.II, 15 artefacts come from level 0.13 to 0.26 m below surface, while Nr. 16 to 19 are manuports of chunks of quartzite, tuff and chert in the silt between 0.25 to 0.55 m below surface. There is no structure or any alignment of any sort detectable in the silt. But some bioturbation in the form of ant or termite activity may have disturbed the horizon.

A number of questions arise, as at the Brakhuti W site. How deep was the artefact horizon originally buried in the silt? Has recent erosion washed away a fair amount of the original surface of the terrace? A red soil must have once been covering the 26 m terrace surface, since in some places the red soil surface is still intact! The artefact horizon then must have been once at a deeper level than today?

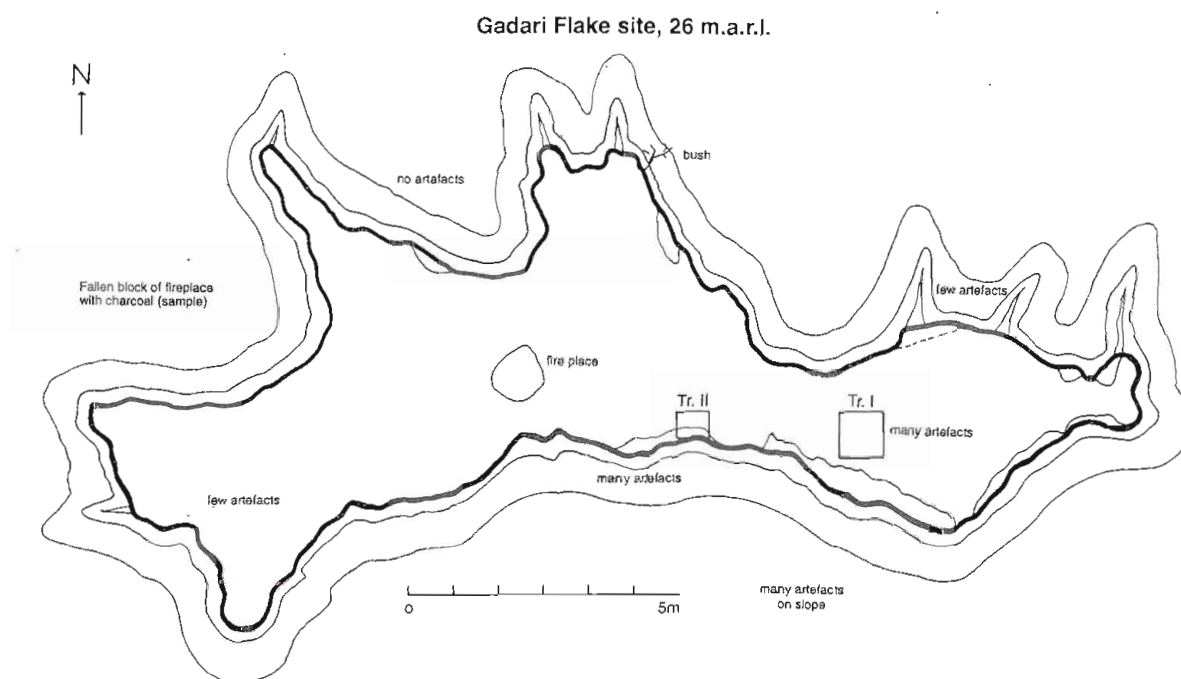


Fig. 106. Surface plotting of the Gadari Flake Site on the 26m terrace surface with lower contours of 24 and 20m.

The Gadari Neolithic Site (Arrowhead Site). The youngest prehistoric inhabitants of the Gadari site complex are the people who occupied the so-called Arrowhead Site. The cultural material from this Neolithic site has been quite destroyed by erosion (Ph.74-Sc) and lies in a very weathered condition as residue on the surface of the terrace remnant. It includes an abundance of potsherds of mainly cord-marked pattern (Pl.218/3). Several small polished narrow stone stems, which are probably remnants of broken arrowheads (Pl.218/3), and a fine stone arrowhead made of „tuff“ (Pl.218/3, 219/1) are scattered amongst the potsherds. There are also a few fragments of polished axes and perforated stone discs (Pl.219/2), a pestle stone, an anvil and a few flat ground stones, but no stone flakes. Two partly destroyed fire-places are also present. A number of isolated ground axes were found in the neighbourhood, at some distance from the site, for example near Gadari E and SE. They seem to belong to the Arrowhead Site, and in that case would point to movements of the people away from their base camp.

Only a selective collection was gathered from the surface of this site. The finest tool is certainly the ground stone point or arrowhead (Pl.219/1) made from a soft, fine-grained rock of phyllite or shale. It was executed with the greatest care on this soft material and is a unique piece, the only one of its kind found so far. It is broken at the base, but the point itself is very well made and exhibits parallel striation marks. It is associated with polished stone celts (Pl.219/2), though these are only fragmentary, but it indicates that the small polished axes of Dang go together with stone arrowheads and with cord-marked pottery. Though surface finds of polished axes were known previously from Dang, though with unknown stratigraphic context (J.L.Sharma 1983), this is the first record of *in situ* remains of polished celts in association with other cultural remains. It is hoped that detailed studies will be carried out on the Neolithic in the future. Such studies would, however, have gone beyond the scope of the palaeolithic research of this project.

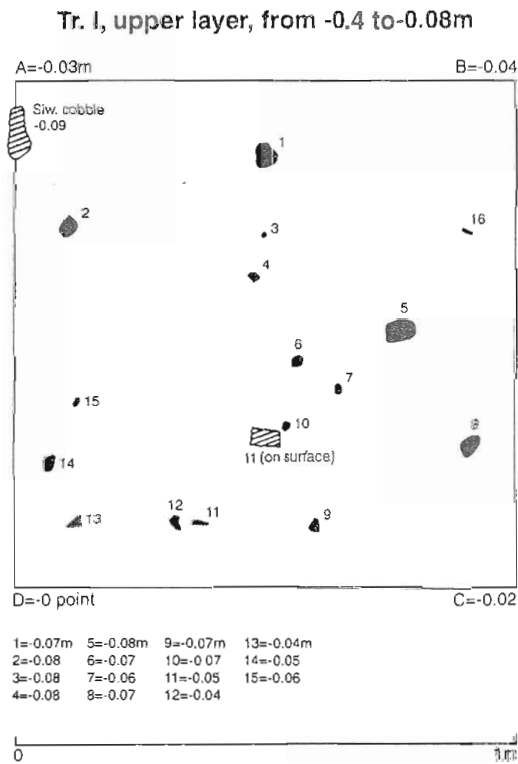
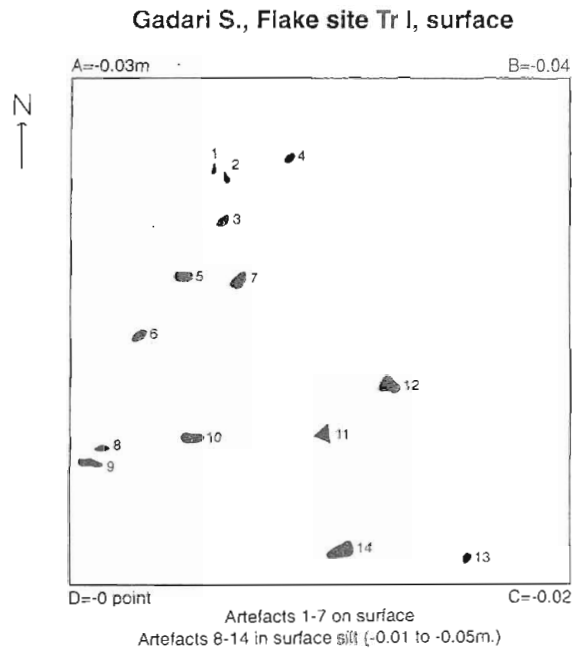


Fig. 107. Cutting I at the Gadari Flake Site.

Gadari S., Flake site Tr. II, at terrace edge

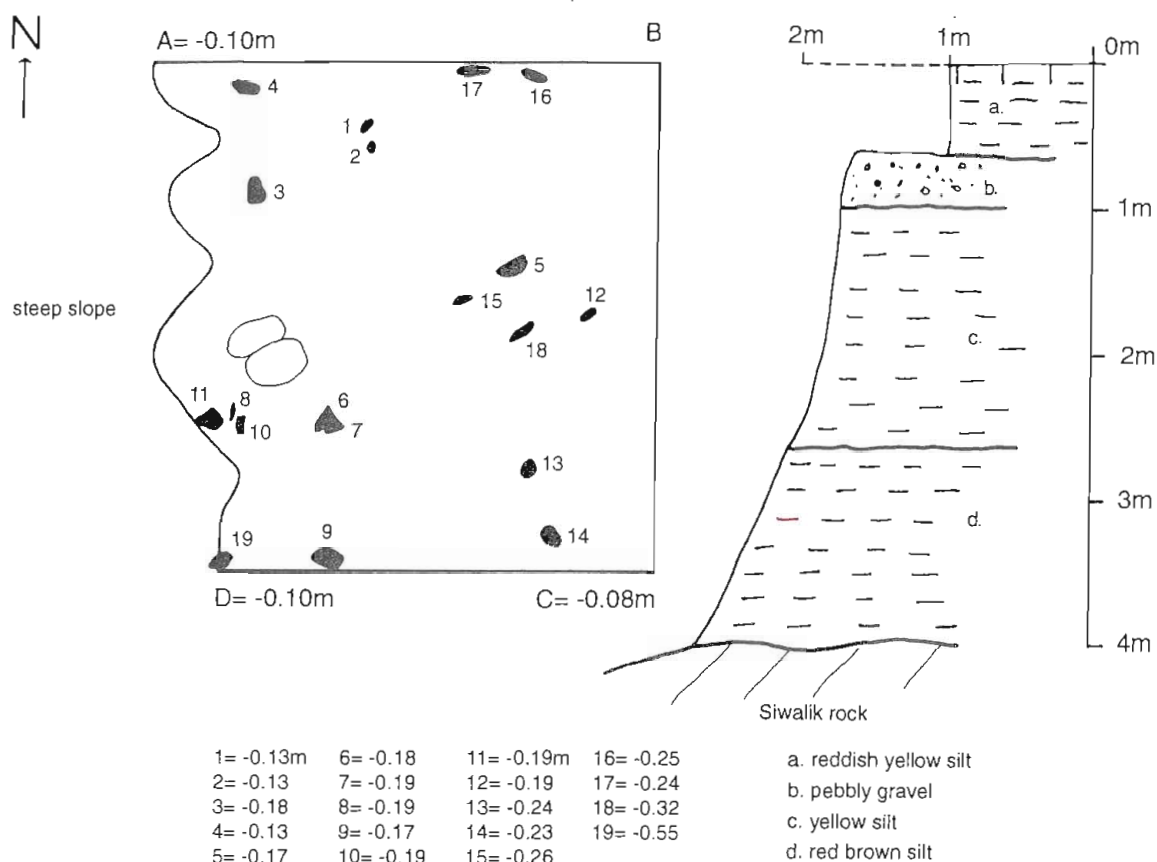


Fig. 108. Cutting II at the Gadari Flake Site with terrace profile.

Two small 1x1 m surface scrapings or cuttings were carried out. The plottings shown in Fig.109 display many fragmentary potsherds on the surface, most of them so weathered that they have broken into tiny pieces. The cord-marked nature, too, of many of them is unrecognisable, having weathered away. Many of the sherds do not lie horizontally on the surface but at an angle, meaning that they have been disturbed by butrowing animals and termites. In the cuttings no polished stones nor ground stones were recovered, only sherds.

The Gadari SE and E localities. The Gadari SE assemblage, found on 10th February 1991, is a surface collection of a few flakes and tools, resembling that of the Gadari Flake Site, and is comparable to the Brakhuti industry. One tool is a typical corescraper, made on an elongate rounded cobble with only one lateral face, trimmed unifaceally to form the typical straight, steep edge.

A particularly interesting tool is a horseshoe-shaped sumatralith-like tool or round unifacial chopper, No.2, (Pl.127/1). The lower face consists of flat, slightly curved cortex; the upper face has a remnant of flat cortex in the centre. The proximal end has broken off (the tool was originally of an oval shape with an approximate length of 120 mm). It has a shallow edge of 70° around most of the circumference, made

by ten shallow, unifacial, primary flake scars and some secondary trimming. The tool is quite weathered, so that all fine retouch has been obliterated. It is an interesting implement, resembling somehow Hoabinhian sumatraliths, but does not have the typical steep edges.

The collected flakes (Pl.126/5, Pl.127/2,3) are Brakhuti type flakes, i.e. with cortex platforms and step-retouch, and some of them (Pl.127/3) with cortex opposite the platform.

The small flat, hexagonal stone stem made of „ruff“ (Pl.126/6) is a tool fragment which seems to belong to the Arrowhead Site. It is ground on all sides of its section, and may be the stem of an arrowhead. Similar „stems“ have come from the Arrowhead Site and also from the Gadati E site (Pl.127/5), the latter having prominent striation wear marks at the narrow distal end and on the lower surface.

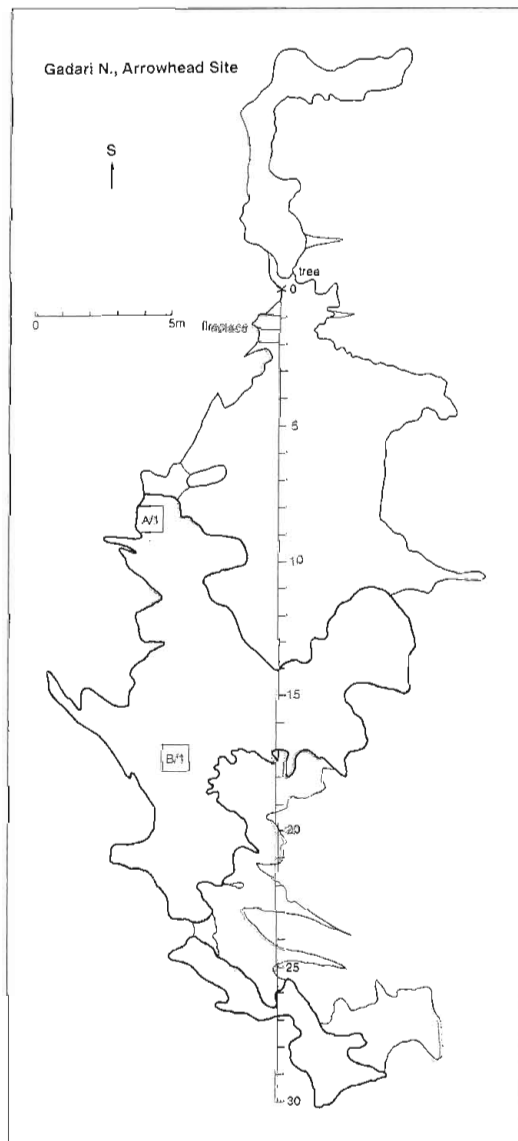


Fig. 109. The Arrowhead Site, surface plotting of the terrace remnant.

The selective collection of 29 artefacts from the surface of the Gadari E flake site, found on 7th February 1991, (Ph.75-Sc) again manifests the same types and technology as the Brakhuti industry. These artefacts come from an horizon 0.45 m below the top of the terrace surface, in yellow silts of the Upper Babai Beds (Fig.82b). The quartzite flakes are made in the same technique, disclosing mainly cortex platforms and step-flaking at the platform edge (Pl.127/5 and 129/2). The few chert flakes, associated with the quartzite flakes, appear to belong to the same site. At the main Gadari Flake Site, too, there is a small amount of chert material. The chert artefacts seem to be an integral part of the assemblage. The collection of the Gadari E locality contains, besides the flakes, a unifacial chopper on a flat cobble (Pl.128/1), a small polyhedral core with three platforms and a number of scrapers. The tool in Pl.129/3 is an elongate ovate scraper on a cortex flake, with retouch on the ventral face, both on the left and right edges, forming a denticulate edge on the right and a straight edge on the left (seen from the ventral face). The short, square distal end is utilised, too. Pl.128/2 depicts a scraper on „tuff“ with two lateral edges opposite each other. It is broken; the lower half of the tool is missing.

The few ground stone tool fragments and the ground stone celt are not from the Gadari E site but were found nearby as isolated finds and seem to belong to the Arrowhead Site. One (Pl.129/1) is a delicate, small, extremely simple celt, 7 cm in length, made on a flat „tuff“ pebble. Only the convergent distal end was ground, from both sides, to form a narrow edge. The ground area is only 5 mm broad and 20 mm wide and displays oblique striations on both faces. Another celt (Pl.128/3) was horizontally split before the tool was ground, to form a convex distal edge; it exhibits striation wear marks. A vertically split ground stone celt (Pl.128/4), with parts of its ground distal edge preserved has at its proximal end some utilisation scars and a notch is cut into the right side. The tool in Pl.127/5 is a very interesting tool. It is a ground, more or less hexagonal stem of „tuff“, with one end broken away. The upper ground, flat face is marked with central oblique striations, while several narrower longitudinal facets, are all marked with oblique striations. The convergent distal end is blunt and slightly battered, bearing signs of vertical wear. It is unclear to what use it may have been put. Similar „stems“ are found at Gadari E (see below) and at the Arrowhead site (Pl.219/2).

Dharpani

Continuing further west from the Gadari site complex, and after crossing the Gadari Khola, one reaches the badlands of Dharpani (Fig.70). Quartzite artefacts were found at Dharpani, to the west of the stream bed, on top of the eroded silt surface 13.5 m a.r.l.. They seem to derive from within the top part of the upper silt of the Babai Formation (Fig.110a,b) and are of the Brakhuti type; for example, one (Pl.106/5) has a long strip of cortex opposite the platform, while another is a corescraper-rejuvenation flake with the stepretouched remnant of a corescraper edge on its dorsal face on the right side.

The geology in this area is interesting. At the mouth of the Dharpani Khola, where it flows into the Babai River, west of Dharpani, the red silt of the Lower Member of the Babai deposits is again exposed below the yellow silts of the Upper Member (Pl.220/1, the man is walking on the yellow silt of the Upper Babai Beds, while in the background one can see black clays of the Sitalpur Formation), similar to Gadari E. Deposits of the Sitalpur Formation have been laid down against the eroded older cliff exposing a basal black clay with molluscs and lignite horizons, overlain by a grey clay which merges into a mottled yellow-grey silt. The latter is topped by a calcrete horizon 1.50 m thick and cut by a pebbly channel gravel lens, loosely cemented with carbonate, which contains many pieces of „tuff“ (Fig.110b). A ground stone stem (like the ones at the Arrowhead Site) and some cord-marked pottery sherds were found in the uppermost part of the gravel in a 20 cm-thick grey soil. The black basal clay is present only in the lowest part at the river bank and continues below the river level.

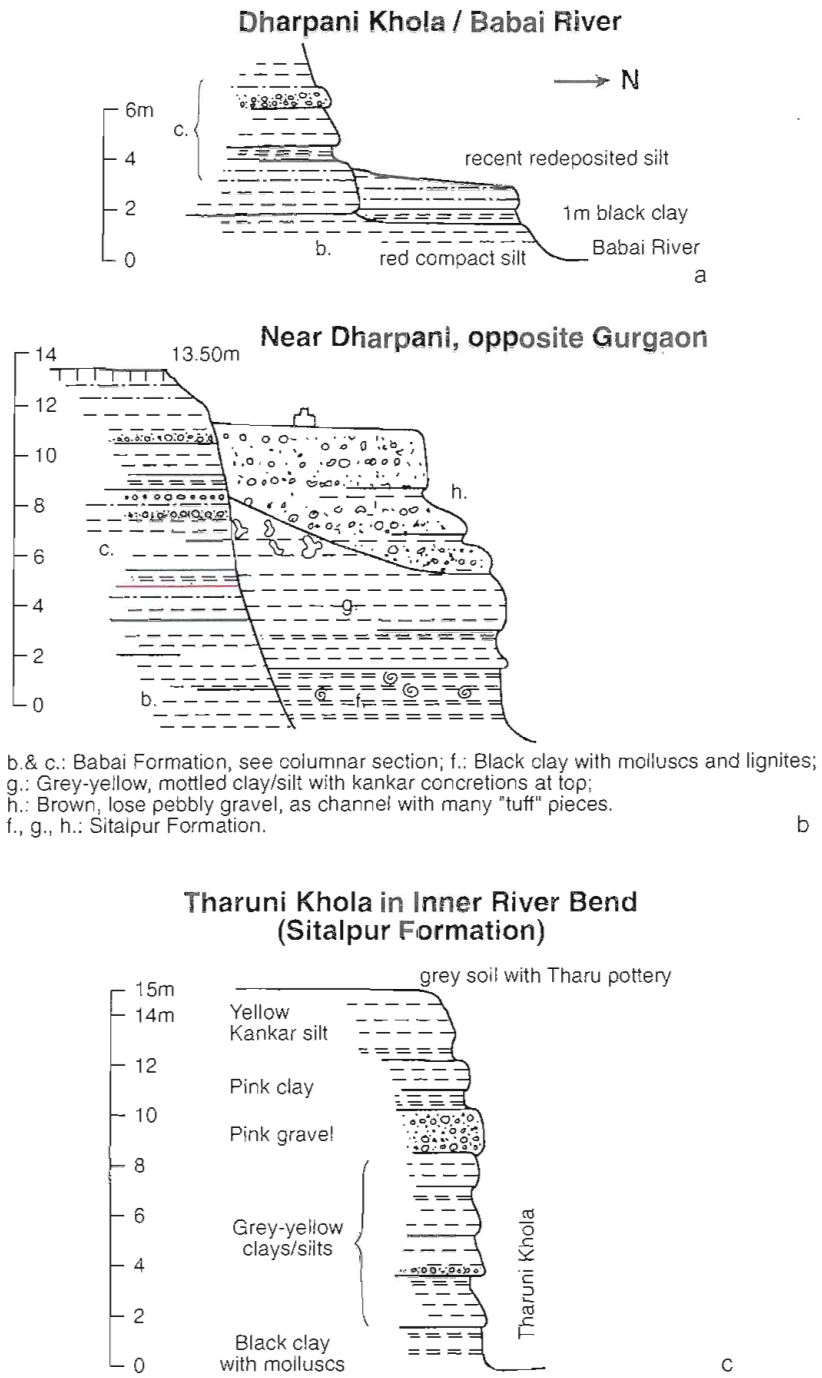


Fig. 110 a. Section at Dharpani Khola, Dang. b. Section near Dharpani village, opposite Gurgaon. c. Section of Sitalpur Beds at the Tharuni Khola, Dang.

Along the river, where it turns to the north, the deposits of the Sitalpur Formation are well exposed. At the base are the black mollusc-bearing clays and lignites of the Sitalpur Formation (very similar to the Sitalpur cliff of the type section). They merge upwards slowly into a grey clay and then into a mottled grey-yellow kankary silt up to about 6 m above river level, where they are overlain up to 11.50 m by a loose brown pebbly gravel intermixed with brown silt, which contains many angular pieces of „tuff“.

These deposits can be followed west to the mouth of the Tharuni Khola west of Dharna, (Fig.111) and are particularly well exposed on the east-facing cliff along the Babai River (Fig.110c). Here again the dark-grey mollusc-bearing clays can be seen at the base up to a level of 1.5 m and followed by grey-yellow clays and silts up to 8.50 m, overlain by brown-pink gravel 1.60 m in thickness (again with many pieces of „tuff“), and by a pink clay up to 12 m. The top of the section is made up of yellow silts with calcrete nodules up to a height of 15 m. A grey topsoil containing weathered Tharu pottery, has developed on the surface. A weathered end-chopper was found on the slope (it must have been moved by human hand).

The entire succession of deposits of the Sitalpur Formation, forming the younger 10-15 m terrace of the inner loop, consists mainly of colourful clays (black grey, brown-pink and yellow-beige) with many molluscs, indicating a very swampy environment during the time of deposition. They are lacustrine deposits of still-water or pond environment, indicating that either the river was tectonically blocked and the valley submerged in swampy ponds, or that the clays represent oxbow deposits. The former is more probable. Such pond clays are very extensive in Dang and Tui. This occurred during the terminal Pleistocene (compare the Sitalpur dates in chapter III.2.a).

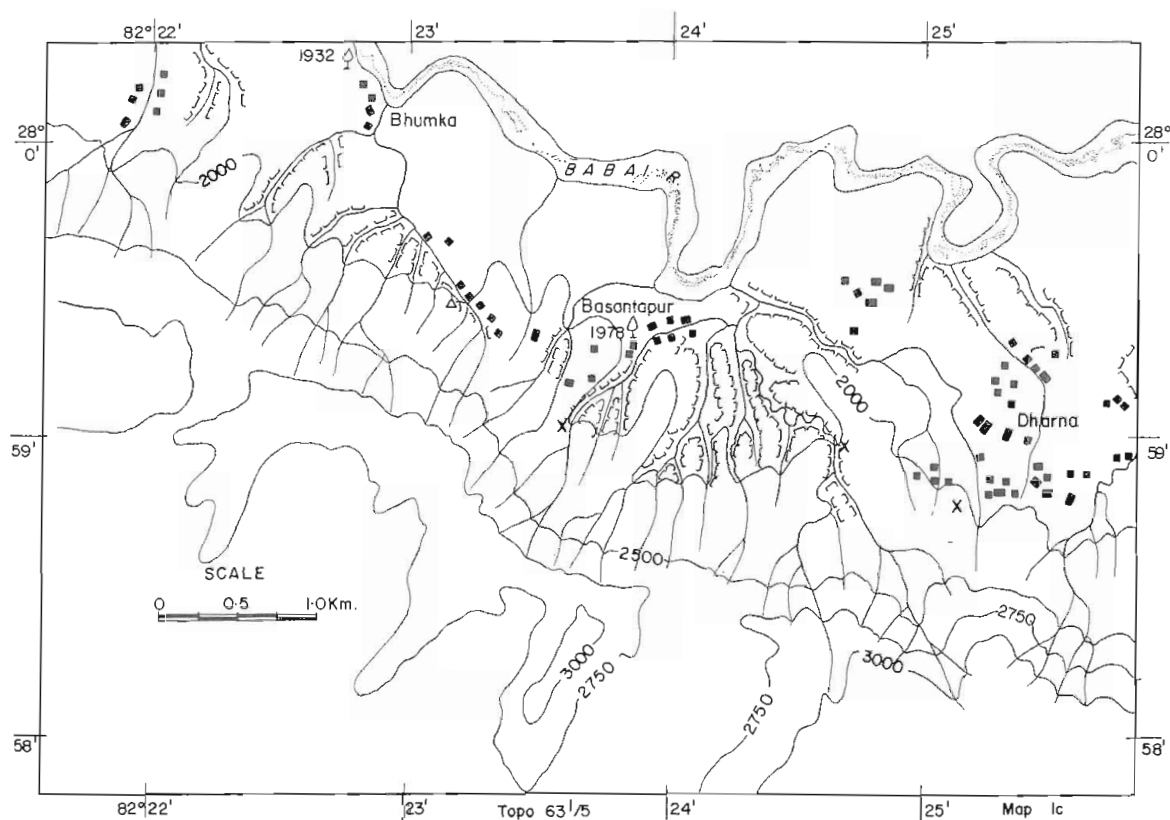


Fig. 111. Regional map 1c of Dang valley around Basantapur (legend see Fig. 17).

On the opposite, northern, site of the Babai River the young terrace of Gurgai village has an elevation of 11-14 m and is also made up of deposits of the Sitalpur Formation. A dark- grey ashy topsoil of 20 cm thickness contains much wheel-made pottery of a fine quality.

The Tharu people, who are the original population of the Dang valley, but are slowly being displaced by people from the plains and the hills, may well have their roots in the later prehistoric population of the area. They still build their original longhouses and have storage jars made of mud, built in unique and delightful designs (Pl.220/2), with clay feet, lids and closeable holes at the side. The Tharus are quite artistic people, decorating the walls of their houses with paintings and clay reliefs of animals and people.

Dolgaon

Near the hills south of Dolgaon and Dharna villages, the alluvial terrace of the Babai Formation is not yet very dissected and so are used for cultivation. Two chert flakes were found at Dolgaon village, on a Siwalik promontory west of „Master“ Jeorajh's house; they appear to be of a Late Palaeolithic type, but are different from the quartzite flakes of the Brakhuti industry. Both pieces seem to come from the same chert core (though they do not fit together) and possess a round-to-straight scraper edge at their distal ends.

On the way from Dolgaon to Dharna a few quartzite artefacts were encountered on a Siwalik hillock. A well-made corescraper of the Brakhuti type, a fine isolated side-scraper with a straight unifacial scraper edge and a Brakhuti type flake with a cortex platform and stepretouch at the platform edge come from here (Pl.8/1-3). These are some of the earliest artefacts found during the survey (Corvinus 1985a,b).

Dharna SW

A round high-backed corescraper of the Gidhiniya type, with steep retouch, was found *in situ* at Dharna SW in the silt near the last houses of Dharna towards Basantapur. Some flakes of „tuff“ and quartzite were seen on the slope below the top of the silt terrace, but nothing was taken. The artefacts seem to have eroded out from the middle part of the upper silt.

South and southwest of Basantapur, the alluvium of the Babai Formation is again extremely dissected, and several flaking sites could be recorded.

The Basantapur Site complex

Basantapur SW. The Basantapur SW site, discovered in February 1990, is situated at the very foot of the hills where the marginal colluvial red silt of the Gidhiniya Formation abuts against the rocks of the Siwalik slopes (Fig.111). Small pockets or remnants of the red silt are seen on the slope up to 8 m higher than the site. The site is now a rocky, uneven platform. Artefacts of quartzite, chert and „tuff“ lie on the surface over an area of 30 by 60 m. This site was once overlain by the colluvial red silt covering the bedrock on the hill slopes. The silt is now not thicker than 2m and the bedrock below it is very irregular. The silt occurs now only as remnants over the bedrock, due to the strong erosion (Pl.221/1). As one goes north, further towards the river, the bedrock suddenly dips down considerably. Prior to the alluviation the bedrock was deeply eroded but it then filled up with the deposits of the Babai Formation, while the foot of the hills was covered by the red silts of the Gidhiniya Formation.

Just north of the site the bedrock suddenly dips down below the stratified yellow silts of the Upper Member of the Babai Formation. Deep incision has obliterated the contact between the red colluvial silt and the stratified yellow alluvial silt. Inset into the stratified silts are pockets of young gully alluvium derived from the erosion of the older alluvium.

The site of Basantapur SW occupies the very foot of the Siwalik hills, overlooking the valley. It is not clear from which level the artefacts may have derived, as they are residues of the washed-away sediments.

But it is quite certain that the industry was embedded in the silt, probably in the top part of it, but the strong recent erosion has destroyed the actual horizon.

Most of the artefacts are quite fresh and seem to have emerged only recently from the eroded silt, but a few are weathered and must have become exposed some time ago. The artefacts belong to the Brakthuti industry. Corescrapers are the dominant tool type. Flakes exhibit predominantly cortex platforms and the typical stepretouch at the platform edge. Several flakes are rejuvenation flakes which were detached from corescrapers as they have much step-flaking at the platform edge and also at right angle to the platform (Pl.107/1). Similar corescraper-rejuvenation flakes were found at Ranighora SW and Dharpani. The flakes seen in Pl.107/2 have, in addition to the stepretouch at the platform edge, cortex opposite the platform, indicating their derivation from corescrapers. A few are „orange flakes“ with cortex along one side and opposite the platform. The flakes of the collected sample conform to the flakes of the Brakthuti industry.

The five corescrapers of Basantapur SW are of the Gidhiniya type, all being unifacially trimmed. Three are high-backed and round, as the one in Pl.107/3 which was also used as a core, having a prepared platform of 74°, from which three shallow flakes were removed (these flakes must have been intended flakes, as they are fine, shallow and prepared, whereas the „corescraper flakes“ are thick and irregular). Besides the platform edge this tool has two steep, straight unifacial edges with fine secondary retouch and use-marks. One is polyhedral in form, has three short unifacial edges at different places, but half of the tool is still covered with cortex. Another one is a high-backed tool with a well-used convex unifacial edge half around its circumference. Two corescrapers are double corescrapers. One is a very heavy tool with two characteristic steep, straight lateral edges both of which have secondary retouch. The other (Pl.108/1), is a sumatralith-like tool; it has two opposite edges from the same face. Both edges are heavily utilised. The tool has a triangular section, so that a bifacial ridge is formed. There is also one round unifacial chopper in the Gidhiniya style (Pl.108/2) with some cortex reaching up from the lower, fully cortical face. It has an edge of 70° along most of its circumference. An end-scraper is made on a flat chunk with very little work but with a rather steep, straight, utilised edge of 67°, trimmed with small, shallow flake scars.

Basantapur W. An interesting but complicated site, Basantapur W (the celt locality), is situated more in the interior of the valley, 150 m from the foot of the Siwaliks and some 150m from the nearest houses of Basantapur. The area is very dissected, and only small remnants of the once intact, flat 25 m surface are left. On one of these smaller silt remnants, covered by a thin grey soil and close to the hills, a polished celt was found (Pl.8/4) in February 1984, on the steep slope of the uppermost part of the yellow silt of the Upper Babai Beds, 0.75 m below the surface. The silt is not the original horizon of the celt, as no other artefacts were found in the silt itself. It is probable that it was washed down from the eroded grey soil cover and redeposited on the slope of the silt. A number of very light-ted weathered potsherd are also found scattered on the slopes of the silt, and must have come from the grey topsoil as well. In the photo of Pl.250/2 the location of the celt is seen at the top right, and Pl.221/2 shows the location close up.

Some 50 m to the northeast, below the silt remnant containing the celt, a number of small chips and flakes along with a fine blade (Pl.8/5) were found on the eroded lower surface.

The blade, the few small flakes of chert and the larger ones of quartzite are heterogeneous in character. They were found in February 1984, right at the beginning of the survey, when there was no inkling of the geological or prehistorical situation that would be revealed by the future survey. The fine blade and the celt made hopes run high (which turned out to be justified), but at the time it was impossible to make any conjectures. The whole field of Quaternary geology and prehistory was entirely new in the context of Nepal and the investigations were pioneering. It was only after the detailed surveys in the following years that a picture slowly emerged. It has become clear now that those first artefacts from Basantapur are of a different cultural and geological provenance: the artefacts were in a reworked secondary position, having been removed from their original level by erosion, and one can only speculate as to where the

original horizon had been. It is probable, however, that the celt and the light-red pottery may have derived together, either from the top of the silt remnant or, more likely, from the thin cover of grey soil, while the other artefacts are not associated with the celt but probably derive from within the silt.

The colourphoto in Pl.250/2 shows the site when it was found in 1984. The photo in Pl.221/2 presents the site five years later, in 1989; the erosion having removed much of the yellow silt in those intervening years.

The celt is made on a small, flat cobble of soft quartzite material which was ground on both faces with the distal end being ground into a sharp, straight, symmetrical edge, exhibiting fine striations as use-marks. The blade is a fine specimen (Pl.8/5), with a prepared platform but no retouch. It is the only artefact of its kind in Dang, and it is unfortunate that it was found on surface, and right at the beginning of the survey, when everything was new and unknown. The other few flakes do not match up with the blade. A double corescraper, found six years later in the vicinity, derives from the top part of the yellow silt and is an interesting specimen, similar to the one at Basantapur SW (Pl.108/1), with a bifacial ridge on the upper face; it is a sumattalith-like tool with a steep unifacial edge around the entire circumference, a tool that goes well with the Brakhuti industry.

The dark-yellow silt at the site of the celt locality is unstratified and homogeneous, and is only 1.60 m thick above irregularly eroded bedrock. It is probably part of the colluvial Gidhiniya Formation (Fig.112), which at this place interfingers towards the valley with the yellow alluvial silts of the Babai Beds, which here are 4-5 m thick. The site has, however, been destroyed by recent heavy erosion, so that the question whether two or more cultural horizons were superimposed upon each other cannot be answered anymore.

At the last western houses of Basantapur village (Basantapur WW), in the dissected silt, a particularly fine corescraper (Pl.9/2) made on an elongate, angular quartzite cobble was found in 1984. It has a trapezoidal section and two steep unifacial edges opposite each other fashioned from the flat cortex. Delicate, regular retouch has produced two very straight, fine edges.

At the riverbank at Basantapur village, the Sitalpur Beds are exposed with black, mollusc-bearing clays at the bottom of the section up to 5 m, overlain, as at Dharpani, by yellow kankary silts and gravel pockets up to 13 m.

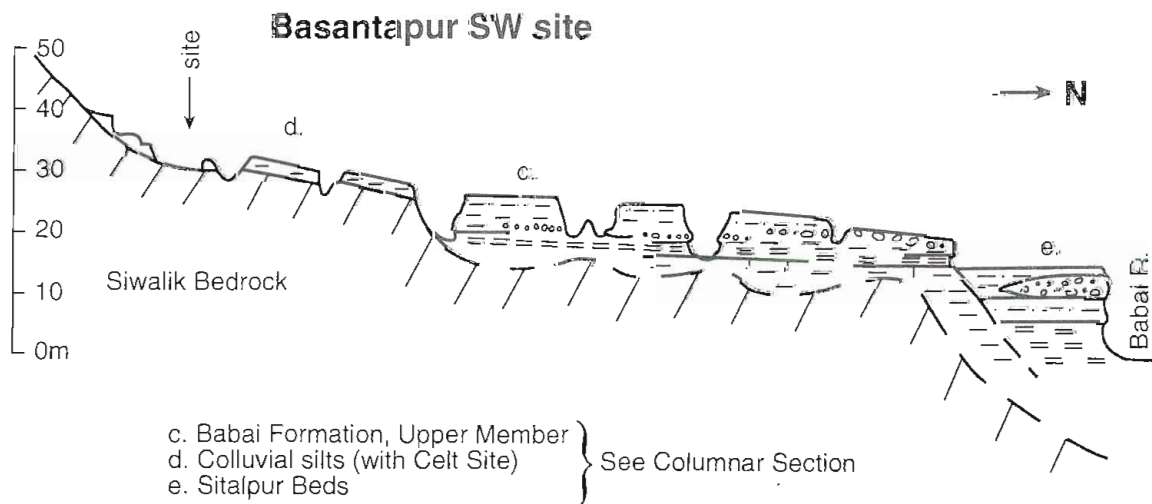


Fig. 112. Section at Basantapur W.

The Daingaoon site

This is a rather rich surface site of mainly small chert artefacts. It is situated at the very foot of the Siwalik slope to the southwest of Birtapachiya-Daingaoon village (Fig.113). The dissected reddish silt of the colluvial deposits abuts here against the Siwalik rocks. The silt surface is very weathered and is covered with kankar pellets and Siwalik pebbles. The site is situated 1.60 m below the actual silt surface, on an eroded, yellow silt surface containing abundant kankar pellets (Pl.222/1). It is not clear whether the silt belongs to the alluvial silts (though the photo in color points to this possibility) or to the colluvial silts of the Gidhniya Formation. According to the photo the site is just at the junction of the two. The site could not be relocated again in the labyrinthic badlands along the foot of the hills. And at the time of the initial survey the complicated geological situation was not clearly understood.

The site has a radius of about 20 by 20 m, bordered by 4-5 m deep gullies, except towards the hills. A thick surface scatter of mainly microlithic artefacts made of a variety of raw materials such as colourful chert, quartz, indurated shale and fine-grained quartzite, covers the surface. They consist mainly of waste flakes and chips and other debris but no discernible tools. This may be due to the short time spent on the collection, the sample of 35 artefacts being mainly concerned with the raw materials. The site is a surface site, as the silt in which, or on top of which, the artefacts were situated has almost entirely eroded away.

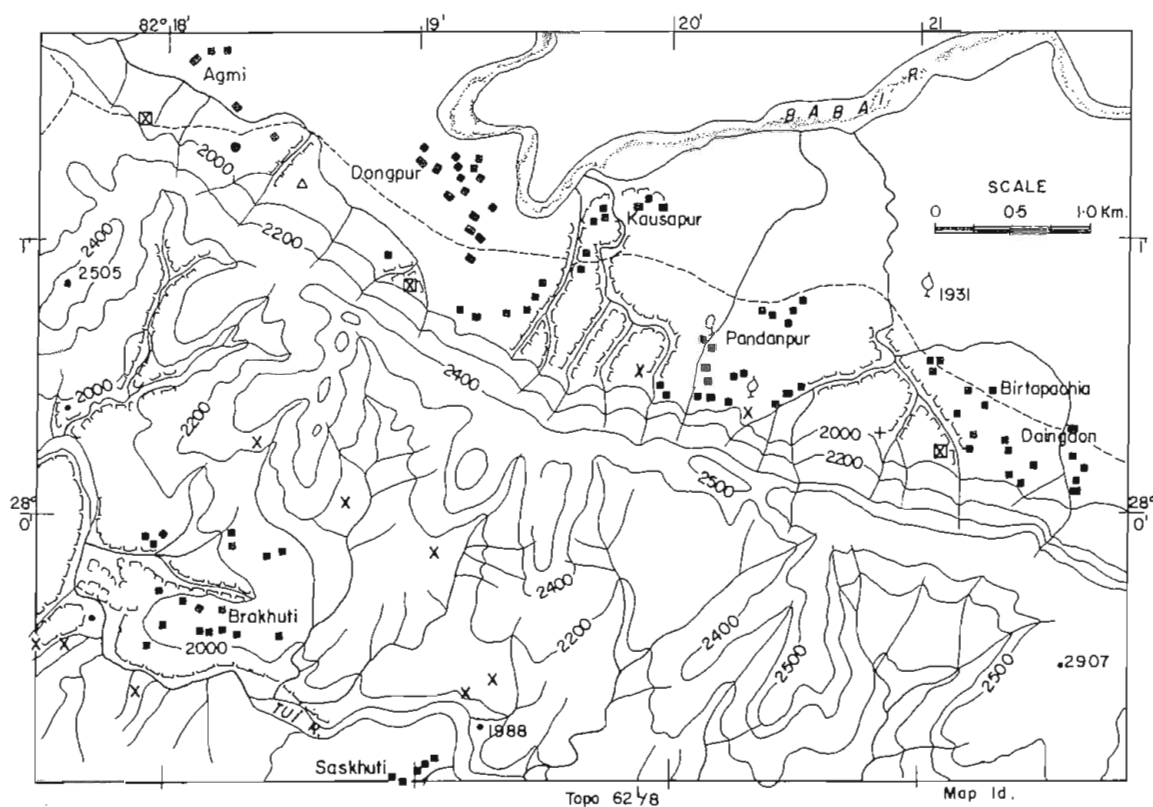
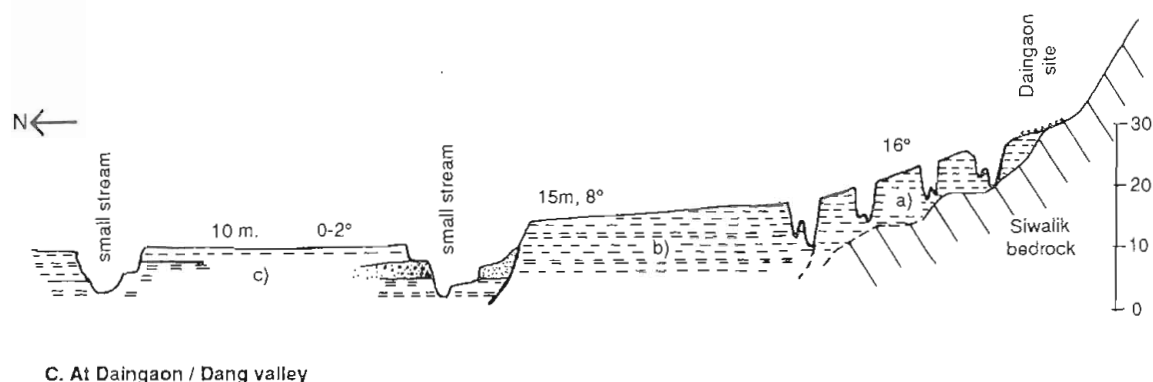


Fig. 113. Regional map 1d of Dang valley around Dongpur (legend see Fig. 17).



C. At Daingaon / Dang valley

Fig. 114. Section at Daingaon (after Corvinus 1991).

There are two elements in this sample: the majority of artefacts belong to an industry of small colourful silica artefacts of a microlithic character, but a few consist of somewhat larger flakes of quartzite of the type of the Brakhati industry (Pl.108/3 and Pl.109/1) with cortex platforms and the typical stepretouch on the platform edge. The microlithic artefacts include crude waste flakes and chunks of chert, two pieces of ocher and a haematite pebble with a dark red streak. There is only one retouched piece, two bladelets and a few blade-flakes and small, utilised flakes. One small quartzite artefact though, is interesting. It is an edge-rejuvenation flake (Pl.109/3a,b), struck from the glossy edge of a tool. A heavy gloss, like that on many tools from the Patu site in eastern Nepal, can be seen over the whole flake, except on the platform. This is the only artefact so far in the whole of Dang which exhibits this type of bamboo-working gloss. It must have been struck from the edge of an adze or another tool used for bamboo-working.

There is another interesting isolated find which differs from the other Daingaon artefacts. It was found in February 1990, when I tried to relocate the Daingaon site, but did not quite succeed (Pl.222/2). It is that of an adze-like tool (Pl.109/2)). While it resembles the Patu adzes, it has no gloss and is thicker and less well trimmed than the Patu adzes. It has a divergent, adze-like bifacial distal edge and is so far the only such tool in the Dang valley, apart from one other adze-like tool from Lalmatiya in the Deokhuti valley. It may not be a coincidence that the glossy rejuvenation flake at Daingaon was found in the vicinity of such an adze.

The three-tiered structure of the geomorphology of the southern part of Dang valley can be well observed in the neighbourhood of the Daingaon site (Fig.114). The red colluvial silt at the foot of the Siwalik hill slopes, with a steep gradient of up to 16°, is followed towards the valley by the stratified yellow-grey silts and gravel lenses of the Upper Babai Formation, with a lesser gradient of 8-10°, and, beyond them, in the central part of the valley, the flat, young 10-12 m terrace surface of the black clays and silts of the Sitalpur Formation. This is all quite clearly seen in the photo of Pl.222/2 (the adze locality): on the left are situated the colluvial silts of the Gidhiniya Formation, and further in the background the yellow stratified deposits of the Babai Beds form the more gentle terrace surface.

Birtapachiya

One other interesting tool comes from the Daingaon area, though lower down, near the river, at the juncture of several small nallahs near Birtapachiya. It is a classical side-chopper (Pl.9/1), found washed into the gully bed. It seems to belong to an older period, maybe the Early Palaeolithic. It is fairly rounded

and has a coating of lime and calcrete. It is a quartzite tool with a jagged unifacial edge of 70 degrees with no step-flaking, only shallow flakes struck off the cortex of the lower face.

Pandanpur area

The badlands continue to the west along the southern valley until one reaches Pandanpur village. A very well made corescraper on a cobble with two flat surfaces was found south of Pandanpur as an isolated find on an otherwise sterile silt surface at the very foot of the hills, where many weathered Siwalik sandstone blocks have fallen down the slope onto the silt. It is different from other corescrapers in that it has two parallel lateral edges not trimmed from the same lower cortex surfaces as usual, but obliquely opposite each other, one from the lower, the other from the upper cortex, so that it has a regular parallelogrammatic section, a fine tool.

West of the last houses of Pandanpur village, the silts continue to be heavily dissected by a number of small kholas from the slopes that join the Babai River at Kausapur village (Fig.113). A few flakes of Middle Palaeolithic appearance (Pl.109/4,5) (quite different from the Brakhuti flakes) were found in the easternmost stream of the Kausapur Khola at Pandanpur W. A grinding stone (Pl.110/1), an isolated find, and a handmade shallow bowl were found as surface finds nearby. The grinding stone has an interesting rill on its upper face, maybe caused by smoothing beads on a string. Such stones with rills have been found in South Africa in connection with ostrich eggshell bead-making.

The geology and stratigraphy at Kausapur, especially of the Sitalpur deposits, is quite complicated by numerous cut-and-fill structures. Near the Babai River, in a nallah, one sees black mollusc-bearing clays exposed as the lowest deposit of the Sitalpur beds, overlain by angular, pebbly gravel of mainly Siwalik origin, which is overlain in turn by reddish-yellow kankary silt, often with a red-brown soil cover, similar to the Dharpani profile (Fig.115). The black clays are seen everywhere at the bottom of the Sitalpur beds. Black clays are still seen, when one follows the main khola southwards (towards the hills), underlying a succession of yellow silt, dark clays and ochre-yellow silts up to 15 m (Fig.116). It seems that the Sitalpur deposits have replaced the deposits of the Babai Formation up to very close to the hills.

Nearer the river, the deposits of the Sitalpur Formation are very widespread, as at Basantapur and Dharna, and the black basal clays, often with a great abundance of molluscs, are exposed by erosion over wide areas, the overlying softer gravels and silts having been washed away, while the clays, being more resistant, are revealed. They are overlain, wherever the succession is still more or less complete, by grey-yellow silts. At several places, channel gravels in association with sandy silts can be seen resting against partially eroded cliffs of the Sitalpur Beds. A yellow, kankary silt is seen at places overlying both the clays of the Sitalpur deposits and the younger channel gravels being younger than both (Fig.117). Yet it is quite consolidated and contains an abundance of kankar pebbles, indicating a drier climate than today. As the lignitic, mollusc-bearing black clays at the type site of Sitalpur gave ages between 13 and 15 ka, the kankary silt overlying the black clays, must belong to the very end of the Pleistocene, before the climate started to ameliorate.

No prehistoric artefacts or sites have been found in these deposits.

Dongpur

West of Kausapur, the alluvium is cut up in a rather spectacular way. The alluvial deposits of the Babai Formation are more than 20m thick, as bedrock is not encountered below the dissected badlands. Dongpur village itself lies on the flat lower terrace. South and south-west of the village, the flat surface shows a „Knick-point“ or „shoulder“ along the northwest flowing khola as it runs towards Agmi (Fig.113). The deposits of the Sitalpur Formation are exposed at the „shoulder“, with the basal black clays and the overlying yellow-grey silts replacing the deposits of the Babai Formation.

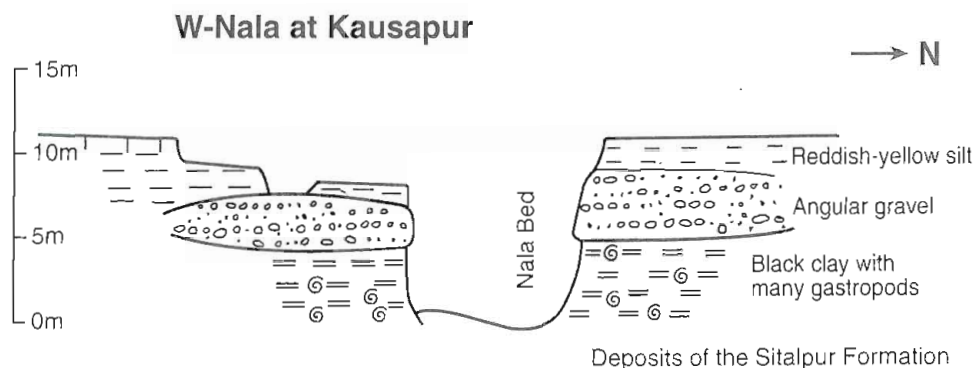


Fig. 115. Section at the W-nala at Kausapur.

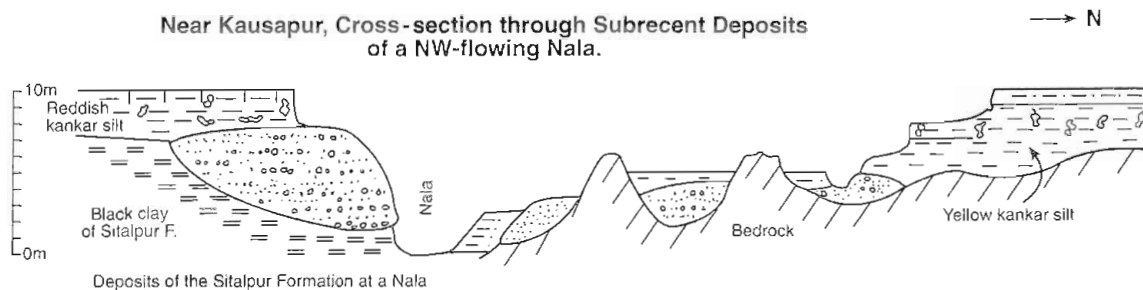
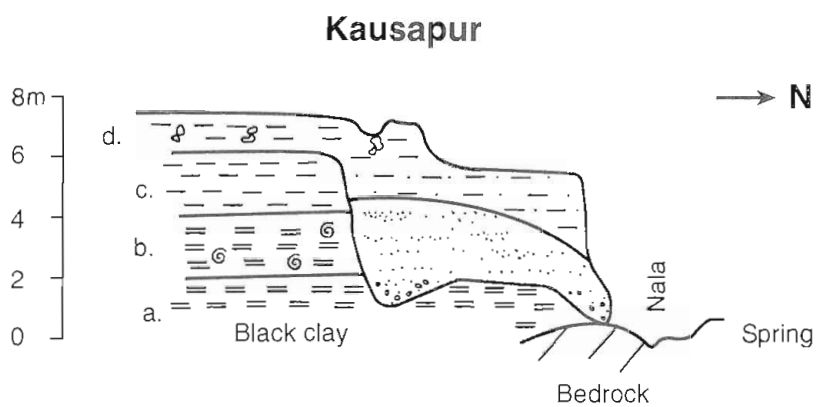


Fig. 116. Crossprofile through subrecent deposits of the Sitalpur Formation near Kausapur.



a. Black clay; b. Dark grey clay with gastropods; c. Grey-yellow silt; d. Channel gravel and sandy silts with calcareous concretions, cut into the older Sitalpur Beds. a., b., c. older Sitalpur Beds.

Fig. 117. Section at Kausapur.

The thick deposits of the Babai Formation southwest of Dongpur have become dissected in a dramatic fashion (Pl.223). The small streams from the hills have separated a barren, alluvial surface of the higher terrace from the foot of the hills, forming a „table“ with steeply dissected walls on all sides to a depth of 15m. In the background, looking north, one can see the plain of the younger Sitalpur terrace with fields and the village. To the west (in Pl.223) the Babai Beds interfinger along the foot of the hills with the coluvial silts of the Gidhiniya Formation.

Further west, across the badlands, at Dongpur W, another rather sensational feature presents itself: a big block of Siwalik sandstone perched on a column of silt of the Babai Beds 15 m high (Pl.243/2 and 224/1). The block on top preserves the silt below it from erosion. No more than 50-60 years ago the silt terrace surface was more or less intact, and much less dissected. I met an old farmer who told me that when he was a small boy he used to sit on the big block with his goats grazing around him on the undissected surface. Since that time people have been engaged in intense deforestation and overgrazing. The result is that the soft alluvial sediments have become devoid of their protective vegetation and are extremely vulnerable to the strong erosive activity of the streams from the hill slopes. This has caused the deep dissection into the badlands which we see today. It is a process which could be checked if the farmers could be made aware of this problem and started planting trees and shrubs instead of only cutting them down. But since there is no such awareness and the cutting of fire wood and fodder for the ever-increasing population of humans and cattle is continuing ceaselessly, the erosion will go on at an even accelerated rate.

Below the block at the foot of the silt column (Fig.118), a number of broken parts of celts and ground stones were found on the surface. They are residue artefacts from the top of the dissected surface around the block. Together with them a number of crude flakes of quartzite and chert were found, too, but no pottery. Evidently there once existed a site of probably Neolithic age with polished axes, ground stones and rough stone flakes. Eleven more ground stones were recovered to the northeast of the block, again on the eroded surface. They belong to the same site. Everything else which may have belonged to this site, and the site itself, have already been washed away. A fine corescraper of the Gidhiniya type was recovered at a level 13 m above the eroded surface, just 1 m below the original terrace surface.

A small microlithic locality, Dongpur S, containing a few tools of thumbnail-scrapers, small retouched scrapers, a burin-like tool and a microlithic core, all made of chert and quartz, was found south of Dongpur village at the very foot of the hills where the silt once abutted against the hills but is now almost non-existent. The artefacts lie on the denigrated surface. Only a small sample was taken from this locality. (The slides documenting it were stolen, along with field-books etc. in Madras in 1989. Therefore, unfortunately, the exact place cannot be relocated in the labyrinth of badlands).

Agmi

At Agmi the Babai River flows very close to the southern hills so that almost all the older alluvial deposits have been removed by erosion. Looking back southwards from Agmi, one can clearly see the fan-like appearance of the deposits of the Gidhiniya Formation along the flank of the Siwalik hills with a gradient steeper more than 10 degrees, while the young surface of the inner valley with the Sitalpur beds is flat, like a table. A small site of chert and quartzite artefacts was recorded at the edge of the Agmi silt fan, where the surface is dissected along its southern edge. The artefacts are on the surface, but derive from the uppermost part of the silt. The small collection is selective and was meant to record the variety of raw materials: colourful cherts, quartzite and „tuff“. The artefacts are microlithic, though there are no microlithic tools. The locality has now been entirely destroyed by erosion.

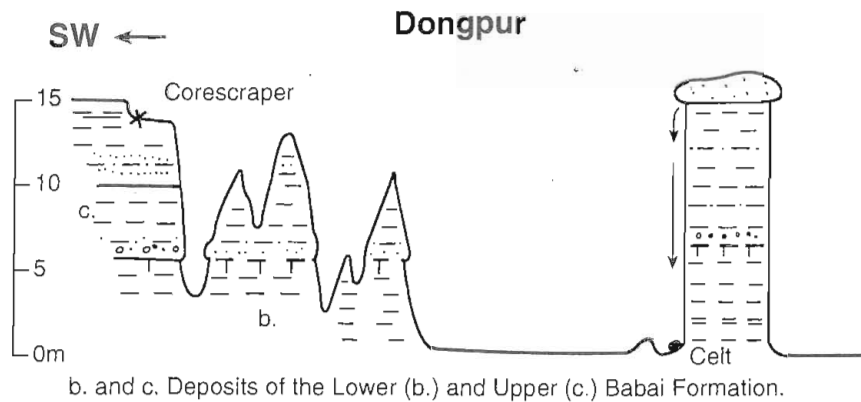


Fig. 118. Section at the Dongpur block.

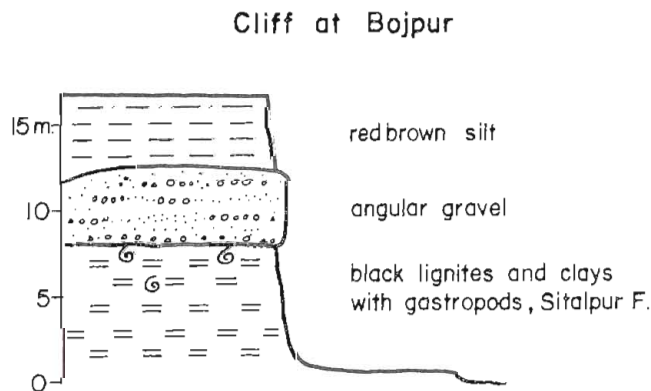


Fig. 119. Profile of deposits of the Sitalpur Formation at Bojpur on the Babai river.

Bojpur

West of Agmi the Babai River flows against the southern hill slopes of the Siwaliks, so that almost no Quaternary deposits are left on its left bank. Opposite, on the right bank, the river cliff at Bojpur (see map of Fig.15) clearly exposes the deposits of the Sitalpur Formation with its black mollusc-bearing clays and lignite horizons from the lower part up to a level of 8 m, overlain conformably by angular, pebbly grey gravel up to 14 m. On top is a reddish-brown silt, forming the 15 m-high, flat terrace surface of the Sitalpur beds (Fig.119).

Sitalpur

Near the village of Sitalpur, on the north side of the Babai River (see maps of Fig.15 and 28), the cliffs at the riverbank and along the road to Tulsipur expose the black mollusc-bearing clays and lignites of the Sitalpur beds. The best exposure is a cliff at the riverbank between Sitalpur and Kachila (Fig.120). It is the type site for the deposits of the Sitalpur Formation. The lower part consists of brown-to-dark-grey clays of a swamp-to-pool environment with roor casts up to about 6 m, overlain by 1.50 m of several thin horizons of lignites which are full of gastropods and diatomaceous clays, and also contain molluscs. A pronounced thin black layer of lignite overlies these beds at about 8 m. Above the lignitic mollusc-bearing

horizons there are colourful mottled clays and clayey silts of colours varying from dark-grey to purple-brown (and pink, when dry). They contain plenty of calcareous nodules and root casts. A concentration of gastropod shells in a powdery diatomaceous clay horizon forms a well-defined layer at a level of 11.20 m. The top of 3.50 m consists of beige-brown silt and clayey silt with no root casts but with the beginning of a kankar pellet formation.

The lignites and mollusc-bearing black clays are also exposed along the road from Sitalput to Tulsipur. From here we took lignite samples for C-14 dating and for pollen analysis. The C-14 dates, carried out by Sarkar from the BSIP in Lucknow in 1992 (pers. comm.) have given ages of $13,270 \pm 190$ BP (BSIP No.BS-1008) for charcoal from the upper lignite horizon at a depth of 1.80 m below surface, and of $15,320 \pm 280$ BP (No.BS-1009) for charcoal from the lower lignite horizon at 3.30 m below the surface (Fig.121, see also Fig.14). This gives a terminal Pleistocene age for the upper part of the Sitalpur Formation. The black-to-brown clays at the bottom of the Sitalpur cliff continue below the recent river level to an unknown depth.

We took 14 samples from the lignites for pollen analysis.

Sitalpur S is a small locality south of the Babai River and opposite Sitalpur village, where a few remnants of the upper yellow silts (see map of Fig.28) of the Babai Formation can be seen along the foot of the hill. A small collection of artefacts of quartzite and chert was made from the upper level of the yellow silt. A corescraper (Pl.110/2) is a fine example of this typical tool type. The flakes conform to the Brakhu-ti industry.

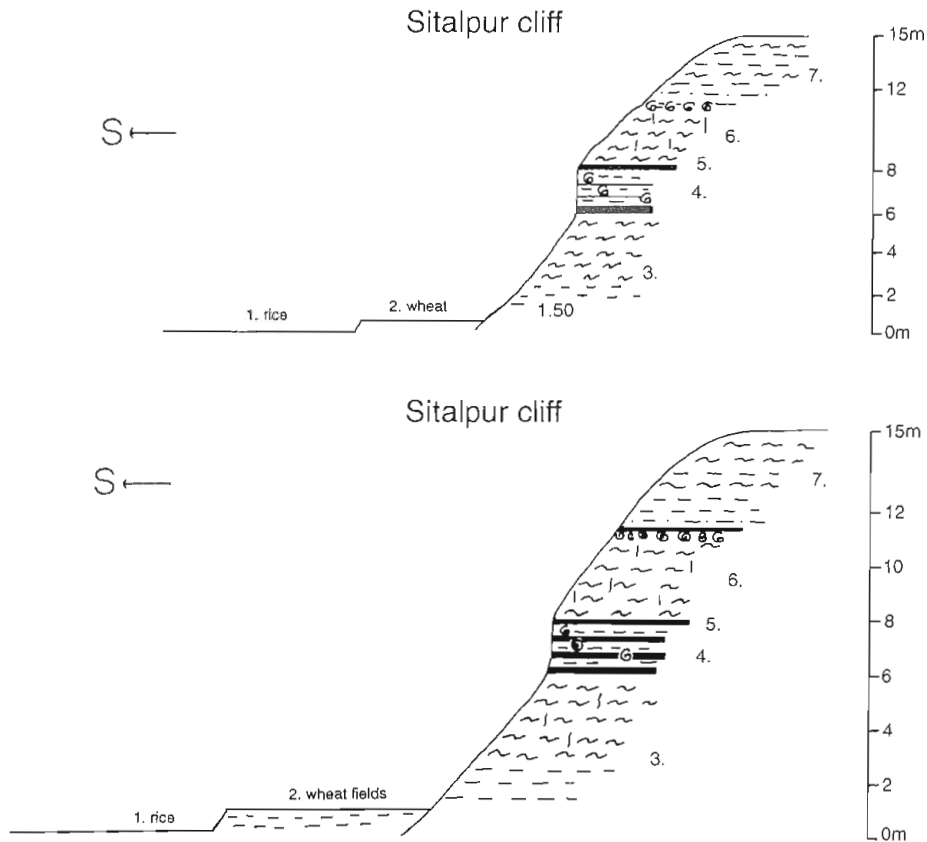


Fig. 120. Section of the Sitalpur cliff.

Sitalpur Cliff on Babai River/Dang

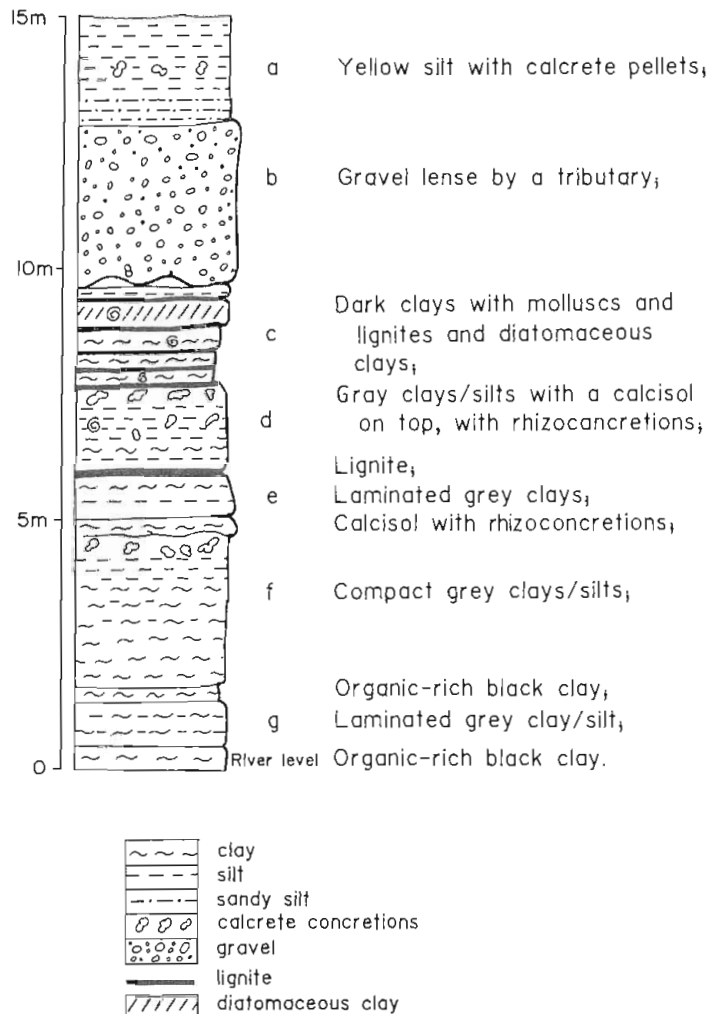


Fig. 121. Profile at the lignite section at Sitalpur.

2.1.3. Sites in the Deokhuri valley

The Lamahi sites

Lamahi was the very first prehistoric site discovered during the survey. It was found on 29th January 1984 near Lamahi village in the Deokhuri valley, while I was carrying out biostratigraphical research in the Siwaliks at the Surai Khola section. I was on my way to look at another promising Siwalik section along the Arjun River, which cuts through a Siwalik range separating the southern Deokhuri Dun valley from the northern Dang Dun valley. When I saw from the car the yellow, almost bare alluvial silt deposits near Lamahi along the northern margin of the Deokhuri Dun, I felt I had to stop and look at these dis-

sected deposits. They were remnants of alluvial or colluvial deposits along the northern rim of the valley, heavily dissected by erosion after the strong deforestation in the Dang-Deokhuri area. I had become very doubtful in the previous 8 months whether prehistoric people ever did penetrate through the thick Terai forest belt and over the first mountain ranges of the Siwaliks into the wide Dun valleys. But this looked definitely promising.

After the first few steps I found some broken pieces of quartz and chert, very foreign material in these silts, and also some quartzite. Then a few small flakes and finally a small discoidal core of quartzite together with a fine, backed lunate of chert turned up. These findings were convincing evidence that microlithic occupations had existed there, and during further search it became clear that several localities with microlithic artefacts were present, eroding out from the uppermost part of the dissected silt.

Four small localities, called Lamahi 1 to 4, were recorded north of the main road, about 1/2 km northeast of the eastern end of Lamahi village (Fig.122), all in association with yellow-to-reddish silts of 1-2 m thickness overlying bedrock of Lower Siwalik rocks. The reddish-yellow, unstratified silts consist of pockets or remnants of a once more extensive surface. The silts seem to be of colluvial nature, having derived as hillwash fans at the foot of the hills from the weathering of the Lower Siwalik mudstones on the hills.

The Geographical situation of the Lamahi sites. Lamahi 1 site is situated 60 m north of the main road, beyond a low Siwalik hillock. The Lamahi sites lie just below the 900 foot (275 m) contour line, while the Rapti River, 4 km to the south, over the subrecent lower terrace of cultivated fields, straddles the 800 foot (245 m) contour line (Fig.122). Unstratified yellow silts of about 1m thickness about against the Siwalik rocks. Microlithic artefacts of chert, quartz and quartzite are scattered partly on the rocky Siwalik surface, partly on the eroded silt surface and – more concentrated – in the gullies, into which they have been washed down by erosion from the silt.

The artefacts which lie on the rocky surface must have derived from the surface or the uppermost horizon of the yellow silt. The silt once extended further up the slope and covered the rocky surface (Pl.224/2 and Ph.88-Sc) and later left behind the artefacts as residue.

The larger artefacts were made of quartzite and „tuffaceous“ material; the smaller microlithic ones, of quartz and colourful cherts. A fine double corescraper came from the yellow silt surface west of site 1. The gully with the highest concentration is 12 m west of the northwest edge of the low yellow-red silt hillock of site 1. A number of flakes, two of them fitting each other, were taken from this gully. Microliths of chalcedony and chert scatter the ground between two rocky outcrops just south of the silt surface towards the road. The main site, with mainly small quartzitic artefacts, is on the yellow-red silt surface (Ph.89-Sc) and within the uppermost part of the silt.

About one 130 m to the east of the main microlithic concentration of site 1, in erosional gullies at a locality called Lamahi 1 E, only large quartzite artefacts but no microlithic elements were found, i.e. a number of choppers, cores and flakes, while above the gullies the quartzite artefacts of a small flaking spot of 2 x 1 m in area were collected. These latter consist of flakes all struck from the same quartzite core, and no microliths were associated with them.

Lamahi 2 site (seen in Pl.224/2, in the back) is about 260 m north of the road and about 160 m north of site 1, at the foot of the Siwalik hills on a shallow yellow silt expanse similar to that of site 1. It once formed a continuous silt surface. The artefacts, mainly microlithic, were found on the slopes of the silt – not on top of it – having been washed out from a horizon in the upper part of the silt. A few artefacts were also lying on bedrock, i.e. on the rocky surface between small Siwalik sandstone ridges to the west of the yellow silt and about 4-5 m higher than the artefacts originally found on the silty slopes. Remnants of silts can be seen at various places in the vicinity and it is obvious that the original silt expanse was more extensive and reached to a higher level, and the artefacts now lie as residue on the rocky surface.

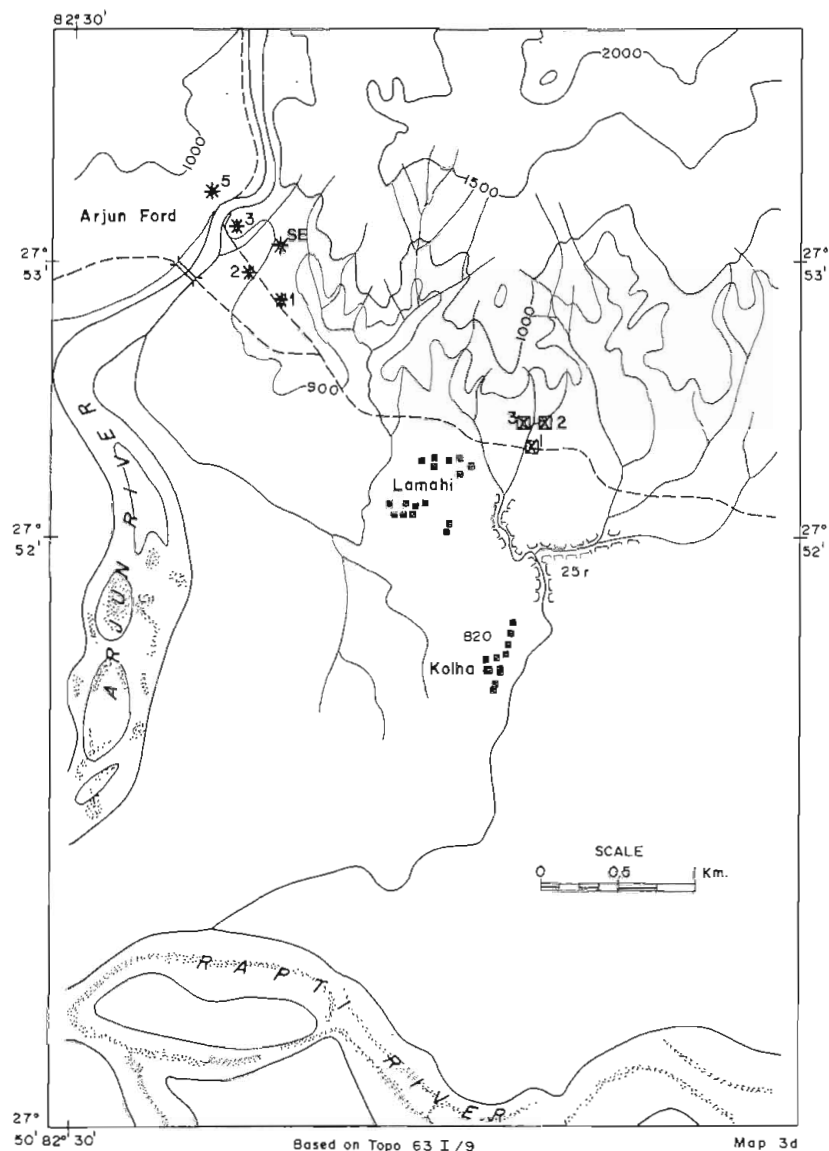


Fig. 122. Regional map 3d of Deokhuri valley with Arjun and Lamahi sites (legend see Fig. 17).

The recent vegetation is thorny scrub, mainly low acacia thorn trees on rocky outcrops, while the silt surfaces are bare and desert-like, due to overgrazing by cattle. On the Siwalik slopes the vegetation is open shrub- and bushland. In recent years the area has been fenced in, to keep the cattle out, and grasses are beginning to cover the once bare silt surface.

Lamahi 3 site is an isolated low hummock (only 2 by 3 m in dimension) of reddish-yellow silt, a remnant of the once extensive silt cover, about 1.5 m thick, above Siwalik bedrock. It is about 200 m to the west of Lamahi site 1. Artefacts of quartzite and „tuff“ seem to have eroded out from about 0.40 m below the surface and are scattered on the slopes. There are no microliths, just some rough flakes and a few corescrapers.

Lamahi 3, cutting-I is a small test cutting into the reddish-yellow silt hummock, from the surface down to 1m. It revealed no artefact horizon at all, only the unstratified silt, with a few pieces of naturally broken „tuff“. The surface of the Lamahi 3 hummock is truncated. The few artefacts found on the slopes must have derived from the top part of the silt which is eroded.

Another locality with only a few artefacts of quartzite and no microliths is Lamahi 4. The silt badlands at this place are dissected to a depth of 5-6 m. The artefacts consist merely of a few isolated crude flakes and a corescraper, all found in a gully. The outcrops belong to the same yellow silts as at sites 1 to 3.

All the Lamahi sites lie just below the 900 foot (275 m) contour line and have an elevation of about 25 m a.m.s.l. of the Rapti River which flows 4 km to the south.

Description of the artefacts of the Lamahi site complex. The Lamahi 1 site. Apart from some medium-sized artefacts of quartzite the majority (62 %) of the 204 artefacts are made from chert. The few quartzite flakes which are present tend to be rather non-diagnostic and are too few in number to allow for a classification. There are, however, 2 prepared quartzite cores, one is a prepared, discoidal levallois core and one is a prepared single-platform core. They compare well with the Middle Palaeolithic Arjun 3 assemblage which is only 2 km to the north-west. A few smaller flakes and cores of quartzite, however, belong to the microlithic assemblage, and one fine backed lunate is also made from quartzite. The local quartzite is, however, not very suitable for manufacturing microliths.

The microlithic tools of La1 (Lamahi 1) include:

- 29 retouched artefacts;
- 4 non-retouched bladelets;
- 4 snapped bladelets;
- 4 non-retouched points;
- 5 utilised microlithic flakes;

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The retouched pieces and flakes can be classified as follows:

- 1 backed lunate;
- 3 backed bladelets (Pl.148/10);
- 5 thumbnail-scrapers (Pl.11/5, Pl.149/1);
- 7 end-retouched blades & microliths (Pl.149/4,5, and 6);
- 5 side-retouched (Pl.11/2);
- 2 geometric tools, retouched at side;
- 5 otherwise retouched pieces;
- 1 small scrapers (Pl.11/4);

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A few other microliths (11 specimens) are slightly geometric in form (Pl.149/9 and Pl.149/16);

Small blades and bladelets are rare (7 specimens), (as are fluted cylindrical cores). A few of the bladelets are snapped, probably intentionally (Pl.11/3, Pl.149/4 and 5).

A number of the microlithic flakes are utilised, but not retouched.

The few points, somewhat larger than microliths, are unique to the Lamahi site 1 (Pl.149/13, 14 and 17). They are not retouched, but they are utilised. One is a levallois point.

Medium-sized utilised flakes, too, form part of the Lamahi 1 site (Pl.149/18).

The microlithic cores of La 1 are well fashioned. There are a variety of core types:

- 2 prepared, truly discoidal cores, bifacially and radially trimmed (Pl.10/4);
- 3 partly bifacial, discoidal cores;
- 4 partly bifacial, flat discoidal cores;
- 9 unifacial cores, discoidal in shape, but with the lower face of cortex (Pl.10/5), (Pl.148/1);
- 3 polyhedral cores with several platforms, often at right angles;
- 1 single-platform, cylindrical core with a prepared platform (Pl.10/6);
- 3 small, irregular cores with one platform;
- 2 two platforms opposite each other;
- 3 alternate bifacial cores (backed cores), often with a cortex back (Pl.148/5a,b);
- 5 irregular cores.

Besides the microlithic cores there are three larger, prepared levallois-like cores and three prepared, single-platform cores.

Three corescrapers (Pl.147/2) were found in the vicinity, though not in direct association with the microlithic concentration and it is unclear whether cobble tools were still part and parcel of the microlithic tool kit as a heavy-duty component, or whether they belong, along with the three choppers from La1E (Pl.147/1), to the older quartzite assemblage of that site.

The Lamahi 1E (1987) assemblage (53 artefacts) is not microlithic. The specimens collected are 11 quartzite artefacts from an eastern gully and 42 quartzite artefacts from the nearby surface, which constituted a small flaking spot. They all seem to have eroded out from the yellow silt, and they all were struck from one large quartzite core. The core is not present but must have been a prepared, probably discoidal core, because many of the well-made flakes show radial flaking on their dorsal faces. Two of the flakes fit together (Pl.150/1a-d). It is a flake industry with the intent of producing usable flakes. Many (36 %) of the flakes have usemarks and one is a scraper. There is not a single flake with a cortex platform; all have plain or prepared platforms. The assemblage resembles a Middle Palaeolithic industry, akin to the Atjun 3 assemblage. The artefacts are patinated and are rather rounded.

The three choppers, one of them a unifacial end-chopper (Pl.147/1), and the two cores from the eastern gullies do not seem to belong to the assemblage of the flaking spot, the few associated flakes having cortex platforms and streptotouch at their platform edge, while two of them have cortex opposite the platform, a typical feature of the Brakhuti industry. One single-platform core, depicted in Pl.150/2a, b, is made of „tuff“ and displays the uni-directional pattern of flake detachment. This tool is one of the border cases, where it is difficult to say whether it was only a core or whether it was also used as a side-chopper, as there are usemarks at the edge. Only one flake from the gullies belongs with certainty to the flaking spot assemblage. One large core from the gullies is interesting: it has a prepared platform from which flakes were struck. Two flakes are still stuck on the platform, the percussion blows not having been strong enough to detach them from the core.

There seem to have been three different manufacturing techniques at Lamahi 1: the prepared core-flake technique from the flaking spot at La1E, the choppers and flakes exhibiting the Brakhuti-type technique from the gullies at La1E, and the major microlithic assemblage of La1. It is, however, unclear whether different populations were responsible for the differences or whether these are expressions of different requirements of one and the same people, with features inherited from earlier periods.

The Lamahi 2 site. The 173 (144+29) artefacts from the Lamahi 2S and La2E and W localities are mainly microlithic and made of chert, although a good percentage of quartzite is present. The quartzite flakes are not very diagnostic. The microliths are similar to those from Lamahi 1, though there are not so many and so well-made tools at Lamahi 2.

The 29 non-microlithic artefacts of the La2W (1987) locality, in erosional gullies west of the La2 microlithic site, are not included in the microlithic analysis.

The Lamahi 2 and 2S microlithic tools include:

- 1 backed lunate in quartzite, the only typical lunate at Lamahi (Pl.148/8);
- 3 backed bladelets (Pl.148/9);
- 2 thumbnail-scrapers (Pl.149/2 and 3);
- 4 end-retouched pieces;
- 3 side-retouched pieces;

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13

- 7 unretouched blade-flakes and bladelets (Pl.149/7 and 8);
- 4 unretouched pointed flakes;
- 7 utilised microlithic flakes (Pl.11/8 and 9);
- 2 utilised snapped flakes (Pl.11/1);
- 6 medium-sized utilised flakes, made of quartzite, are of levallois-like prepared pattern (Pl.10/1, 2 and 3);

A number of the microliths are well shaped, either radially trimmed (Pl.11/8 and 9), or pointed (Pl.11/6 and 7).

A few have slightly geometric shapes; some of which are included among the retouched microliths (Pl.149/10, 12 and 15).

The microlithic cores of Lamahi 2 are not so characteristic as those from Lamahi 1, though they are comparable. They are all made from chert. There are no discoidal, bifacially prepared cores as there are at La1. The cores include:

- 2 discoidal unifacial cores (but not such well-shaped round forms as at La1);
- 3 polyhedral cores, one with 3 platforms;
- 1 single-platform cylindrical blade-core (Pl.148/2);
- 3 single-platform irregular cores (Pl.148/3, 4 and 7);
- 1 double-platform core;
- 3 alternate bifacial, backed cores (with a cortical back) (Pl.148/6a,b);
- 2 irregular cores.

Besides the microlithic cores there are four non-microlithic quartzite cores: two fine discoidal levallois cores, La2E (Pl.146/3 a,b), a polyhedral core from La2W and one large single-platform core from La2W.

There are also a number of medium-sized quartzite flakes and a cylindrical, ground stone.

In addition there are a few heavy-duty tools of quartzite at Lamahi 2, but, as at Lamahi 1, they are not directly associated with the microliths. They include an oval uniface of quartzite (Pl.148/11), four corescrapers and a side-chopper, all of which are uniaxially trimmed, as well as three scrapers and a few trimmed undiagnostic pieces.

A few of the quartzite flakes from La2E and W (1984) (Pl.10/1-3) are levallois-like being similar to those of Arjun 3, and are associated with a prepared discoidal core.

The 29 artefacts from the locality La2W (1987) which are not microlithic consist of well-made quartzite flakes, associated with a fine uniaxial side-chopper, 3 scrapers and 2 prepared discoidal cores, which reinforces the similarity to the Arjun 3 site nearby.

The artefacts from the Lamahi 3 site are rather crude and heterogeneous in type and raw material, and not comparable with the microlithic sites of La1 and La2. There are some 20 microliths of chert, but there are no microlithic tools. The larger quartzite flakes are non-diagnostic, except seven prepared levallois-like flakes. The heavy-duty tools include an end-chopper, a round uniaxial chopper, five corescrapers and a fine uniface.

Tab. 4: Classification of tools and cores from Lamahi 1 and 2.

Microlithic tools and utilised blades	Lamahi 1	Lamahi 2
2 backed lunates	1	1
6 backed bladelets	3	3
7 thumbnail-scrapers	5	2
11 end-retouched microliths	7	4
8 side-retouched microliths	5	3
5 otherwise retouched microliths	5	–
2 geometric tools	2	–
1 scraper	1	–
8 unretouched points	4	4
24 geometric flakes	11	13
11 utilised bladelets	4	7
12 utilised microlithic flakes	5	7
6 utilised snapped flakes	4	2
Non-microlithic artefacts		
9 utilised flakes	3	6
11 utilised flakes from the La1E-flaking spot	11	–
1 levallois-like point	1	–
1 cylindrical ground stone	–	1
Cores		
Microlithic cores	1984/1985, 1987	1984/1985, 1987
2 discoidal, bifacial, radially trimmed	2	–
3 discoidal, partly bifacial	3	–
4 flat, discoidal, partly bifacial	4	–
11 discoidal, unifacial (lower face)	9	2
6 polyhedral cores, several platforms	3	3
2 cylindrical cores	1	1
6 single-platform cores	3	3
3 double-platform cores, opposite platform	2	1
6 alternate bifacial, with cortical back	3	3
7 irregular cores	5	2
Non-microlithic cores		
5 levallois cores	3	2
3 prepared single-platform cores	3	–
1 polyhedral core	–	1

Of heavy-duty tools (none directly associated with the microlithic concentration), 7 are at locality La1E and 11 at La2W and La2E.

Heavy Duty Tools:	Lamahi 1 E	Lamahi 2 (mainly W)
1 unifacial oval chopper	1	–
1 unifacial round chopper	1	–
1 end-chopper	1	–
1 side-chopper	–	1
1 uniface	–	1
7 corescrapers	3	4
4 scrapers	1	3
2 worked pieces	–	2

Summary of the Lamahi site complex. Lamahi 1 is a microlithic site with a total of 204 collected artefacts (166 from La1(1987); 14 from La1(1984), 10 from La1 top (1987); 8 from La1W(1984) and 6 from La1E(1985). Of these the vast majority are microlithic, while a small percentage consists of prepared quartzite flakes and prepared levallois-like cores. There are a few large heavy-duty tools just east and west of the actual site of concentration of the microliths (at La1W and La1E5). It is not clear whether they belong to the microlithic assemblage as a heavy-duty component or are older.

Lamahi 1E (with 53 artefacts) is not microlithic but comprise prepared quartzite flakes (at a distinct flaking spot) and a few heavy-duty tools, mentioned under „heavy-duty tools“.

Lamahi 2 S is microlithic, with a total of 173 collected artefacts, of which 16 are non-microlithic, including a uniface, and three corescrapers, mentioned under „heavy-duty tools“.

Lamahi 2W (with 29 collected artefacts) is not microlithic, but comprises levallois-like prepared quartzite flakes and two prepared discoidal cores, together with a side-chopper, a corescraper and three scrapers, mentioned under „heavy-duty tools“.

Lamahi 3 is very heterogeneous, with a few microliths of chert, while the rest of the artefacts are of quartzite and „tuff“ and are rather crude and non-diagnostic, except for a fine, large uniface, an end-chopper, a round unifacial chopper of the Gidhiniya type and a few corescrapers. Some of the flakes are prepared in the levallois fashion.

The assemblages from Lamahi 1 and 2 belong to a microlithic industry with a major tool component of backed lunates, backed flakes, thumbnail-scrapers and side- and end-retouched microliths, together with few bladelets and few geometric forms. The microlithic flakes of Lamahi 1 and 2 show a majority (40.5 %) of flakes having a plain platform (Fig.18), while 14.5 % are prepared and 20.5 % still retain cortex platforms. The vast majority of flakes (81 %) have no cortex on their dorsal faces (Fig.19). The blade/bladelet element represents only 6.5 % of all the specimens, and the presence of stepretouch on the platform edge amounts to only 26 % (Fig.20) as compared with the much larger percentage exhibiting this feature in the Brakhti industry. The diagram depicting the dorsal flake scars (Fig.21) shows a majority (41.5%) of flakes which have scars of flakes detached from the same platform as the flake itself, indicating that the major core type was a single-platform core, whereas radial flaking is rare (4.5 %).

The quantitative characteristics are shown in Figures 22-25, the great majority (61 %) of flakes being smaller than 3 cm (Fig.23). A narrow-peaked line diagram with a peak at 0.3 marks the Th/B ratios, indicating that 58 % are thinner than 0.4 (Fig.25). The B/L ratios show that only 3.5% are narrower than 0.5, pointing to the rareness of blades (Fig.24). The platform angle of the flakes are in 65.5 % of the cases smaller than 110 degrees (Fig.22).

The raw material of almost 60 % of the artefacts consists of chert; „tuff“ is negligible, but still present; while quartzite is still quite prominent at 30 % (Fig.26). The artefact composition is shown in Fig.27, revealing the majority of the Lamahi artefacts to be non-retouched, non-utilised flakes and other waste. The blade component is small. The tools and utilised flakes are summarised in the table at page 162.

The Middle Palaeolithic Arjun 3 site (see below), which used a levallois technique is only 2 km away to the northwest of the microlithic sites of Lamahi. The presence of a few levallois cores and prepared flakes at a few localities at Lamahi indicates two possibilities: either 1) the microlithic sites of Lamahi 1 and 2 are superimposed on localities where previously Arjun 3 people left signs of their activity, and erosion has exposed the older horizon; or 2) the microlithic industry is older than generally assumed, shifting back into the Late Pleistocene, and with an inherited levallois element.

The two other microlithic sites of the studied area, Bhatarkund 1 and the Ammapur sites, which are essentially microlithic and quite similar to Lamahi, have a prepared flake/core element of quartzite associated with the microliths. Ammapur has only 1 levallois flake but no prepared cores, but Bhatarkund has a definite levallois element (see prepared platforms in Fig.19, and radial flaking in Fig.21).

One interesting feature is that all three site complexes have a heavy-duty tool component of choppers and corescrapers directly or indirectly associated with the microliths. At the Lamahi site complex, choppers and corescrapers, while present, are not in direct contact with the actual microlithic concentrations, merely in close proximity of only a hundred metres or so to the west and east. The Ammapur sites have choppers and corescrapers, too, in direct association with the microliths. Only the Bhatarkund 1 site has no choppers and no corescrapers directly associated with the microliths, though it does have some prepared quartzite flakes.

After the description of Lamahi, the very first site complex discovered during the survey, that of the sites in the Deokhuri valley will now be recorded in the order of their appearance from east to west. The stratigraphy of the Quaternary deposits in the Deokhuri valley has been described in chapter III.2.3.

At the very east of the Deokhuri basin, a number of well-preserved sites are found on the south side of the Rapti River, namely east of Bhalubang (Fig.123) where the river emerges from the mountains into the valley and has formed, on both sides, high terraces on which a conspicuous red soil has developed. Of these terraces only discontinuous remnants are left, at Lape, Sanpmarg and Bhalubang. At Bhalubang, the Deokhuri valley opens up westwards into the wide Dun valley. Remnants of the higher, older terraces are located far apart from one another along the northern and southern rims of the Deokhuri valley, while the wide, central part of the valley is filled with young Holocene sediments, as in Dang valley, forming a low terrace of an average 10 m height above river level.

Lape

The easternmost site, east of Lape village (discovered on 16th February 1990), is situated on a large remnant of the once extensive high Terrace I at the very eastern part of the Deokhuri valley. The height of the terrace surface is approximately 20-25 m a.r.l. and remnants of a deep red soil can still be seen covering a thick alluvial silt. The stratigraphy can not be seen, as the whole terrace seems to consist of silt. It is probable, though, that it is similar to the nearby Sanpmarg terrace. A few artefacts are eroding out from the silt, though they are not frequent, and the exact horizon could not be established. The few artefacts are cobble tools similar to the Sanpmarg site (see below).

They consist mainly of choppers.

One is a fine, but very weathered side-cum-end-chopper, made on a long, flat cobble (Pl.130/1). The straight lateral edge was made by simple unifacial secondary trimming of mostly step-flakes, and the end edge by only three primary flakes, but no secondary retouch. The tool is too weathered to allow description of the trimming, but the end edge is well defined. The upper face consists of a flat surface of cobble cortex.

Another is a pointed end-chopper (Pl.130/2), made on a split cobble, the lower face being the split surface. The point of the apex is well shaped and was trimmed by a few shallow flakes, while the rest of the edge was made by only four primary flakes.

A small pointed chopper is made on a flat cobble and trimmed by seven shallow primary scars and a few finer scars at the point (Pl.130/3).

The high terrace at Lape once continued westwards and joined the high terrace at Sanpmarg, east of Sanpmarg village. Now the two are separated by low-lying Holocene alluvial terrace ground.

Sanpmarg

The most interesting site in this area is that of Sanpmarg, 1km east of Sanpmarg village, where a terrace remnant with a deep red soil on top borders the Rapti River. It is, like Lape, a remnant of the once extensive older terrace surface along the southern bank of the river. It yielded an assemblage of interesting cobble tools from a palaeosol. The site was first discovered in February 1989, and was studied in February 1990 and October 1993.

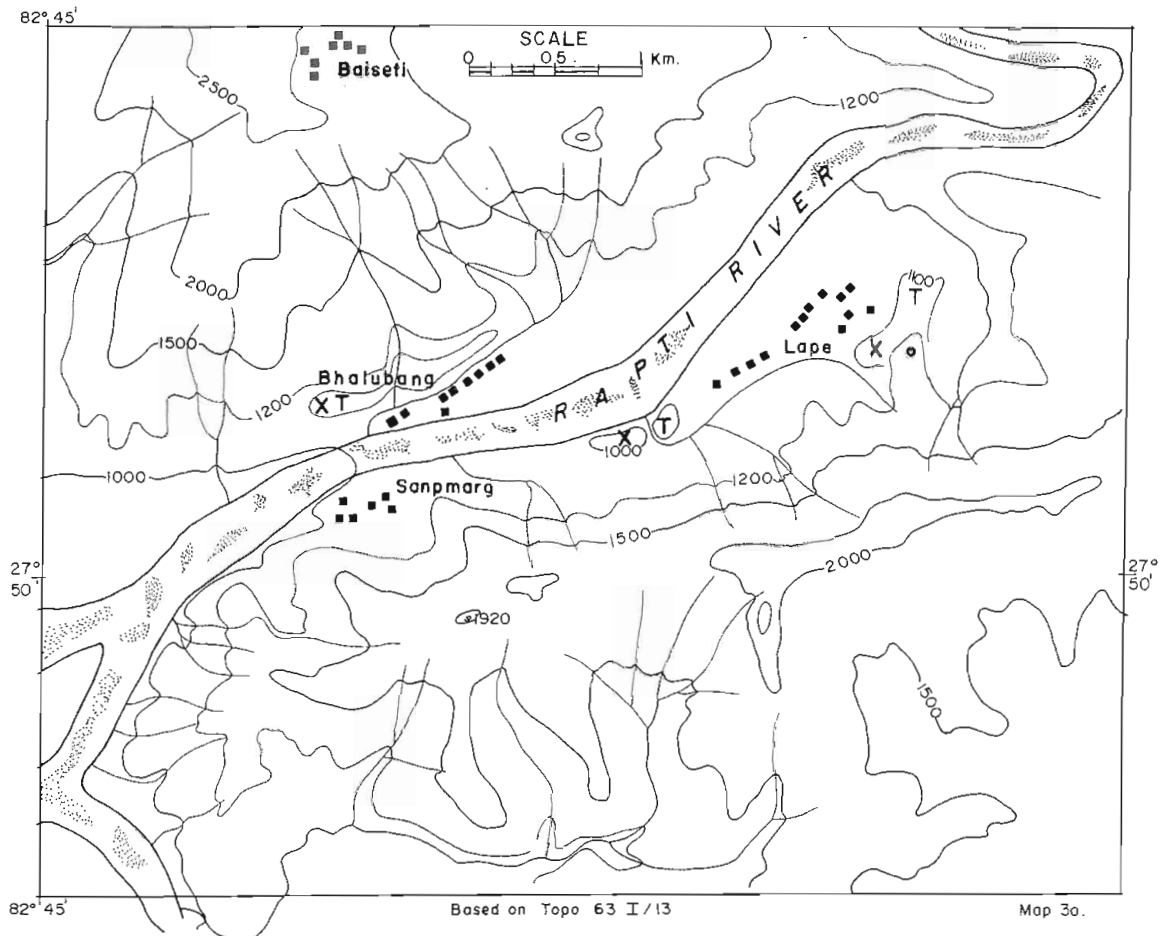


Fig. 123. Regional map 3a of Deokhuri valley with Sanpmarg and Lape sites (legend see Fig. 17).

The red soil surface of the terrace is 21 m above river level (which is 326 m above sea level) (Fig.124). The 1 m-thick red soil has developed on a light yellow-brown homogeneous silt of 5.50 m thickness (a. in the profile) without apparent stratification. Underlying it is the uneven, knobby surface of a palaeosol (b. in the profile) (Pl.251/1) that developed on a yellow silt, which has a maximum thickness of 2.50 m. The silt was pedogenised after a period of stabilisation and now forms a slightly red, slightly calcitrised soil (a calcisol) with polygonal peds, indicating a more arid climate during its formation than the upper red soil. It forms a duricrust surface, more resistant than the upper silt, as it is exposed as a pronounced eroded platform. This surface, 16 m a.r.l., is the artefact-bearing horizon from which heavy-duty choppers, particularly end-choppers on quartzite cobbles, are eroding out. These lie on the knobby surface and in erosional gullies within this lower silt (Ph.91-Sc). No artefacts seem to come from the upper yellow silt above it.

The lower silt is overlying unconformably the undulating surface of a fluvial cobble-boulder gravel (c. in the profile) of great thickness (Pl.251/2). The top of the gravel is exposed at the right, while the artefact-bearing red duricrust horizon is seen to the left of centre. At the river cliff, the gravel has a thickness of 15 m. Below the gravel, Upper Siwalik soft sandstones are encountered (Fig.124).

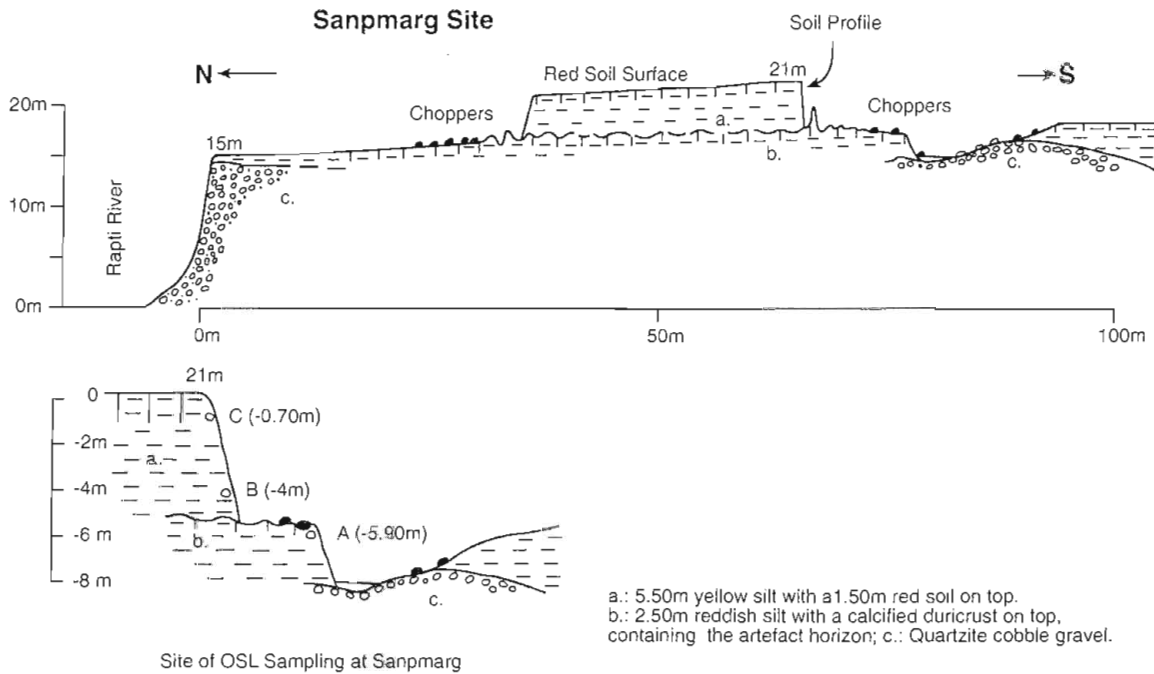


Fig. 124. Section at the Sanpmarg Site on the Rapti River.

An excavation at the southern part of the site, from the red soil surface of the yellow silt down to the gravel, would be useful for determining the actual occupation horizon. In 1990 a soil profile was taken by a student of A. Bronger (Kiel) from the edge of the cliff for TL dating and an analysis of the development of the red soil, but unfortunately all samples were lost and never processed. Later, in 1995, I took new samples with G. A. Wagner (Heidelberg) for OSL dating which was carried out by A. Kadereit (Heidelberg). Not much intact red soil is left in Dang-Deokhuri, so that Sanpmarg becomes all the more important. Besides the undestroyed red top soil, there is also the artefact-bearing palaeosol at a depth of about 5.5 m below the red top soil, which makes this site particularly important.

The OSL dates from Heidelberg yielded the following ages (see appendix II):

Sample C: 15.61 (2.34) ka;

Sample B: 41.77 (5.45) ka;

Sample A: 32.91 (4.21) ka.

The age of the artefact horizon in the palaeosol, therefore, must be somewhere between 30 and 40 ka (see appendix II).

The upper part of the silt succession, above the palaeosol, (a. in the profile) has partly eroded away, but in the south the red calcified palaeosol extends up to the hills and abuts against the Siwalik hills.

Thus two distinct soil horizons are seen at Sanpmarg: a) the upper red top soil has developed over the once extensive 20 m terrace surface; it is deep-red, especially further east at Lape, and this indicates a long period of rubification on a stable land-surface in a humid climate. b) The lower, buried soil must have formed during a slightly more arid period than the top soil, as indicated by its retention of carbonate.

It is suggested that the red top soil formed following the amelioration of the climate after the last glacial maximum, while the lower soil may go back to the more humid interstadial phase of the last glacial (stage 3) between 25 to 40 ka, which correlates with the obtained OSL dates.

The artefacts are all large choppers, almost all of them unifacial end-choppers on elongate quartzite cobbles. Sizes vary between 120 to 200 mm. There are almost no flakes. The Sanpmarg site is an end-chopper site and was probably a wood-chopping work site. The choppers can be seen eroding out both on the southern and the northern side of the 21 m terrace block. On the northern side, closer to the river, the eroded surface of the red duricrust horizon also exposes manuport cobbles of quartzite along with the choppers (Pl.225/1).

In 1993 I counted 13 end-choppers on the south side and about 20 artefacts on the northern red silt surface. No artefacts were taken in 1993, so as not to disturb the surface evidence for a possible later excavation. In 1990, only a few choppers (5) were collected as a sample and in 1995 another six were taken. Thus most artefacts have been left in the field. The collection consists of 9 end-choppers, 1 side-chopper, 2 side-cum-end-choppers, 1 round chopper, 1 splayed chopper and an „orange“ flake.

The end-choppers, for example the tool in Pl.130/4, are examples of the typical large Sanpmarg end-choppers made on elongate cobbles of quartzite. They are very similar to each other. One end is fashioned by unifacial trimming into a convex distal edge. This is the most common tool type at Sanpmarg. But there are also other forms of choppers, side-cum-end-chopper, uniaxially trimmed to form one lateral edge and a rather round-pointed distal edge; and side choppers, too, are present. I took only one (Pl.131/2), made on a split cobble, on which only some shallow unifacial trimming is seen along one side, forming a long, straight, saw-like edge. A special chopper is depicted in Pl.131/1, also unifacial, but with a broad, splayed edge, made by removing only six large, shallow flakes and with no secondary trimming, though usemarks are seen. It is quite similar to a splayed tool at the site of Lalmatiya. There are almost no other artefacts apart from partly worked cobbles and cobble manuports. The site must have been a temporary occupation at which a certain kind of heavy-duty work was carried out. One end-chopper has a slight wear-gloss at its edge, which is very interesting. Such gloss is very common with the adzes of the Mesolithic Patu site in eastern Nepal, but in the Dang-Deokhuri area it is not common and is only found at specific sites which contain similar elongate, unifacial end-choppers, one at Mashot, and almost all such end-choppers at Kakraha (see below).

Bhalubang

The Bhalubang locality lies on the northern side of the Rapti River, at Bhalubang village (Fig.123), and opposite the Sanpmarg site. A new bridge was constructed there over the Rapti River in 1990. The locality is at the foot of the northern hills, just north of the village. It is a dissected, truncated terrace of alluvial reddish-yellow silts with a red-brown soil on top. Bronger and Wichmann took soil samples from this locality in 1989 (Wichmann, 1993). The terrace height is 20 m a.m.r.l. At the river cliff, the 6m-thick silt overlies a cobble-boulder gravel of more than 10 m thickness (Fig.125). The terrace deposits belong to the Babai Formation. Artefacts are found eroded out from the silt in erosion gullies (they are not found on the top of the terrace surface). One was taken from in situ 0.6 m below the terrace surface. No definite artefact horizon was evident.

We took a few (8) heavy-duty artefacts in 1985 and 1987, from gullies in the silt, and a few in situ flakes from the top part of the silt at 17.50 m height in 1989 (Fig.125).

The artefact assemblage is small and consists of cobble tools (1 end-chopper, 1 side-chopper, 2 core-cum-choppers, 1 corescraper), 1 large flake tool, 2 cores and 5 flakes. The choppers and corescrapers are typical of the Brakhuri industry. There is a slightly concave side-chopper with a shallow unifacial edge for cutting, but with no heavy usemarks, and a unifacial end-chopper (Pl.131/5) with a broad, splayed edge, made by simple unifacial primary trimming, with no secondary trimming (it may have been a core, as usemarks cannot be seen). Pl.131/3 depicts a core-cum-chopper which was originally a core from which a number of flakes were taken off uniaxially from the cortex on its lower face, resulting in an irregular

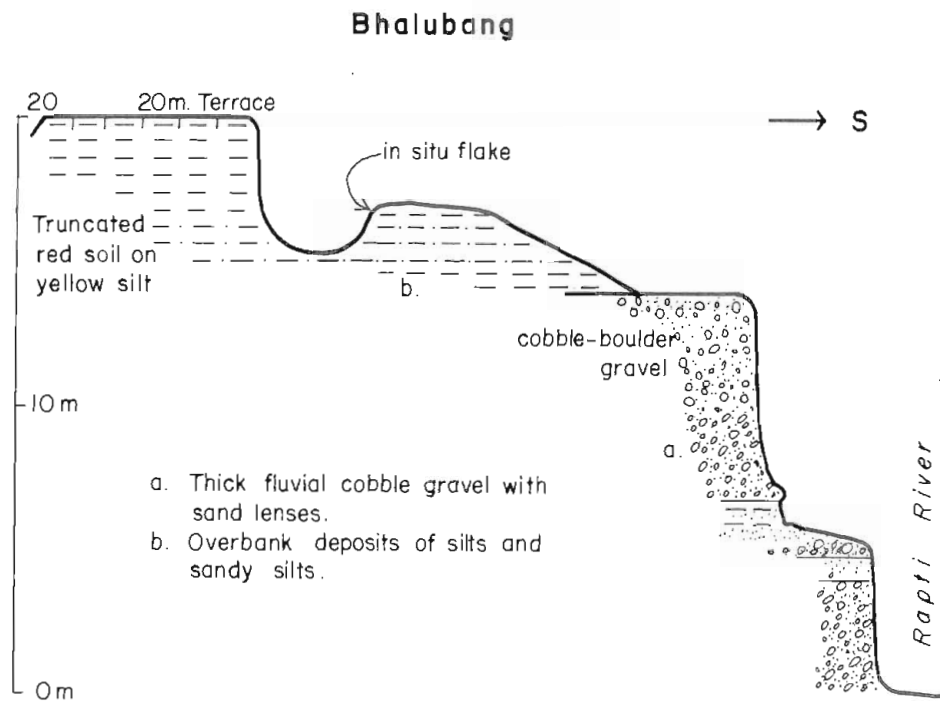


Fig. 125. Section at Bhalubang on the Rapti River.

convex edge which seems to have been utilised subsequently. Two are unifacial cores rather than choppers, the lateral edges of both being sharp and effective, but they have no secondary trimming, nor are any use-marks seen. The lateral edge of one, though, is quite well defined and seems to have been utilised, while a second bifacial edge opposite the unifacial edge is an irregular core edge. The few flakes are undiagnostic.

One interesting tool is illustrated in Pl.131/4 from locality Bhalubang E, found *in situ* 0.5 m below the terrace surface in the silt. It is a flat unifacial flake tool made on a large flake with a cortex platform and a dorsally prepared face. It has a utilised and slightly retouched distal edge opposite the platform, where a rounded, nose-like edge was made by a few secondary flakes; a slight wear-gloss can be distinguished on the latter edge. Such gloss is rarely seen on tools of the Brakhti industry.

Lalmatiya

The site of Lalmatiya was found in February 1985 while surveying the northern margin of the Deokhuri valley at the Kartis Nala between Lalmatiya and Bhalubang villages, about 2 km north of the Rapti River (Fig.126). A colluvial silt fan of a thickness of 4-5 m, belonging to the Gidhniya Formation, stretches between two rocky spurs at the foot of the hills into the valley northeast of Lalmatiya village. It overlies irregularly eroded, weathered Siwalik bedrock. In fact, the bedrock below the silt forms a shallow basin beneath the alluvium, and the silt fills this basin. Further north, the basin of weathered bedrock can be clearly seen together with the yellow silt filling it. A deep-red soil has developed over the mottled yellow colluvial silts (Pl.245/1); it extends for about 3/4 km to the hills and has been dissected by erosion. It is in connection with this yellow-to-red silt that an occupation site of a chopper-flake assemblage was recovered.

Towards the south and into the valley, it is only the deposits of the youngest, approximately 10 m-high terrace that fill the wide valley; no deposits of the Babai Beds are present.

A profile of 2.50 m was cut at the edge by Bronger & Wichmann in 1990 for an analysis of the red soil (Wichmann 1993). The border of the red soil to the BC horizon is located at about 2m (deeper than at Arjun, where it is 1.50 m, and at Bhalubang, where it is also 1.50 m).

The Lalmatiya site lies on the contour line of 1,000 feet (305 m), 25 m above the river at the 925 foot (280 m) point. Many artefacts in the form of flakes, chips and broken waste, along with a few shaped artefacts—all made of quartzite, quartz, indurated shale, chert and „tuff“—are scattered on the surface on bedrock. Most artefacts are concentrated on the surface, where the red silts meet the underlying bedrock along the border of the bedrock basin, below the eroded red silt (Fig.127). Some have washed down the slopes and into the gullies. They constitute the residue of the washed-away silt. The artefacts are quite fresh. Only a few have a weathering patina. Artefacts are not found anywhere else, away from the red silt fan, nor are they on the very top of the silt surface. Given the high position of the artefacts on bedrock (as residue from the silt) the artefact level in the silt must have been in the very top part in the red soil (Fig.127).

The artefact collection of 47 specimen is a selective sample. The artefact composition is shown in Fig.134, and the tool composition is as follows:

6 Choppers	50 % of total number of tools
2 Corescrapers	16.5 %
3 Scrapers	25 %
1 Adzes	8.3 %
9 Utilised flakes	19 %
21 Flakes	44.5 %
5 Wastes	10.5 %

The artefacts from the top of the Lalmatiya surface are quite rough and rather undiagnostic. Those few which could be classified are described as being similar to the Brakhutj industry. The raw material is of quartzite (83 %), chert (8.5 %), some quartz (4.5), and very little „tuff“ (2 %) (see Fig.133). The artefacts collected from the slopes and the gullies below the terrace top are more distinct.

The question arises as to why this site was chosen – in the nook between the hills, at the very margin of the wide valley, so far away from water and raw material. There was certainly protection in the back by the hills, but from where did the Lalmatiya people get water and raw material? While there were probably springs at the foot of the hills the obtaining of raw material of quartzite must have been a problem. The Rapti River now is far away, more than 2 km, though at that time it may have been closer to the site than today.

At Lalmatiya, as at all sites having an affinity with the Brakhutj industry, we find the typical corescrapers and unifacial choppers. There are two elongate corescrapers (Pl.133/1), with a straight, steep unifacial edge trimmed along one face only. They are heavy, square-sectioned tools on large, elongate cobbles, but with a particularly straight and well-defined edge.

A few unifacial choppers, too, were recovered from Lalmatiya. Two are made on a flat cobble (Pl.136/1), and are well-fashioned side-choppers with straight, finely retouched unifacial lateral edges. Both are trimmed only on one face and, though shaped similar to corescrapers, have shallower edges. The illustrated one was made on a split cobble, and subsequently the whole tool was broken longitudinally. There are also two end-choppers; one is a fine end-chopper, made from a black volcanic or intrusive rock, and displaying a convex unifacial chopper edge, which one flake having come off from the lower face. It is an interesting tool, displaying a definite gloss at the chopper edge. The other one is a strange end-chopper with a broad, very splayed edge opposite a narrow butt, affording a good grip in the hand. The edge was made with only two large, flat scars, and while there is no secondary trimming, there are definite usemarks. There

is also a round unifacial chopper of the Gidhiniya type (Pl.132/2). At one end only two flakes have been removed from the lower cortical face. Opposite the latter is a convex unifacial chopper edge with usemarks.

In addition, there are a few scrapers in the collection, which have rather steep scraper edges. One (Pl.135/1) with secondary, albeit irregular, retouch on both sides, another (Pl.135/2) was made on a chunk with fine, shallow unifacial retouch at one edge on the upper face, and a third one was made on a small round cobble with very fine unifacial retouch along three short edges trimmed from the cortex of the lower face.

One interesting tool at Lalmatiya is an adze (Pl.132/1a,b), made on a flake. It is a longitudinally split tool (split from the butt), and has a straight, slightly oblique distal adze edge with bifacial usemarks—rather similar to the adzes at Patu (see chapter V.2.3.). Opposite the split side is a bifacially trimmed, slightly zigzag lateral edge. This is the only such tool so far found in the Dang-Deokhuri valleys.

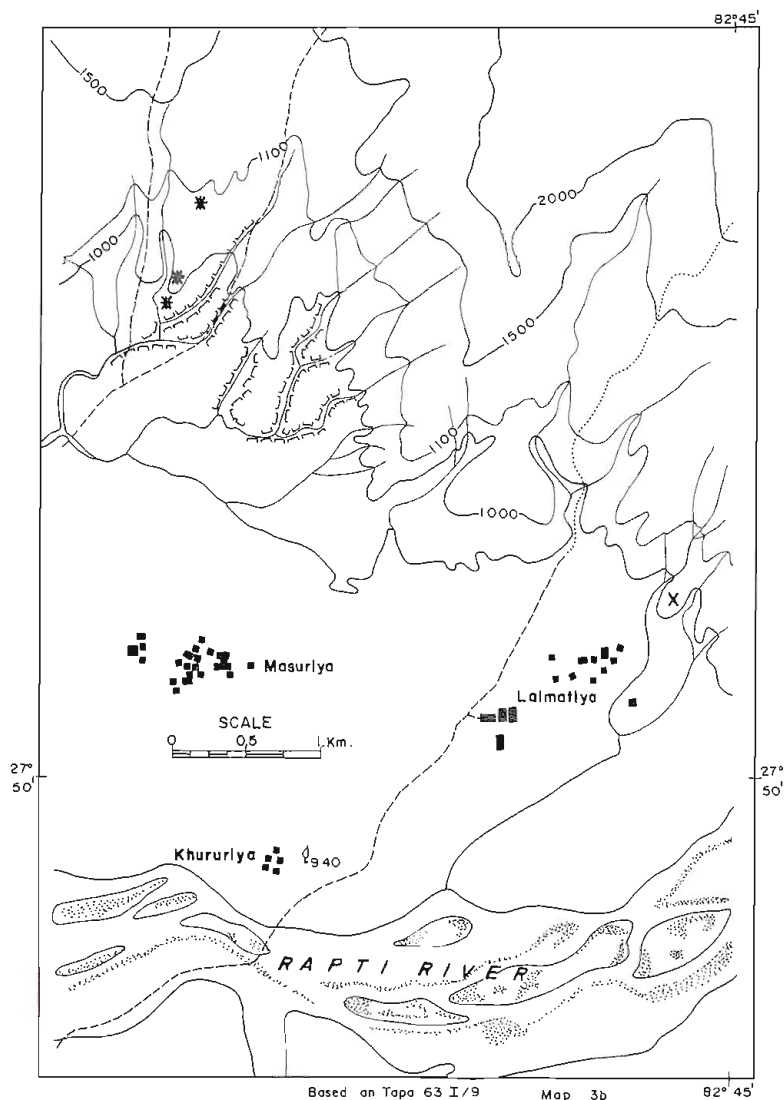


Fig. 126. Regional map 3b of Deokhuri valley with Lalmatiya and Masuriya sites (legend see Fig. 17).

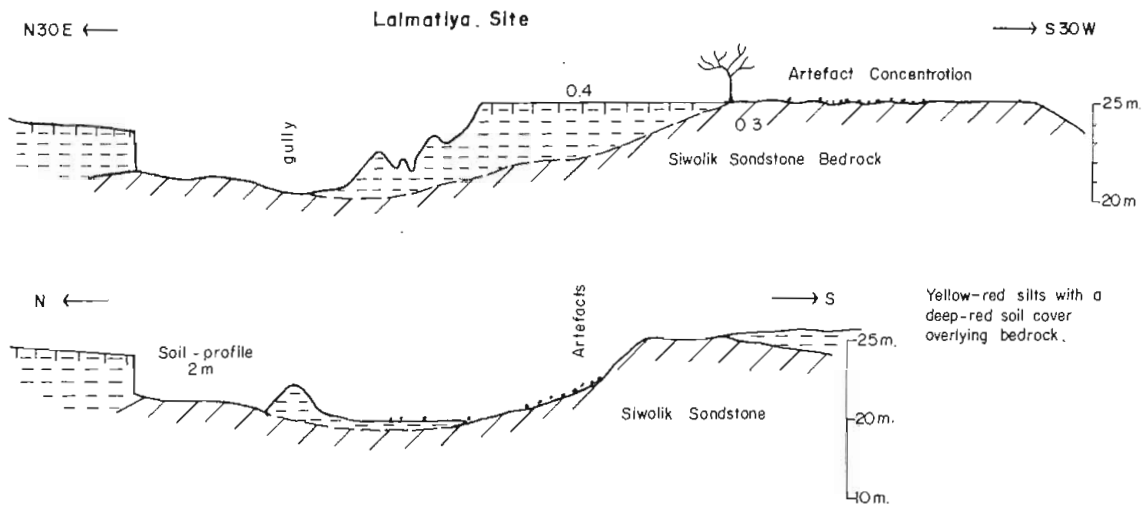


Fig. 127. Sections at the site of Lalmatiya.

The 30 collected flakes, the statistics on which have been assembled together with the Masuriya 4 material, are of the Brakhuti type, 60 % of them having cortex platforms (Fig.129) and the majority (40 %) have, as at Brakhuti W, uni-directional and very little multi-directional flaking scars at the dorsal face (Fig.130). 17 % have cortex opposite the platform (Fig.131) (Pl.135/1,4), while some (6 %) are „orange“ flakes (Pl.135/3). Stepretouch at the platform edge is common, too (Fig.132) (34 %) (Pl.133/2 and Pl. 135/3,4), and there are a few snapped flakes (10 %) (Pl.134/2 and 5). But there are also a number of flakes which do not have the typical Brakhuti features, and have no stepretouch at the platform, but instead have central dorsal ridges formed by two flake scars (Pl.134/3,5), or have deeper flake scars struck from the same platform and are well shaped (Pl.134/6 and Pl.133/2). A number of the flakes were utilised (Pl.134/1 and 6 and Pl.135/4).

All in all, it is an interesting collection. The adze was either imported into this assemblage or, more probably, was an isolated and later introduction to the area. The former case would imply that the Lalmatiya site is contemporaneous with Patu, i.e. of early Holocene age. But the geological evidence and the typological features of the Lalmatiya site would indicate contemporaneity with the Brakhuti industry.

The Masuriya sites

The extensive site of Masuriya is situated only 4 km to the northwest of the Lalmatiya site, directly at the foot of the hills, north of Masuriya village, in a narrow side valley, formed by the Boge Khola, which joins the Dolai Khola to the south (Fig.123). There are four artefact localities, Masuriya 1 to 4, each situated at a different level.

The main, and richest, artefact site is Masuriya 4, the northernmost of the group. It is located on the highest part of a narrow, tongue-shaped colluvial fan of the Gidhiniya Formation, that extends from an amphitheatre on the hill slope downwards towards the plain of the valley. The amphitheatre is filled with yellow-to-red colluvial silt of an average thickness of 5 m, which had developed a deep-red soil on its surface over a presumably long period of time.

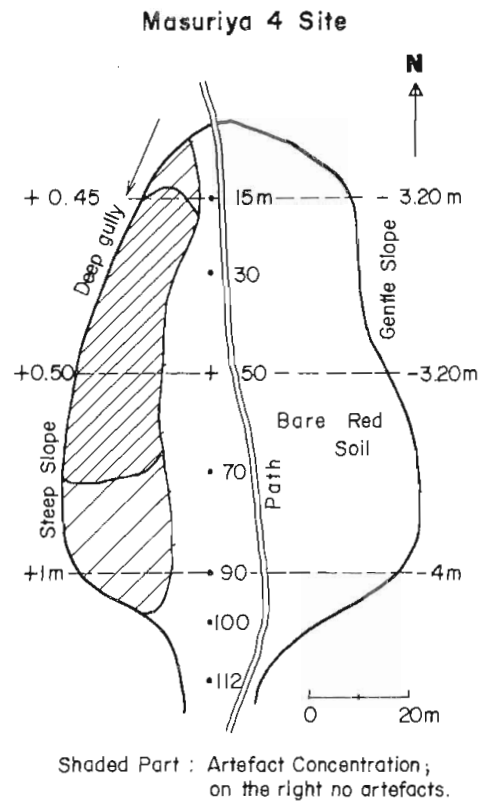


Fig. 128. Plotting of the Masuriya 4 Site.

The artefact site with the exposed artefact scatter lies on the red surface of the amphitheatre, quite hidden away in a cleft of the hills, and stretches over an area of 110m by about 20m from north to south and east to west respectively on a 120 m-by-80 m red surface of the colluvial silts (Fig.128). The silt overlies irregularly dissected bedrock. The silt on the eastern side has a greater thickness, and bedrock below it dips down eastwards. The Masuriya 4 site lies on or near contour line 1200' (365 m), 85 m above the level of the Rapti River. It has a much higher gradient from north to south than the terrace surface in the Rapti valley below, and is about 30 m higher than the next lower red surface, that of Masuriya 3. (Compared to the red surface of the Lalmatiya site, the Masuriya site lies 40m higher up the slope).

The Masuriya 3 locality is located on the surface of a thick red soil sediment which seems to have been washed down from the original red soil of the Masuriya 4 site. Bedrock of the Lower Siwalik sediments crops out below the soil sediment. The washed-down fan of the red soil sediment slopes down in a S10E direction into the valley. It contains almost no artefacts. Only one cotescraper was collected, which must have come from the Masuriya 4 site. Masuriya 3 lies at contour line 1100' (335 m) or just above it, while the river level is at 925' (280 m).

Lower down from Masuriya 3 one reaches the dissected 25 m terrace level of the Rapti valley. The sites of Masuriya 2 and 1 are situated there, just around contour line 1000' (305 m).

At the Masuriya 2 locality, Lower Siwalik purple clays are exposed between ribs of hard calcareous sandstones, which steeply dip southwards. The bedrock was deeply dissected before it was filled in by yellow alluvial silts and coarse rubble and blocks of Siwalik sandstones overlying the silt. Only remnants of

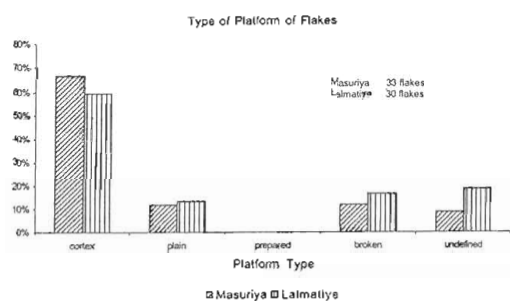


Fig. 129. Type of platform of flakes of Masuriya 4 Site.

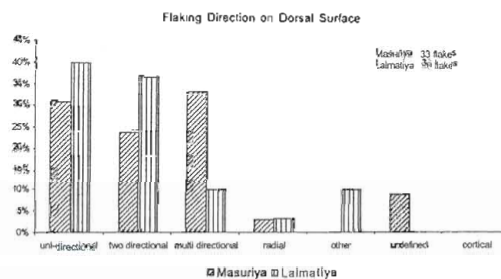


Fig. 130. Flaking direction on dorsal face of the flakes of Masuriya 4 Site.

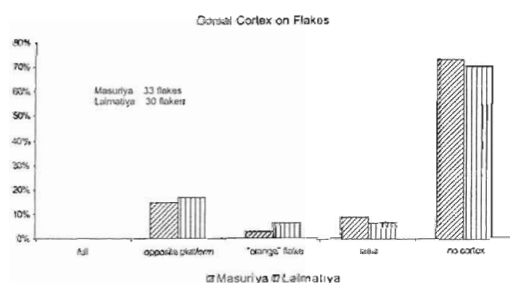


Fig. 131. Dorsal cortex on flakes of Masuriya 4 Site.

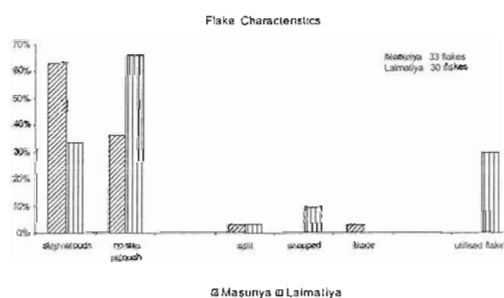


Fig. 132. Characteristics of flakes of Masuriya 4 Site.

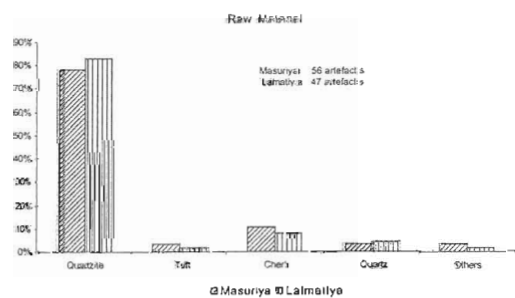


Fig. 133. Raw material of artefacts from the sites of Masuriya 4 and Lalmatiya.

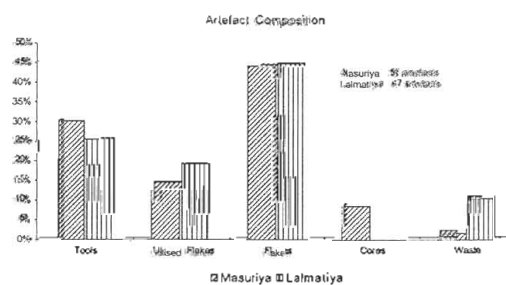


Fig. 134. Artefact composition of the sites of Masuriya 4 and Lalmatiya.

these deposits are still seen at places, having once covered the bedrock as an extensive 25 m surface. A large core and some flakes of quartzite were lying on the eroded bedrock. They may be reworked artefacts from above, washed down with the rubble.

Slightly further down, the Masuriya 1 locality is a rocky surface with remnants of very dissected yellow alluvial silts overlying bedrock. A flaking spot, consisting of both fresh and weathered flakes was recorded there, of which a small sample was taken.

These very dissected areas of rocky surface with remnants of yellow silts at Masuriya 1 and silts with overlying rubble at Masuriya 2 are the remains of the once extensive 25 m alluvial terrace in the valley, while Masuriya 4 is a fan deposit of colluvial hillwash of fine unstratified silt of the Gidhiniya Formation. Prehistoric man lived on this high fan surface as well as lower down on the alluvial terrace. Masuriya 3 is not a terrace but a secondary slopewash deposit, of redeposited red soils from higher-lying red surfaces, such as the Masuriya 4 red soil, washed downhill and accumulated in the shallow basin just below.

The most interesting site is Masuriya 4. It is an occupation site, most probably a camp site, of a Palaeolithic industry, in a hill-protected niche above the wide Dun valley, maybe next to an animal migration route leading over the hills into the water-rich valley. Many artefacts, almost all made from quartzite, are scattered over the surface: flakes, tools and much waste, especially on the western side of the long stretch of bare red surface, where they seem to have eroded out from the red soil (see Fig.128). Here, the weathered bedrock of Siwalik sandstone crops out below the eroding silt. Weathered boulders and blocks of sandstone, amongst which the artefacts are scattered, cover the surface with patches of red silt (Pl.225/2). The surface must have once been covered entirely by the silt, but most of it has now washed down the slope to Masuriya 3. The red surface of the Masuriya 4 site slopes down eastwards, so must the bedrock below it. The eastern edge of the red surface, 35 m east of the 50 m point in the centre, is 3.20 m lower than at the 50 m point, while 25 m to the west the edge of the site is 0.40 m higher than at the 50 m point.

It seems that the silt cover was once thicker than it is now after erosion, but how much thicker is difficult to determine. The artefacts along the western edge are lying mainly on the weathered bedrock surface. They are the residue of the original horizon which was destroyed by erosion and which was probably once embedded in the colluvial silt. On the eastern side of the Masuriya 4 surface there are no artefacts; and only bare red soil can be seen. It is therefore not clear whether the artefacts were embedded in the upper part, i.e. in the red soil, or below it in the lower part of the colluvial silt, or even below the colluvial silt. The latter two possibilities seem to be more probable, as otherwise one should expect artefacts on the bare red surface, too, which is in the process of eroding. An excavation trench, running east to west, a necessary future undertaking, would probably reveal the horizon.

The artefacts from the Masuriya 1 to 4 sites are selective collections.

The collection of artefacts from Masuriya 1 consists only of flakes. They are well made and are similar to those of Masuriya 4, yet they come from a different stratigraphical setting on the rocky surface, which once was covered by the yellow alluvial silts, that form the 25 m terrace level (while Masuriya 4 is 85 m a.r.l.).

There are no flake tools, only a few utilised flakes. It is a small and selective sample; that is, only specific flakes were collected. Almost all of the flakes have cortex platforms (Pl.144/1-4), and some have cortex opposite the platform (Pl.144/1-3). „Orange“ flakes are also present (Pl.142/6), but many of them exhibit multidirectional dorsal trimming (Pl.144/4).

The artefacts on bedrock at Masuriya 2 site are similar to those at Masuriya 1. The collection is too small to say anything conclusive about, but the flakes conform well with Masuriya 1 and Masuriya 4. one fine discoidal, bifacially prepared core (Pl.137/1a,b) comes from here. Such cores are not found in the Brakhuti industry, only at the Arjun sites.

At Masuriya 3 nothing was found except an isolated corescraper, which must have come from above, i.e. from Masuriya 4. It is a corescraper of the typical kind, made on a flat cobble with only one side steeply fashioned into a straight unifacial edge.

Description of the artefacts from Masuriya 4. The sample collection of 56 artefacts from site Masuriya 4 consists of flake tools and associated cobble tools, and of selected flakes (see Fig. 134).

The composition of the 56 collected artefacts from Masuriya 4 is as follows:

4 Choppers	23.5 %	
2 Corescrapers	11.7 %	47 % cobble tools
2 Sumatralith-like	11.7 %	
9 Scrapers	53 %	53 % light duty
A total of 17 tools:	30.4 %	of total number of artefacts
8 Utilised flakes	14.5 %	of total number of artefacts
25 Other flakes	44.5 %	of total number of artefacts
5 Cores	8.9 %	of total number of artefacts
1 Waste	1.8 %	of total number of artefacts

The heavy tool component consists of round unifacial choppers of the Gidhiniya type, and of end-choppers, together with corescrapers and steep-edged sumatralith-like tools. The light tool component consists of flake tools shaped into scrapers by fine retouch (not heavy scrapers as at Gadari) and of utilised flakes. The assemblage is mainly a well-made flake industry associated with cobble tools. There is, though, no blade element, as there is at Arjun. It is an interesting assemblage, called here the Masuriya industry comprising a well-conceived tool kit, more sophisticated than the Brakhuti industry. It is akin to the Middle Palaeolithic Arjun industry, albeit without points and blades. A levallois element is present in the form of prepared discoidal cores and flakes detached from such cores. The associated cobble tools seem to be of greater importance at Masuriya than at the Arjun 3 site. Corescrapers are definitely an integral part of the industry but at Masuriya 4 form a conspicuously smaller part in the assemblage (11.7 %) than at Brakhuti W or at the Gadari Flake Site, where with 42 % and 52.5 % respectively they make up the majority of tools, while conversely smaller flake tools display a higher percentage (53 %) at Masuriya than at Brakhuti (16.7 %) and Gadari (5.2 %).

A typical corescraper is No.1 (Pl.141/1), an elongate cobble tool, where only one face has been fashioned into a steep, straight unifacial edge. A narrow, high-backed sumatralith-like tool is illustrated in Pl.140/1a,b, with a perfectly flat base of a split cobble surface, a fine tool. Another interesting tool is a very narrow, high-backed sumatralith-like double corescraper (Pl.139/1a,b), with a narrow, completely flat base of cortex. Cortex goes from the base at the butt to the top, like the sole of a moccasin. It is very high-crested, with a bifacial ridge on the crest, which resulted from the steep trimming on both sides and from some further unifacial trimming at the crest itself. The triangular-sectioned double corescraper (Pl.138/1a,b) is quite similar. It is a sumatralith-type high-crested tool, where two faces were shaped into a steep unifacial edge, so that a central high ridge or crest results on the upper face. These narrow, high-crested sumatralith-like tools are a special feature at Masuriya and seem to have developed from normal corescrapers by continuous rejuvenation from both sides, resulting in two steeply retouched edges opposite each other. On the other hand, these reduced tools could be cores, and the steep retouch at the edges could have been meant for thinning the proposed flake on the core. If that is so, it is hard to explain the utilisation marks, and even battering marks, on the edges of the implements.

Two tools are Gidhiniya-type round unifacial choppers (Pl.137/2 and Pl.138/2a,b), perfect little tools, with their lower faces of cortex, while the upper faces were fully trimmed with many small flake scars along one working edge, which in the case of No.4 shows heavy battering marks. No.31 is a fine

Sanmarg-type end-chopper (Pl.141/2), if quite weathered, whose unifacial edge and the upper face of the edge is smooth, and may have been ground or polished. There is only one small side-chopper with a very straight, well-retouched unifacial edge, and the lower face entirely of cortex.

There are 5 collected cores, all prepared. Two are simple flat, single-platform cores with one face of cortex and one prepared platform. Two are discoidal cores, one is a flat, partly bifacial core (Pl.139/2) on which the upper convex face consists half of cortex, while the other half was trimmed with large shallow flakes and step-flakes as preparation for a platform, and the other is a small conical core, while Pl.143/4a,b depicts a prepared discoidal levallois-like core.

The 8 flake tools are all scrapers with fine retouch made on flakes. Most of them are side-scrapers having one long lateral edge (Pl.140/2, Pl.136/4), 2 are simple end-scrapers, (Pl.136/2), one with a denticulate edge and 1 is a nosed scraper (Pl.136/3). The retouch is always fine and unifacial. One scraper is a special tool, a convex side-scraper, made on a Kombewa flake, both of whose faces are flake surfaces and both have a platform and bulb of percussion. One has stepretouch opposite the platform, resulting from a former corescraper edge. It then has been fashioned into a side-scraper by fine retouch along one side on the ventral face.

The 8 utilised flakes in the collection are all well-made, with either the straight or convex side being utilised (Pl.142/1-3); or the distal convex edge, or else a small concave edge (Pl.142/5) or a concavo-convex edge at the side (Pl.140/3) was utilised. Other well-prepared flakes show no usemarks (Pl.144/1 and 2). The flake in Pl.144/3 is a corescraper-rejuvenation flake with the remnant of a corescraper edge at right. The oval-shaped flake in Pl.142/4 is a particularly well-made flake of levallois-type preparation, as are the flakes in Pl.142/1,2 and 5. They are detached from prepared cores and conform to the discoidal cores available in the Masuriya localities (Pl.137/1, Pl.139/2 and Pl.143/4) or to discoidal unifacial cores. The latter would result in flakes with multidirectional dorsal faces but with cortex platforms.

The sample of 33 measured flakes from the Masuriya 4 site is rather small for purposes of comparison, but, nevertheless, exhibit interesting features. The flakes in this selective sample may be placed formally between those of the Brakhuti industry and the Arjun Middle Palaeolithic industry: 67 % have cortex platforms (82 % at Brakhuti) (Fig.129). The percentage of plain platforms, on the other hand, is slightly higher (12 %) than at Brakhuti (8.4 %). The dorsal scars have a comparatively higher percentage of multidirectional (33 %) and radial (3 %) trimming at Masuriya compared to only 12 % and 2.6 % respectively at Brakhuti (Fig.130). These features indicate a higher standard of sophistication, although the characteristic of "cortex opposite the platform," is rather more frequent (15 %) in Masuriya 4 (Fig.131), compared to Brakhuti (6 %). Stepretouch at the platform edge (Fig.132) occur more often (63 %) than at Brakhuti (50 %). The provisional conclusion is that the process of flake detachment at Masuriya, indicates, with its levallois element, a greater command of technique and so a greater closeness to the Arjun 3 Middle Palaeolithic industry than to the Brakhuti industry at Brakhuti W in the Tui valley and at Gadari in the Dang valley. The Gidhiniya assemblage, though, does come closer to Masuriya.

The flakes are on the average medium-sized ones (70 %). The platform angles have a pronounced peak (48 %) at 110° to 115°. The B/L ratios show homogenous shapes peaking at 0.6, and the Th/B ratios have a pronounced peak at the medium ratio of 0.3.

The raw material (Fig.133) is in 78.5 % of the cases quartzite, similar to Brakhuti and Gidhiniya (both 85 %), while Gadari has a surprisingly low percentage of quartzite (48 %) in favour of "tuff," (45 %). The non-availability of the quartzite raw material at the site, being so far away from the river—must have posed a problem, like at Lalmatiya.

Localities between Masuriya and Lamahi

Going on foot from the Masuriya sites further west along the foot of the hills, one encounters frequent remnants of the yellow silts of the once extensive alluvial 25 m terrace. The entire area between just west

of Lalmatiya and Lamahi along the northern border of the Deokhuti valley (Fig.8) was once filled with alluvial sediments of silts, sands and clays as terrace deposits, and of red colluvial silts as "hanging" fans on the hill slopes (Pl.226/1). But everywhere these deposits are no more than isolated remnants, some of them still covered by the remains of a red soil. Between the silt remnants, ribs of Siwalik sandstones crop out, testifying to the unevenly eroded, undulating bedrock level below the silt-filling (Ph.96-Sc). Artefacts are encountered at many places in these half destroyed badlands, in association with the deposits—mostly in small quantities, having washed out from the sediments, so that they lie either on bedrock between the silt remnants or on the slopes of the alluvial/colluvial deposits. It is difficult to determine their original position in the sediments. It is also difficult to say anything about the character of these localities. The assemblages are small, often isolated clusters of artefacts, and one may presume that their actual site locations were destroyed by the heavy erosion and that these artefacts are residual elements of what were once perhaps more extensive sites.

The following are some of the localities around Morighat, Pipri, Kalapani and Pahrwa.

At Morighat N, 1 there are some quartzite flakes and a corescraper on Siwalik bedrock between remnants of a thin cover of silt. At Morighat NW, 2 some quartzite artefacts (flakes and a round unifacial chopper of Gidhiniya type) came from the slope to the next higher western terrace tongue of hillwash and yellow silt, below which Siwalik bedrock crops out. At Morighat NWW (see Ph.96-Sc) a few weathered artefacts of flakes (Pl.146/1) and two corescrapers are eroding out from the dissected silt. These various artefact spots are positioned in the top part of the colluvial silts (Fig.135).

The site of Pipri 1 lies 1.25 km north of Pipri village (Fig.135) on a dissected silt surface above weathered Siwalik sandstones. The silts are yellow and have weathered into a covering red soil which once formed the 25 m terrace. Here again artefacts of quartzite and chert are coming to light from the edge of the red soil owing to erosion, not from the top but from within. There are not many artefacts, but enough to show that a small site had been present. The artefacts are finer than at Lalmatiya. A small sample of 11 artefacts was taken.

The few Pipri 1 artefacts are well made. The 2 cores in Pl.145/2 and 3 are prepared, flat cores, similar to the ones from Masutiya 4. A third small specimen is a prepared cubic core with several small platforms at right angles to each other. One interesting flake (Pl.145/1a,b) is a Kombewa type, with one flake face having a prepared platform, and the other one a plain platform. The flake face with the plain platform was the original flake. The other flakes (Pl.144/5) are similar to the ones at Masutiya 4. Pipri 1 and Masutiya 4 seem to belong to a later Middle Palaeolithic culture.

The locality of Pipri 2 is a few hundred metres to the north-northwest of Pipri 1, from where two "tuff" flakes and a fine specimen of a pointed unifacial chopper were taken. The chopper is heavily used at its left edge and its rounded point. It is quite similar to the choppers found at Lape and at Sanpmarg.

Locality Pipri 3 is situated on a slightly raised terrace knoll of hillwash on the surface of which some artefacts are scattered. One very large flake was taken. It looks like an Early Palaeolithic flake. The edge is rather jagged, showing ancient usemarks, and there are no fresh scars.

At Kalapani NE artefacts can be found on a rocky surface overlain by the remains of a red soil. An electric pole has been constructed here (serving as a marker). The red silt which fills the uneven bedrock basin must have once formed a continuous red surface along the foot of the hills, and a red soil must have covered once both the alluvial terrace surface and the colluvial fan surface. Some artefacts of quartzite and quartz are scattered on the surface, but nothing was taken. The countryside is like a desert, not a natural but a man-made desert in a landscape where there should be lush forest, but which has been destroyed by men and by overgrazing "holy" cows. The existence of the cows, which multiply without restraint but scarcely give any milk, cannot be justified, as the farmers would have it, by the dung they are producing as fertilizer for the fields, because most of their dung is dropped all over the unused countryside, in the

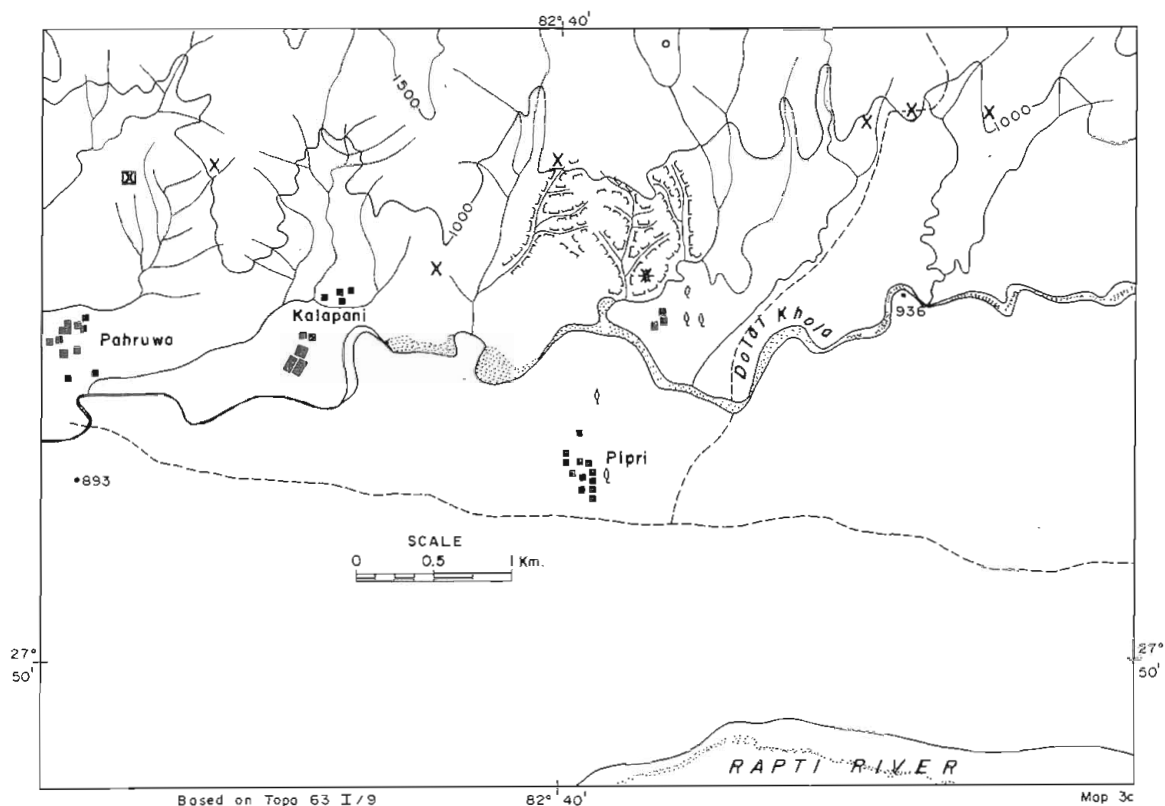


Fig. 135. Regional map 3c of Deokhuri valley with Pipri sites (legend see Fig. 17).

“desert,, instead of being carefully collected by the people, as is done in India. The cattle in Dang-Deokhuri are completely unproductive, but the law forbids slaughtering them.

At Pahrwa NNE, isolated remnants of red colluvial silt fans, lie against the mountain slope, some 10m higher than the highly dissected and once continuous 25 m alluvial terrace of yellow silts below them in the valley (Pl.226/2 and also Pl.226/1). No artefacts were found on top of the red silt remnants. In one of the red colluvial silt remnants a dark blue uniface made of phyllite was in the process of eroding out from the colluvial silt. This locality is seen in Pl.226/2, in the middle ground. The colluvial red silts are 30-35 m above the Dolai Khola level and 10 m above the alluvial level.

The uniface (Pl.146/2) is a fine specimen, made on a split cobble and very simply trimmed on one face with a few shallow flakes, with very fine unifacial retouch on both lateral edges, which are well utilised. The round apex was not utilised, and hence the implement is not an adze. It is a unique and isolated tool, like the adze from Lalmatiya, and made from an altogether different raw material than all the rest of the Dang-Deokhuri artefacts.

Lower down, on the 20-25 m terrace surface of the yellow alluvial silts (Pl.226/1), from where one can see the red silt fan remnant on the hill slope in the background, a small microlithic site is found at Pahrwa N. The yellow silts are very calcareous and are covered by kankar pellets, indicating very dry climatic conditions during the deposition of the silts.

The small sample of microliths show no tools, only a few well-made microlithic flakes, and waste from black chalcedony, very fresh with sharp edges.

The level of the tributary of the Dolai Khola (Fig.135) is at 890 feet (270 m), while the microlithic level is between 900 and 1,000 feet (about 290 m), i.e. at the 20-25 m terrace level. The uniface comes from a level 30m above the Dolai Khola bed; the red colluvial silt block is about 35 m above the Dolai Khola.

The area at the foot of the northern range of hills between Pahrwa/Narti and Lamahi, 10 km to the west of Pahrwa village, has not been investigated on foot, but there seems to be a continuation of the scanty remains of the alluvial silts of the 20-to-25 m terrace, although very few remnants of the red colluvial silts can be seen.

The sites of Lamahi have been described earlier. But nearby, only 2 km to the northwest of the Lamahi microlithic sites, at the emergence of the Arjun River into the Deokhuri valley, one of the most important Middle Palaeolithic sites was discovered in 1987, that of Arjun 3.

The Arjun Middle Palaeolithic Sites

Arjun 3, site description. One of the most interesting Palaeolithic sites in the Deokhuri Dun valley is the area of the Arjun complex (Arjun 1,2,3,4 and 5) on the left bank of the Arjun River. The river emerges here from a narrow valley in the Siwalik Hills into the Deokhuri valley, where it joins the Rapri River (Fig.122) and developed terraces along its bank. The highest is 30 m a.r.l. and is capped by a deep-red soil (Pl.252). Only remnants of the terraces are left on the left bank, where erosion has created badlands. Connected with the high 30 m terrace on the left bank a complex of sites could be recorded. The artefact localities are all of a Middle Palaeolithic culture. They were first discovered in March 1987, during explorations of the Arjun River terraces.

On the right bank are, except a small, dissected older terrace remnant, only lower terraces without any red soil and covered with forest; they will not be considered here.

Arjun 3 is the largest and most important site of the Arjun River sites. At the time of discovery many artefacts were found eroding out from the base of the 8 m silt of the 30 m terrace, close to the contact with the underlying fluvial gravel.

Although the entire area has been very dissected by recent erosion, a large block, roughly 30 m by 10 m, of the highest terrace (T1) of 30 m is still preserved on the left bank of the Arjun River (Pl.252). It has a red soil cover intact on its surface. Soil profiles were cut into the terrace edge by Bronger and Wichmann in order to analyse the red soil (Bronger, report, 1993; Wichmann Ph.D.thesis, 1993). TL samples taken at the same time revealed ages of 10.1 ± 1.5 ka for the top red level at a depth of 0.30 m, 15.9 ± 2.5 ka for the level at a depth of 1m and 29.5 ± 4.1 ka for the level at a depth of 2.5m (Zöller 2000), which is 5.5 m to 6 m above the occupation level.

Before the artefacts were collected the whole area of the artefact scatter, of roughly 90 by 120 m was plotted. A detailed map of this area was therefore prepared in March and April 1987, and all surface artefacts were plotted on it (Fig.136). In 1988, 1989, 1991 and 1995 the newly eroded artefacts were plotted again on the map. Altogether 1,354 artefacts have been plotted and collected so far at the Arjun 3 site.

Prehistoric sites subjected to strong erosion, as most of the sites in the Dang-Deokhuri area, are very vulnerable and are quickly destroyed by the erosion. Such exposed surface sites are, however, very informative if they have not been disturbed by human hand, and continue to be left untouched.

At Arjun the author was able, between the years 1987 and 1991, to observe not only the amount of cultural material eroding out from the original sediment (Pl.226/3) but also to obtain informative data on the rate of sheet erosion each year. It was observed that during one year the sheet erosion of the soils (which are bare for nine months due to overgrazing by cattle, and only covered by a thin grass cover during the rainy season) was up to 3 cm/year on the flat, slightly undulating silt surface. This could be measured on the basis of some *in situ* flakes which were just beginning to erode out one year and were left in the field for remeasurement the next year. Some 2 to 3 cm of silt were washed away in that one year, 6 cm

in two years (Pl.227/1a). Artefacts and stones on silt stilts can be seen at many sites, like the flake at Saunri on a 10 cm stilt (Pl.227/1b).

Observation and collection over the years at the Arjun 3 site established that the artefact horizon was at a level of about 8 m below the red terrace surface of the 30 m Terrace I, (i.e. at a level of 22 m a.m.r.l.), at the base of the exposed upper 8 m-thick silt. Only remnants of the original horizon have been left by the erosion.

The stratigraphy of the terrace deposits at Arjun 3, from bottom to top, are as follows: a basal fluvial gravel of 7 m overlies bedrock just south of Block II, where bedrock exposes a sudden, deep nickpoint at 22m (seen in the section of Fig.137). The gravel is overlain by a 6 m lower silt and a 5 m upper gravel lens, the top of which forms the surface level of 22 m a.r.l. at the Arjun 3 site, above which the upper clayey silt of 8-9 m thickness was deposited, up to the 30 m terrace level, the artefact horizon being at the base of this upper silt. This upper 8 m-thick clayey silt is a mottled, weathered deposit of pond environment that reveals desiccation cracks and root-decaying, together with replacement of calcareous matter over a long period and would indicate a change of environment to a drier climate.

The Arjun River at the time of the Middle Palaeolithic occupation was not at the same deep level as it is today, but flowed in a gravelly bed just below the level of the site. The northeast-southwest cross-profile through Arjun 3 (Fig.137) shows that the ancient Arjun River, before the occupation, had cut its bed deeply into bedrock beyond a nickpoint, as deep as today, and had subsequently filled its ancient channel with the lower gravel, the lower silt and the upper gravel, after which the occupation of Arjun 3 took place along the bank of the river, at a height of 22 m above the recent river level. After the occupation, the river continued to fill up its bed with 8m of the yellow, upper silt to a height of 30.50 m above the recent river level, and formed the older, higher 30 m Terrace I level. The upper silt is intensely dissected, as seen in the photo of Pl.252, and the entire surface around the blocks of the terrace remnants is covered with a scatter of eroded artefacts.

The section given at the top of the Arjun 3 map (Fig.136) is a composite section of the site, while Fig.137 shows two sections taken through Block II, in NE-SW and NW-SE directions, and Fig.138 shows a schematic NW-SE section of Arjun 3 site with a superimposed section of Arjun 1 and Arjun 2.

A younger, lower 10 m terrace was formed later, after renewed dissection, which can be seen on the opposite, western bank of the river. It consists of coarse, rather unsorted cobbly gravel, with a grey top soil above it and is cultivated with fields (Pl.253/1).

The largest artefact concentration, with almost 50 % of all collected artefacts (Fig.136), is seen around Block III in the 10 m squares of E-3, D-4, E-4, F-4, G-4 and H-4, but also further south around Block I (Fig.136, seen also in Pl.252 at right). Another smaller concentration, with 170 (13 %) artefacts, is at Block I. The remaining 44 % of artefacts are from the rest of the plotted area. Each year new artefacts erode out from the silts. Since 1995 no new collections have been made.

The whole site of occupation covers an area of 9,600 qm, (i.e. 80 m E-W by 120 m N-S), and probably more, as the horizon is still covered by sediment in the south. It was indeed a large site. The area around Block III was the main place of occupation, and it also had the largest percentage of tools and blades. A comparatively large number of tools is also found in squares B-8 to B-11 and C-6 to C-10. The main site lies today 30 m east of the river and 22 m above the recent river bed. Considering the close contact of the older fluvial gravel just below the artefact level, one can assume that the occupation site was situated at the ancient riverbank itself.

As the collection of this site is not a selective but a plotted one, the composition of the artefacts reflects, to a certain extent, their original composition and distribution, though one needs to recall that it is a surface site (if only recently exposed), that some disturbance took place after the erosional exposure, and that the smallest waste material must have partly been washed away.

The position of the artefact horizon having been established, it was, nevertheless, important to verify the horizon by a few test cuttings. (All the original data of this work were, however, irreplaceably lost

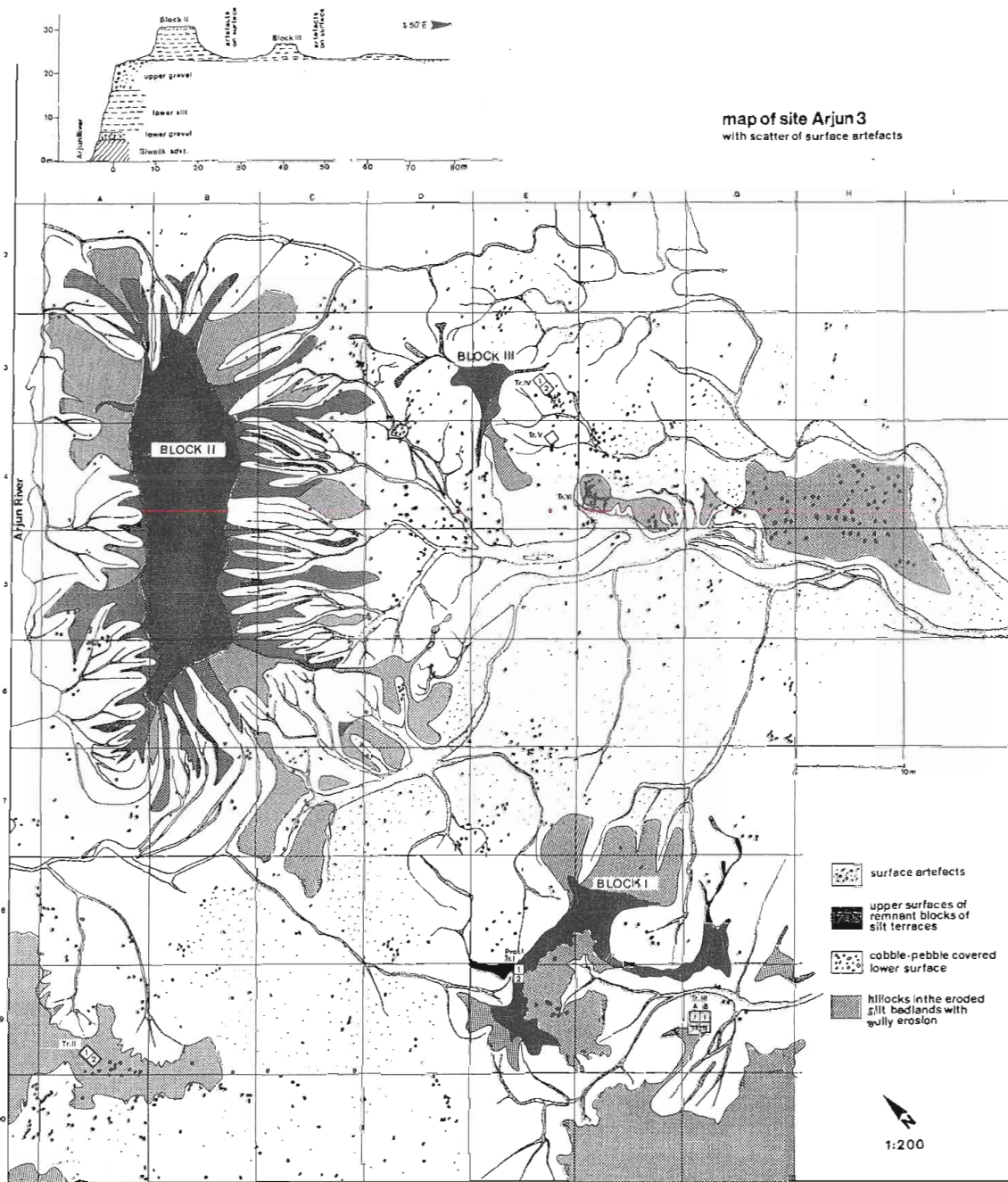


Fig. 136. Plotting of the Arjun 3 Middle Palaeolithic site.

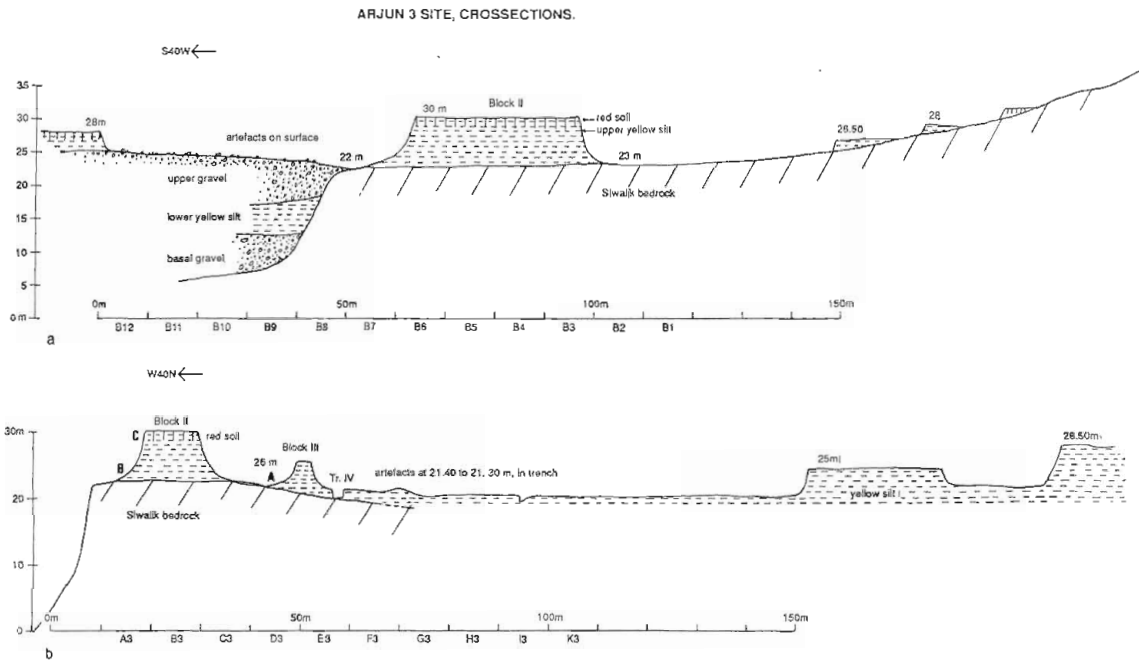


Fig. 137a.b. Section SW-NE and NW-SE, at the Arjun 3 site.

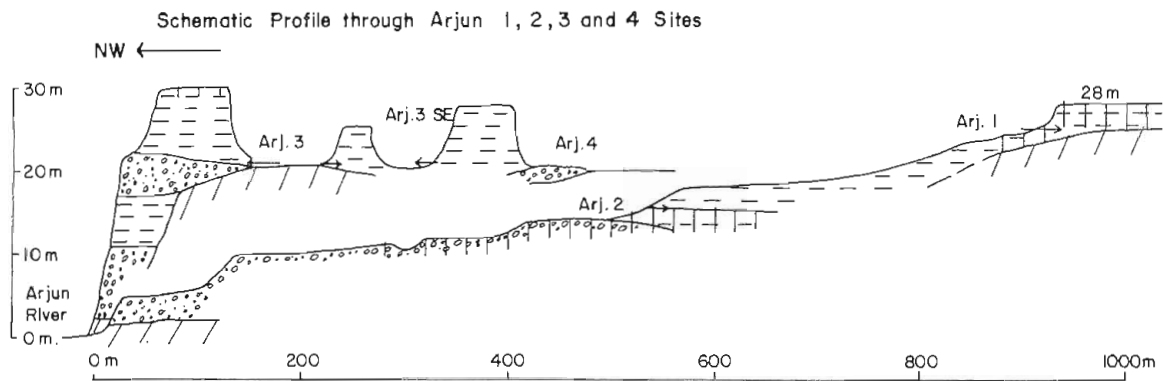


Fig. 138. NW-SE section at Arjun 3 and 4 site, with superimposed section of Arjun 1 and Arjun 2.

after a conference in Madras in 1989 as a result of a theft of my briefcase, which contained all field notes, slides, drawings, etc. Only copies of the drawings were not lost.)

Six small 1x1 m cuttings were made in the areas of the largest concentrations of surface artefacts. Cutting I, in square E-9, was made 2 m through the sterile silt of Block I (from a surface level of 27 m a.m.r.l.) without encountering any artefacts or reaching an artefact horizon. Cutting II, in square A-9, was made from a level of 24.80 m 1.50 m down through sterile silts with the same results.

Cutting III was cut into a silt cliff just south of Block I, in square G-9. The surface of the small silt cliff was 25.50 m a.m.r.l. At a level of 24.20 m to 24.05 m a.m.r.l., (1.30 m to 1.45 m below the surface) an artefact horizon was seen being cut by the erosion in a gully (Pl.227/2 and 228/1). The cliff was cleaned and cut down to the artefact level, where the remnant of a floor was exposed (Fig.139). The artefacts were plotted and removed. (Much of the details of this cutting are missing because of the theft; the same is the case for cuttings IV-VI). Altogether 26 artefacts were lifted from the artefact horizon of Cutting III. The artefact horizon is at the base of the silt, 0.35 m to 0.40 m above the gravel layer which underlies the upper silt of the Arjun 3 site (Fig.136).

The cuttings IV, V and VI were put down at the southern foot of Block III, where a concentration of surface artefacts was seen (Pl.228/2 and 229/1). The established 0-point on Block III was 25.5 m a.r.l. The surface artefacts were collected during the map plotting (Fig.136), before the cutting was done.

Cutting IV (2x1 m) was made in square E-3 at a level of 21.60 m (i.e. point A, 3.90 m below 0-point), which slopes down gently towards point C (21.45 m), where artefacts are eroding out from the silt (Pl.228/2). Twelve artefacts were collected from the surface during the map plotting, and seven artefacts were collected in the process of eroding out on the surface of A2 at the start of the cutting. The artefact horizon was reached slightly below the surface, at the 21.40 m to 21.35 m level, which is 8.60 m to 8.65 m below the main Arjun terrace surface. From this level 15 artefacts were lifted (Fig.140).

Cutting V, 1x1 m in square E-4, was cut into a small hillock, 6 metres west of IV, where five surface artefacts were collected from the surface. It was cut in three steps from a level of 21.90 m a.r.l. to 21.60 m a.r.l. A blade was recovered from level 21.59 m and a side-flake and a chip from 21.75 m a.r.l. (Fig.141). Two metres to the west, a small gully cuts into the silt and exposes bedrock some 0.5 m below the artefact horizon. Southwest of Cutting V, the uneven bedrock rises intermittently to the surface without intervening gravel.

Cutting VI, 2x1 m in square F-4, was put down 8 metres south of Cutting IV (Pl.229/1). The southeast corner (point A) was 4.05 m below the 0-point on Block III, i.e. at the level of 21.45 m a.r.l., being the highest point, and C at the level of 20.78 m a.r.l., being the deepest point. From the surface of the trench and from the immediate surroundings a great number of artefacts were plotted onto the map. The artefact horizon in Cutting VI has mostly eroded away. It was at a level of 21.45 m and slightly below, to judge by the surface artefacts, which eroded out *in situ*. Only one artefact was recovered from inside. The artefact level is at the same level of 21.40 m a.r.l. as in Cuttings IV and V.

Some 8 m to the southwest of Cutting VI, beyond a larger nala, bedrock dips down drastically and is overlain by a gravel layer, which crops out just below the artefact horizon. Cutting III, 45 m to the south of Cutting VI (53 m south of IV) shows this situation: the artefact horizon being at a level of 24.10 m a.r.l. at the base of the silt and 0.35 m to 0.40 m above the underlying gravel. A schematic cross section, N-S, from Block III to Block I (Fig.142) displays these stratigraphic features; the artefact horizon is indicated as an interrupted line.

This cross section makes the stratigraphic position of the occupation floor of Arjun 3 quite clear. Ar both sides, in the south around Cutting III, and in the north around cuttings IV, V and VI, the floor was encountered at the base of the 8-9 m upper silt, overlying bedrock in the north and gravel in the south. The drastic vertical dip of the bedrock, indicating an infilled waterfall, is well seen along the river cliff west of the site (Pl.253/2), also recorded in the SW-NE section in Fig.137 and Fig.138.

OSL-samples from the Arjun 3 site were taken by Wagner and Corvinus 0.1 to 6.0 m above the artefact horizon, and analysed by Kadereit at the Max Planck Institut of Nuclear Physics in Heidelberg. The ages are (see appendix II):

- Sample C: 30.04 (2.3) ka;
- Sample B: 67.15 (6.7) ka;
- Sample A: 58.56 (7.7) ka.

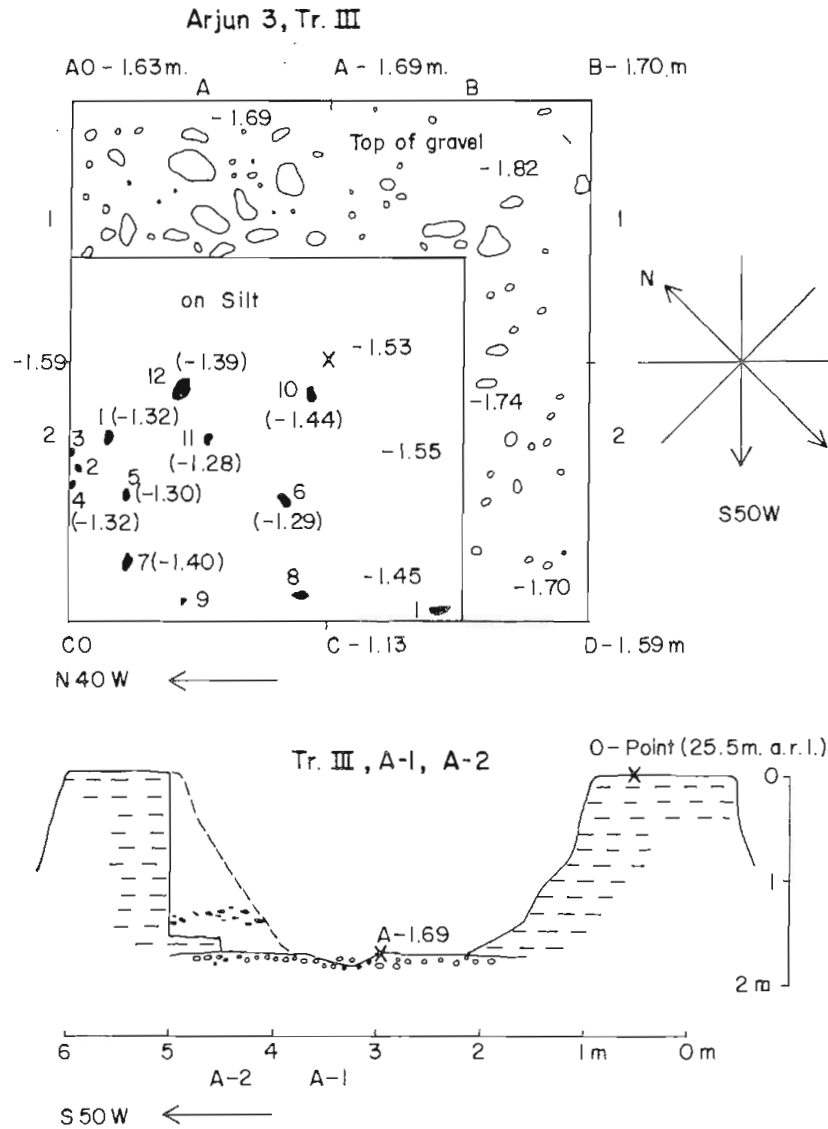


Fig. 139. Arjun 3, plotting of cutting III.

The ages do not, however, match expectations, particular sample A from the artefact horizon. The author's own assumption is that the Middle Palaeolithic artefact horizon has an age of somewhere between 100 ka to 70 ka, as on geological and sedimentological ground one would estimate an Eemian age (for further explanations of OSL-ages see comments in appendix II).

A deep-red soil has developed on top of the 30 m terrace, indicating a long prevalence of a warm, humid, monsoonal climate. It must have developed since the last glacial high, when the climate began to ameliorate.

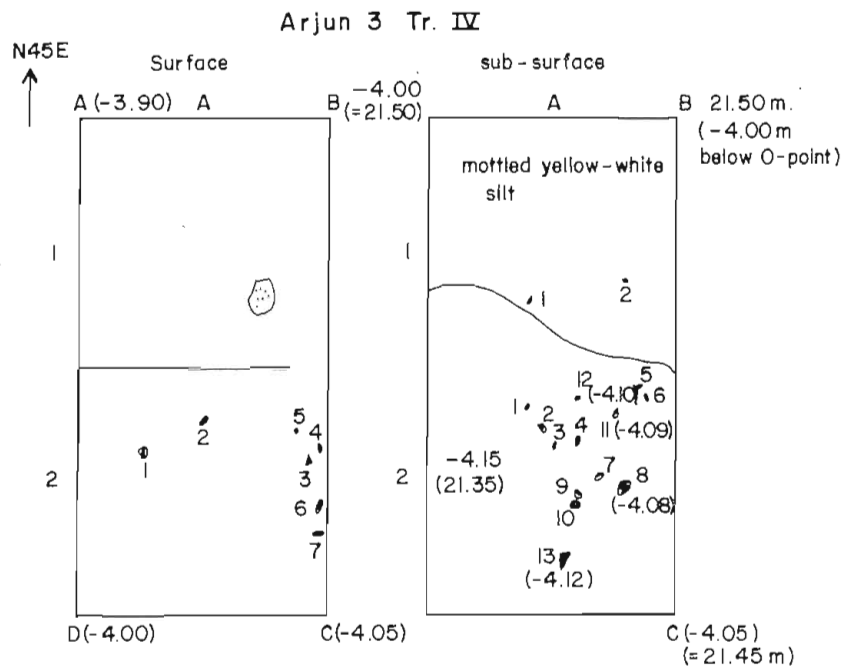


Fig. 140. Arjun 3, plotting of cutting IV.

The typological characteristics of the artefact assemblage, which point to a Middle Palaeolithic industry, now called the Arjun 3 Industry, and the stratigraphic situation at the base of the 8 m silts above a fluvial gravel suggests an age considerably older than the Late Pleistocene industries found at many places in the top part of the alluvium of the Babai Formation. The hominids responsible for the Arjun 3 industry lived some time before the last glacial period, maybe towards the end of the last interglacial period. We will come back to this question later, after the description of the artefacts.

The artefact assemblage of the Arjun 3 industry. The artefact assemblage of the Arjun 3 site is a complete and unselected collection, and therefore is of particular importance. During the plotting of the site every artefact which had eroded out from the horizon was lifted from the surface. Even the smallest perceivable waste products were collected for a statistical study. The greatest percentage of specimens in the artefact assemblage at Arjun 3 consists of waste—small chips, flake-like pieces, irregular waste flakes, chunks and cores—while tools and utilised flakes are present in smaller quantities (Table 5). The latter display, however, well-defined and diagnostic features. The site was most probably a camp and factory site. The scarcity of implements in relation to the waste (Fig.143), and the presence of flakes and other artefacts which fit together (Pl.155/1-3), would indicate a factory. Moreover, there are artefacts, found in the same square, which were detached from the same type of quartzite rock, indicating that they may have been detached from the same core at this very place.

The Arjun 3 site assemblage is a Middle Palaeolithic industry characterised by the presence of a) a blade element, b) flakes and points with well-prepared and faceted platforms and c) prepared discoidal cores.

The chart exhibiting the raw material (Fig.144) used for tool production shows that the great majority (91 %) of artefacts was made from quartzite, while the small remainder consists of „tuff“ (5 %), quartz or chert.

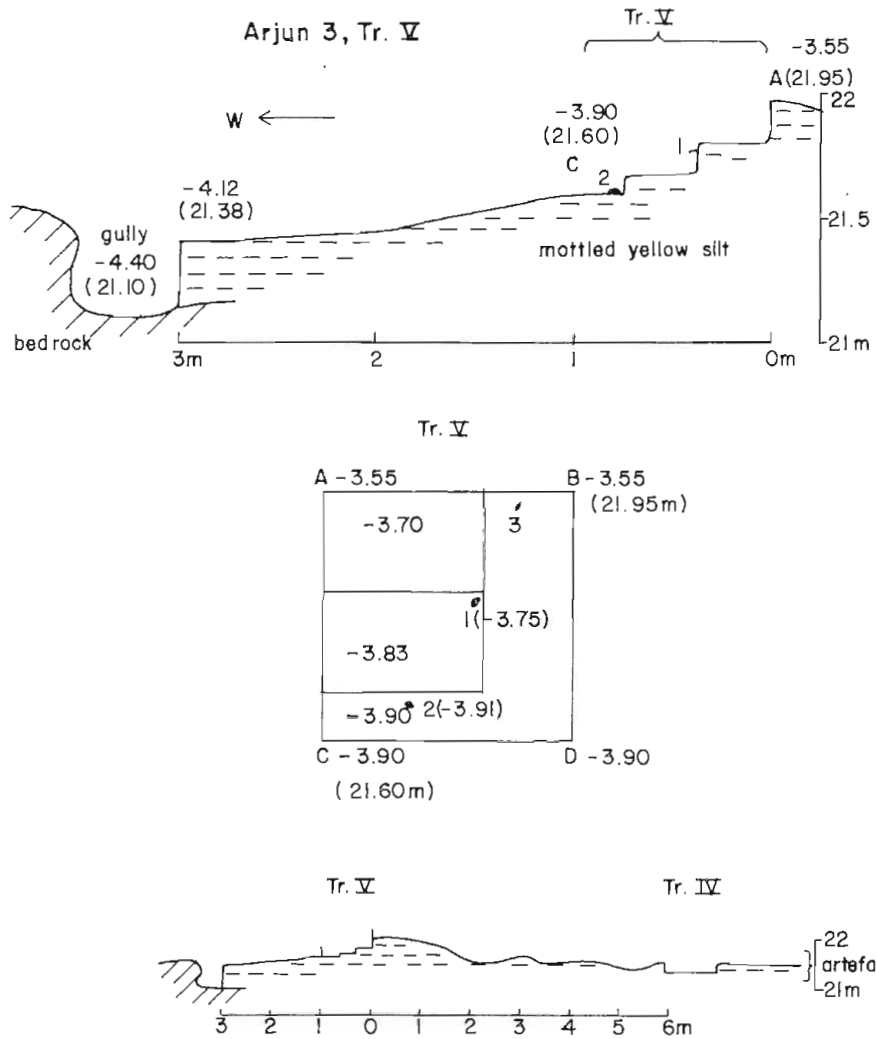


Fig. 141. Arjun 3, plotting of cutting V.

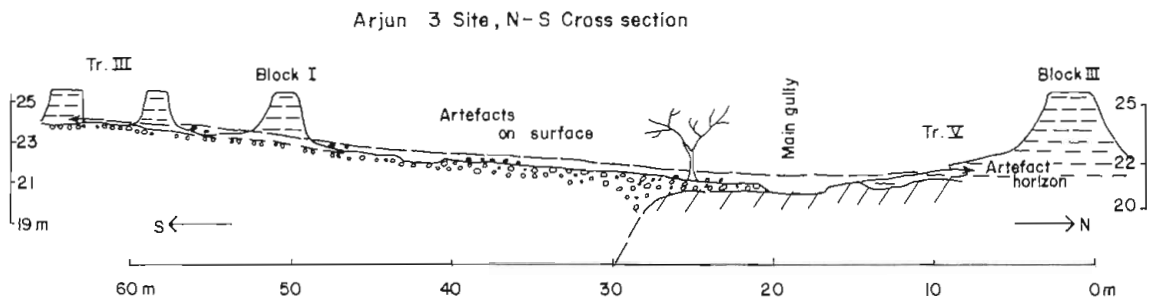


Fig. 142. Schematic crosssection N-S through Arjun 3 area, with artefact horizon indicated.

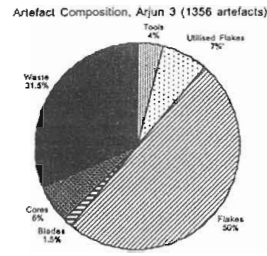


Fig. 143. Artefact composition of Arjun 3 site.

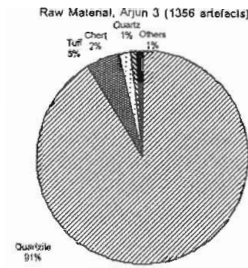


Fig. 144. Raw material of Arjun 3 artefacts.

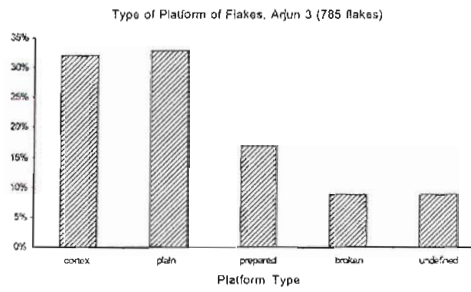


Fig. 145. Type of platform of flakes of Arjun Site.

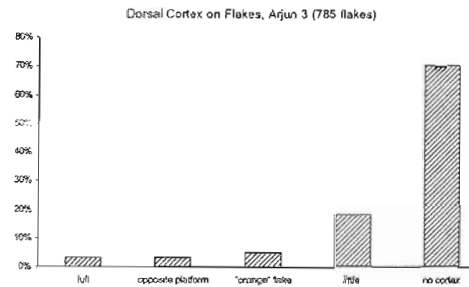


Fig. 146. Dorsal cortex on flakes of Arjun 3 Site.

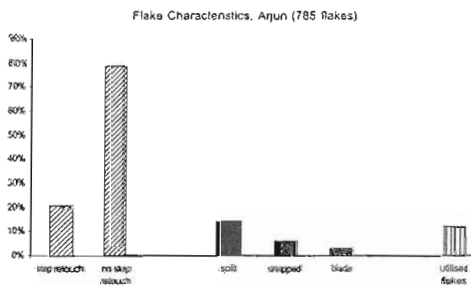


Fig. 147. Characteristics of flakes of Arjun 3 Site.

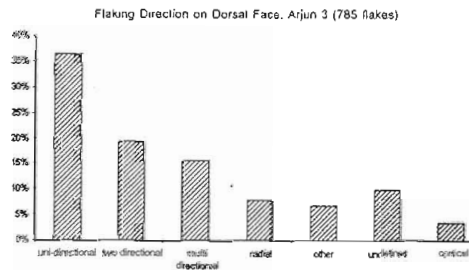


Fig. 148. Flaking direction on dorsal face of flakes of Arjun 3 flakes.

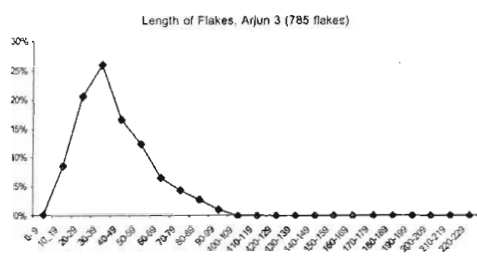


Fig. 149. Size of flakes from Arjun 3 Site.

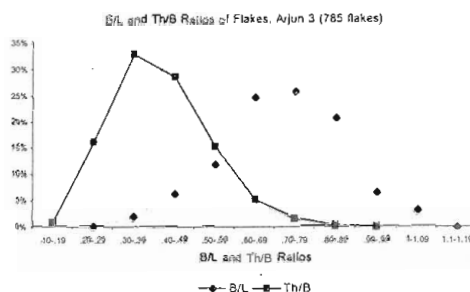


Fig. 150. Breadth/length (B/L) ratios of flakes of Arjun 3 Site, together with thickness/breadth (Th/B) ratios of the flakes from Arjun 3.

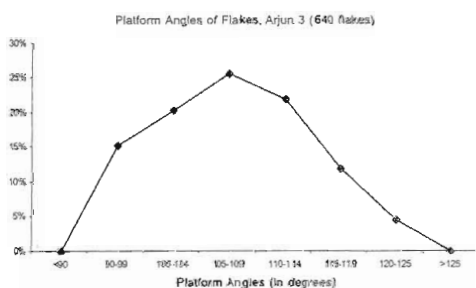


Fig. 151. Angle of platform of flakes of Arjun 3 Site.

Tab. 5: Composition of all artefacts from Arjun 3 site.

Artefact Types	A 2 - A 5	A 6 - A 8	A 9 - A 11	B 2 - B 7	B 8 - B 11	C 2 - C 5	C 6 - C 9	C 10 - C 12	D 2 - D 5	D 6 - D 7	D 8 - D 11	E 2 - E 4	E 5 - E 7	E 8 - E 11	F 1 - F 4	F 5 - F 7	F 8 - F 11	G 3 - G 4	G 5 - G 7	G 8 - G 9	H 3 - H 6	I 5 - I 9	I II III	IV V VI	Total	%
Tools	-	1	2	3	9	-	4	3	11	1	3	1	4	4	1	1	1	-	1	1	4	1	-	-	56	4.1
Utilised flakes	1	4	3	1	7	4	3	4	17	3	4	7	7	1	4	7	2	5	4	1	5	-	2	-	96	7.1
Utilised pieces	-	1	-	2	-	2	3	-	2	-	-	1	1	-	2	1	-	1	1	-	-	-	-	-	17	1.3
Cores	3	6	2	2	4	3	5	3	4	3	-	1	4	2	1	6	3	1	4	4	2	2	1	-	66	4.9
Core fragments	-	-	-	-	2	-	1	-	-	-	-	2	-	2	1	1	-	2	-	3	1	-	-	-	15	1.1
Flakes	19	40	46	9	26	30	27	23	61	25	35	43	36	22	53	18	9	37	27	12	38	1	17	7	661	48.8
Blades	1	-	1	-	-	-	-	1	7	1	-	2	2	-	3	2	1	2	-	-	4	-	-	1	28	2.1
Flake-like	8	10	7	5	2	3	5	3	12	4	5	18	10	9	12	2	2	7	10	2	10	-	4	7	157	11.6
Chips	20	3	5	1	3	21	1	-	8	2	2	13	3	1	17	2	1	6	3	-	12	-	3	7	134	9.9
Chunks	4	8	10	-	4	4	6	2	12	2	4	9	3	1	10	-	1	7	8	2	3	-	1	4	105	7.6
Other waste	-	2	2	1	-	2	1	1	2	-	-	2	1	-	-	-	2	1	-	-	2	-	-	-	19	1.4
	56	75	78	24	57	69	56	40	136	41	53	99	71	42	104	40	22	69	58	25	81	4	28	26	1354	99.9

The industry is a flake industry, with flake and blade tools and unretouched but usable flakes, in association with an element of large cobble tools. Some 70 % of all artefacts are derived from flakes, and 15 % from cobbles, while the rest is undefinable. A total of 40 % of the cobble artefacts are cores, but only 13 % of them are tools. The flakes were detached mainly from prepared cores, but also from unprepared cores with cortical platforms. Fig.145 shows that the majority of flakes have plain or prepared platforms, though a considerable number of them have cortex platforms which were struck from the cortical base of unprepared cores. This latter feature, though, is not the predominant one, as it is at the Brakhuti assemblage or the Paru industry.

The composition of the 1354 collected artefacts (Fig.143) is such that the majority of artefacts are waste, cores or unutilised flakes (at together 85.5 %), while tools make up 4 %, utilised flakes 7 % and blades 2.1 % of the total.

The tool composition at Arjun 3. Apart from the light-duty element of smaller flake and blade tools (35.7 %), there is a characteristic component of large cobble tools present at Arjun 3 (Table 6). A total of 50 % of them are unifacial choppers, i.e. side-, end- and round choppers; 1.8 % polyhedrons; and 7.2 % other heavy-duty tools (a uniface, a pick, a bifacial tool and a trimmed chunk); while 5.5 % are hammerstones or anvils. A few of the scrapers are also made on cobbles or chunks. Eighteen specimens (32.1%) are scrapers, and 2 are retouched points.

The special characteristics of the tools are summarised in Table 7. Altogether 62.5 % of the tools are made on cobbles, while 32 % are made on flakes, and the rest on slices or undefinable chunks. The high percentage (77 %) of unifacial tool trimming is due to the fact that almost all choppers are unifacial. Only 17.5 % of tools are bifacially or partly bifacially trimmed. Some 48 % have much cortex, i.e. they retain at least half of the cortex on their surface, while 16 % have no cortex. Secondary retouch can be found on more than 80 % of the tools.

Tab. 6: Arjun 3, Tool Composition.

Tool Type	Number of Tools	(%)
Side chopper	19	34.0
End chopper	8	14.3
Round chopper	1	1.8
Polyhedron	1	1.8
Side scraper	6	10.7
End scraper	5	8.9
Other scraper	5	8.9
Pionted scraper	2	3.6
Point	2	3.6
Pick	1	1.8
Biface	1	1.8
Uniface	1	1.8
Worked utilised piece	1	1.8
Hammersstone	2	3.6
Anvil	1	1.8
Total tools	56	100
Utilised flakes	96	
Utilised blades	28	

The surprisingly high percentage of cobble tools in an assemblage with levallois elements is a special characteristic of the Middle Palaeolithic of the Arjun 3 site. Besides scrapers, blades, points and utilised flakes, the chopper component is significantly strong. Corescrapers, however, fail to make an appearance at Arjun 3. It seems that the steep-edged, unilaterally trimmed corescraper is a tool type belonging to younger local industries, especially the Brakhuti industry, while continuing on into still younger periods, as at the Paru site. But later survey revealed that this tool type is present at several activity locations in the close neighbourhood.

Choppers constitute the predominant feature in all of the prehistoric assemblages (except in the Early Palaeolithic) known so far in Nepal. By at least the beginning of the Late Pleistocene they seem to have been a major component in all Stone Age assemblages from the Middle Palaeolithic period onwards. The Acheulian culture is still too little known from the two sites discovered so far, but as far as can be seen, choppers are not an integral part of this culture in Nepal.

The cobble tools (heavy-duty): This group comprises 28 choppers, one polyhedron, one unifacial, one pick and a bifacial tool. There are no corescrapers at Arjun 3 (Table 6).

The choppers (19 side-choppers, 8 end-choppers and 1 round chopper) are almost all unifacial. Their edges, whether on the side or at the end, are trimmed unilaterally from a cortex base. They have mainly straight, but also in some cases convex edges, while a few have concave and concavo-convex edges. They are all made on elongate or round, usually rather flat cobbles. Almost half of them are made on split cobbles, for example Nos. B-8/5 and B-9/9. Only one (No. C-8/8) has a partly bifacial edge. Most choppers (67% of all choppers) are side choppers and only a few are end-choppers, of which only 4 are true end-choppers on elongate cobbles. One of these (Pl.152/1) is a double end-chopper and is not unifacial, unlike the others, but both ends are bifacial. One chopper, seen in Pl.19/1 seems to be a multi-purpose tool. It is a unifacial end- and side-chopper on a cobble, the lower flat face of which is of cortex; the upper face has a few large primary scars. The convex distal edge is well made by fine unifacial retouch (like a scraper

Tab. 7: Characteristics of Tools from Arjun 3 Site.

	Pieces	%
Blank Type		
On cobble	35	62.5
On flake	18	32.0
On slice	1	1.8
Other	1	1.8
intermediate	1	1.8
Trimming		
Unifacial	43	77.0
Bifacial	10	17.8
No trimming	3	5.5
Secondary retouch		
Present	47	84.0
Not present	16	9.0
Cortex		
> 50%	27	48.0
< 50%	20	35.7
none	9	16.0

edge), which continues into the lateral, concave edge; there are fine usemarks at both edges. The rest of the choppers are all more or less manufactured in the same fashion, with unifacial lateral chopper edges of 60 to 75°. The round chopper No. F-9/7 is made on a split round cobble, one part of which broken off, so that the round circumferential edge is not complete. The upper split face has shallow primary flakes and some unifacial secondary trimming. It is a fine tool; it may have been a uniface before it was broken, similar to the uniface in Pl.151/1. Such unifacial choppers are very common in the later assemblages with no apparent change in the types. Round choppers become much more prominent in the later assemblages.

An interesting implement is the tool in Pl.22/2a,b. It is an elongate, triangular-sectioned core with three platforms: two unifacial platforms of cortex and one bifacial platform as a ridge. It was afterwards utilised as a side-chopper along two straight lateral unifacial edges.

These heavy-duty tools are simple tools for heavy work and do not show signs of any specialisation at Arjun 3. Specialisation in the choppers becomes apparent only in later periods, for example in the Gidhi-niya and Brakhuti assemblages, reflecting a change of tool requirements, i.e. of activity and ecology in the more recent times.

There is only one polyhedron on a cobble, with little cortex left. It has six or seven short, steep edges partly bifacial, partly unifacial, with many flakes of all sizes removed around the entire circumference.

One of the finest tools is a uniface or unifacial ovate (Pl.151) made on an original large side-flake. The lower face is cortex. The upper face has a small remnant of the original flake surface in the centre, but the whole rest of the upper face was trimmed well with large, shallow primary flakes and fine secondary retouch along the edges. It has a regular oval shape.

The bifacial tool No. D-5/7 is not a biface in the true sense, but a longitudinally broken tool with bifacial trimming, and probably made on a thick flake. It is an elongated, pointed tool with a round butt and one partly bifacially trimmed lateral sinuous edge.

The pick (Pl.152/2) is a pointed tool made on a split cobble, on which a triangular-sectioned pick point was roughly shaped from the upper face.

Light-duty tools: There are 18 scrapers, of which 13 (72%) are made on flakes and 5 on chunks or other waste. Six are side-scrapers, 5 are end-scrapers, one has both a distal and lateral edge and 5 are unspecialised scrapers. All but three have dorsal unifacial retouch (Pl.15/3), while two have ventral retouch (Pl.16/4) and one scraper has dorsal and ventral retouch. Only 3 are pointed scrapers (Pl.15/1 and Pl.16/2) and one, Pl.15/2 is a fine pointed scraper with a convex scraper edge at the place of the removed platform, but where the point was not used.

A few scrapers will be described:

No.B-9/2 (Pl.16/4) is a fine oval scraper on a cortex flake with retouch on the ventral face at its convex distal edge.

No.D-4/15 (Pl.15/1) is a well-trimmed side-scraper, a pointed ovate tool on a side-flake with removed bulb. It has dorsal unifacial retouch on its left side and at the point.

No.D-9/2 (Pl.15/2) is a well-made end-scraper on a flake with removed platform. It has a round unifacially retouched edge at the place where the removed platform used to be.

No.E-7/37 (Pl.15/3) is a round side- and end-scraper on a flake. It is retouched on the dorsal face along its left side.

No.E-8/3 (Pl.16/2) is a pointed scraper from a side-flake with a prepared platform; its rounded point on the left side of the platform shows fine, secondary retouch on the dorsal face.

There are two fine points made from prepared cores, each with faceted platforms. The finest is No. I-4/1 (Pl.14/1), which has a well-retouched sharp point, and is also retouched on the left side. The platform has been reduced and flattened, probably to hasten the tool. The other, No. C-10/7, is retouched on the ventral side.

Blades (including blade-flakes), which constitute 2.1 % of the artefact composition, are a distinctive feature of the Arjun industry. Made from prepared blade cores, they are large tools between 15 mm to 115 mm in length (averaging 20- 50 mm, with a peak at 30 mm to 40 mm). The breadth/length ratio has a mean value of 0.4, but 32 % are snapped blades, so that the B/L ratios are distorted.

The finest blade (Pl.14/2) has been struck from a prepared core with a small, faceted platform and four dorsal scars in the same direction as the blade. Its whole upper part was snapped away.

Another blade (Pl.14/3) has been snapped on both ends;

The snapped blade in Pl.14/4 has been retouched at the right, and the bulb and platform were removed.

The snapped blade-flake in Pl.18/4 has a faceted platform, and the distal end is snapped away;

Pl.18/2 and 3 illustrate two snapped, utilised blade-flakes with a faceted platform, and the distal end being removed;

Other utilised blade-flakes are illustrated in Pl.14/5 (with a plain platform and cortex at the distal end), Pl.153/1 (made of „tuff“, with a cortex platform and a notch on the right side), Pl.153/3 (a blade-flake with a plain platform and a reduced distal end), Pl.153/2 (a blade-flake with a small cortex platform), Pl.154/2 (a rejuvenation flake).

The cores at Arjun display considerable variety. They have been categorised into two major groups with several sub- groups: A) the prepared cores with one or more non-cortex platforms and B) the unprepared cores with one or more cortex platforms.

The most common and conspicuous cores are simple single-platform cores (core type Nr. B.1); these are quartzite cobbles where the platform is a flat cortex base from which a number of flakes have been removed, usually uniaxially. Equally pronounced are prepared cores of a discoidal, tortoise-shaped character (core type A.1, Pl.20/1-3). Similar but less regularly prepared cores belong to core type A.2 (Pl.21/3, Pl.155/2). Cores of types A.1 and A.2 are well prepared and show levallois features. Many flakes correspond to such prepared cores, where platforms exhibit faceting, and the dorsal faces display signs of preparation prior to detachment. A few conical/cylindrical cores meant for blade detachment (type A.3, Pl.21/4, Pl.22/3) are present, too, but large blade cores have not been found, although such blades are present. The polyhedral cores (type A.4, Pl.21/1,2) are small, prepared cores, a variety of the discoidal core. Of the 66 described cores, 37 (58%) are prepared, and 27 (42%) have unprepared cortex platforms.

A. Prepared cores with one or more non-cortex-platforms:

- 1) prepared discoidal cores, of tortoise shape, 7 specimens, (Pl.20/3a,b; Pl.20/2a,b; Pl.20/1a,b);
- 2) almost discoidal or irregular discoidal cores, 13 specimens, for example D-4/55 (Pl.155/2) with fitting flake No.53; D-7/7 (Pl.21/3a,b);
- 3) prepared cylindrical cores, 2 specimens (Pl.22/3a,b and Pl. 21/4a,b);
- 4) polyhedralcores, 2 specimens (Pl.21/2a,b, Pl.21/1a-c);
- 5) cores with two bifacial platforms opposite each other (Pl.22/1a,b);
- 6) cores with two prepared platforms at right angles to each other (Pl.19/2a-c);
- 7) cores with one platform consisting of one flake surface, 3 specimens (Pl.156/1a,b);
- 8) cores with three platforms from flake-surfaces, 1 specimen;
- 9) cores with two platforms (one flake face, one cortex), 2 specimens (Pl.156/2);
- 10) cores with zigzagging, alternate bifacial platforms, 1 specimen.

B. Unprepared cores with one or more cortex-platforms:

- 1) cores with one cortex platform, 18 specimens;
- 2) cores with one cortex platform from which at opposite sides flakes have been removed: 9 specimens (Pl.22/2a,b);
- 3) cores with two cortex platforms at right angles, 1 specimen;
- 4) unifacial cores with flakes taken from the cortex of the lower face 1/2 or 3/4 the way around the circumference, 4 specimens;
- 5) one irregular core fragment with a fitting flake from a cortex platform (Pl.155/2).

The preparation of the cores conforms well with the platform features observed on the flakes (i.e. the prepared/faceted and plain platform types) and with the dorsal characteristics of the flakes, indicating the intentional preparation of the flakes prior to the detachment from the core.

A total of 785 flakes from Arjun 3 have been subjected to a statistical analysis, in order to highlight their special characteristics in comparison to the flakes of the later Brakhuti industry.

The flakes at Arjun 3 are well made (apart from the large percentage of waste flakes). The diagram displaying the types of platform (Fig.145) shows that a rather high percentage of flakes (17 %) have prepared faceted platforms, which are sometimes extremely small. Some 33 % have plain platforms (which means that the prepared and plain platforms together come to 50 % of the total, indicating prior core preparation), while 32 % have cortex platforms. The rather high percentage of cortex platforms on the flakes is connected with the manufacture of choppers, which represents quite an important component of the Arjun tool kit (though not as high as in the later industries). The same is observed in all later assemblages in Nepal: they all contain a high percentage of unifacial choppers, in the Brakhuti industry and the Mesolithic Patu industry. The Brakhuti industry always has a much higher percentage (up to 80%) of flakes with cortex platforms, because unifacial choppers and corescrapers form the major component of the tool assemblage.

The diagram relating to dorsal cortex (Fig.146) shows that the majority of the flakes (70 %) have no cortex on the dorsal face, while 18 % have very little cortex, 3.5 % have some cortex opposite the platform, and only 5 % are „orange“ flakes, where the cortex reaches from the platform along one side to the distal end. These last two categories are an integral part of the manufacturing process of unifacial choppers. They always make up a higher percentage in the Brakhuti industry, because of the larger percentage of unifacial cobble tools there.

Fig.147 shows that only 21 % of flakes have stepretouch at the platform edge on the dorsal face, which is, at more than 50 %, such a characteristic feature of the flakes of the later Brakhuti industry, and there indicates that they are manufacturing flakes of choppers and corescrapers. Split and snapped flakes are more common at Arjun than in the Brakhuti industry.

Flakes have well-prepared dorsal faces (Fig.148). They exhibit predominantly uni-directional flake scars but the percentage is considerably smaller than in the case with flakes from the younger Brakhuti industry (which is usually more than 50 %). In contrast, they display more radial scars (from prepared levallois cores) and more two-directional and multi-directional flake scars (from cores with multiple platforms).

Concerning the size of the flakes (Fig.149), 61.5 % are medium-sized, between 30 mm to 69 mm (with a peak at 30-39 mm), while 29.5 % are small-sized, below 30 mm, and only 9 % are larger than 70 mm. Three specimens are very large flakes, above 150 mm, the largest being 225 mm. Only 8.7 % of the flakes are smaller than 10 mm, though there must have been a larger percentage of small waste, which was either washed away or went unnoticed on the surface.

Amongst the chips and flake-like waste, the average is also small: the chips have a peak at 10-19 mm (57 %), while only 3 % are even smaller than 1 cm. The flake-like pieces are slightly larger, with a peak at 20-29 mm.

The breadth/length ratios (B/L), as seen in Fig.150, indicate only 2 % of flakes with ratios less than 0.4 (blades), and 8 % (narrow flakes) with a ratio below 0.5, while the thickness/breadth ratios (Th/B) reflect the fact that the Arjun flakes are well made, with 50 % thinner than 0.4.

The angle of the platform on the flakes (Fig.151) is in 61 % of the cases less than 110°.

The presented statistic features point up the sophisticated flaking technique of the Arjun 3 industry and the well-defined levallois element, seen in the prepared faceted platforms and in the presence of radial dorsal flaking from prepared cores corresponding to the discoidal tortoise-shaped cores, for example, in the flakes illustrated in Pl.16/1,5, Pl.17/1-6, Pl.18/1-3, Pl.153/4-5 and Pl.154/5-6.

Many of the flakes are well shaped and often pointed, and they are usually utilised for example the flakes in Pl.16/1-2, Pl.17/1-2,5-6, Pl.153/3-5 and Pl.154/3,5-6.

Some flakes were snapped, probably intentionally, for example Pl.17/3 and Pl.18/2-4; and a number of flakes are split (Pl.18/6).

Many other flakes were utilised: Pl.16/3, Pl.17/4, Pl.18/5-6,8.

A number of flakes seem to be rejuvenation flakes from the production of choppers for example, in Pl.154/1-2. Some so-called „orange“ flakes are manufacturing flakes of large cobble tools.

There are a few flakes which fit together: Nos. F-4/8 and 40 (Pl.155/1), along with a few flakes that fit to cotes, for example in Pl.155/2, and three flakes that fit to a chunk (Pl.155/3). Some flakes were struck from the same core and found in the same square.

Summary remarks on Arjun 3 site. The Arjun 3 site is the only stratified Middle Palaeolithic occupation site so far encountered in Nepal. It is embedded below an 8-9 m-thick alluvial silt of the upper 30 m terrace of the Arjun River. The site was exposed by recent heavy erosion, which dissected the former terrace into a badland topography. The test pits dug into the foot of the eroded silt verified the exact position of the floor as being at the base of the silt, above fluvial gravel and bedrock.

The site seems to have been a factory-cum-camp site. Apart from a vast majority of manufacturing waste (85.5 %) there is a tool kit (4 %) consisting of light-duty tools, namely of scrapers, points, blades and utilised retouched flakes (7 %), in association with a considerable number of heavy-duty tools in the form of unifacial choppers and a few other large cobble tools. The light-duty implements were made by the prepared core technique from discoidal tortoise-shaped cores along with a few blade cores. Many of the flakes display levallois-like preparation on their dorsal faces. The raw material is almost entirely quartzite.

The occupation was a well-chosen site at the riverbank, at the place where the river emerged from a steep and narrow gorge-like valley in the Siwalik mountains, into the wide, open Dun valley. The hills afforded protection in the back. The river was, as it is today, a perennial stream.

Several TL and OSL dates are available, based on analyses in the Max Planck Institute in Heidelberg. The red top soil (between 0.30 m and 1 m) yielded TL dates between 10.1 ± 1.5 ka and 15.9 ± 2.5 ka (Zöller 2000), while a date of 29.5 ± 4.1 ka was determined for the silt at a depth of about 2.5 m.

Three OSL dates from the Arjun site, executed at the former Forschungsstelle Archäometrie at the Max-Planck Institut of Nuclear Sciences, are also available (see Appendix II, 372 ff). The OSL-age of 30.0 ± 2.3 ka for a sample from the red top soil is identical with the TL-age. The silt at the occupation horizon yielded ages of 67.2 ± 6.7 ka (sample 6.0 m below ground level) and 58.6 ± 7.7 ka (sample from 8.5 m below ground level). From the geological and typological point of view, the Middle Palaeolithic occupation seems to have taken place before the onset of the last glacial, before 70 ka, during the last interglacial.

A word must be added here about the paper by Zöller (2000), which, though the age identification of the first 2.5 m is accepted and corresponds with those from Kadereit & Wagner, may give a misleading interpretation of the archaeological data. The samples dated by Zöller were not taken by the author himself but by Dr. P. Wichmann (Wichmann 1993) and by Prof. Dr. A. Bronger (Bronger et al. 2000) for paleopedological and not for archaeological purposes. Apparently, a mismatch with respect to archaeological sites had occurred during sampling. Thus, the TL ages given by Zöller (2000) cannot be interpreted as a chronological frame of the „Hoabinhian-like“ industry in eastern Nepal. Zöller (2000, 234 f) already points out the uncertainty of such interpretation. The samples discussed in Zöllers paper are all from the western Dang-Deokhuri area. I have never interpreted the cultural material of Arjun as „Hoabinhian“. It is the cultural material from the eastern Nepal site of Patu which I interpreted as a Mesolithic culture akin to the Hoabinhian. Of this site there exist only Holocene ^{14}C data but no TL dates (though I took carefully collected samples for TL analysis from Patu in 1987, and these I sent to Dr. Singhvi in Ahmedabad, but they have not yet been analysed).

Sites around Arjun 3. In the vicinity of the Arjun 3 site, a number of other Middle Palaeolithic localities were recorded, which all belong to the same cultural period. Two localities, called Arjun 1 and Arjun 2, had been found previously, in February 1984 and February 1985, after which a detailed survey of the area was carried out. It was during this work that the Arjun 3 main site was discovered, as described in the previous pages. These new localities were spread as a half circle around the main Arjun 3 site, encompassing about one square kilometre.

Arjun 1 is situated on the northern side of the highway leading west from Lamahi, about 800 m east from the bridge over the Arjun River. Artefacts were found eroding out in a 200 m x 100 m area from a deep-red silt at a level 3 m below Terrace I, at a height of about 28 m a.m.r.l. All artefacts were collected from this small flaking spot, where they had been exposed by erosion on a small red silt ridge, 0.20 m above the eroded ground: a snapped blade, some flakes, a fine discoidal core, some chips and one quartzite cobble were collected from the surface. Since the artefacts are not rounded and are contained in a definite horizon they seem to belong to that time of sedimentation, and belong to the same industry as Arjun 3.

In February 1985 once again all newly eroded artefacts from this small flaking spot were collected. Arjun 1 was re-examined in March 1987, and again a few artefacts with levallois character were found, certainly belonging to the same period as the Arjun 3 site. In April 1987 a small test pit was sunk into the hillock, where the artefacts had come from, and it established the artefact horizon within the red soil at the erosion level of the artefacts (Pl.229/2, Fig.152 top and Fig.138). But all notes, plottings and slides of the Arjun 1 site together with a great part of the data of the Arjun 3 site were stolen during the theft in India in 1989, and all this data are irreparably lost.

Descending westwards from the deep-red surface of Terrace I, one arrives at the next lower Terrace II (at a height of 20 m), which has a yellow-brown silt underlain by a lower, buried red silt/soil. A gentle slope with rain gullies separates Terrace II from the 13 m-high Terrace III. On this slope, another artefact locality, Arjun 2, is eroding out from the top of a red silt in the small rain gullies (Fig. 152 top and Fig.138). The assemblage consists of a scraper and a number of well-made prepared flakes, all struck from one core of reddish quartzite. The core itself was not found.

Terrace III consists of a deep-red silt, quite dissected, overlying at a height of about 8 m a.r.l. a coarse fluvial cobble gravel. Terrace IV, some 5 m a.r.l., exposes coarse cobble-boulder gravel (Fig.152). The gravel is unsorted, with components of pebble-to-boulder-sized quartzites, limestones, phyllites, and a large percentage of Siwalik sandstones and mudstones. The cobbles of the Siwalik rocks are angular; they derived from the Siwalik Hills close-by. The quartzite cobbles and boulders are well-rounded and are probably reworked from the Siwalik Boulder Conglomerates. Cobbles of „tuff“, the raw material Early Man in Dang-Deokhuri loved to use, are quite numerous, too. The matrix is calcareous, and therefore the ledges of the gravel along the riverbank are well cemented.

The artefacts from Arjun 1 consist of 90 surface artefacts from the 1984 and 1985 collections. In 1987 twenty other artefacts were collected from the surface at the small 1x2 m testcutting, having eroded out in the intervening two years, along with 7 artefacts from the subsurface, just a few centimetres below the surface. They are all made of quartzite and have a deep red patina. Having eroded out only recently from the sediment, they are quite fresh and sharp-edged. Except for two snapped blades and two small blade-flakes, there are no tools. All the rest of the material are unutilised flakes and waste chips. The flakes resemble in type and technique those of the neighbouring site of Arjun 3. They have prepared or plain platforms, and were struck from prepared cores. Their dorsal faces show the levallois-like preparation of the core. The artefacts indicate that a small flaking area of the same people as the Arjun 3 site was once present here.

Approximately 50 m to the south of Arjun 1 another small locality, Arjun 1 b, was found on the surface of the same silt, and a number of tools were recorded, which also belong to the Arjun 3 industry. It includes a large unifacial end-chopper (Pl.198/1) made on an elongate rounded cobble one end of which

was shaped into a unifacial convex edge, and two levallois-type discoidal cores (Pl.198/2,5), a large well-retouched side-scraper (Pl.198/4) and a number of flakes from prepared cores (Pl.198/3). The side-scraper is made on a slice of hard cherty quartzite, its straight unifacial edge having been fashioned by small, shallow flakes and fine stepretouch. There is also an interesting Kombewa flake (Pl.198/3). It has a bulb of percussion of a former, larger flake on its dorsal face, while obliquely on the ventral face is the percussive bulb of the flake itself. The former bulb was on a cortex platform, part of which can be seen on the dorsal face, while the present bulb is on a plain platform, with some stepretouch at the side. This was the stepretouch at the platform edge of the former flake (the one with the cortex platform), which was reshaped for renewed flake detachment.

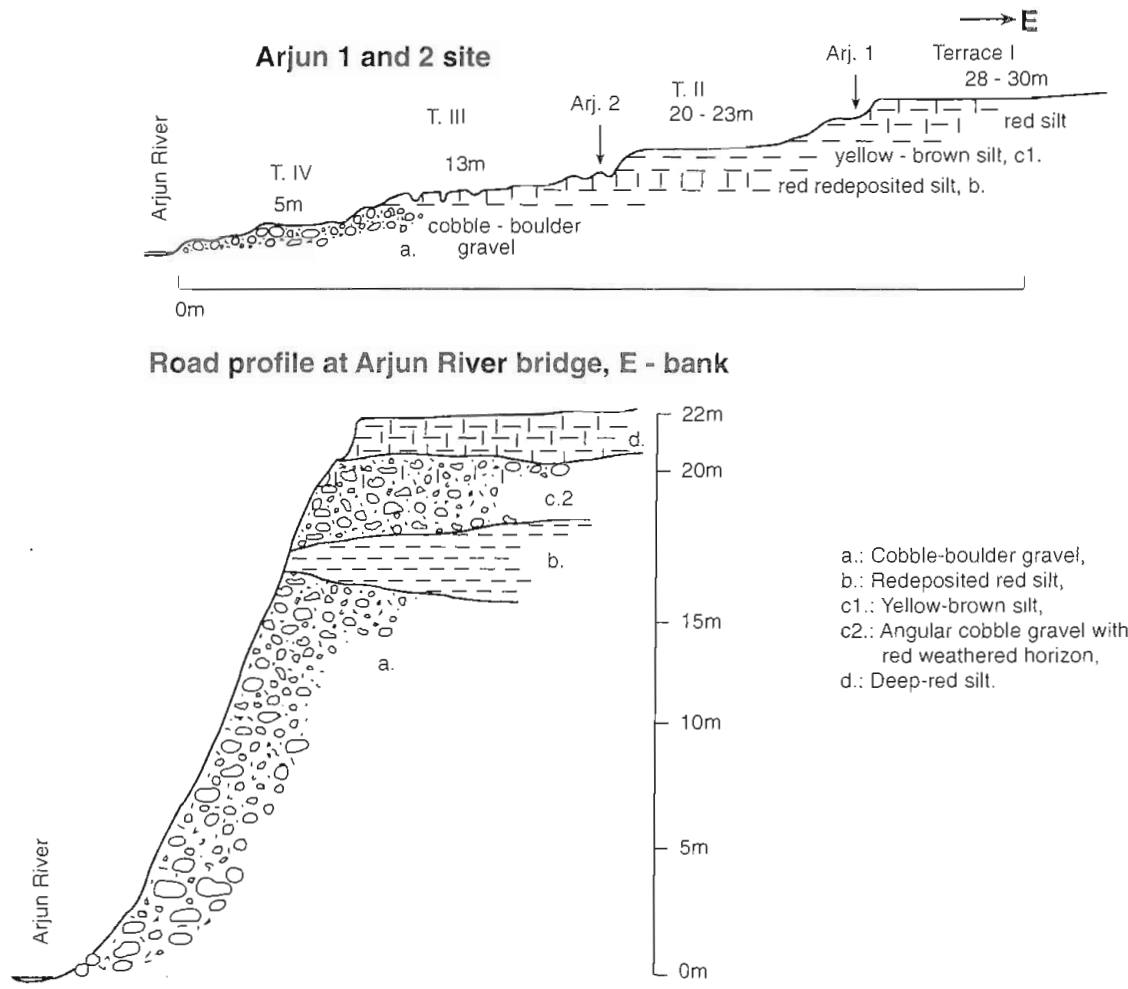


Fig. 152. Profile of Arjun 1 and Arjun 2 localities.

The small collection of artefacts of the Arjun 2 locality seems to be from a small flaking spot, as most of the artefacts have been struck from the same core of reddish quartzite, though the core itself was not recovered. The artefacts are, as at Arjun 3, of a Middle Palaeolithic type, and include a well-retouched convex scraper (Pl.199/1) a few flakes struck from prepared cores (Pl.199/2) and a double-platform core of „tuff“ along with a „tuff“ flake. The flakes have the same distinct features as those from the Arjun 3 site.

This and the closeness of localities 1 and 2 to the Arjun 3 site indicate that the population of the Arjun 1 and 2 localities must have been the same as the one that occupied Arjun 3.

After the survey of the Arjun 3 site, the whole area was further explored and several other localities were located in the vicinity, east of Arjun 3, and called Arjun 3SE, Arjun 4, and, on the other side of the river, Arjun 5.

Site Arjun 3SE, some 300m to the east-southeast of Arjun 3 (Pl.254/1) is a larger locality on a recent flood fan, on the surface of which many artefacts were concentrated, and the sediment of which derived from the silts of the terrace remnants behind it. These terrace remnants belong to the same 30 m terrace as at the Arjun 3 site. At several places the artefacts were seen to have washed out from the base of the silt, as at Arjun 3. They were made by the same people as those from the latter site. The distance between the eastern border of Arjun 3 to Arjun 3SE is not more than 100 m to 150 m (Ph.109-Sc).

There are 54 artefacts as a selective collection of locality Arjun 3SE, amongst which are 6 corescrapers, 2 end-choppers and 1 side-chopper as heavy-duty tools, and 4 prepared discoidal cores. One utilised blade and 7 utilised flakes were amongst the 36 collected flakes.

Particularly noteworthy are the 6 corescrapers found on the surface of the Arjun 3SE locality, both on the flood fan („Schwemmfächer“) and at two small activity spots, namely „the tree“ and „the spot“ at the base of the silt. At first glance they do not seem to belong to the Arjun 3 industry, because such tools are not found at the main Arjun 3 site assemblage. But the association of them with the rest of the clearly Middle Palaeolithic Arjun 3 type artefacts is unmistakable. Arjun 3SE/1, 2 and 12 (Pl.200/3-4) are thick, square corescrapers with heavily used edges, as is the tool of „the spot“/1 (Pl.200/2). Tool No.7 of „the tree“ locality (Pl.201/5-6) is an interesting narrow, „reduced“, corescraper-like implement with two steep lateral edges, uniaxially flaked from cortex with fine stepretouch. Both edges are well used.

Another heavily used tool is the large side-scraper (or corescraper) No.2 of „the spot“ (Pl.200/5), which was made on a cobble with a concave edge retouched by fine stepretouch.

The light-duty category at Arjun 3SE is characterised by a number of levallois-type discoidal cores, which are typical of the main Arjun 3 site, including Arjun 3SE/13 and 19 (Pl.201/4) from the flood fan, and especially No. 21 from the „tree-locality“ (Pl.201/1). A particularly flat, discoidal unifacial core is Arjun 4/2 (Pl.199/3). These prepared discoidal cores are very similar to those from Arjun 1b (Pl.198/2) and from Arjun 3. There are also some fine utilised blades, for example Arjun 3SE/11, with a length of 96mm (Pl.201/2, also Pl.226/3) and Arjun 5a/1 with a length of 97 mm (Pl.199/5). The flakes have prepared or plain platforms and well-prepared dorsal faces (Pl.201/3).

Locality Arjun 4, slightly south of the Arjun 3SE locality, with only 4 collected artefacts, a unifacial side-chopper, a very flat, discoidal unifacial core (Pl.199/3) and two prepared flakes, is an eastern continuation of Arjun 3SE.

Locality Arjun 5, opposite the Arjun 3 site, on the western side of the Arjun River, is nevertheless part of the Arjun industry. The collection contains a utilised blade (Pl.199/5), 2 large side-scrapers (Pl.199/4), both made on a flat cobble of „tuff“, and having one straight lateral edge shaped uniaxially from the lower cortex; and a unifacial end-cum-side-chopper (Pl.200/1) made on a flat, oblong cobble; and a few utilised flakes.

Interpretation: pattern of artefact composition and site distribution. The field notes relating to these important localities were all lost in a theft at Madras after a conference, and the data can only be recaptured from memory and on the basis of some photos, drawings and the artefacts.

Around the main site of Arjun 3 in the centre of the complex, a number of smaller localities are situated in a half circle (to the east, south and west) around Arjun 3, and none more than 500 m away from it. Ar-

Arjun 3 was the main centre of activity, having been a camp-cum-factory site at the riverbank. The other localities were situated away from the riverbank itself, where presumably specific activities were carried out.

The artefacts of localities Arjun 1 and Arjun 2 as well as of Arjun 3SE, 4 and 5 all belong typologically to the Arjun 3 industry. Although they are only small and selected samples, they bear resemblance in their manufacturing features to the Arjun 3 Middle Palaeolithic. They all have prepared flakes and blades and all, except Arjun 2, have prepared, discoidal cores.

Heavy-duty tools, too, are part of their tool kit:

Large side-scrapers were found at Arjun 1b (Pl.198/4) and Arjun 5a/5 (Pl.199/4). Unifacial end-choppers, were also found at all localities. The convex end-edge sometimes continues as a lateral edge along one side (Arjun 5b/1, Pl.200/1). They are all rather weathered from long exposure on the surface but seem to belong to the Arjun 3 industry. Corescrapers, which are absent at the main Arjun 3 site, turn up only at the Arjun 3SE locality: 3 at Arjun 3SE itself (Pl.200/3-4), 2 at the small activity locality called „the spot“ (Pl.200/2,5) and a heavily utilised narrow tool at „the tree“ locality (Pl.201/5-6).

The composition of artefacts varies among these localities, and this suggests that different activities were carried out at each site. The main site, Arjun 3, displays the definite features of a camp-cum-factory site (Fig.143). Tools form a rather small component against the vast majority of waste. Large cores are rare, and it seems that the stone knapping for the primary manufacture was done elsewhere, and only the secondary, finer phases of manufacture were carried out in the camp. Light-duty tools and utilised flakes, used for light type of work, form the majority of smaller implements (8.5 % of all artefacts). Heavy-duty tools are present, too, but to a much smaller extent (2.1 %), and consist mainly of side-choppers (for heavier cutting).

Locality Arjun 2, to the south of Arjun 3, seems to have been a small activity spot, where perhaps one member of the group carried out work with a few small tools, which he made at the spot.

Locality Arjun 1 is another, larger activity spot 500 m to the southeast of Arjun 3, and spreads over an area of some 20 m by 20 m. Besides a few blades, the bulk of artefacts are small waste flakes and chips, and a single discoidal core, all pointing to some major knapping activity, but no tool use. The small Arjun 1b locality, a little further south of Arjun 1, however, displays tool-use activity of both heavy and light work, including sharpening of the utilised tools.

The Arjun 3SE site is the closest to the main site and, like Arjun 3, is situated at the base of the 8m-silt, the artefacts having been washed out from it below the 30 m terrace remnants. The artefacts imply some specific heavy activities with large tools. There is not a single corescraper in the main site of Arjun 3, or at Arjun 1, but at Arjun 3SE there is suddenly a relatively large number of these steep-edged heavy tools in association with a few blades and discoidal cores. This would mean that corescrapers were known to the Arjun Middle Palaeolithic people, but were not used everywhere, certainly not at the Arjun 3 main site at the river. These heavy tools, good for cutting down small trees and branches (as learned by own experiments) seem to have been used only at places where such activities were called for, as at Arjun 3SE. The small Arjun 4 locality is very close to Arjun 3SE, and its few tools blend in with the Arjun 3 SE locality.

Locality Arjun 5, on the other side of the river, bears witness to some tool-use activity: a few scrapers, an end-chopper and a few utilised flakes and blade-flakes.

The interesting observation is that all localities in the Arjun area, though close to each other, are found in different environmental and geological settings and contain evidence of a variety of activities.

The main site, Arjun 3, is situated right at the bank of the Arjun River, which emerges here through a steep valley from the Siwalik Hills. The Arjun people had the river and the hill to their back and the open, flat valley to their front. Stratigraphically it is positioned, at an elevation of 22 m a.t.l., at the base of the upper silt, above bedrock, in the northern part of Arjun 3, and above fluvial gravel in the southern part. After the occupation the site was buried under 8-9 m-thick alluvial silts.

Arjun 3SE, closest to Arjun 3, but away from the river, has a similar geological position at the base of the silt. Arjun 4, next to Arjun 3SE, is on a fluvial gravel, the overlying silt having eroded away. Arjun 2, about 200 m to the south of Arjun 3 and at an elevation of about 16 m.a.r.l., is situated on a buried red soil, which was exposed at the time of occupation, and was later buried under a few metres of yellow silt which is comparable to that burying the Arjun 3 site, but is truncated by erosion. The tubification of the buried soil reaches down into the underlying fluvial gravel. Arjun 1, about 500 m to the southeast of Arjun 3, is the locality furthest away from the river, where the alluvial sediments, overlying bedrock, are much less thick. The site is situated within a deep-red soil, 25 m a.r.l., 3 m below the surface. Bedrock crops out below the occupation. Fig.152 gives a schematic profile of the area, as it is currently understood.

The typological and geological data of the various localities of the Middle Palaeolithic complex at Arjun provide us glimpses into the life of the hominids at Arjun by illuminating a definite pattern of their activities. Different activity spots with different artefact types in different environmental settings are distributed over an area of about one square kilometre around the main site, so that a distinct pattern of occupation and activity types emerges.

The main occupation was at the riverbank itself, where water was available. It was here that the main camp was located, on weathered bedrock at the fringe of the gravel-filled riverbed. The large amount of manufacturing debris in association with utilised implements points to camp activities of making tools and using them for camp-related work.

Other activities were carried out around the main camp. Heavier work with cotescrapers and choppers was done nearby to the southeast at Arjun 3SE and Arjun 4, slightly away from the river but in a geological setting similar to Arjun 3. Southwards, towards Arjun 2, the ground sloped down to an exposed ancient red soil, on which some light work and tool trimming was executed, perhaps by only one person, somewhat away from the main camp. At Arjun 1, furthest away from the river, the situation was geologically not dissimilar to Arjun 3. Stone knapping activity took place on a thin veneer of silt which had started to accumulate above bedrock, as at Arjun 3. But the silting up after the end of the occupation was not so intense as at the latter, because the locality was further away from the river. The silt here is only about 3 m thick instead of the 8 m at Arjun 3. The Late Pleistocene to Holocene rubification of the surface thus reached down through the site to bedrock (Fig.138).

The emerging picture that can be deduced from the data is that at the Arjun river bank a main camp site existed, while other distinct activities went on around it, reaching south (Arjun 2), where an ancient red surface was exposed, which had covered the older fluvial deposits, and southeastwards (Arjun 1) where the alluvial sediments thin out over bedrock. All localities became buried under the upper yellow silt, though with differing thickness.

Sites in Deokhuri South

The only area which has been surveyed in the southern part of the Deokhuri valley is south of Lamahi, south of the Rapti River, on the jeep track to Koilabas, and in the eastern part, from Kalakata to the west along the foot of the southern hills to the Bahurwa Khola (see Fig.8). Along the southern border of the Deokhuri valley, the Siwalik hills are densely forested down into the valley. Between Kalakata and Bahurwa Khola no terraces were encountered, and the search here was conducted mainly for fossil recovery within the Siwaliks. But south of Lamahi high river terraces have been formed along the Kakraha Khola, a southern tributary of the Rapti River.

In this area, along the Kakraha Khola, south of the Rapti River, a few localities were encountered near Gathwa village and further south near Kakraha village (Fig.8). Two localities are located south of Garhwa village, where beyond the recent young rice terrace of the lowland the first higher terrace levels begin.

Garhwa 1 and 2. Locality Garhwa 1 is situated 2 km south of Garhwa village (and 11 km south of Lamahi) on a flat range of badland hills to the east of the jeep track to Koilabas. The hill range is about 30 m in height and not broader than 100 m in width, and runs east to west. It constitutes the dissected, but once continuous, southern terrace 25 to 30 m above the level of the Rapri River (at contour line 900 feet). The terrace range consists of alluvial deposits of yellow-brown clays at the bottom, then grading up into silt and fine micaceous sands, overlain by lenses of fluvial quartzite gravel. The terrace deposits along the southern flank of the Deokhuri valley are much coarser and quite different in character and composition from those in the north, and reflect the diverse rock strata of the Siwaliks of the southern range, which is made up of coarse Upper Siwalik sediments of mainly boulder conglomerates and sandstones. In the north, the Siwaliks are of the Lower to Middle Siwalik Group and consist of fine-grained mudstones and claystones, which are the source of the finer-grained alluvial northern terrace deposits and of the colluvial silt deposits.

On the first flat terrace surface, to the east of the road, 8 m above the gully bed, are a few weathered quartzite flakes (4 were taken from Garhwa 1) and one side-chopper. The artefacts derive from a thin red soil which covers the yellow silts and sands.

About 1 km to the southeast of Garhwa 1 is another locality, Garhwa 2, on the dissected terrace. Numerous gravel lenses intercalate with the yellow silts and sands, as at Garhwa 1.

A few quartzite artefacts have washed out from the eroded red soil.

The artefacts of the Garhwa localities consist of only a small sample collection of 4 (at Garhwa 1) and 5 (at Garhwa 2) specimens. It includes 2 unifacial choppers, one with a distal edge and the other with a side-edge. There is an interesting core together with a fitting flake (Pl.157/1a,b). The core is unprepared and has two platforms, one of cortex the other of a large flake face. The flake fits onto the flake-face platform. At the point of percussion one tiny flake came off from the core during the impact but is missing. On the core one might easily take this flake scar for a usemark. The other flakes are similar to the Brakhu-ti-type.

Kakraha. About 8 km to the south-southeast of Garhwa village lies Kakraha village, at the very foot of the southern Siwalik Hills in the Koilabas area. Kakraha village is situated just below the 1000 foot (305 m) contour line. South of the village one can perceive on the eastern side of the Kakraha Khola a 34 m-high terrace with very steep slopes. The terrace deposits consist of fluvial cobble gravel of 3-8 m in thickness above Upper Siwalik Boulder Conglomerates. The Boulder Conglomerate served as a source for the cobble gravel of the terrace deposits. The gravels are overlain by a red-to-red-brown soil of 1 to 2 m. A once dense forest still covers the terrace surface and continues up to the Siwalik slopes.

On top of the terrace, an exposed artefact scatter 40x70 m in area covers the surface, with a denser concentration in its centre. The artefacts lie amongst surface pebbles and cobbles of the terrace gravels. The artefact concentration is divided by a small gully through the centre into a western and eastern part. The site is quite rich at the terrace edge in the south, but part of it has already been destroyed by the erosion and been washed down the slope into the young valley. The site thins out in the jungle to the north and to the east, but extends for 30 m to the west from the gully and for 40 m to the northwest, but it is only the first 20 m which show any rich concentration. Sheet erosion must have been strong, as many pebbles and some artefacts lie perched on silt stilts (Pl.227/1b).

Kakraha site is not a factory site but seems to have been the scene of a certain activity connected with bamboo work (see below), where cobble tools had been produced for this purpose.

The cobbles were easily available on the terrace surface. Elongate, rounded, slightly flattish cobbles of quartzite were chosen for the manufacture of the tools.

The 62 collected artefacts represent only a sample. They consist of 16 tools, 37 flakes, 4 cores and 5 other waste products, including a haematite pebble. Among the tools are 4 unifacial end-choppers, for example Pl.159/1 (all end-choppers have a gloss at the edge); 3 side-choppers, such as No. 5

(Pl.160/1a,b), which is a lovely flat unifacial tool; 1 round chopper; 5 cotescrapers, for example No.20 (Pl.159/2) and the tool in Pl.161/1a-c, of which the steep lateral edge is shown enlarged so as to be able to see the retouch and utilisation at the edge; 1 side-scraper on an end-flake (Pl.158/1); and 2 hammerstones. Besides these artefacts there are 4 cores, of which 2 were used as cotescrapers and a third one has usemarks after having been used as a core.

One speciality of this site are the unifacial end-choppers, very similar to the end-choppers at Sanpmarg. These tools are a characteristic tool type of the Deokhuri valley. The Kakraha choppers were made, as at Sanpmarg, on elongate, ovate quartzite cobbles one end of which was unifacially trimmed into a convex, 70 degree edge. Of particular interest at this site is that all end-choppers possess a gloss at the edge of their cortical lower face, like the one shown in Pl.159/1. They seem to have been utilised for some special heavy bamboo work. This is notable in as much as such a gloss is also observed at many adzes (though not on end-choppers) at the site of Paru in eastern Nepal. An end-chopper with such a gloss on both faces of the edge has also been found at the 90 m-high terrace of the Mashot/Arjun confluence. At Sanpmarg one end-chopper also bears a slight wear-gloss. All these tools in the Deokhuri valley with gloss are a distinct type of elongate, unifacial end-choppers, which have a pronounced convex distal edge similar to the one depicted in Pl.130/4 and 159/1.

The majority of the flakes are of no particular interest, as they seem to be mostly tool-production flakes, and so were left at the site. A few, though, were detached from prepared cores (Pl.158/3-4), and a number of them were apparently utilised. One of the flakes (Pl.158/2) is a fine point on an end-flake. One well-made side-scraper (Pl.158/1), was made on an end-flake. Of the 37 flakes, 34 (92 %) have a cortex platform, while only 3 % have a plain platform. 32 % of the flakes have stepretouch at the edge of their dorsal platform, and 2 are „orange“ flakes. These features indicate that the majority of them are tool-manufacturing flakes. They are similar in character to the flakes of the Brakhuri industry.

Going back to the northern and less forested side of the Rapti River and crossing the Arjun River bridge, we proceed westwards to survey the western part of the Deokhuri Dun valley.

Kari Sora Site

At a distance 5.3 km west from the Arjun Khola bridge, one crosses a small stream, the Kari Sota (Fig.153). On the right side of the stream, a slightly dissected 12-15 m terrace can be seen, the deposits of which consist of pebbly gravels overlain by yellow-brown silt. A few quartzite flakes were found on the surface in the gullies near the stream (none were taken). Nearby, a fine oval axe (Pl.162/1a,b) with a ground edge made on a „tuffaceous“ cobble was also found on the surface in a small rain-fed gully. The axe is a fine, if somewhat damaged specimen with a divergent straight distal edge and a convergent small proximal edge. Both edges have some utilisation scars. Fine striations are seen vertical to the broad edge. Only a small part of the broad ground edge is still present. Some light-red weathered potsherds were also observed on the surface. The pottery is of both handmade, and wheel-made type.

Handmade bowls are still being made nowadays by the women of Deokhuri (Pl.230/1). One woman showed me such bowls of hers with a wide rim. Similar handmade pottery is also known from Assam in Northeast India (Satmah, 2001). To study the recent pottery of the Dang and Deokhuri valleys would be a worthwhile undertaking. Not only is the practice of handmade pottery still alive in Deokhuri, but the pottery produced by the potter community of Lamahi is by far the best-quality pottery in the country, and they export it far from their valley (Pl.203/1).

A pointed chopper discovered at the Narayani bridge terrace surface is an isolated find (Pl.163/1a,b). It was made on a flat cobble, with unifacial trimming on the apex, where a delicate point was fashioned. Utilisation marks are found on both sides of the point. This artefact is the very first artefact found during the survey (on 6th December 1983) as an isolated surface find.

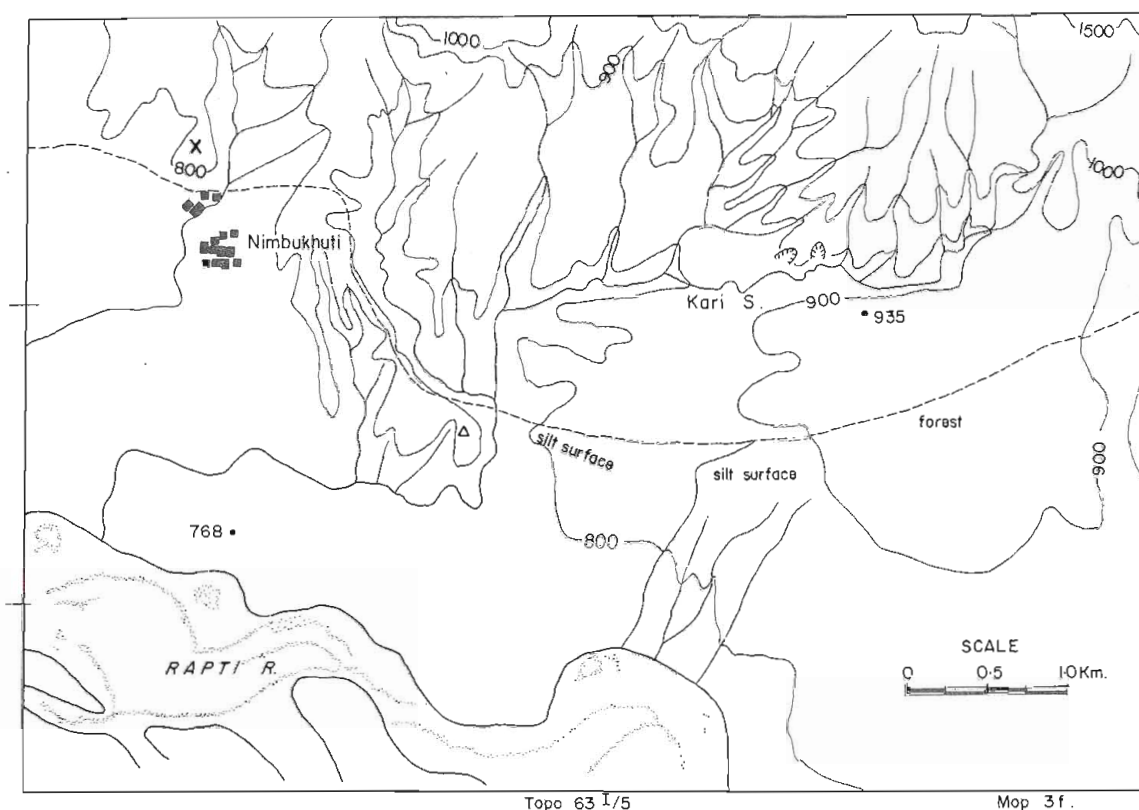


Fig. 153. Regional map 3f of Deokhuri valley at Nimbukhuti (legend see Fig. 17).

Nimbukhuti/Satbaria

Eight kilometers west of the Arjun bridge (Fig. 153), one encounters along the northern valley margin a high terrace of 25 to 30 m with a pronounced cliff (Pl. 204/1). The terrace reaches up to a height of 40 m a.r.l. at the foot of the northern range of hills. The Rapti River south of Nimbukhuti village is at contour line 760 feet (230 m) while Nimbukhuti village lies just below the 245 m contour. The 15 m-high Nimbukhuti cliffs (30 m above the Rapti river level) are exposed along the road and reveal fluvial deposits rising above the lower 15 m terrace of rice fields. The high terraces have elevations between 800 feet, near Nimbukhuti, to 900 feet, near the hills (245 to 275 m).

At the Nimbukhuti and Satbaria cliffs (Pl. 204/1) the alluvial deposits of the terrace deposits expose a compact red-brown clay to clayey silt of probable lacustrine origin in the lower part, with a thickness of 3-6m. The deposit contains at places abundant gastropod shells. It is a mottled, pedogenetically affected clay containing iron- manganese pellets, and displays the rubified surface of a palaeosol.

Above it, a sharp, irregular contact separates the lower from the upper deposits. The overlying deposits are fluvial in origin and consist of yellow-brown to yellow-beige stratified silts, sands and gravels and have a thickness of 10-13 m. They contain a number of coarse gravel lenses, especially in the upper part. At Satbaria several cobble- pebble channels deposited by small streams from the north replace the silty and sandy deposits in the uppermost part. The components of the rather unsorted gravel are subangular cobbles of Siwalik sandstones (but no quartzite). They indicate an origin from the nearby Siwalik hills by

lateral accretion and point to a fluvial environment, more turbulent and of a higher water regime in the upper part, and quieter in the lower part. The deposits are correlatable to the Lower and Upper Member of the Babai Formation of the Dang and Tui valleys.

The upper silts contain abundant root casts and tubular calcrete concretions (kankar), the erosional slopes being covered with eroded kankar pellets and concretions. This would indicate a period of stabilisation during more arid climatic conditions, probably during the later glacial period of stage 2. Only slight rubification is seen on the surface of the yellow silts and sands. Though quite an extensive search was undertaken over the surfaces, very little was found, except an isolated end-chopper, a steep-edged core/chopper and a few quartzite flakes. Maybe the absence of good raw material was responsible for the rarity of artefacts.

The end-chopper was made on an elongate cobble of quartzite, only one end of which was trimmed uniaxially to form a convex distal edge. It is the same kind of end-chopper characteristic of the Sanpmarg site in eastern Deokhuri, and also conforms to those from the Bhatarkund 2 site in western Deokhuri. The partly bifacially trimmed chopper (Pl.163/2) is heavily battered by use at its convex lower edge. The flakes are non-diagnostic and crude. They all have cortex platforms and would best fit into the Late Palaeolithic Brakhuti industry. Only flake No.7 is well-made, displaying radial dorsal scars.

The Bhatarkund sites

About 16 km west of the Arjun bridge towards Nepalganj a large microlithic site richer than Lamahi was discovered in March 1990. It is situated south of the road on a small hill knoll or terrace remnant (Pl.230/2) beyond the Bhararkund stream, 1200 m north of the flood-bed of the Rapti River and 60 m a.m.r.l. (at an elevation of 280 m, just above contour line 900 feet). The river is at an elevation of approximately 220 m (720 feet). Beyond the low rice fields of the lowest flood-bed of 3 m (up to 600 m north of the river) there is jungle between 450 to 550 m north of the river, at a height of about 20 m a.m.r.l. At a distance of 820 m from the river, it rises to a higher terrace level of 45 to 53 m above the river level (at an elevation of 265- 273 m) extending from 820 m to 1,020 m north of the river. It is a bare terrace with a deep-red soil covering it. On this terrace, which is unevenly dissected, a site called Bhatarkund 2 was found with a scatter of a non-microlithic assemblage of heavy-duty tools, which will be described later. The microlithic site is situated a few hundred metres further north between 1,200 to 1,250 m north of the river at an elevation measuring 60 m a.r.l.(Fig.154).

The microlithic site has an extension of 48 m from north to south and of roughly 20 m from east to west. The richest surface concentration is only 12 m by 12 m, in the centre (Pl.230/2, behind the man in the photo). The surface of the terrace remnant at the site is made up of a thin, deep-red weathered silt which seems to be a soil sediment. It covers brittle, weathered Siwalik sandstones, which crop out everywhere at the edge of the site. The red silt has a maximal thickness of 1.50 m in the north, thinning out progressively to the south: 0.50 m in the centre and only 0.30 m in the south.

At the central concentration area, the microliths are either lying on the eroded surface or are just eroding out from the red silt at the edges of the terrace surface, particularly at the steep western edge (Pl.230/2, where the man stands). The red silt surface is bare and is in the process of being washed away by the yearly heavy monsoon rains. It seems that the site was embedded within the red weathered silt.

The microlithic site of Bhatarkund 1. The 214 artefacts described here were collected from the surface. The collection is a selective one and represents specimens which attracted the eye amongst the majority of waste. The collection contains a considerable variety of microlithic tools, especially lunates and thumbnail-scrapers, as well as other small scrapers and a nosed concave scraper. No genuine blades are present, only a few bladelets. An element of geometric artefacts, though not very distinct, is, as at Lamahi and Ammapur, also characteristic of the assemblage. End- and side-retouched microliths are common, too, again as at Lamahi and Ammapur.

The microliths include 53 tools:

- 6 backed lunates (Pl.12/2,3,5); 3 lunates with natural back (Pl.167/1-3);
- 8 thumbnail-scrapers (Pl.11/10-13),(Pl.12/4),(Pl.167/4-5);
- 8 other microlithic scrapers (Pl.11/14), (Pl.12/1,13)(Nr.100 is a denticulate scraper), (Pl.167/6-8);
- 2 nosed concave scrapers (Pl.12/12);
- 7 side-retouched microliths (Pl.167/10-11), (Pl.12/9,11);
- 2 end-retouched microliths;
- 3 side-and-end-retouched flakes (Pl.167/12), (Pl.12/8);
- 1 retouched chunk;
- 8 utilised blades (Pl.167/13,15-17), (but no true blades);
- 3 pointed microliths (Pl.13/1).

The microliths also include slightly geometric forms and usable microliths apart from the waste:

- 24 geometric microliths (Pl.13/2-3), (Pl.167/9,14), (some of them are also amongst the retouched pieces);
- 2 snapped microliths (Pl.167/9), (Pl.13/4);
- 24 other utilised microlithic flakes (Pl.167/18-19), (Pl.12/7,10).

The microlithic cores include:

- 2 prepared discoidal bifacial cores (Pl.13/8);
- 2 flat discoidal, bifacial cores (Pl.167/21);
- 9 round or oval unifacial cores (Pl.13/5-6), (Pl.167/20), (Pl.168/1,8);
- 2 flat, unifacial single-platform cores;
- 2 polyhedral 3-platform cores (Pl.13/7);
- 8 backed alternate bifacial cores (Pl.168/2-5), (Pl.13/9);
- 4 double-platforms opposite each other (Pl.168/10);
- 3 double-platforms at right angles (Pl.168/9);
- 12 single-platform cores (Pl.13/10), (Pl.168/6), (Pl.168/7);
- 2 irregular multi-platform cores;
- 3 prepared levallois-like cores (Pl.166/2), (Pl.166/1).

The round unifacial cores and the backed alternate bifacial cores are a typical feature of this microlithic assemblage. The former are also characteristic of Ammapur and Lamahi, while the backed alternate bifacial cores are present at Lamahi but not at Ammapur.

Particularly interesting is the presence of a haematite pebble with a deep-red streak at Bhararkund. The use of colour seems to have been known.

The microlithic flakes of Bhararkund have been subjected, together with the Lamahi and Ammapur flakes, to a statistical analysis (Fig.18-27). The size of the flakes (Fig.23) shows a definite peak at the range of 20 mm to 29 mm, and 72 % are smaller than 30 mm. A large percentage (33.5 %) of the striking platforms are plain and a considerable percentage (26 %) are prepared, while only 19 % have a cortical platform (Fig.18). Step-retouch at the platform edge is only found among 25 % of the flakes, and the blade element is very small (6.5 %). A large percentage of the flakes (53 %) seem utilised (Fig.20), though this is probably distorted by the selective nature of the sample. Dorsal scars show that a majority of the flakes (37.5 %) have been struck from single-platform cores, but discoidal cores were common, too, as seen by the relatively high percentage of radial and multidirectional scars (Fig.21). The majority of the flakes (66.5 %) have platform angles of 110° and smaller (Fig.22), and only 3 % are narrower than 0.5 (Fig.24). A majority of 66.5 % of flakes are thinner than 0.4 (Fig.25).

The artefact composition is shown in Fig.27. The collection is a selective sample and therefore reflects the true nature of the assemblage only to a certain extent. But the high percentage of cores and both utilised and non-utilised flakes, along with the considerable number of tools, still indicates that Bhararkund 1 was a factory-cum-camp site.

Chert is by far the most common (80 %) raw material in the Bhatarkund 1 assemblage (Fig.26), while „ruff“ is altogether absent. Quartzite was used in 19 % of all specimens and chalcedony is very rare (1 %).

There are also a number of large quartzite flakes present, made from prepared cores (Pl.166/3-6,9), together with some snapped flakes (Pl.166/7) and „orange“ flakes (Pl.166/8) and three prepared discoidal quartzite cores with levallois features (Pl.166/1-2). They appear to be Middle Palaeolithic. Such cores reach up into the Late Palaeolithic, but not into the Holocene. As they are found together on the eroding surface with microliths, the obvious assumption is that they belong together and that the microliths are, as at Lamahi, not a Holocene, but a Late Pleistocene assemblage.

Except for the backed lunates, the thumbnail-scrapers, a few pseudo-geometric forms and some well-shaped microlithic flakes there are no special features which would distinguish the Bhatarkund 1 assemblage from the other microlithic sites. The industry is similar to the Ammaput and Lamahi sites, and it can therefore be assumed that all three sites are contemporary.

Bhatarkund S Site is microlithic, like Bhatarkund 1. It has, again like Bhatarkund 1, a quartzite flake element, levallois in appearance (Pl.165/2-5). The artefacts are in the process of eroding out from the silt. The small sample of 24 collected microliths, all on chert, are non-diagnostic, but the cores conform to the round unifacial microlithic cores of site 1.

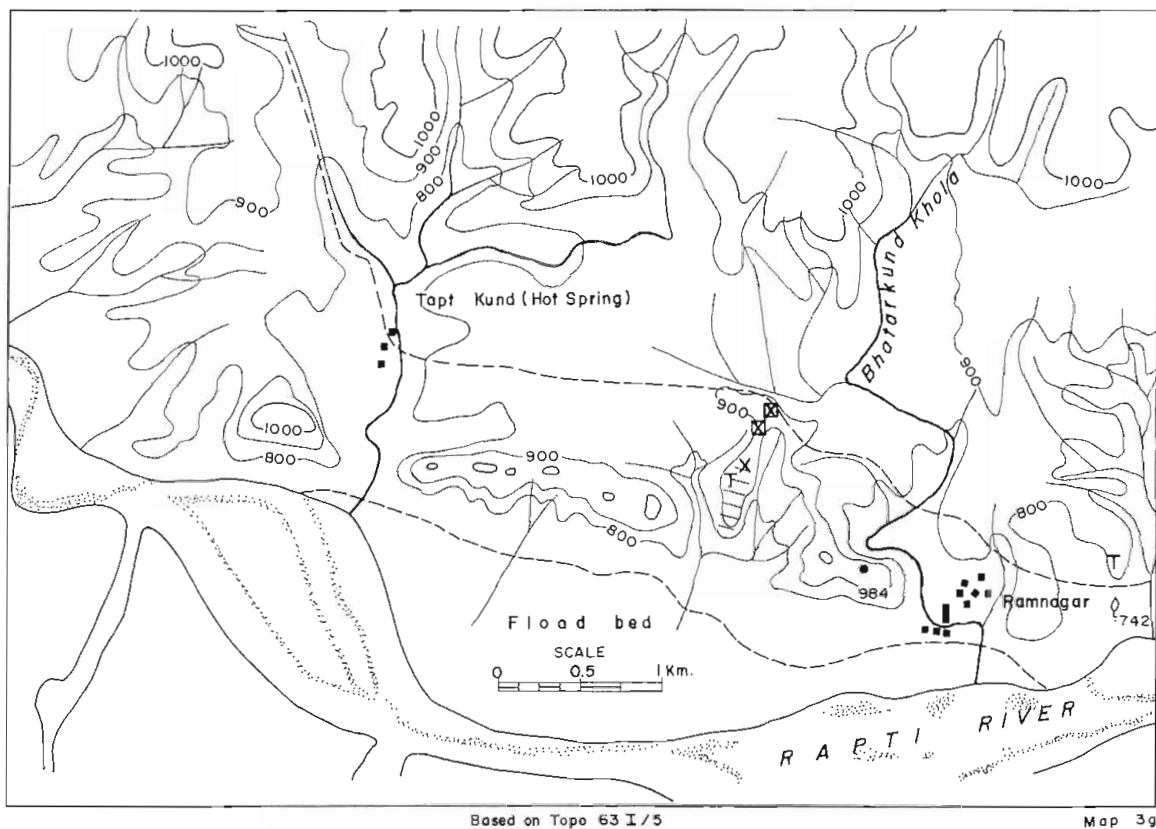


Fig. 154. Regional map 3g of Deokhuri valley with the sites at Bhatarkund (legend see Fig. 17).

The Bhatarkund site 2. The Bhatarkund 2 site, situated some 300 metres to the south of site 1 on the wide, red, bare soil surface of the 50 m terrace, is very different from the microlithic sites 1 and S. It contains a cobble tool assemblage without any microliths. All cobble tools are unifacially trimmed with a completely untouched lower cortex face.

Choppers, corescrapers and flakes made of quartzite were found on the surface, especially at the edges of the terrace. The two large end-choppers (Pl.164/1), resemble those from the other sites in Deokhuri: Sanpmarg, Masuria 4 and Nimbukhuri. The unifacial side-chopper (Pl.165/1) is a borderline case that could be a corescraper, given its lateral, well-retouched unifacial edge, but the angle of the working edge is, at 73 degrees, too shallow. The tool in Pl.164/2 is a well-shaped oval uniface with a heavily utilised right edge, a retouched round apex and an unretouched left edge. Another side-chopper is a fine flat, straight-edged unifacial tool made from „tuff“. These are only a few selective tools from this site. There are no microliths to be found. The heavy-duty tools are quite similar in type and shape to those from the sites of Lauki, Oj and Saunri on similar red terrace surfaces further east of Bhatarkund (see below).

A comparison of the three microlithic sites of Lamahi, Bhatarkund and Ammapur. Comparing the three sites in question with each other makes it quite obvious that they all belong to the same cultural unit, i.e. to people with a command of similar techniques, though with slightly differing requirements. The majority of microliths are made from chert and less so from chalcedony, quartz and quartzite. There is no characteristic blade element apparent, except for an occasional bladelet as figured from Lamahi in Pl.149/4-5, both snapped and maybe at Ammapur 4 (Pl.1/8) or at Ammapur 3 (Pl.68/5), also snapped and at Bhatarkund (Pl.167/16-17). Only small bladelets or blade-flakes struck from single-platform or cylindrical cores, and sometimes from discoidal cores, are represented. There are no true blade cores either. Classical geometric forms are absent, too, except for the occasional geometric shape, such as at Ammapur 3 (Pl.1/13-15) or at Lamahi, (Pl.149/9-12), or at Bhatarkund (Pl.13/2 and Pl.167/9). Those specimens which have been classified as „slightly geometric“ are in fact forms which do not seem to have been fashioned intentionally into geometric shapes.

The most prominent tool types are backed lunates (or crescentic microliths) and lunates with a natural, blunt back, thumbnail-scrapers and backed bladelets. Backed lunates are more prominent and better made at Ammapur and Bhatarkund but rare at Lamahi. Again, the thumbnail-scrapers at Lamahi are not typical, while those from Ammapur and Bhatarkund are well made. Backed bladelets are present at Ammapur and Lamahi but not at Bhatarkund. Other bladelets often display some retouch and are here classified amongst side-retouched or end-retouched microliths. At all three places there are a number of such side- and end-retouched microliths or otherwise retouched pieces which do not have any distinct shape. Many of the microliths without any retouch must have been utilised. The waste, however, is by far the greatest component at the sites.

Lunates. Ammapur: Pl.1/1-6. Bhatarkund: Pl.12/2-3, 5-6; Pl.167/1-3. Lamahi: Pl.148/8.

Thumbnail-scrapers. Ammapur: Pl.1/9-12; Pl.69/3. Bhatarkund: Pl.11/10-13; Pl.12/1,4; Pl.167/4-5. Lamahi: Pl.11/5; Pl.149/1-3.

Side- and/or end-retouched microliths. Ammapur: Pl.1/17-19. Bhatarkund: Pl.11/14; Pl.12/8-9, 11-13; Pl.167/6-8, 10-12. Lamahi: Pl.11/2,4.

The microlithic cores of all three sites are comparable and quite distinct. The finest cores are discoidal bifacial cores, biconvex in section with both faces radially flaked. They are rare but distinct at Lamahi (Pl.10/4) and Bhatarkund (Pl.13/8). No typical fluted blade cores are present, except some cylindrical single-platform ones at Lamahi (Pl.10/6). Other characteristic cores include discoidal or oval unifacial cores made from small chert pebbles, the lower face being cortical or mostly cortical. The finest is in Lamahi (Pl.10/5), with a radially flaked, high-backed upper face (tortoise-shaped). The other discoidal unifacial cores are made from round chert pebbles, on which microliths were taken off more or less radially on the upper face from the lower cortical surface, as figured in Pl.168/1 from Bhatarkund, in Pl.148/1 from La-

mahi and in Pl.2/1, and Pl.68/2 from Ammapur. These unifacial pebble cores are typical of all three sites.

Also prominent are so-called backed, alternate bifacial cores, namely cores with a cortical back and with flakes having been taken off opposite it, on alternate faces from both sides. These cores are found at Lamahi (Pl.148/5-6) and Bhatarkund (Pl.168/2-5 and Pl.13/9), but not at Ammapur. Of further interest are a few polyhedral cores, again made from round chert pebbles, and containing at least three platforms, often at right angles to each other for example from Ammapur (Pl.1/21 and Pl.69/8) or from Bhatarkund (Pl.13/7). They are present at all three sites. Cylindrical single-platform cores are rare in Lamahi (Pl.10/6) and Ammapur (Pl.68/1) and absent at Bhatarkund. Most of the other small cores are rather irregular and have one or at most two platforms.

Comparing the flaking techniques of all three sites, one notices that Bhatarkund used a more sophisticated technique and so offers a purer microlithic assemblage than the other two sites: it has the fewest cortical platforms and the highest percentage of prepared platforms (Fig.18). It also has the least stepretouch at the platform edge (Fig.20), while showing the highest radial dorsal scars in association with a high percentage of multidirectional scars, indicating that prepared discoidal cores were the dominant core type (Fig.21). The platform angles in all three assemblages are very similar to each other: 66.5 % at Bhatarkund and 65.5 % at both Lamahi and Ammapur (Fig.22). The diagram displaying sizes shows that Bhatarkund 1 has by far the highest percentage (72 %) of flakes smaller than 3 cm (Fig.23). The B/L ratios, however, show that Ammapur has more flakes narrower than 0.5 (10.5 % in Fig.24), which is corroborated by the diagram of flake characteristics, showing that Ammapur has a slightly higher percentage (14 %) of blade/bladelets than the other two sites.

The chart of the raw material (Fig.26) demonstrates also, that Bhatarkund 1 is the most diagnostic microlithic site, having the highest percentage (78 %) of chert and the lowest (19 %) of quartzite, and having no „tuff“ at all. Chalcedony, which is such a common raw material in Indian microlithic cultures, is negligible because this material is extremely rare in Nepal, and the geological evidences makes clear why: chalcedony is a very common raw material in Central India, particularly in the Deccan Traps, and probably easily tradable to the south and north, but Nepal, beyond the wide Indo-Gangetic plain, is far away indeed from the best source of this fine raw material.

The artefact composition (Fig.27) is somewhat distorted due to the selective nature of the collections. At Lamahi (the first site ever found) the waste is much greater, given that the collection did not favour types, but rather the raw material present. Therefore the percentages of waste products is highest and that of tools lowest at Lamahi. The Bhatarkund 1 site yielded more tools and more utilised flakes than Lamahi, but this is only because the search focused on refined pieces. At the Ammapur sites the tool component is the highest, with selectivity again being the factor, but cores make up the lowest percentage of all three sites. This latter fact is not related to selection, as almost all cores were collected at all sites.

The artefacts of the sites of Ammapur and Bhatarkund 1 were made more skilfully than those at Lamahi, but all three sites are part of the same culture.

The microlithic sites of Bhatarkund and Lamahi are associated on the surface with fairly large quartzite flakes and cores made by a prepared, levallois-like technique, which has affinities with that used at the Middle Palaeolithic site of Arjun 3. The question arises whether the element of large levallois-type flakes and cores is an integral part of the microlithic industries of the three sites inherited from the Middle Palaeolithic, and representing a different set of tools in association with the microliths, or whether they are a separate older element unconnected with the microlithic assemblages. The question of this relationship cannot be solved without further studies. If the levallois element is an integral part of the microlithic tool set, this would mean that the microlithic occupation in Dang-Deokhuri would reach back into the Late Pleistocene. In fact, in India there is evidence that the microlithic technology developed in the Late Pleistocene (with some dates as early as 30 ka years, S.Misra, pers.comm).

Another perplexing feature is that all microlithic sites in Dang-Deokhuri have a heavy-duty component of unifacial choppers and corescrapers directly or indirectly associated with the microliths. Again these are only surface associations. Only the Ammapur site has such heavy-duty tools in direct contact with the microliths on the surface, while at the Lamahi site complex such tools are present in the very close vicinity of, but not at, the microlithic concentration itself. Only the Bhatarkund 1 site exhibits no heavy-duty tools in direct association with the microliths. Choppers and corescrapers, however, are well represented a few hundred metres to the south, at Bhatarkund 2, but with no microlithic association. At the small locality situated between the two sites, Bhatarkund S, exhibits only typical microliths eroding out from the top part of the silt, but without choppers or corescrapers. Thus, at Bhatarkund, there seems to be a distinct separation between the microlithic and the heavy-duty tool assemblages, pointing to two distinct cultures.

Tapt Kund

The area of Tapt Kund lies at the western exit of the Rapti River from the Deokhuri Dun valley, where the river begins to cut through the Siwaliks. There are some hot springs here, which may have attracted Early Man. But nothing was found on the flat surface surrounding the springs, where former mineral-rich ponds have evaporated, leaving salt crusts on the surface. The elevation is 230 m (at contour 750 feet) (Fig.154).

A small conical core made from black chert was found 2 km northwest of the hot springs, in the colluvial silts of a small gully in the Siwaliks. It is an isolated find (on 26th February 1984). Other isolated finds were made 0.5 km west of the first Tilkanya bridge (5 km NW of Tapt Kund) where a chopper, a flake and a corescraper of quartzite were found on a remnant of a red soil, covering the fossiliferous Upper Siwalik sandstones.

Jalkundi

This locality is 14 km northwest of Tapt Kund/Real at a small hamlet called Jalkundi (Fig.155). A first few quartzite artefacts (1-4) were recovered from this locality from a pebble-cobble-covered terrace remnant east of the village, and north of the Simal Sota stream. One of the artefacts looked like a very weathered Early Palaeolithic biface (Pl.169/1a,b). The site was revisited several times, in March 1990 and later, after the discovery of the handaxes in Dang. The terrace is 32 m above the stream bed, between contour lines 750 and 800 feet (230-245 m) elevation, and exposes a rather extensive fluvial gravel over Siwalik sandstones. The gravel is composed of cobbles and pebbles, predominantly of quartzite and to a lesser extent, of Siwalik sandstone, but of very few other rock types. The quartzite cobbles, which are well rounded, derive from upstream outcrops of Upper Siwalik Boulder Conglomerates. The gravel (seen in the foreground in Pl.254/2) is overlain by a silt which has weathered into a red soil of about 1.50 m in thickness. The red pedogenesis has also slightly affected the underlying gravel. Unconformably overlying the red soil is a yellow sandy silt roughly 2 m-thick (Fig.156), intercalated with occasional pebbly gravel of mainly quartzite that derives from lateral fluvial contributions from the hills. The yellow silt has a calcareous horizon with tubular kankar 1 m below the surface, indicating a period of stabilisation during a more arid period than now, probably during stage 2 (25-15 ka) of the last glacial. The terrace surface is at an elevation of 244 m (at contour line 800 feet) (Pl.254/2).

To this arid land-surface phase must belong a number of fresh quartzite artefacts of the typical Brakhuti type. They derive from the top part of the yellow silt, Nr.16-28. Below it, however, on the gravel, two very weathered bifaces, Nr.5 and 6, were found in March 1990. In January 1991 a rough biface and a discoid were recovered from within the gravel. The artefacts 3 bifaces, 2 cores, 3 scrapers and a bifacial discoid are specimens which seem to be of an Early Palaeolithic origin.

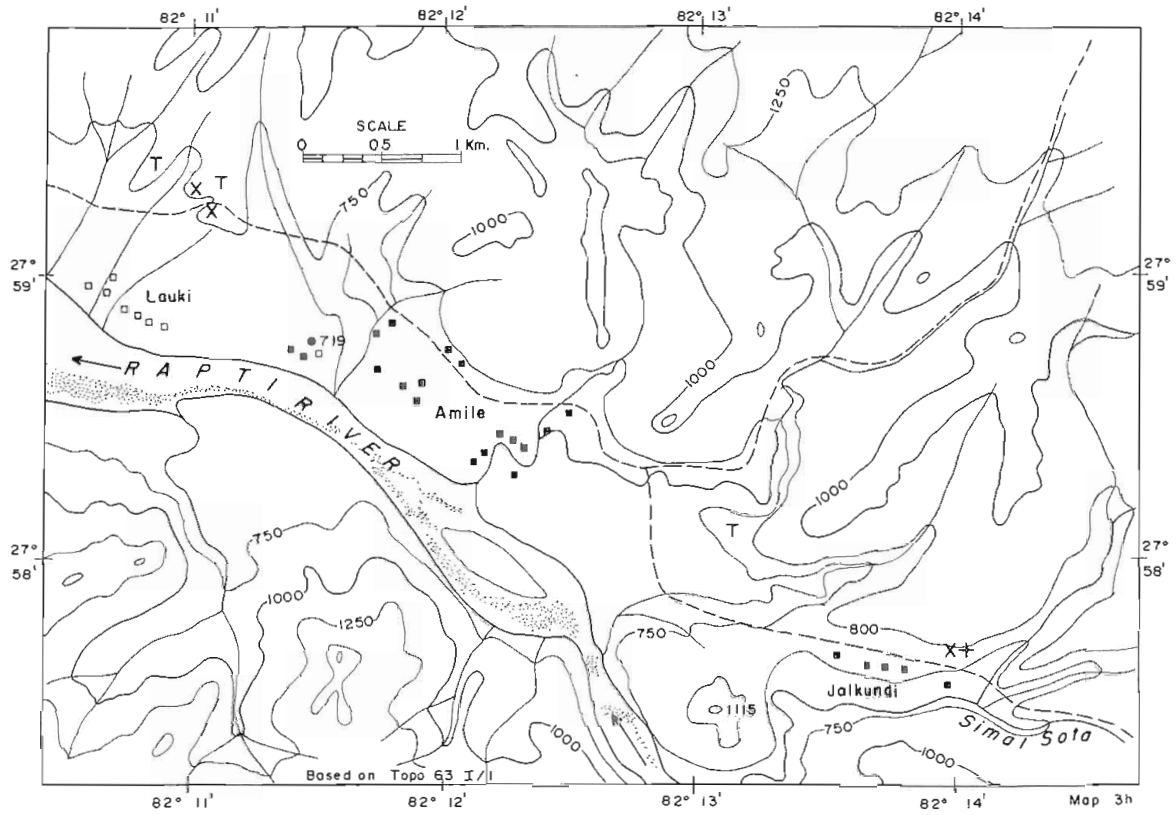


Fig. 155. Regional map 3h of Rapti valley with the sites of Jalkundi and Lauki (legend see Fig. 17).

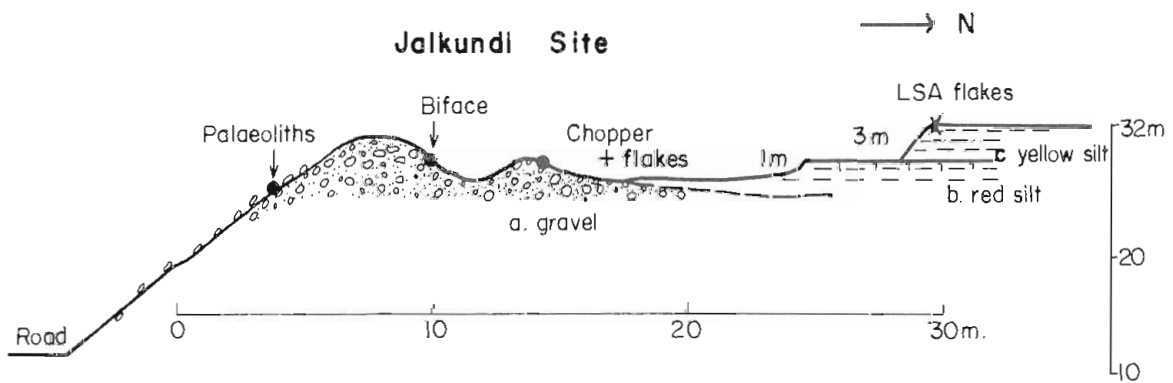


Fig. 156. Profile of Jalkundi Site.

The best example of an Early Palaeolithic element is the biface (Pl.169/1a,b), a flat, oval, well-shaped tool made on a side flake, rather weathered, and with one straight lateral edge and one sinuous lateral edge, both bifacially trimmed. The apex and butt have flar, sharp-angled edges. The second biface is even mote weathered and may provisionally be classified as a biface. The tool in Pl.169/2 is a very rounded or

rolled bifacial tool with a heavy butt and an untrimmed left side, while the right side and apex have broad but shallow bifacial trimming, though this has been damaged by recent flaking, while another one is a rounded or rolled scraper on a small cobble with two opposite edges, that are very used, one with unifacial trimming, and the other with secondary bifacial trimming. One of the edges is very battered. Two tools are found *in situ* in the gravel. One is a flat, partly bifacial discoidal tool with a convex bifacial edge, at one place quite rounded. The other is a scraper made on a very rounded/rolled cortex flake, retouched on the ventral lower cortical surface.

The other 17 artefacts, which derive from the overlying silt, conform to the Brakthuti industry in being typical unifacial cobble tools. One is a fine double-sided unifacial chopper (though one side is rather steep with 75 degrees). Three are corescrapers; one is a unifacial double-sided unifacial corescraper made from „tuff“, with a straight, short edge snapped off at both ends. The other, is also a double corescraper with two lateral, well-retouched edges opposite each other and a heavily used distal end-chopper edge, a fine tool, and the third (Pl.170/2a,b) is an oval-shaped unifacial corescraper with one convex, steep lateral edge trimmed from the lower cortical face. There are also some large side-scrapers made on end-flakes, one with two lateral edges and the other (Pl.170/1a,b) with one straight lateral edge. A few of the collected flakes conform to the type of the Brakthuti industry (Pl.169/3, Pl.171/5).

The earliest history of the Jalkundi site is probably connected with the Early Palaeolithic period before the formation of the buried red soil. Much later, the place was revisited during the deposition of the yellow kankary silt in a period of an arid climate by people with artefacts akin to the Brakthuti industry.

The 30 m terrace surface of the yellow calcareous silts and gravels can be followed to the west and east, though dissected by erosion. At places the yellow silt is very calcareous, containing root-casts and tubular concretions. The terraces belong to the Simal Sota stream before it joins the Rapti River.

The Rapti River near Jalkundi has cut its bed through a narrow gorge about 6 km west of the exit from the Deokhuri Dun (see map Fig.8). Two kilometres west of Jalkundi the river leaves the gorge and enters a wider valley. Here the river has formed extensive 50-60 m high terraces on its northern side, at the confluence of a number of lateral tributaries from the north. The tributaries are from east to west: the Simal Sota (with the Jalkundi site), the Baidapur and Gothlawa kholas (with the Lauki site between them), the Oj Khola (with the Oj site), the Batriya Khola, the Saunri Khola (with the Saunri site) and the Gabor Khola. From the south only small nalas and gullies join the Rapti River, and no terraces have developed. From east of Amile (Fig.155) till the river finally emerges into the western Terai near Nepalganj, the highest terraces have elevations of from 25 m a.m.r.l. (near Lauki) to 40 m at Oj (Fig.157) and almost 60 m at Saunri (Fig.158). They are all capped by a thick red soil. The high terraces were occupied by Early Man, the majority of them having yielded occupation sites.

The sites described in the following pages are all situated on the highest, red terraces of the Rapti River in the Siwalik Hills between the Deokhuri basin and the Terai plain. The occupations are all characterised by unifacial cobble tools.

The Lauki Site

The Lauki surface locality is situated north of the small village of Lauki, 4 km west of where the main road branches off onto the gravel road from Amile to Tulsipur (Fig.155). An extensive terrace surface at a height of more or less 22-25 m a.m.r.l. (at an elevation of 750 feet or 230 m) stretches along the northern side of the Rapti River. The terrace deposits consist of fluvial pebbly gravel (up to a level of 17.50m), overlain by yellow silts with a number of gravel and sand lenses (up to 22 m). The silt surface is slightly rubified. A few scattered artefacts were first found in February 1985. They seem to derive from the silt surface.

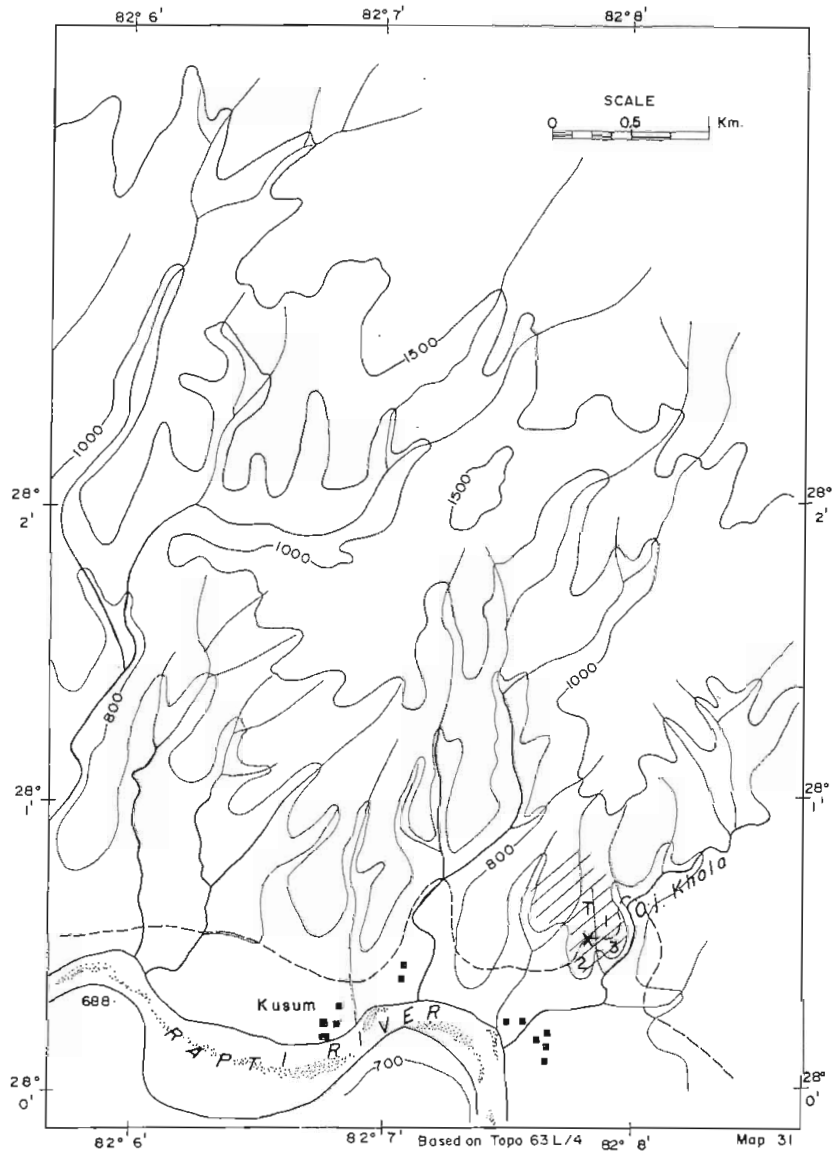


Fig. 157. Regional map 3i of Rapti valley with the sites at Oj (legend see Fig. 17).

The terrace is quite extensive and continues to the east on the southern side of the road, where the terrace surface is 3 m higher and is covered by a red soil. Here, at the locality Lauki NE, a number of rather crude, fresh quartzite flakes and other artefact debris were found in a cobbly gully, 5 m below the red surface. These artefacts seem different from the tools found on the surface.

The Lauki surface is bare of vegetation and therefore exposed to erosion. It is now fenced off against cattle grazing to give the grass a chance to grow again. No new artefacts were found in later years except one side-chopper.

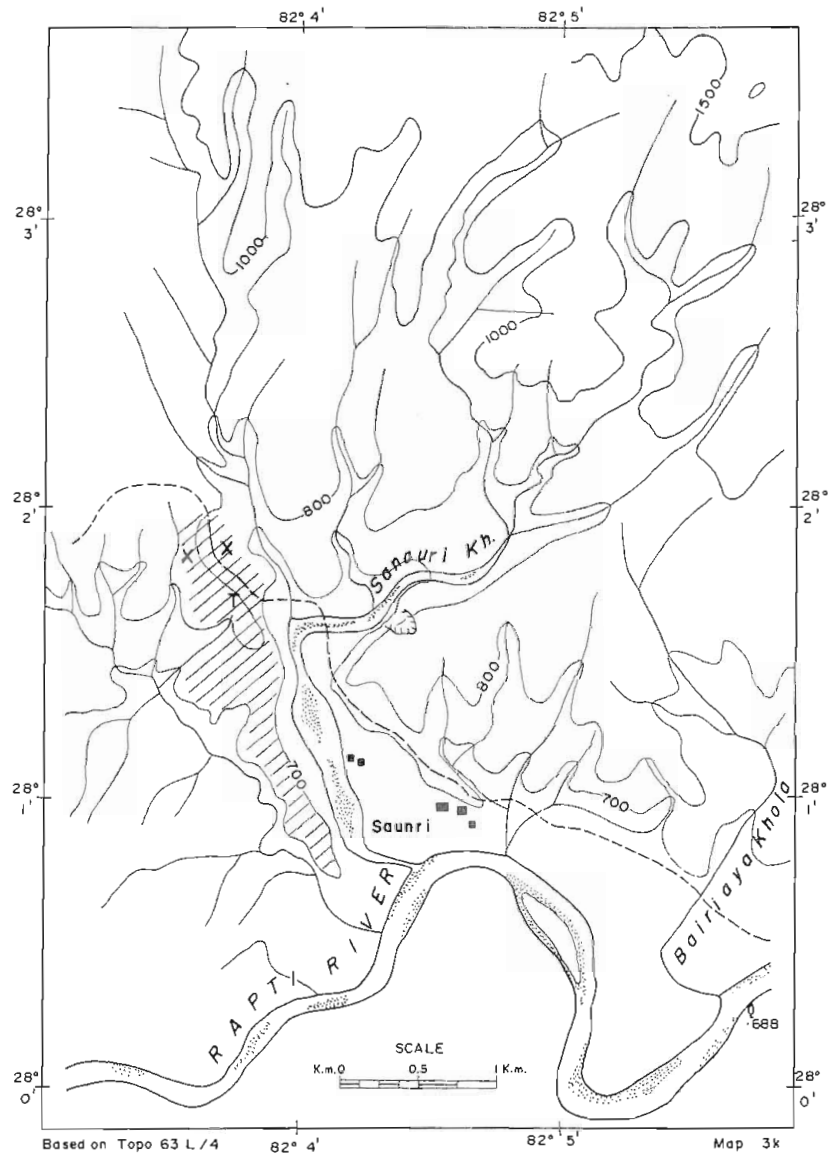


Fig. 158. Regional map 3k of Rapti valley with Saunri Site (legend see Fig. 17).

The main Lauki locality is a cobble tool site in association with rather well-shaped flakes (Pl.171/2-4,6-7). It is not a rich site, and the artefacts, being scattered over a large area, derive from the silt, which continues to be subject to strong erosion.

The cobble tools are few and perhaps not so characteristic as those from the other similarly situated sites (Oj and Saunri). The collection includes 1 corescraper, 3 choppers (1 side-cum-end-chopper, 2 side-choppers), 1 discoidal tool, 1 „cleaver“-like cutting tool and a number of flakes. But though the tools are too few for a diagnostic interpretation, they do fall within the broad range of types represented by the cobble tool assemblages of the Dang-Deokhuri valley. There is a short, rather untypical corescraper (Pl.171/1)

with three steep edges: two short edges are at right angles to each other, trimmed from the flat, split lower face, and one is above it, trimmed from the upper cortical face. A large percussion mark is seen on the cortex; it resulted from a powerful but failed blow. One of the 3 choppers is an oval unifacial chopper with two rough lateral edges and a short, denticulate distal edge, the other is a broken (intentionally?) tool and represents a flat unifacial chopper with a utilised, finely retouched unifacial edge around the entire circumference; the third one is a unifacial chopper made on a slice, with a lateral edge trimmed from the lower split surface. An (intentionally?) broken, discoidal unifacial tool resembles a Hoabinhian sumatralith. An edge is shaped around the entire circumference, except at the broken part. No.19 is also an interesting cleaver-like cobble tool made on a large rectangular slice, with cortex on both sides (resulting in a trapezoidal section) and at the butt. The apex is a straight, well-done unifacial edge, like the edge of a cleaver and may have served the same function.

The few flakes in the collection (Pl.171/2,4,6-7) are well-shaped, utilised ones of the Brakhuti type, one (Pl.171/3) being a chopper-rejuvenation flake. The other flakes are undiagnostic (some are of chert), while a crude chert core has a fitting flake.

Oj Khola Site

At the point where the Oj Khola flows into the Rapti River (some 6 km NW of Lauki), very extensive terrace surfaces can be seen along the northern side of the latter (Fig.157). These terraces belong to the Rapti River terrace system, similar to those of Lauki and Saunri, and were formed by the Rapti River during its downcutting through the Siwaliks from the Deokhuri Dun valley into the Terai (Pl.231/1).

The highest terrace surface along the Oj Khola is 37m above the stream bed (or 40 m above the Rapti River bed, just above contour line 800' or 245 m). It is covered with a thick, deep-red soil. The entire cliff of the terrace, exposed along the road consists of fluvial terrace deposits of the Rapti River with a thickness of more than 40 m. The underlying Siwalik rocks are not exposed.

West of the Oj Khola, at Oj W (Fig.159), the deposits consist of 27 m of rather unsorted, weathered cobbly gravel in a red sand matrix in the lower part. The gravel consists mainly of rounded quartzite cobbles but also contains very weathered Siwalik sandstone cobbles. The gravels are intercalated with intermittent silt layers. Overlying the thick lower gravels are 2-4 m of yellow-brown silt (Pl.231/1), which has weathered into a red palaeosol (seen in the middle of the photo). Unconformably above it are yellow silts (with no conspicuous calcretisation), intercalated with pebbly-cobbly channel gravel lenses of quartzite and weathered Siwalik sandstone cobbles and pebbles. At a height of 33 m the uppermost gravel lens can be seen, overlain by the upper yellow silt (Fig.159). The top of this silt has weathered to an oxisol with all the features of insipient ferricretisation. The deep-red surface of 1 to 1.5 m must have experienced, similarly to the Bhatarkund red surface, a long period of weathering and rubification. It is possible that the buried red soil belongs to the stage 5 (Eemian interglacial), while the red oxisol on top has probably developed since the Late Pleistocene. The latter forms the 40 m terrace surface. The artefacts come from the upper red soil and are quite weathered.

On the western part of this red surface, just northwest of an electric pole, a number of large quartzite cobble artefacts are eroding out *in situ* from the red silt above the highest gravel lens.

There are several artefact localities on the extensive, red, 40 m terrace surface; they are called Oj 1, Oj 2 and Oj 3 (or Oj W). It seems that the terrace was densely inhabited. It was probably a forest habitat, judging by the heavy-duty tools found there.

The artefacts belong to the cobble tool complex so characteristic of Dang-Deokhuri, all made on quartzite cobbles. The Oj site represents all the tool types of the Dang-Deokhuri cobble tool complex: abundant unifaces and choppers, a cotescraper element and a rare scraper element. It is the most diagnostic tool complex of all the terrace sites of W-Deokhuri, and was apparently a site engaged in heavy-duty

work. The collection consists of 5 unifaces, 7 choppers, 2 corescrapers, 1 ovate tool on a large flake, 17 flakes (including 4 utilised ones) and 3 cores.

The unifaces are unique to Oj. There are none at Jalkundi and Lauki, and only one at Saunri. They are heavy, usually rather thick tools, not fine and flat like those from the Hoabinhian in Southeast Asia. They have always a flat cortical lower surface. They are oval or oval-elongate in shape. The two in Pl.173/1 and 2 are fine oval-elongate tools, with an edge along the entire circumference (No.7), while No. 1 has a blunt, unworked butt. The lateral edges of both tools are well utilised, and the round, convergent apex as well. A third one, made on a split cobble, is flatter than the others, with both its ends pointed and trimmed unilaterally around the entire circumference. The heaviest uniface and the least trimmed one, is made, rather unusually, on a large, very thick cortex flake, where only the ventral face was well trimmed to form a round, convex apex and a lateral edge. Interesting is the tool in Pl.172/1; it is a uniface that was broken or intentionally snapped at both ends, so that only the central part of the tool is left with its two very well-retouched and utilised straight lateral edges.

The seven choppers too, are a characteristic element of Oj. Three are end-choppers, 2 are side-choppers, 1 is a side-cum-end-chopper and 1 is a hammerstone-cum-anvil. They were all unilaterally trimmed on round or oval cobbles. Three (Pl.174/2) are round choppers, their well-utilised edge going either three-quarter or halfway around the circumference. Two are side-choppers, each with one lateral chopping edge, while the rest of the cobble is left untrimmed or almost untrimmed, and one (Pl.174/1) is a heavy uniface side-cum-end chopper made on an elongate cobble with a flat cortical lower face from which a straight lateral and a convex distal edge (both well-utilised) have been shaped by uniface trimming. One large tool is an anvil-cum-hammerstone: the lateral, slightly concave edge is heavily battered, and the central part of the lower cortical face bears heavy anvil marks.

The two steep-edged uniface corescrapers have two opposite working edges. One is interesting; it seems to be a multi-purpose tool: it has a steep, well-utilised corescraper edge at one side, trimmed unilaterally from the lower cortical face, and another lateral edge, which is trimmed from the cortex of the upper surface, so that it results in a trapezoidal section. The other is similarly worked, with two opposite edges, one trimmed from the lower, cortical face, the other from the upper, split cobble face.

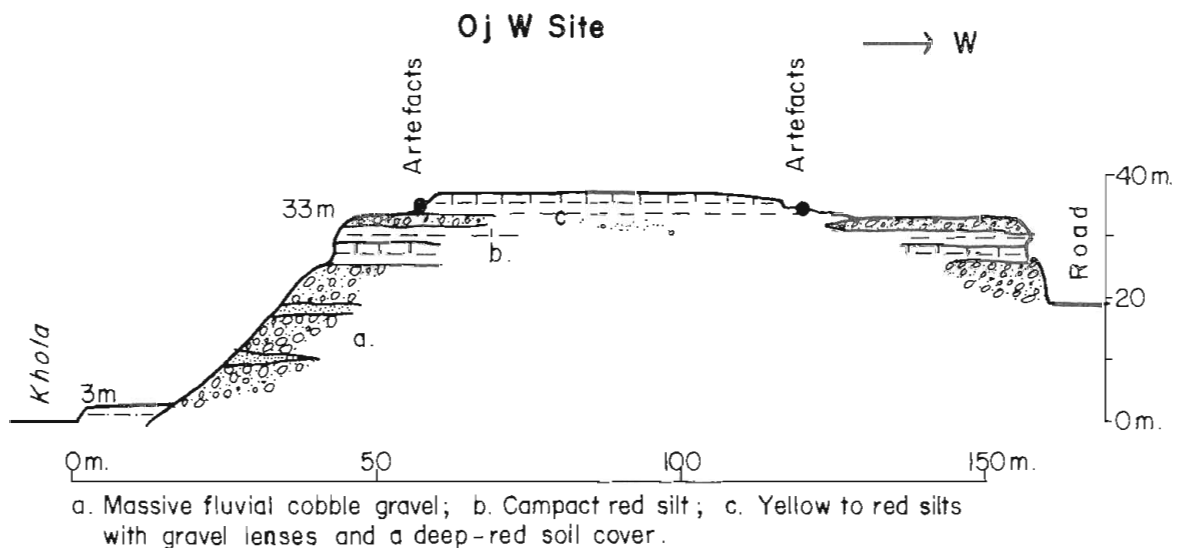


Fig. 159. Profile at Oj Site between road and Oj Khola.

The few smaller flakes (such as Pl.172/2) are waste flakes caused during the manufacture of the cobble tools, while 2 are utilised flakes (Pl.172/3-4), one has cortex opposite the platform and is obviously a manufacturing flake, but has been utilised at both convex sides, the other is a fine example of a pointed end-flake, utilised as a side- and end-scraper. Some chert flakes and the two chert cores look alien, but, given the surface origin of the collection, it is difficult to judge whether they belong with the other artefacts of the site or are younger.

The Saunri Khola Site

Further west of Oj along the Rapti river valley the high, red terraces continue along the river with thick fluvial deposits similar to the ones at Oj. Terrace heights are more than 50 m a.t.l. and the terrace surfaces are covered equally heavily by deep-red soils. The Saunri stream merges with the Rapti River just below contour line 670' (205 m), and the extensive high terrace has a maximum height of 58 m above the Saunri stream bed at elevations between contour lines 800' and 900' (Fig.158).

An artefact site complex of cobble tools was recorded on a very extensive red terrace surface west of the big bend of the Saunri Khola. Artefacts are seen eroding out from the dissected edge of the red soil. Further south on the same wide, red surface as well as at the southern edge, where the terrace is cut by a small stream (Pl.231/2), more artefacts are found *in situ* in the upper silt that is covered by red soil (Pl.231/3). The site is large and seems to consist of several localities or spots of occupation. A number of the artefacts are seen resting on stilts of silt 10 cm in height. This indicates rapid sheet erosion on the red surfaces, which are almost bare of vegetation.

At Saunri Khola the Rapti river valley slowly widens towards the east into the Terai plains. The high terrace deposits continue along the Rapti River above Gabor Khola and Gothari Khola. At Gothari Khola they are 40 m high and are of alternating fluvial gravels and silts/sands in equal proportions (Pl.232/1). A young fault can be observed in the terrace deposits, displacing the deposits vertically by 10 m. Cobbles are drawn along the fault line. Such faults, displacing Late Pleistocene river deposits, indicate very young tectonic movements along the Himalayan mountain front.

The artefacts of the Saunri site belong to the cobble tool complex of the Dang-Deokhuri type, though the small collection does not contain as many distinctive elements as can be found at Oj. There are 2 well-made unifacial corescrapers with straight, finely retouched lateral edges and a distal working edge at right angles to it. There are 3 choppers, one (Pl.175/1) is a side-chopper (typical of the Dang-Deokhuri cobble tools) with a well-utilised, finely retouched lateral edge of 75°. Another side-chopper was found *in situ* in the red soil (in Pl.231/3) – a flat tool rather like a uniface. The third one (Pl.175/2) is a unifacial, round chopper and/or core, with few marks of utilisation. No. 24 (Pl.176/1) is a simple, well-shaped oval uniface, with marks of utilisation on its right side, top and bottom. Two are scrapers (Pl.176/2-3) made on flakes. One has a convex edge which was utilised and forms a point with a straight left edge; the other, has fine retouch at the distal and left edges. The flakes are undiagnostic, though there seems to be a burin element present in the form of a short vertical edge at the distal end on two of them. Ten Flakes are all made from the same core (which is not present), but no pieces fit together. One is a large ovate tool on a flake, the proximal end having been utilised.

From the abundance of sites at the explored terrace surfaces it seems obvious that many more similar artefact sites may be found on these terraces, if the latter are further surveyed. Almost all the higher terraces in the area surveyed between Amile and Saunri along the northern bank of the Rapti River have yielded a chopper-flake assemblage from the uppermost silt, which is always capped by a red soil.

Remarks on the stratigraphical context of the Deokhuri sites

Fig.160 shows the suggested stratigraphical correlation of the major sites in the Deokhuri valley. The Sanpmarg, Arjun, Nimbukhuri, Jalkundi and Oj sections can be correlated with each other in their strati-

graphical context, all displaying fluvial deposits of the Babai Formation. In addition Oj, Jalkundi and Nimbukhuti contain buried, red palaeosols, which can also be correlated with each other.

Oj, along with Lauki and Saunri, display deposits of the Lower Babai Member consisting of thick fluvial sediments, mainly gravels, flushed down by the Rapti River into the low base level of the Terai, after the restraint of the gorge. Cultural material at these sites is only found in the top part of the deposits of the Upper Member of the Babai Formation, above the red palaeosol.

Jalkundi is situated not on the main stream of the Rapti but on the Simalsota tributary, which joins the Rapti in the gorge area between the Deokhuri Dun and the Terai. The deposits brought down by the Simalsota are less thick. Truncation of the older deposits probably also had something to do with the relatively thin aggradation of the Jalkundi deposits. The presence of Early Palaeolithic artefacts in the basal gravel at Jalkundi points to the antiquity of the gravel (if it is not reworked; but from where would it have been brought?!). The Upper Member, above the palaeosol, also has only thin deposits.

The Nimbukhuti locality is situated in the centre of the Deokhuri valley, close to the northern rim and two to three km north of the Rapti River. The lower part of the Lower Member of the Babai Beds is buried beneath the surface and only the clayey lacustrine beds with a palaeosol covering them, can be seen in the profile. Above it, the fluvial deposits of the Upper Member are particularly well exposed (Pl.204/1).

Correlating Nimbukhuti with the Arjun site complex is facilitated by the data relating to the locality of Arjun 2, which is located on a red palaeosol (not indicated in the section of Arjun 3 in Fig.160, but in Fig.138), which at places underlies the Middle Palaeolithic horizon at the Arjun site (see Arjun 2, this chapter). If the western palaeosols of Oj, Jalkundi and Nimbukhuti can be correlated with the palaeosol below the Middle Palaeolithic Arjun 3 site, dated to more than 70 ka, we can with little hesitation identify the palaeosols of the latter three sites with a stage 5 event.

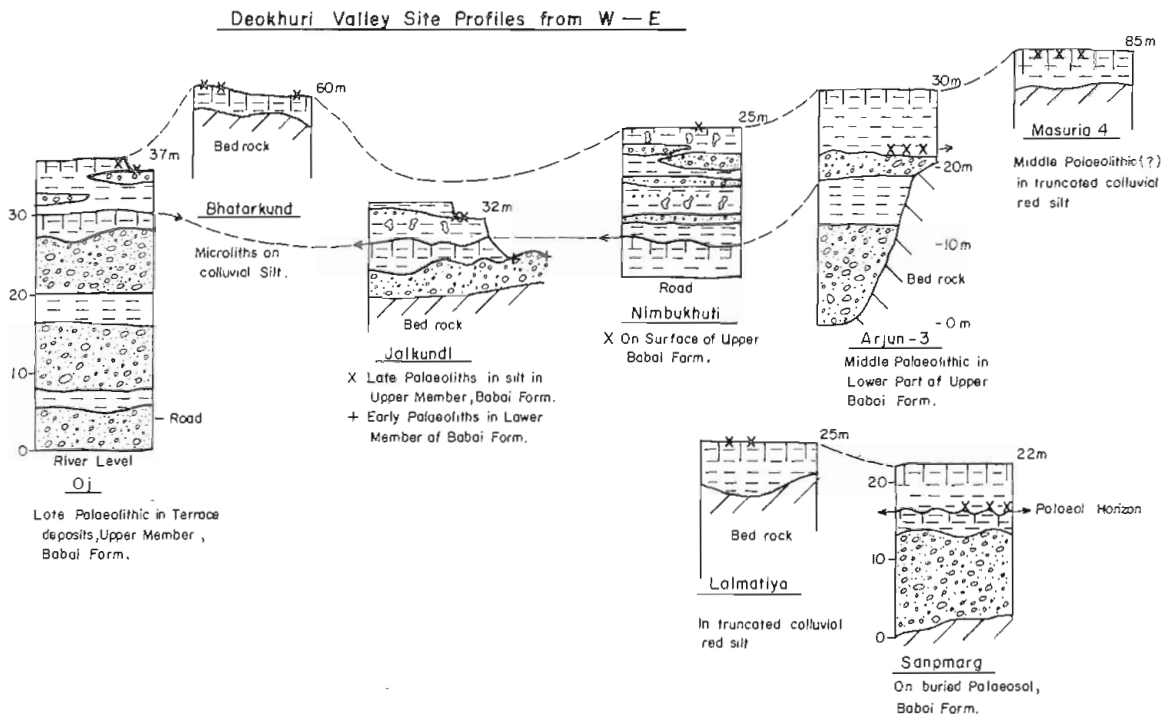


Fig. 160. Comparative profiles at sites in the Deokhuri valley.

The slightly rubified palaeosol of the artefact horizon at Sanpmarg, however, dated by OSL to 35 to 45 ka, is younger. It can be correlated with the mild stage 3 period within the last glacial, so that here the thick gravels below it, flushed out from the eastern hills at the entry into the Deokhuri valley, are in all probability younger than the lower gravels at Oj and Saunti.

The two sites of Lalmatiya and Masuria are associated with rubified silts of colluvial character belonging to the Gidhiniya Formation. They are similar to ones in the Tui and the southern Dang valleys, that fill small basins on the slopes and at the foot of the Siwalik Hills, which consist, as in Tui and southern Dang, of mudstones and claystones of the Lower Siwalik Group, and thus have the same origin.

The Masuriya site has, however, been described, on typological grounds, as being of a Middle Palaeolithic industry. This would make the deep-red weathering of the colluvial silt in which the artefacts are embedded older than that of their cousins in the Tui and southern Dang valleys, and would connect it rather with stage 5. Colluviation processes from the weathering of Lower Siwalik mudstones may have, therefore, been occurring over a long time, ever since the Eemian.

2.1.4. Sites on high terraces

The Mashot Valley Sites

In March 1990 a survey of the Mashot and Arjun river valleys, northern tributaries of the Rapti River in the Deokhuri Dun valley, was included into the investigations. The Mashot and Arjun Rivers drain the Siwalik range which separates the Deokhuri Dun from the Dang Dun (see Fig.8). The Mashot River has its source area at the same place as the Tui Khola, but runs east (while the Tui runs west) for about 14 km (as the crow flies) to join the Arjun River which has its source about 17 km further east. At the confluence of Mashot and Arjun their joint stream turns to the south to cut through the Siwaliks for about 4 km, past the village of Beldamar, to enter the Deokhuri Dun valley (Fig.161).

The Mashot and Arjun rivers have cut their beds deeply into the Siwalik rocks and formed high river terraces along their banks. The high terraces are up to 90 m above the riverbed and are covered with conspicuous red soils (Fig.163) above the fluvial deposits of coarse gravels, sands and silts. The terraces along the Mashot River from its confluence with the Arjun westwards were surveyed for about 6 km, and those, too, from the confluence southwards to the Deokhuri valley. Particularly conspicuous terraces, all belonging to the same level and period, are to be found between the villages of Chisapani and Beldamar. Four of the high-level terrace remnants on the left bank east of Chisapani, called Mashot 1 to 4, yielded prehistoric occupations (Fig.161). A 92 m-high terrace on the right bank west of Chisapani also bears a site, called the „92 m site“. The 80 m-high terrace at the confluence of the Mashot and Arjun contained few artefacts, but the 70 m terraces south of Beldamar (Beldamar 1 and 2) show signs of occupation.

The 92 m terrace site: The westernmost and highest Mashot terraces are about 1.5 km west of the Mashot River bridge along the road leading north to Dang valley. On the southern bank of the Mashot can be seen a series of high-level terraces, the highest of which is 92 m a.r.l. (Fig.162) on which an artefact locality, the previously mentioned „92m site“ was found. The deposits consist of yellow-brown silts once covered by a red soil (Ph.117-Sc). The terrace is badly weathered and dissected, so that bedrock of Siwalik sandstone crops up below the silt. Artefacts consisting of flakes and corescrapers, all made of quartzite, are scattered on the dissected silt and weathered bedrock. Some of them are very weathered, while others, which were washed out from the silt recently, are very fresh. What seems to be the remnant of a fire-place can be seen in the silt, too. The artefacts belong to the Brakhuti industry, with corescrapers (Pl.99/1) and flakes of the fourth-stage (Pl.99/2) and fifth-stage type with cortex opposite the platform and stepretouch at the platform edge (Pl.99/3).

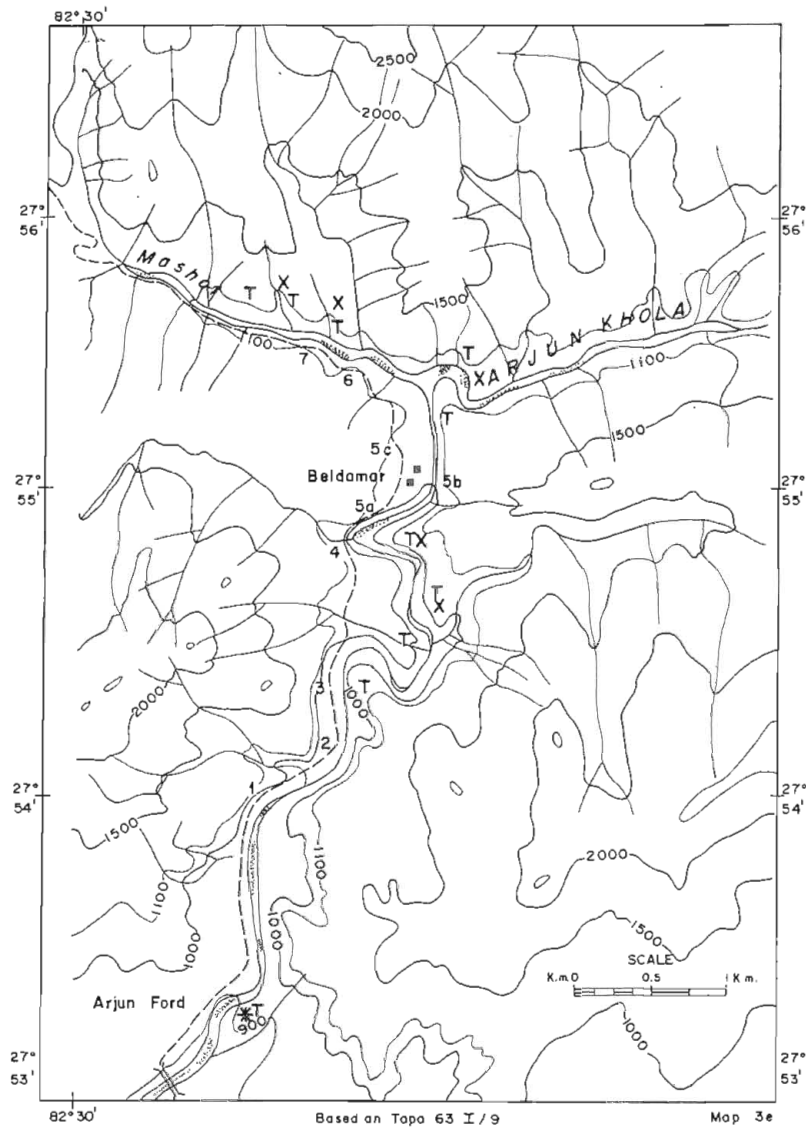


Fig. 161. Regional map 3e of Arjun and Mashot valleys (legend see Fig. 17).

Below the uppermost 92 m terrace appears the next lower terrace level of 82 m, covered with red-brown silts above a quartzite cobble gravel and merging into the 70 m terrace, which also consists of red-brown silts. On the bare silt surface of the 70 m terrace three weathered fire-places were seen, together with a small area of very weathered potsherds; but no stone artefacts.

Mashot 1 and 1a: Downstream from the Mashot bridge a number of high-level terraces can be seen on the northern side of the Mashot (Fig.163). The highest terrace level is 65 m above the river and slopes down gently to 55 m. It consists of reddish-yellow silts. A lower terrace level, at 42 m, carries yellow silts, and further down a gravel-covered 32 m terrace level is seen at the cliff edge. The gravel is resting unconformably above Upper Siwalik sandstones which form the steep northern cliff of the Mashot Khola. The 32 m and 42 m terrace levels have no artefacts, only the highest (55-65 m) level does. This latter ter-

race level must have once been covered with a red soil. Much washed-down red soil is visible in the small gullies, although the original red soil has been dispersed by the heavy erosion.

Abundant artefacts are found on the surface. They seem to have derived from a level within the uppermost reddish-yellow silt, where it abuts against the hills. The people responsible for the artefacts lived here at the very inner edge of the terrace, in the shadow of the hill side. The artefacts conform to the Brakhtui industry and consist of a few well-made, utilised flakes (Pl.99/4-5). Only a small collection was made.

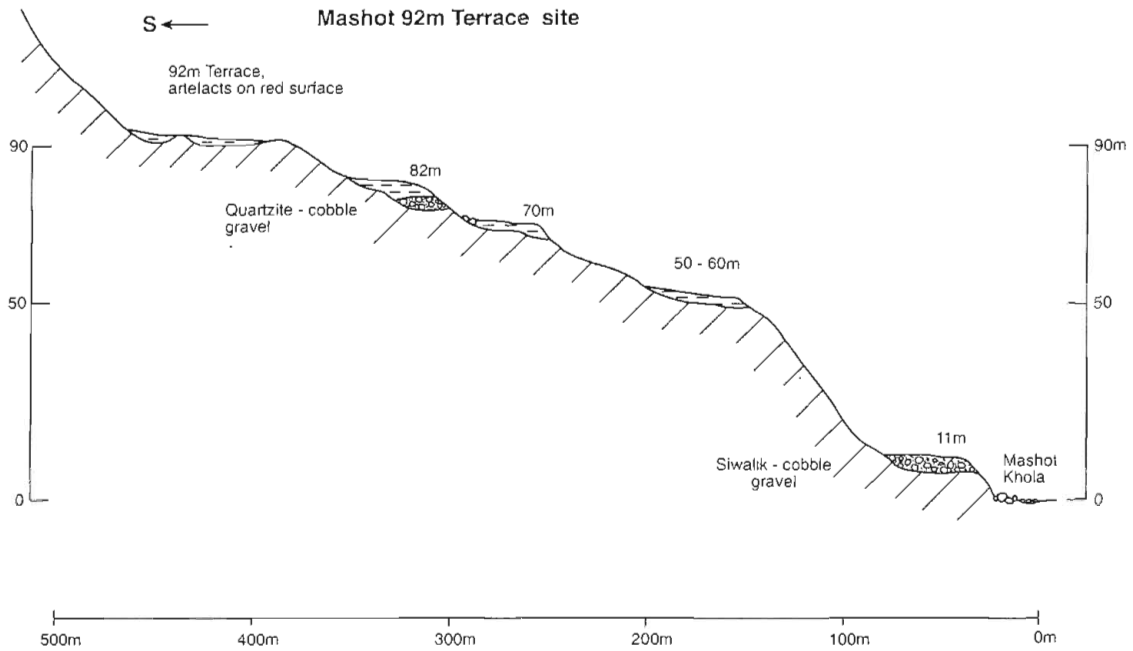


Fig. 162. Profile at the site of Mashot 92m Terrace.

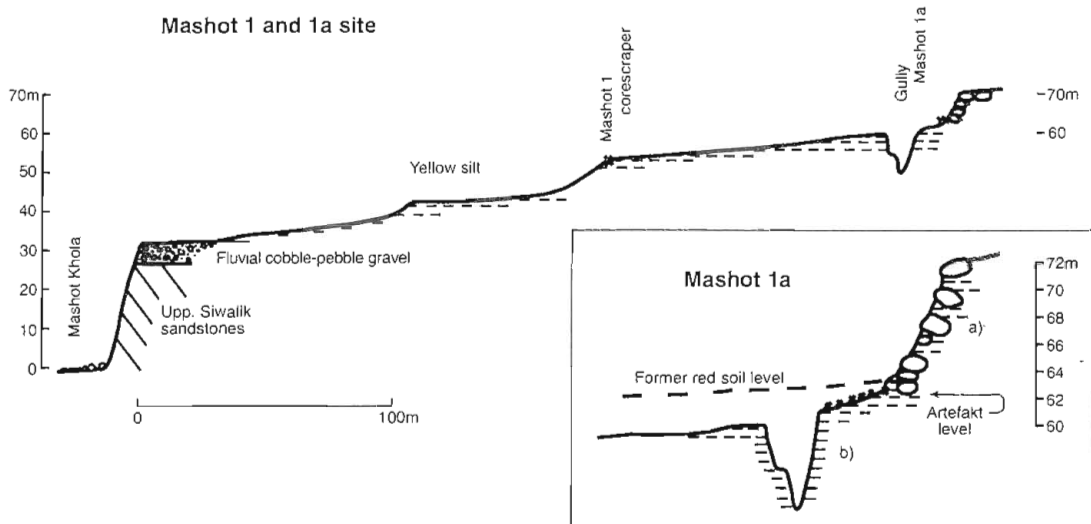


Fig. 163. Profiles at the sites of Mashot 1 and 1a.

It is not possible, given the heavy erosion, to say much about the original stratigraphical position of the site. The people lived either 1) on the red soil after its formation, and the artefacts became dislocated during erosion, remaining as a residue at their original place and were later embedded in the hillwash, or 2) they lived on the terrace during the end phase of the silt deposition (in the later Pleistocene). In the latter case the artefacts derived from the silt before the red soil formed. The latter is more probable.

On the next western knoll of the 65 m terrace, a red soil remnant abuts against the hill sides about 2 m higher than the artefact level at Mashot 1a. But there are no artefacts here, only a fragment of a black polished stone.

Mashot 2 site: Some 300 m westwards from the Mashot 1 site along the hill slope, past two smaller terraces, each separated by deeply incised gullies, thickly covered with forest, another rich artefact scatter is encountered on another remnant of the 65 m terrace level. This is Mashot 2. It was surveyed in detail as it is a rich site and, above all, the artefacts are eroding out from the red soil.

The site of Mashot 2 is further away than Mashot 1a from the nearest hill slope, i.e. 80 m south of the foot of the hill. The artefact locality is only 12 m x 12 m in extent. At its western edge, at the slope leading down to the next western gully, erosion has cut down to the artefact level. The artefacts are eroding out from 0.40 m below the grass-covered surface and lie scattered downhill from it. In the centre of the terrace remnant the erosion just touches the artefact level, and here a test plotting of 1 m x 2 m was made to collect all artefacts from the surface and the immediate sub-surface, in an attempt to verify the horizon of occupation. The artefacts appear on these levels, but they had been embedded, previous to the erosion, within the upper part of the weathered red silt. From the surface 21 artefacts were collected from square A/1, and 28 from A/2 (Fig.164).

Almost all subsurface artefacts from the plotting come from the 0 to 10 cm sub-surface (in A/1, 146 of all 167 artefacts and in A/2 109 of all 135 artefacts), while only 21 and 34 came from levels between 0.11 to 0.21 m below the surface. One factor disturbing the horizon is the presence of recent burrows (of ants or earthworms), filled with soft earth or casts excreted by earthworms (Goudie 1988). The many artefacts in layer 1a and 2 in the southwest corner of A/2 (Fig.164) derive from these burrows, redistributed by the bioturbation of ants or earthworms.

The artefact level at Mashot 2 is a rich horizon of definite occupation, one confined to a few centimeters at a sub-surface level of the test plotting. This horizon, while now only occupying the first 10 centimetres below surface, had its original stratigraphic position, before the heavy erosion, some 0.50 m below the surface in the red soil. As far as one can conclude now, the site is a Late Palaeolithic assemblage similar to the Brakhuti industry.

The artefacts of the Mashot 2 plotted site: Altogether 351 artefacts were collected from Mashot 2, from a 1m x 2m plotted area. Of these, 49 artefacts come from the surface (apart from 117 mere waste pieces consisting of broken fragments of cobbles, pebbles and chunks), while 302 artefacts come from the sub-surface of the 2 square metres.

The Mashot 2 site artefacts are rather undiagnostic. They belong to a flaking workshop where, except for the large amount of waste, very few tools were left in place. The rather high number of small flakes and chips smaller than 2 cm (50 %) and even smaller than 1cm (8 %) from the subsurface indicates that a considerable activity of stone knapping took place here.

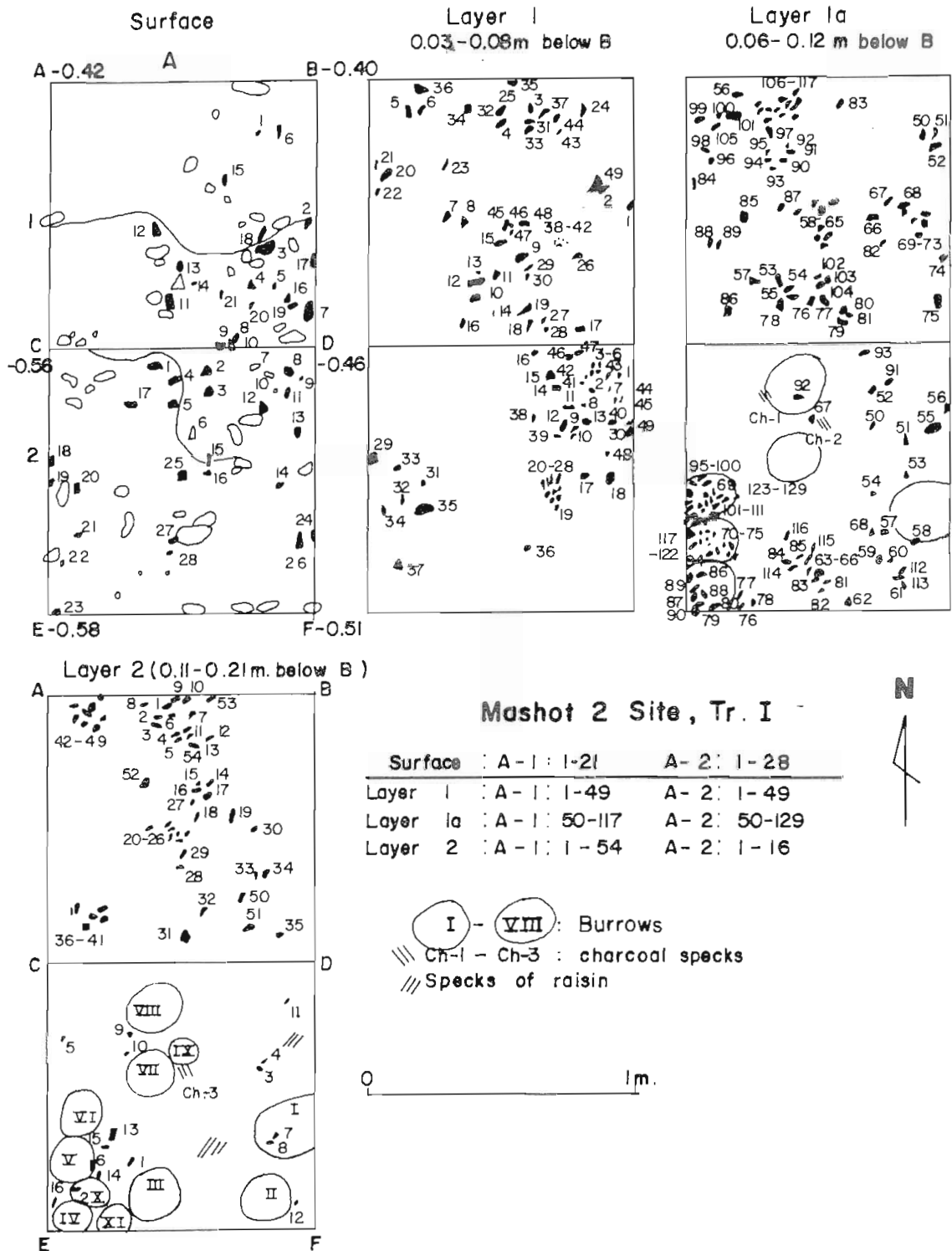


Fig. 164. Plotting of Tr.I of Mashot 2 Site.

The artefacts of the Mashot 2 plotted area consist of (apart from 29 artefacts of a selective collection from the area):

On the surface:

A-1:	2	corescrapers of „tuff“,
	18	flakes (12 on „tuff“, 6 of quartzite),
	1	worked cobble of „tuff“,
	21	artefacts
<hr/>		
A-2:	17	flakes (9 of „tuff“, 8 of quartzite),
	5	flake-like pieces (1 of „tuff“, 4 of quartzite),
	2	chunks of „tuff“ and quartzite,
	3	worked cobbles of „tuff“,
	1	worked slice of quartzite,
	28	artefacts

In the sub-surface (0.03 m to 0.21 m below the surface from B-Point):

A-1:	2	tools, (1 corescraper remnant of „tuff“, 1 scraper of quartzite),
	77	flakes (68 of „tuff“, 9 of quartzite),
	15	flake-like pieces (13 of „tuff“, 2 of quartzite),
	42	chips (31 of „tuff“, 11 of quartzite),
	28	chunks (24 of „tuff“, 4 of quartzite),
	2	worked cobbles of „tuff“,
	1	core fragment of quartzite,
	167	artefacts (139 of „tuff“, 28 of quartzite) and 4 broken pieces;
<hr/>		
A-2:	1	tool, a corescraper of „tuff“,
	1	core of „tuff“,
	53	flakes, (43 of „tuff“, 10 of quartzite),
	18	flake-like (13 of „tuff“, 5 of quartzite),
	32	chips (24 of „tuff“, 8 of quartzite),
	26	chunks (21 of „tuff“, 5 of quartzite),
	1	worked cobble of „tuff“,
	3	broken cobble pieces of quartzite,
	135	artefacts (104 of „tuff“, 31 of quartzite) and 10 unworked pieces;

Total: 351 artefacts

One conspicuous characteristic is that the majority of artefacts, 273 of the total of 351 (77.7 %), is made of the curious fine-grained „tuff“ material. Many of these very brittle „tuff“ artefacts are, in spite of being very weathered and fragile, surprisingly fresh-looking, with still sharp though very brittle edges and facets. They have weathered *in situ* within the soil, having not been moved from their original location. During the time of occupation this now brittle and very light-weight material must have been a perfect sharp-edged raw material for manufacturing tools (Pl.232/2). It certainly was the favourite material, more favoured than quartzite. This indicates that after the time of occupation this „tuffaceous“ material

must have undergone a distinct kind of weathering and leaching, which has rendered it completely useless for stone-knapping now.

The Mashot flakes show features similar to the Brakhuti flakes: they have often stepretouch at the platform edge on the dorsal face, their platforms are of cortex and their dorsal trimming shows that they were struck mainly from unprepared and irregular cores that had one or two cortex platforms. There are only two tools: one is a simple scraper made on a slice of quartzite with one straight unifacial edge, and the other a small corescraper of „tuff“.

Because of their heavy weathering it is often difficult to distinguish any usemarks on the „tuff“ flakes. The analysis shows that 52 % have a cortical platform, while 19 % have a plain platform (at the Brakhuti W flake site the figure is only 10 %), and 1.5 % have a prepared platform. The flakes are rather undiagnostic, especially the small ones. They are all waste flakes. Like their Brakhuti counterparts, they match up as manufacturing flakes to corescrapers and choppers. The flakes Nos.1- 4 of Mashot 2, Tr.I,A/2, surface illustrate this fact very well: all have deep and fine stepretouch near the platform edge at the dorsal face. No.1 is particularly interesting, as it displays, apart from the stepretouch at the platform edge, additional delicate rerough at the distal end. Some 30 % of the flakes have stepretouch at the platform edge, which is less than the 58 % at the Brakhuti W flake site. But „tuff“ weathers easily while lying exposed on the surface, and the many „tuff“ artefacts at Mashot 2 are very weathered. There are very few flakes which look well-made and could have been utilised as flake tools, except perhaps flakes 20-28 of A-2. This „tuff“ flake had broken into 17 pieces and could be fitted together again (Pl.232/2). It was a large, thick flake with a steep distal edge, which may have been utilised. Its heavy stepretouch at the platform edge could have resulted from its being detached from a well-used corescraper. As at Brakhuti W, there are a certain number of both split flakes (9 %) and snapped flakes (3.5 %). The dorsal character of the scars implies that a high percentage (50 %) of previous flakes were detached from the same platform as the flake itself; only 2.4 % show radial scars. Platform angles are rather shallow, with 68 % of the flakes having angles smaller than 110 degrees. At Brakhuti W this percentage is 63 %. 8.4 % of the flakes are narrower than 0.5 (a breadth less than half of their length), as compared to only 5.5 % at Brakhuti W. The Th/B ratios, too, are similar to those of Brakhuti W.

The 49 surface artefacts from the plotted area of the two square metres are all larger than those from the subsurface. While on the surface only 8 % of the artefacts are smaller than 2 cm in size, this figure jumps to 64 % in the uneroded subsurface. It is clear that on the surface all the smaller artefacts either have been washed away or have disintegrated under the force of the surface weathering, with only the more resistant quartzite artefacts and the larger „tuff“ artefacts remaining as residue on the surface. The few surface flakes are rather well defined and bear a strong resemblance to the Brakhuti flakes. The two corescrapers are of „tuff“, No.3/A-1 having two straight, steep unifacial edges opposite to each other.

Apart from the plotted and excavated artefacts from the two square metres, 29 artefacts were collected from the non-plotted surface. These are altogether more diagnostic than the former. Amongst them is a large quartzite corescraper with two lateral edges (Pl.98/2), typical of the Brakhuti industry, and an endscraper on a flake with a retouched distal edge (Pl.100/4). The flakes show stepretouch at their platform edge (Pl.100/1-2,4). One of them has a double bulb (Pl.100/1a,b) and one is an interesting Kombewa flake (Pl.100/3a,b). Altogether the assemblage compares well with the Brakhuti industry.

Mashot 3 locality: The terrace of Mashot 3, some 300 m to the west of Mashot 2, is more extensive than the terrace remnants of Mashot 1 and 2 and consists of a well-preserved bare, red surface, 70 m above the Mashot River. There are no stone artefacts, only some thick, hand-made potsherds with cloth-markings and some black pieces of chert near a fire-place.

Mashot 4 locality is another high-level terrace west of Mashot 3 on the northern bank of the Mashot River. Mashot 4 is opposite Chisapani village at the same height as the former locality, but apart from a „tuff“ scraper no other artefacts were found.

Mashot/Arjun Sangam: At the confluence of the two streams an 80 m-high terrace has developed over folded Upper Siwalik „salt & pepper“ sandstones. Terrace deposits consist of thick fluvial gravels unconformably overlying the sandstones and topped by 2-5 m of a deep-red soil. There is no artefact site, only an isolated, very weathered end-chopper was found on the surface. It is made of white quartzite and has a conspicuous gloss with fine striation marks at its edge.

Beldamar 1 and 2 sites

After the confluence of the two streams, the river, now called the Arjun, flows southwards, cutting at right angles to the strike through the Siwaliks. At Beldamar, 1 to 1.5 km south of the confluence, high level terraces have developed on the left bank. The highest level, with a red soil, is 72 m above the river. It has been heavily dissected and only remnants of it can be seen. The main terrace level is 56 m above the river, also with a deep-red soil capping. „Tuff“ and quartzite artefacts are lying on the surface, which seem to have eroded out from the red soil at Beldamar 1 and from a neighbouring terrace of the same height at Beldamar 2. The red soil of the 56 m terrace level seems to be rather a redeposited soil sediment of an older red soil, probably washed down from the eroded 72 m level, than an *in situ* soil.

The described sites in the narrow river valleys between the two Dun valleys of Dang and Deokhuri show clearly that the entire area was occupied by the people of the Brakhuti industry. It seems that during the time of this industry the environment favoured easy movement through the Siwalik mountains which nowadays, in the warm, moist climate of the post-glacial period, are densely forested (if they have not been cut down by modern populations). Even before the recent availability of the OSL and TL datings (Corvinus & Kadereit, in press) this evidence together with the geological data pointed to cooler and drier climates and less vegetation during the migrations and movements of the Brakhuti population.

2.1.5. Remarks on the cultural material of the Dang-Deokhuri area

The Dang-Deokhuri area of Nepal has yielded the most complete sequence of Palaeolithic cultures in Nepal from the Early Palaeolithic to the Neolithic period. Therefore particular attention has been given to this area.

But considering the wealth of prehistoric sites in these Dun valleys, it is very probable that other large valleys such as Chitwan, Surkhet and Dailekh, if surveyed, will yield similar sites, because the climatic and ecological conditions were most certainly similar in the Pleistocene and Early Holocene.

The Kathmandu Valley was surveyed previously (Joshi 1964) but yielded no sites, and it has been surveyed again to some extent by this author, but again with negative results. One reason for the lack of prehistoric occupations may be because the entire valley has been cultivated so extensively, up to the very hilltops, that nothing was preserved in the wake of continuous, stepwise cutting and terracing. Another reason may be that no earlier people than the Neolithic people ever occupied the Kathmandu valley. It is at a much higher elevation than the Dun valleys in the Siwaliks and is considerably further removed from the plains and deeper in the mountains.

Comparisons amongst the sites in Dang-Deokhuri are facilitated by the stratigraphical and geological data and the fact that climate and environmental conditions must have been the same for sites of a comparable stratigraphical order. This is particularly the case for the sites of the Late Palaeolithic Brakhuti industry.

Sites from the earlier periods are rare. The Early Palaeolithic has provided only the Gadari handaxe site in the Dang valley and the Brakhuti boulder gravel site in the Tui valley, which both lack conclusive age determinations. Though both are situated in the basal part of the Dun alluvium, they may still be

long to different periods and different environmental and ecological context. They share no typological similarities. Both sites are located along a riverbank but the quartzitic raw material which both sites made use of was available at the site itself only in the case of the Brakhuti boulder gravel site; at the Gadari handaxe site in Dang, however, there is no such raw material nearby, the rubble horizon consisting of soft sandstone debris. But not far away upstream near Ranighora there are basal cobble gravels with a quartzite cobble component, which must have been exposed at the time of the handaxe occupation, as part of the earliest fill in Dang. In fact at Ranighora itself, a small assemblage of what seems to be Early Palaeolithic, albeit with no bifaces, was encountered recently.

The Middle Palaeolithic culture is present only in the Deokhuri Dun valley, at the Arjun sites and at Masuriya 4. They both have typological similarities with each other, but they belong to different stratigraphical and environmental settings. Masuriya is connected with the colluvial fan sediments, and Arjun with alluvial terrace deposits one near the hill slopes, away from the river, and the other at the riverbank (pointing perhaps to a dominance of hunting at the higher site and fishing at the river site). For Masuriya there is no age determiner apart from the geological setting. Arjun 3, though, is associated geologically with the last interglacial and has provisionally been dated by OSL analysis. It is possible that Masuriya 4 is of the same period, though from a somewhat later phase. Since we do not know whether Masuriya was buried by the colluvial silts, which is probable, or only embedded in it at a certain level within the silt, we can only speculate about its age. If culturally it belongs more or less to the Middle Palaeolithic, similarly to Arjun 3, one would assume a low stratigraphic level in the colluvial deposits or below it.

Given the geological and environmental differences, these must have influenced the cultural behaviour of the groups and must have caused variations in their life-styles, including their ecological subsistence patterns, and thus in their tool requirements (for example no blades and points at Masuriya, unlike at Arjun). Or vice versa: they chose different environments conducive to different subsistence, or moved to different ecological niches in response to seasonal climatic changes.

The raw material of mainly quartzite was easily available at Arjun, but at Masuriya must have been at quite a distance from the river. There is no quartzite raw material at the latter site.

The Sanpmarg assemblage has a special status as regards its stratigraphical position and its tool kit. It is not comparable with any of the other sites. It is stratigraphically older than the Brakhuti industry and younger than the Middle Palaeolithic Arjun industry, consisting as it does almost entirely of end-choppers. One can only conjecture what kind of occupation it must have been. It was certainly not a factory site, but it may have been the scene of certain heavy activity for which such end-choppers were required. Availability of raw material was no problem, given the riverbed at the side of which the group lived which was filled with quartzite cobbles. The occupation on a palaeosol points up the fact that the people lived during a phase of land stabilisation in a milder and somewhat more humid environment.

The most abundant occupation in Dang and Deokhuri was towards the end of the Babai Formation in Late Palaeolithic times by the manufacturers of the Brakhuti industry. Larger sites, smaller localities and activity spots are found abundantly in all Dun valleys and on river terraces. For this period, the evidence of a cool, dry climate is seen in the artefact-embedding sediments of fluvial overbank silt which is rich in calcareous concretions and small kankar pellets and root-casts. OSL dates point to the last maximal cold stage of the last glacial period. The environment was probably much less vegetated than today, so that migrations and movements were easy, which is probably one reason for the abundance of occupation sites.

Sites vary in their tool kits, their stratigraphical position and geomorphological situation. They are found always in the top part of the alluvial Upper Babai Beds, but also in the colluvial silts of the Gidhiya Formation. The latter sites are situated further away from the river, while the sites in the alluvial Upper Babai Beds are situated close to the river.

The tool kits show variability in raw material and artefact composition. Age differences between sites in the alluvial deposits and those in the colluvial beds are difficult to postulate, but inferences can be drawn by the difference in stratigraphic positions and the variability of artefacts between the sites, for example between Gidhiniya and Brakhuti, or the Gadari Flake Site and the Gairakhuti site.

The microlithic culture is represented in the Dang-Deokhuti area with three sites (Lamahi, Bhatarkund and Ammapur) and a small, quite destroyed locality at Daingaon. Comparisons between the three sites are given in chapter V.2.1.3. under Bhatarkund. They all belong to the same cultural unit. Interesting is, that at two of the sites a heavy duty tool element of cobble tools is associated with the microliths. The stratigraphical relationship with the Brakhuti industry is still unclear, as nowhere the two industries were found in juxtaposition and dates are not available. The geological situation seems to point to occupations of the microlithic-using groups from India after the period of the Brakhuti industry.

2.2. Possible Early Palaeoliths in Siwalik sediments at Surai Khola

At this point mention should be made of an occurrence of possible Early Palaeolithic artefacts in an Upper Siwalik context in the Surai Khola area. This area was studied extensively for a separate, biostratigraphic survey (Corvinus 1988; Corvinus & Nanda 1994; Corvinus & Rimal 2001). The Upper Siwalik sequence ends with the „Boulder Conglomerate“, called by this author the Dhan Khola Formation. It consists of thick, heavily consolidated conglomerates in the lower part and of sandstones, siltstones and loosely consolidated conglomerate beds in the upper part. In view of the possibility that artefacts could be found in these Upper Siwalik strata, the latter were searched occasionally, but nothing was noted previously. It was only recently in November 2001, during a more intensive search, that a few (5) rather heavy, rolled artefacts were found (Pl.233/1) in one of the uppermost conglomerate layers. This layer was exposed at a loop along the road leading into the Deokhuri valley (Fig.165), about 5 km east-southeast of Kalakata village (as the crow flies). The conglomerate layer, dipping 25° NNW and having a thickness of about 2.5 m, is exposed at this place along the loop (Fig.166) as a ledge which is covered by cobbles that were eroded out of the conglomerate.

The few artefacts were found amongst the cobbles. They could have only derived from the conglomerate. The specimens are very rounded. They consist of 2 heavy, round bifacial choppers of the Oldovan type, 1 large rectangular flake and 2 smaller flakes. One bifacial chopper (102 mm in diameter) has a few very rounded scars, four on one face and five on the other. The other chopper (127 mm) has six scars on one face and five larger and several smaller scars on the opposite face. Two of the scars are rather fresh; all others are rounded and patinated. The large rectangular flake (205 mm in length) has a long lateral edge which shows some unifacial trimming all along it. It must be noted, however, that the scars of this flake are of slightly different freshness, or rather slightly different abrasion and patina. One flake of a length of 15 mm is very thick (55 mm), and its dorsal face consists half of cortex and half of a number of shallow scars, all of the same patina. The small flake (90 mm in length) has a very rounded/abraded convex edge made by five shallow flake scars on the upper face.

The artefacts look authentic. If they are, they are Early Pleistocene, having been incorporated into a boulder gravel before the uplift of the Surai Khola monoclinical range. We have as yet no dates for this last uplift at Surai Khola, but the strata below the Boulder Conglomerate belongs to the *Elephas planifrons* Interval Zone (Corvinus & Rimal 2001), equivalent to the Pinjor Formation in India, which began by around 2.5 m.y.

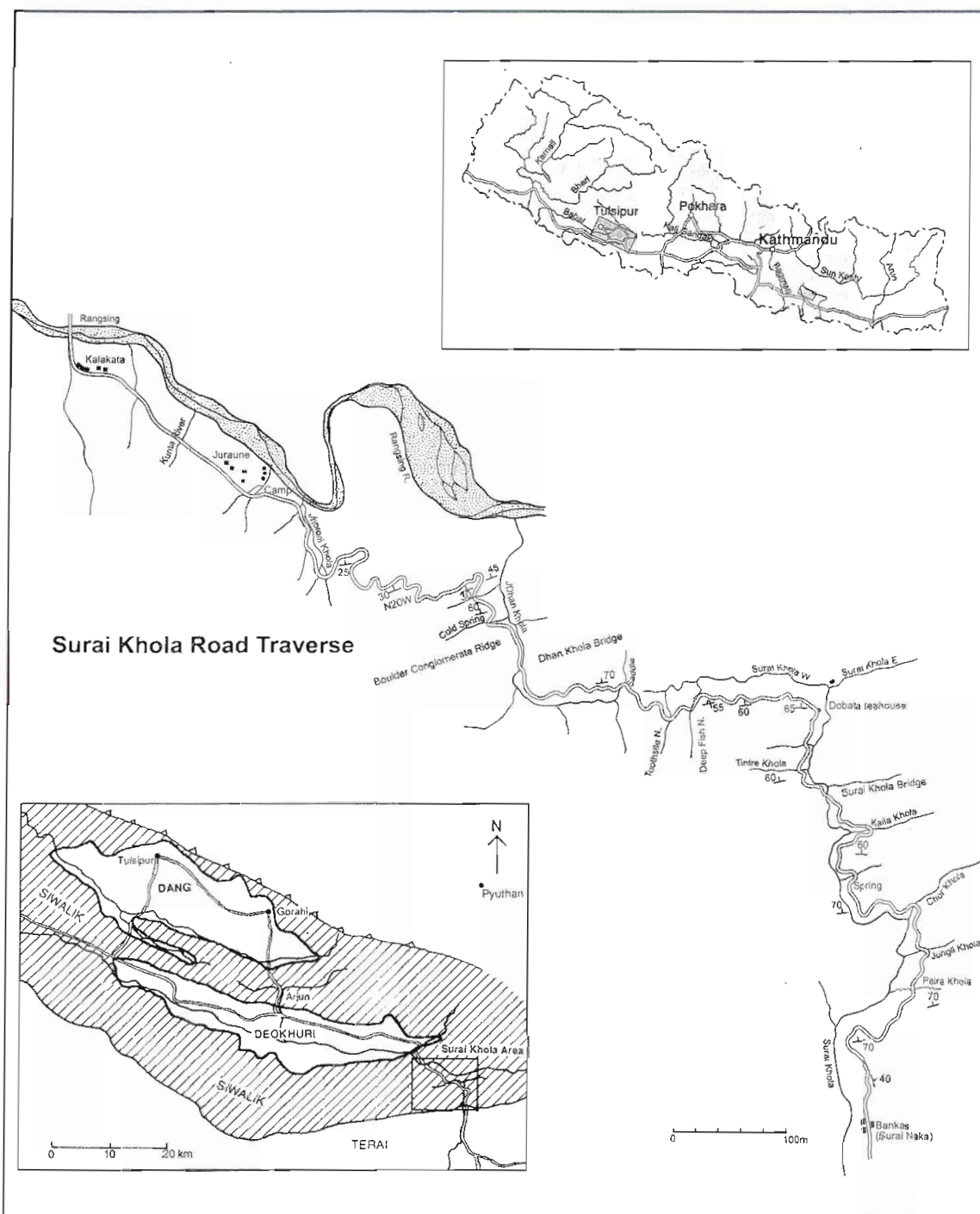


Fig. 165. The road traverse through the Siwaliks at Surai Khola, and inset map of the Dang-Deokhuri Dun valleys. The Early Palaeolithic artefact site is at the big loop southeast of Juraune village (after Corvinus & Rimal 2001).

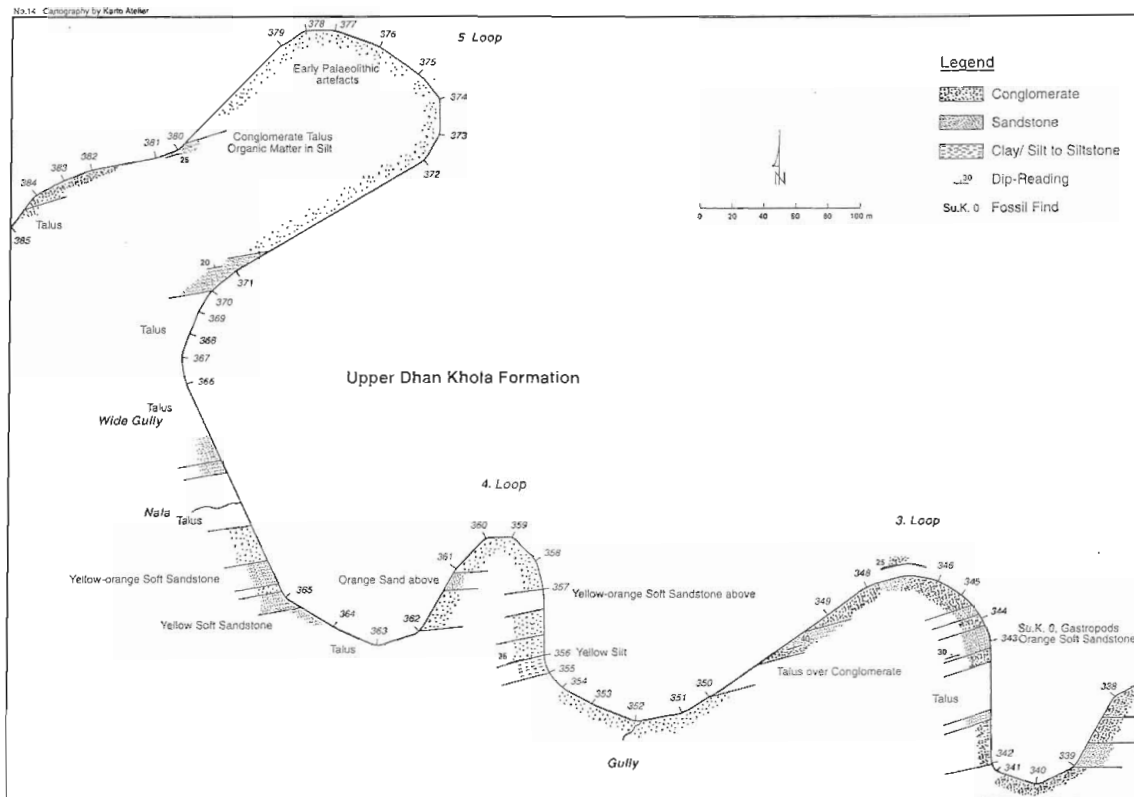


Fig. 166. The Early Palaeolithic locality in conglomerates of the Upper Dhan Khola Formation (Sheet 14 of the road traverse (after Corvinus, in press in J. of Himalayan Geology).

2.3. Central Nepal, sites in the Satpati area

2.3.1. The Satpati handaxe site

The discovery and description of Acheulian handaxes has been described in chapter IV.2.b. But another discovery of Acheulian bifaces has surpassed the earlier findings in importance, by virtue of its unique stratigraphical position within folded sediments of the Upper Siwalik Group.

All prehistoric findings apart from the one described in this chapter come from a post-Siwalik context, i.e. from alluvial and colluvial sediments of the Dun valleys and from terrace surfaces. But the Acheulian bifaces from Satpati, described in this chapter, have an altogether different geological context.

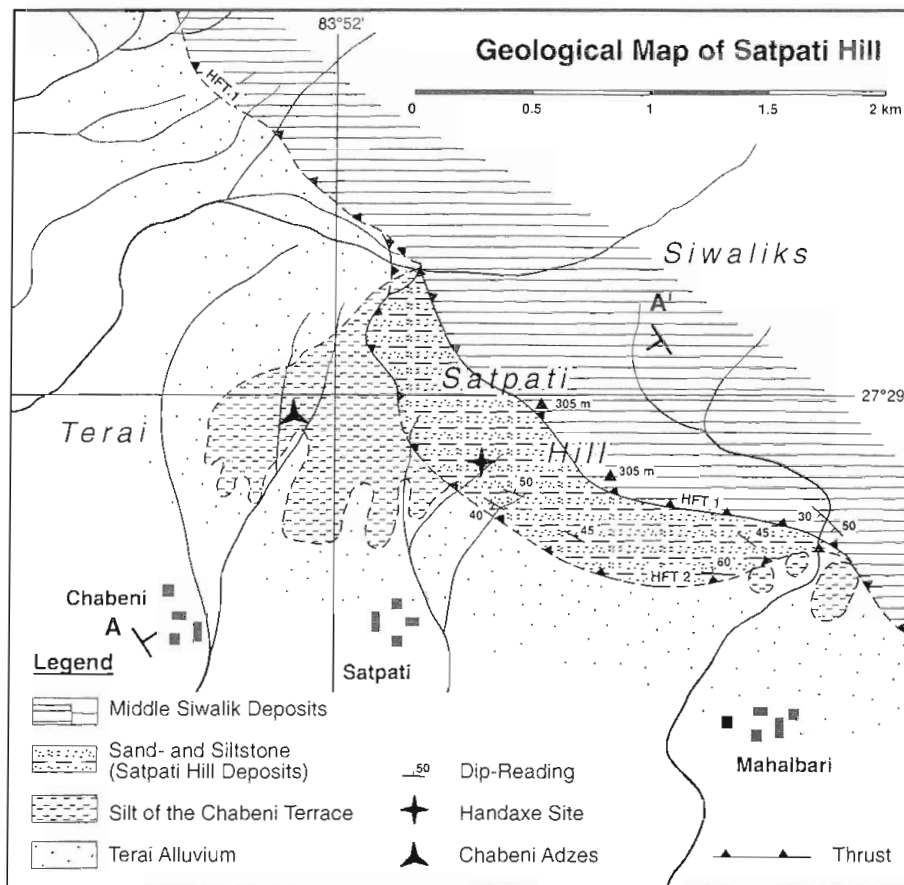
The Satpati handaxe site was discovered during a field trip with Japanese geologists in January 1991 in the Siwalik foothills of Nawal Parasi District (see Fig.1). It was one of those chance findings which occasionally occur during geological field work. While walking along the foot of the hills, trying to locate and map the Himalayan Frontal Thrust (HFT), the author discovered two sites of two very different cultures in the area 7 km west of Tribhenighat, where the Narayani River enters the plain from the mountains. One is a unique handaxe site, near the village of Satpati, found in folded alluvial sediments within the foothills, and the other, much younger one, is a site of unifacial adzes on a terrace surface in front of the foot of the mountains, at the neighbouring village of Chabeni. The bifaces, found high up on the slope of

a hill called hereafter Satpati Hill, were at first a puzzle, as no terrace deposits or any other younger deposits or surfaces could be detected above the find locality. The few tools must have derived from the folded deposits of the hill itself.

It was only in November 1997 that the situation became clear, when the author was making a thorough search for more artefacts and a detailed study of the geological context (Fig.167). It was at that time that the finest handaxe ever found in Nepal came to light. It was in the process of freshly eroding out from a folded sandstone horizon exposed on a small saddle of the hill (Pl.233/2).

Field data and geology

Satpati Hill is part of the southernmost Siwalik range in the Satpati-Chabeni area of Nawal Parasi District, Lumbini Zone. Its coordinates are 27° 28 1/2' latitude and 83° 52' longitude. The Siwalik range in the Satpati-Chabeni area strikes in a northwest-southeast direction, with exposures of Middle Siwalik deposits of the Arung Khola Formation (Tokuoka et al. 1988) forming the foothills, being separated from the alluvial plain by the HFT, or Frontal Churia Thrust (FCT), as the Japanese call it. Along this thrust the Siwalik deposits override the younger Pleistocene and Holocene alluvium of the Gangetic Plain (of which the Terai is a part).



Sources: Toposheet 63 M/15, 1:50000; aerial photos 7819-85 and 86, 1:50000

Fig. 167. Geological map of Satpati Hill.

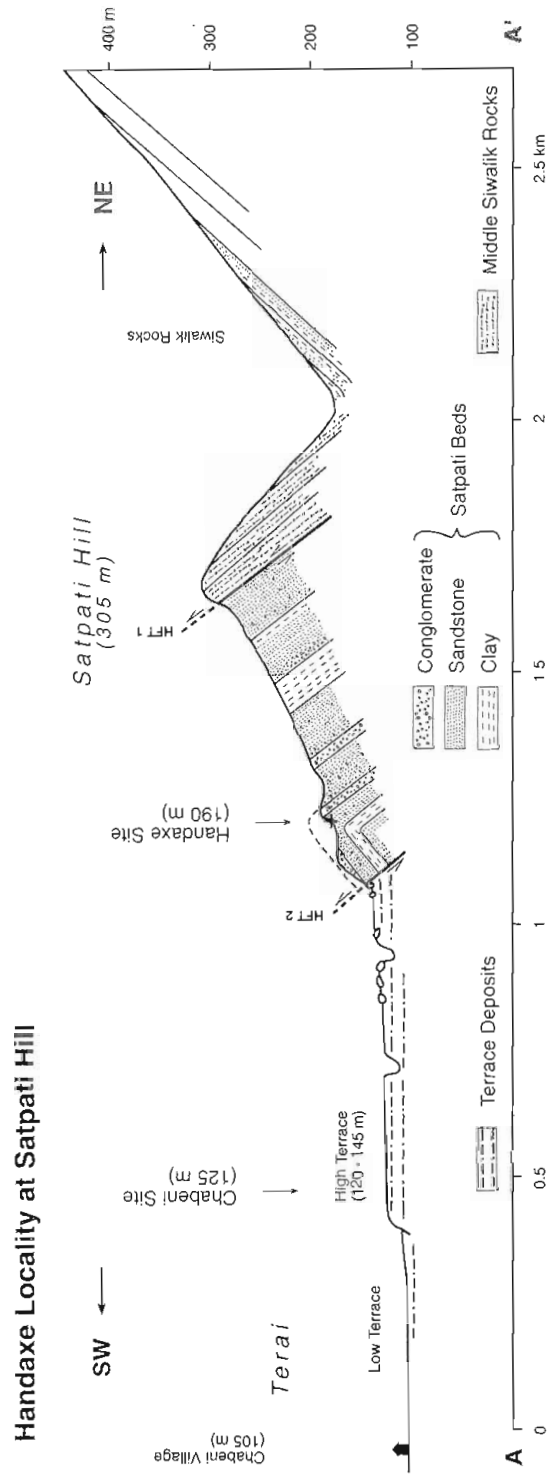


Fig. 168. Profile at the handaxe site of Satpati Hill.

North of Satpati village, according to Tokuoka and Takayasu (pers. comm.), the HFT bifurcates into two strands, around an oblong hill of folded alluvial deposits of sandstones and conglomerates (see Fig.167).

The sediments of the oblong hill (the Satpati Hill) belong to the Early or early Middle Pleistocene, a fact documented by the unexpected discovery of handaxes *in situ* in these deposits. The first bifaces were found in a gully descending from the oblong hill. By following the gully up to where it began, more artefacts could be found at various heights up the hill, until a certain sandstone horizon, 40 m - 45 m up was located, above which nothing was found. The artefacts must have derived from this level. A well-preserved tooth of a bos (Pl.233/3) which was identified as *Bos namadicus* (Badam pers. comm.) was found on the hill just above this level, at a height of 50 m. Later, the very fresh and unabraded handaxe, found in 1997 at the sandstone exposure itself, confirmed the *in situ* positioning of the artefacts.

Satpati Hill, extending for about two kilometres in front of the older Siwalik range, rises 200 m above the alluvial Terai plain, which at Satpati village lies at an elevation of 160 m above mean sea level. The sediments of Satpati Hill consist of soft, yellow, slightly consolidated micaceous beds of sandstones (pebbly at places) and conglomerates, as well as of lenses of very well-rounded quartzite cobbles and boulders intercalated with yellow, slightly consolidated silts and a few layers of grey clay.

The deposits, here called the Satpati Beds, have been folded into a small anticline along the HFT (Fig.168) striking in northwest-southeast direction. The southern part on the south side of the hill has partly eroded away, thus exposing the artefacts on the hill slope. The southern limb of the anticline may be a drag fold along the frontal thrust. Most of the deposits of Satpati Hill dip to the NE.

The Satpati Beds override the alluvium of the Gangetic Plain at the southern strand of the HFT (HFT2) while a northern strand of the HFT (HFT1) was mapped by the Japanese team within the valley between Satpati Hill and the northern Siwalik Hills. A detailed survey undertaken by this author in 1997 revealed, however, that at the crest of Satpati Hill itself the Satpati Beds are overridden by a thrust of the HFT (which now becomes HFT1) which thrusts Middle Siwalik rocks consisting of alternations of hard, calcareous sandstones and siltstones conforming to the Chor Khola Formation (Corvinus 1988, 1993; Corvinus & Nanda 1994; Corvinus & Rimal 2001), over the Satpati Beds (Fig.168). Thick, impenetrable vegetation had hidden the contact at the crest, so that the previous interpretation by Takayasu (pers. comm. in Corvinus 1995) of a layer of a boulder gravel at the crest, conformably overlying the Satpati Beds, is incorrect.

The Satpati Beds of the oblong hill of Satpati, which have been affected by the tectonic activities of the HFT, are considerably older than the alluvial sediments of the Gangetic Plain. The Satpati Beds belong in all probability to the folded Upper Siwalik Group of sediments. Comparisons with the well-studied Siwalik areas at Sutai Khola and Rato Khola (Corvinus 1988; Corvinus & Nanda 1994; Corvinus & Rimal 2001) suggest that, more particularly, they belong to the uppermost part of the Upper Siwaliks (see below).

The finding of a molar of *Bos namadicus* and of Early Palaeolithic handaxes in the Satpati Beds would support such suggestions (Pl.233/3).

The finds in their stratigraphical position

A collection of 18 stone tools was made in 1994 on the hill slope from a level of about 45 m (Pl.255/1 and 123-Sc) (just below the *Bos* tooth) and on the slope (Pl.234/1) down to the foot of the hill, as well as in the narrow gully which cuts into Satpati Hill (Pl.234/1-2). They all derive from the Satpati Beds, with some of them having calcrete still adhering to them. An investigation of the entire hill slope proved that the artefact horizon is a sandstone layer, the top of which has eroded away, situated at the crest of the

small anticline exposed in a small saddle between two gullies 45 m up the hill (Pl.255/1 and Ph.123-Sc). In the two photos the exact place is marked. In Ph.123-Sc one can see the anticlinal nature of the strata. The sandstone is a 1-2 m-thick, grey-beige micaceous sandstone with occasional pebbles of quartzite. It is overlain, a little further south, by a yellow 1.50 m-thick, slightly consolidated calcareous siltstone containing kankar, which in turn is overlain by a 1 m-thick conglomerate consisting of well-rounded quartzite cobbles and pebbles. The conglomerate, which is partly cemented, forms a small hillock to the south above the saddle. A few of the artefacts were found on the slope near the level of the sandstone (and lower down), but none were found above it.

Then, during a third visit in November 1997, where the site was again minutely examined, the best preserved specimen, a very well-made and completely unabraded handaxe, was found by the author at the sandstone exposure itself (Pl.233/2, see also Pl.188 and 189) 45 m up the hill, where it evidently had been washed out very recently. The location of this find (seen clearly in Ph.123-Sc), i.e. the uniqueness of its position, leaves no doubt that the handaxe could not have come from anywhere else but from the sandstone itself up on the hill. In this particular place the overlying deposits have eroded away. The sandstone horizon is exposed here on a narrow, freshly trampled goat track on the small saddle between the two gullies (Pl.235/1). This track had not been there before but was a fresh track in the thickly vegetated, bushy terrain, which is scarcely negotiable by humans. The goat track ascends from the steep eastern cliff over this saddle to a westerly slope. The sandstone at the saddle exposes a fresh vertical cliff of hardly one metre and the handaxe, which was lying on the track at the base of the small cliff (Pl.235/1) had recently derived from it. In the author's opinion there cannot be any doubt that the sandstone horizon is the original horizon in which the tool was embedded: 1) the handaxe was not there when I searched the site previously; 2) it could not have come from any horizon lower down, or from higher up, as the sandstone forms a small hillock here, overlain by no other deposit; 3) the handaxe is too fresh and completely unabraded to have been transported; 4) it has a sandy calcrete crust adhering to one surface which is the same matrix as the sandstone; 5) the other, previously found artefacts were all found near this spot, slightly below this level, but never above it.

The well-rounded quartzite cobble gravel which stratigraphically overlies, conformably, the sandstone on the north flank of the small anticline is also exposed on a slightly lower hillock on the south flank of the anticline. Rounded quartzite cobbles are seen washed down on the foot of the hill. The quartzite cobble gravel is part and parcel of the folded Satpati Beds.

The proximal part of another fresh biface was found *in situ* (with 80 % probability of being *in situ*), in the sandstone of the northeasterly dipping limb that is exposed on the hill a little further east of the main handaxe locality. It is, like the 1997 handaxe, completely fresh and unweathered.

Twenty-one Early Palaeolithic artefacts came from the Satpati deposits of Satpati Hill together with a tooth of *Bos namadicus*, unidentified limb bone fragments containing a matrix of micaceous sandstone in their cavities, and a large vertebra, probably of *Bos* or *Bubalus*.

The Satpati handaxe site is marked with a + in both the map (Fig.167) and profile (Fig.168). All artefacts were found close together, either on the previously described crest of the anticline or down slope from the crest or washed down into the gullies below.

By taking all these observations into account, the following points become clear: 1) the Acheulian artefacts are derived from the folded sediments of the Satpati Beds; 2) the Satpati Beds belong in all probability to the upper part of the Upper Siwalik strata; 3) the rock strata from which the artefacts and the *Bos* tooth derive, were folded by the latest tectonic movements along the HFT, which uplifted the Siwalik range; and 4) the uplifted strata contains an Early Palaeolithic handaxe assemblage of Early Pleistocene to early Middle Pleistocene age, and the tectonic event of the uplift of the Satpati Hill is younger than the Acheulian occupation.

Geological interpretation and discussion

A comment by Takayasu (pers. comm.) which was later expanded upon by Corvinus (1995), namely that the top crest of Satpati Hill was conformably overlain by a thick colluvial cobble rubble has been proved wrong by the present author's detailed investigations. The crest is a well-pronounced thrust zone where earlier Siwalik rocks of calcareous sandstones were thrust over the Satpati deposits. The slope below it is covered with blocks and cobbles of weathered Siwalik rocks from the calcareous sandstones from the crest, which gave the erroneous impression of a colluvial scree overlying the Satpati Beds.

The close investigation of the Satpati Hill deposits made it increasingly clear that the Satpati deposits are Siwalik deposits, belonging to the upper part of the Upper Siwaliks, the Boulder Conglomerates. At the Surai Khola sequence the Boulder Conglomerates (called there the Dhan Khola Formation, Corvinus 1988, 1994; Corvinus & Rimal 2001) consist in their lower part of consolidated beds of boulder-cobble conglomerates, and in their upper part of soft, yellow-to-beige, only slightly consolidated sandstones and pebbly sandstones, with occasional beds of moderately consolidated cobble gravels intercalated with soft, yellow siltstones and some grey clay beds, which are very similar, in fact, to the Satpati Beds. Besides, in 1999, a few probably man-made Early Palaeoliths were discovered in a lens of the upper part of the Dhan Khola boulder conglomerates (chapter V.2.2.).

In the Rato Khola area the geological situation is especially similar, both tectonically and stratigraphically. At the very foot of the Siwalik range the HFT thrusts a narrow slice of the uppermost Siwalik deposits (very similar to the Satpati Beds) over the recent alluvium of the Gangetic Plain, while a few hundred metres north they are, in turn overridden by thick fossiliferous Siwalik sandstones which contain a wealth of Plio-Pleistocene vertebrate fossils, described in the above mentioned articles. The author suggests that the Satpati Beds can be correlated with the upper Dhan Khola Formation, which forms the youngest and uppermost part of the Siwaliks.

A few consequential points may be noted relating to these discoveries:

1) So far there has not been any previous incidence along the Indian and Nepal Himalayas of definite Palaeolithic implements of Acheulian culture within sediments folded by the Himalayan tectonics.

2) The find of Early to Middle Pleistocene bifaces in tectonically affected alluvial deposits within the Siwalik sediments provide relative age indications for the movements of the Himalayan Frontal Thrust along the foot of the mountains. The Satpati deposits with their handaxes belong to the upper part of the Upper Siwaliks and are pre-tectonic, having already been in place prior to the latest folding and uplifting event of the Himalayas, or, in other words, the movements of the HFT continued after the Acheulian occupation. The Satpati handaxes are older than the post-Siwalik, horizontal alluvial deposits of the Terai/Gangetic Plain and the in-filling of the Dun valleys.

3) The Early Palaeolithic occupation at Satpati took place along a sandy, gravelly riverbank, the sediments of which became buried under about 200 m of alluvial molasse sediments above the culture-bearing horizon, and then were lifted up by the latest tectonic movement of the Himalayan orogen. These movements must have occurred in later Early Pleistocene to early Middle Pleistocene times. The buried evidence of man's occupation during the Early Palaeolithic became exposed again by recent erosion.

4) This is the second occurrence of Early Palaeolithic tools in a stratified context in the Nepal Himalayas, the other being the site of Gadari in the intermontane Dun valley of Dang in the western Nepal Siwaliks (see chapter IV.2.2.) in a basal rubble at the base of the Dang basin alluvium (Corvinus 1990, 1991). The discovery of the handaxes at Gadari in 1990 was the first indication of Early Palaeolithic occupation in the Nepal foothills. The Gadari handaxe site is post-tectonic, i.e. post-Siwalik in its geological context, the tools deriving from the oldest, basal part of the Dang valley alluvium. They were subsequently buried under the thick alluvium of the Babai Formation (Corvinus 1995), and thus are younger than the Satpati site.

It is hoped that a few palaeomagnetic samplings of the sediments can be carried out. If they turn out to be normal it means that they are younger than 0.73 m.y., indicating an age younger than that for the last Himalayan uplift of the Satpati Beds. If they are reversed the Acheulian tools are older than 0.73 m.y., and they would be the oldest evidence of the Acheulian culture on the Indian subcontinent so far.

The finds of Acheulian handaxes in the Himalayan foothills in Nepal have led to two interesting conclusions: First, that Early Palaeolithic hominids of the Acheulian tradition penetrated deep into the Himalayan foothills, as evidenced by the Gadari assemblage, in early post-Siwalik times just after the Siwalik uplift, and secondly that occupation sites of even earlier Acheulians were incorporated into the Siwalik uplift, pointing up the fact that the earlier Acheulians lived in the region prior to the latest Himalayan uplift.

The Satpati Early Palaeolithic assemblage

Altogether 21 artefacts were collected from the Satpati deposits of the Satpati Hill: 7 handaxes, 2 probably unfinished handaxes, 2 bifacial tools, 1 pick, 5 flakes and 4 core tools. They are all made of quartzite, which must have been locally available in the river beds. Three artefacts, No.1 and two others, were found in the cobbly, sandy bed of the central khola below the actual site.

Three artefacts were found on the slope below the actual site (Pl.234/1), 5-20 m above the central khola bed: No.2 was 5 m, No.13 (Pl.234/2) 15 m and No.10 was 20 m above the central khola bed. Four artefacts come from below the southern outcrop of the conglomerate bed, about 30 m above the central khola bed. Five artefacts are from the slope near the sandstone layer, about 40 m above the central khola bed. The 1997 handaxe, No.21 (Pl.187, 188), comes from *in situ* from the sandstone layer itself, 45 m up the hill (Pl.235/1). Two artefacts were found in the adjoining khola bed, which cuts down to the west of the actual artefact site instead of towards the east. One artefact, No.12, was found in probable *in situ* position in the sandstone of the NE-dipping limb exposed a little to the east of the main handaxe locality.

Description of artefacts. The twelve bifaces and bifacial tools from Satpati were all made from quartzite, mainly on cobbles and rarely on flakes. They were made by large, deep hard-hammer technique and softer shallow secondary trimming along the edges. They are not particularly refined, apart from No.2 (which is, however, broken) and the 1997 handaxe. The collection, though small, probably belongs to an early stage of biface manufacture.

The 1997 handaxe (No.21) is the finest specimen of the collection (Pl.187 and 188), 175 mm long, 105 mm wide and 47 mm thick, of oval shape and flat section. Probably made on a flake, it retains cortex along the butt and along the lower part of the right side, which is blunt due to the cortex and some blunting retouch, so as to hold it comfortably in the hand. The left side is shaped into a sharp, straight edge and the distal end into a rounded apex by shallow flaking and retouch. Near the butt, remnants of sandstone matrix adhere to the surface of the tool, indicating that it derives from the sandstone layer at which it lay. It is a completely fresh specimen.

No.2 (Pl.179 and 180), though broken, is a well-trimmed specimen. It is the lower part of a large handaxe with a flat biconvex section. Only little cortex is left near the butt. The tool was trimmed bifacially by shallow, primary flakes and step-flakes, and has fine retouch along both sides, so that a straight edge of an angle of 65 degrees is formed. Both edges were well utilised. The tool has a patina and is slightly rounded.

Another well-made specimen is handaxe No.1 (Pl.177 and 178), a fine oval tool, the lower face of which was trimmed all over its surface by shallow primary flaking and by small step-flakes along the edges. The upper part near the apex was reshaped by a few large step flakes, which removed the original, probably pointed apex. The upper face retains a fair amount of cortex near the butt, which has a straight unifacial edge. Both lateral edges are trimmed bifacially, forming slightly sinuous edges of 70 to 75 degrees.

The large biface No.10 in Pl.181 and 182 retains much cortex at the heavy butt and has a thick, irregular biconvex section, and seems to be an unfinished or broken handaxe. The well-made apex has partly broken off. The lateral edges are bifacially, though crudely, trimmed. At the left edge a heavy percussion mark can be seen, where only a small part of the intended large flake broke off (which would have produced a sinuous usable edge), leaving the tool unfinished.

The white, oval handaxe, Nr.13, illustrated in Pl.183 and 184 is made on a fine-grained white quartzite cobble. Both surfaces and part of the butt retain cortex. The tool has little overall trimming. A unifacial edge was produced at the right side by shallow flakes and step-flakes. It is the shallow, tongue-like point which is particularly well shaped, and this must have been the main focus of the tool. It is very delicate and thin compared to the overall heaviness of the tool, and has a very straight, sharp edge.

The blue biface, No.14, (Pl.185 and 186) is an elongate ovate, unfinished tool, made from fine-grained blue quartzite. It was roughly trimmed with large primary flakes from both sides so as to form zigzag lateral edges. The apex is broken: the removal of a large, longitudinal flake has destroyed the original point.

The small handaxe, No.3, (Pl.189) seems to have derived from the sediment only recently, as it is sharp and fresh. It is a small, pointed, oval tool with a thick biconvex section and little trimming. It was made by deep primary flakes and a few step-flakes, so that the edge which runs around the whole tool is zigzag and sinuous.

No.12 is the lower, broken-off butt-half of a handaxe and is very fresh. The upper face is well trimmed, with a number of larger flake and step-flake scars that produce a bifacial edge, while still retaining some cortex. It has a round butt with a sharp, straight edge.

The broken butt part of a handaxe, made on a large flake, a pick, 2 bifacial tools, 2 core tools, 2 worked pieces and a number of flakes form the remainder of the small assemblage.

Concluding remarks

The discovery of the Satpati handaxes indicates that an Acheulian occupation site was present at the foot of the rising Himalayas. The Satpati bifaces are made in the Indian tradition and the connection of the people responsible for them is to India.

The Satpati cultural assemblage, though only a small one, is of crucial importance, firstly because of its unique stratigraphical position within folded and uplifted sediments of Upper Siwalik context, and secondly because of its geographic position. Separated from the main occurrences of the Acheulian culture (in central, western and southern India) by the wide Gangetic Plain Acheulian groups had migrated far to the north, occupying the foot of the Himalayas and even penetrating into the mountains. The climate was probably cooler and drier, being influenced by one of the earlier glacial periods, and, if so, the vegetation was less dense than today. After the Satpati occupation, the rivers from the north continued to deposit thick molasse sediments, thereby burying the site deeply under them. It is only due to the tectonic uplift and folding that the site has been exposed again.

The Acheulian culture, sites of which are found so abundantly in India south of the Gangetic Plain, must have flourished also in the Gangetic Plain, but such sites are now buried under thick alluvial sediments, which continue to be flushed from the mountains into the plains (the alluvium of the Gangetic Plain is estimated to be 5,000-6,000 m thick). The evidence provided by Satpati and Gadari in Nepal shows that the Acheulian culture in India spread as far north as the Himalayas, penetrating into the mountains as far north as the Dang valley north of the Siwalik ranges.

The Satpati Acheulian remains are the oldest in Nepal, having been involved in the latest Himalayan uplift of the Siwaliks. They seem to be of Early Pleistocene age. The other Acheulian site in Nepal, that of Gadari in the Dang valley, is younger, being connected with the earliest post-Siwalik alluviation of the Dun valleys (after the Siwalik uplift), which probably started in the earlier Middle Pleistocene. There re-

mains the task of clarifying the actual ages of these sites by other means than the geological interpretations employed so far.

The finds of Early Palaeolithic tools in Upper Siwalik-type sediments in Nepal can be corroborated on the basis of Early Palaeolithic occurrences in the Porwar Plateau in Pakistan (Rendell et al. 1985; Dannel et al. 1988), which were provisionally dated by correlating them with tectonic events, though the ages are much debated (Hemingway and Stapert 1989).

In India, too, recent attempts to date the earliest Acheulian in India by radiometric analysis of a volcanic tuff found in association with Acheulian handaxes at Bori in Maharashtra has raised heated discussions, having yielded controversial ages between 1.4 million years (Korisettr et al. 1988-89) to 75,000 years (Shane et al. 1995), while an age of 0.67 ± 0.03 million years (Misra et al. 1995) seems to be the most likely, in that it takes into account not only the pure radiometric dating but also the geological and stratigraphical data at the site and the associated cultural material.

Whatever the outcome of the controversy, the fact remains that evidence has come to light in recent years which tends to place the earliest Palaeolithic occupations in South Asia much further back than previously thought.

The same is the case in East and Southeast Asia. The earliest appearance of *Homo erectus*, his age and his association with stone tools is much discussed, and new discoveries are being made, especially in China (Aigner 1978; Yi and Clark 1983; Wu Rukang and Dong Xingren 1985; Huang Weiwen and Hou Yamei 1997), discussed in chapter VIII.3.1.1. In Java, the ever enigmatic question about the age of *Homo erectus* there remains unsolved (see chapter VIII.3.1.2.), for all the attempts to push the antiquity of man and his stone artefacts back in time (Allen 1991; Battstra 1992; Bartsrtra et al. 1988; Keates 1998; Corvinus 2004).

The importance for Nepal is that we may now push the antiquity of the human occupation of the Himalayan foothills far back, into the earlier Pleistocene, and that the extension and migration of Acheulian man went beyond the Gangetic Plain right into the Himalayan mountains. It is not the Gangetic Plain which formed the northern border of the handaxe population on the Indian subcontinent, and it is not the Himalayan foothills; rather it is the higher Himalayan mountain belt which served as the northern and northeastern boundary of their migrations.

2.3.2. The Chabeni Site

Much later than the Acheulian occupation and the uplift of Satpati Hill, terraces began forming along the Himalayan front in the Terai below Satpati Hill and the Siwaliks. The villages of Satpati and Chabeni are situated on the low, wide, recent alluvial plain of the Terai at an elevation of 100 m a.m.s.l.

A higher, older terrace exists north of the village of Chabeni, 20 m above the low terrace surface (Fig.167). It consists of alluvial silts topped at places by narrow colluvial scree of Siwalik sandstone blocks and boulders. Such colluvial fans are very common along the foot of the Siwalik hills and seem to be small flush deposits (as in the case of the Chabeni terrace) or larger landslide deposits from the hills into the foreland. The terrace is covered only by brush and an occasional tree.

The higher terrace of Chabeni yielded a prehistoric occupation site of probably Holocene age. The silt surface of the terrace slopes down southwards and breaks up into badlands at a small canal. At the erosional margin, abundant artefacts of quartzite and chert are eroding out from the uppermost horizon of the silt at the contact with the overlying scree deposit, indicating that an occupation site of a large camp, the Chabeni site, is embedded in the top part of the silty terrace deposits. The site is being eroded out at the edge of several small gullies that cut into the terrace.

The terrace is probably only a remnant of a formerly more extensive terrace surface and is at present rapidly being dissected by the recent streams flowing out from the Siwaliks. The Chabeni occupation must

have existed just after the formation of the terrace in Holocene times, but before the deposition of colluvial blocks and scree from the Siwalik slopes onto the terrace, and before the recent erosion.

The artefacts of the Chabeni site are found over a considerable area on the surface. They consist of a large number of rough flakes and waste debris in association with unifacial adzes, unifaces and unifacial scrapers, which show surprising affinities with Hoabinhian unifacial tools in South East Asia. No pottery is associated with the stone artefacts.

The Chabeni site, as exposed now, is about 100 m by 100 m in extension. It has been divided into four localities:

Localities 1,2,3 and 4 are areas within the Chabeni site, each of them not more than 50 m by 50 m. Chabeni 1, also called the „flake spot“, is the richest of them, as many flakes and waste chips are coming out from the silt.

Locality 2 is a small area just south of the „flake spot“, where the terrace deposits break up into the badlands. It is also called the „adze place“, particularly many unifacial adzes having been recorded there in 1991 (Pl.235/2). Locality 4 where many unifaces were found in 1994 is just northwest of locality 2 and west of locality 1.

Locality 3 is a small area north of locality 4 with only a small sample collection.

A few hundred metres to the east of the Chabeni complex on the terrace, a large area is littered with great amounts of potsherds on the surface, but with no stone artefacts. A potters village, now gone, seems to have existed on this terrace north of Chabeni before the occupation of it by the present community of Tharus, Kumals (pottery-makers) and Kuwars (idol-makers), who live in recently established villages. A few flat ancient-type bricks can also be found amongst the potsherds. At one place, hundreds of broken potsherds, especially fragments of pottery horses (Pl.23), are scattered amongst brush near a small shrine. These are still produced by the Kuwar community as orders for special festivals, where they are offered at shrines by the Tharus and Kumals.

The cultural material of the Chabeni Site

The collected artefacts from all four localities are sample collections and are therefore selective. An analysis of waste to tools was not possible, and so it cannot be said with certainty whether the site was a factory. The interpretation of the 53 tools, though, points to it being both a camp and working place.

The artefacts of the site consist in the majority of flakes and waste of quartzite and white cherty quartzite, and rarely of chert. Besides the waste, a considerable number of tools are present: unifaces, corescrapers, scrapers and choppers. Particularly frequent are the unifaces, which form a very diagnostic feature of the Chabeni site. In fact, they do resemble Hoabinhian unifacial tools from northern Southeast Asia.

The collection of 118 artefacts consists of:

- 38 artefacts from Chabeni, locality 1;
- 40 artefacts from Chabeni, locality 2;
- 12 artefacts from Chabeni, locality 3;
- 27 artefacts from Chabeni, locality 4;
- 1 artefact from Chabeni, east of the „canal“.

—
118 artefacts

The Chabeni artefacts include:

- 26 unifaces or unifacial adzes (all made on cobble);
- 1 unifacial disc (on cobble);
- 1 knife (on a flake);

- 7 scrapers (3 are unifacial, made on cobble, 4 are made on flake);
- 5 choppers (4 are unifacial, made on cobble, 1 is partly bifacial);
- 1 sumatralith-like tool, made on cobble;
- 3 corescrapers (all 3 are unifacial, made on cobble);
- 1 sling-ball (made on a round cobble);
- 1 polished cylindrical stone, broken;
- 7 utilised flakes;
- 62 flakes, i.e. waste flakes;
- 2 flake-like pieces;
- 1 core.

Of the 53 tools of the Chabeni collection, 38 are unifacially trimmed, this means that 72 % of the tool kit, consist of unifacial tools made on cobbles or split cobbles, where one face was left completely untrimmed or almost untrimmed, consisting of cortex. This high percentage of uniface is surprising, being hitherto unmatched at other sites in Nepal, including Patu.

The unifactes are flat, oval and elongate-oval tools with biconvex, sometimes plano-convex section, made from quartzite or chert cobbles or from split quartzite cobbles. Large, flat primary flakes were removed from only one face, while the other face was left entirely cortical (or, rarely, may have only a few shallow scars). The edges were then trimmed unifacially by shallow flaking along the circumference. A number of these tools are very flat and were made on large cortex flakes (Pl.24), which has a straight distal edge or on flat split cobbles (Pl.26,27), which is a completely oval-shaped tool, with an edge all around the circumference and some bifacial retouch on the cortical face. Others have a less flat overall section being only flat at the convergent butt, maybe for hafting, and have a divergent distal edge, such as the uniface in Pl.190/1. There are some rather small unifactes with a pronounced lateral edge (Pl.190/3 and Pl.190/2). There are also unifacial adzes with a very pronounced splayed distal adze edge and steep lateral edges, and a rounded butt, one example being the tool in Pl.25, a perfectly shaped tool.

Apart from the majority of unifactes or unifacial adzes, there are also a few corescrapers (Pl.191/1), and steep, sumatralith-like unifacial tools (Pl.191/2).

The B/L ratios of the unifactes show that they are of a standardized oval shape, with a peak at 0.5 to 0.6. Their apex was not made into a straight or obliquely straight transversal edge the way most of the Patu adzes were, but were unifacially trimmed into a convex edge at the apex. They have an amazing resemblance to Hoabinhian unifacial axes from Vietnam (Pl.26). The length of the unifactes is rather unstandardized. Some of the unifactes are very small, only 60-70 mm in length, while others are very large, up to 175 mm. The thickness ratio (Th/B) of the unifactes is very standardized with medium values of 0.4, i.e. indicative of neither a very thin nor very thick section. Only the few heavy-duty choppers and corescrapers have the thick section usual for them.

Three of the few scrapers are made on cobbles and are unifacially trimmed. Four other scrapers are made on flakes and are either unifacially or bifacially trimmed.

Of the 69 flakes, 7 are utilised. None of the flakes bear any special features. Their length ranges from 20 mm to 100 mm. Their shapes peak at a B/L ratio of 0.7, indicating little inclination towards elongate flakes or blades, and their thickness/breadth ratios with a definite peak at 0.2 to 0.4 represent standardized medium values.

The flakes of Chabeni show the same characteristics as those from Patu (Corvinus 1987, 1989). A high percentage (75 %) have a cortex platform, none have a prepared platform and only 9 % have a plain platform. As at Patu, the large majority of flakes have stepretouch at the platform edge on the dorsal face but no other trimming. This stepretouch was done prior to detachment which indicates that the flakes are probably manufacturing flakes of such larger cobble tools as choppers, corescrapers and unifactes. Surpri-

singly few flakes are cortex flakes: only 3 %, while 78 % have no cortex at all, apart from the cortex platform. These flakes compare well with their Patu counterparts.

Interpretation of the Chabeni material

The Chabeni artefact assemblage is a cobble tool industry, displaying a particularly fine finish. The predominant tool type is the flat uniface (Pl.24, 26 and 27), oval or elongate-oval in shape, with an edge along the whole circumference, and unifacial adzes with a convex or divergent distal adze edge (Pl.190/1 and Pl.25). A few scrapers, choppers, corescrapers and sumatraliths make up the rest of the tool kit. The tools were manufactured on cobbles of quartzite by predominantly unifacial trimming. One face was left as a cortical surface, while the other, upper face was trimmed all over by removing large, shallow flakes, and a cortical edge was formed all around the circumference by smaller stepflakes unilaterally on one face only. The flakes are mostly the manufacturing debris left over from tool-making, and only a few flakes seem to have been utilised.

The unifacial tools bear a striking resemblance to Hoabinhian tools from Southeast Asia. In Peninsular India such tool types are absent, and it is possible that the connection of these people was not with southern India, but with Southeast Asia via Northeast India.

The Chabeni assemblage is the first of its kind in Nepal and although similarities exist to the Patu industry in eastern Nepal, the two industries are distinct from each other. Both industries seem to be contemporaneous and both are cobble tool industries whose characteristic element is the unifacial tool. But while Chabeni exemplifies the complete predominance of unifacial tools, mainly oval unifactes, (akin to the Hoabinhian unifacial tools), and contains no adzes of the Patu type, the Patu industry is characterised by the manufacture of a distinctive tool kit of bifacial and unifacial adzes in association with unifacial choppers and corescrapers.

To the west of the Satpati-Chabeni sites, in the Dang- Deokhuri Dun valleys no similar sites with adzes of the Patu type and unifactes of the Chabeni type were recorded, in spite of the great abundance of sites. Only one adze was recovered in the Deokhuri valley, at Lalmatiya, as an isolated find (Pl.132/1a,b), made in the Patu fashion. Another isolated find in the Deokhuri valley is a unifacial adze-like tool, made of blue phyllite, from Pahrwa NNE (Pl.146/2), which was made rather in the Chabeni fashion.

2.4. Eastern Nepal, sites in the Rato Khola area

2.4.1. The site of Patu

The largest and most extensive occupation site in all Nepal was discovered in January 1985 at the foot of the Siwalik Hills in the eastern district of Mahottari, where the Rato Khola emerges from the Siwaliks into the Terai plains at the village of Patu (Fig.169). First results of the explorations were published in *Quartär* (Corvinus 1987 and 1989).

The geological setting

When travelling north towards the Himalays over the wide Indo-Gangetic Plain, the mountains rise very suddenly and abruptly from the flatness of the plains. The rivers, emerging from the Himalayas, freed from their narrow courses in the mountains, shed their heavy load of gravels, sands and overbank deposits at the base of the mountains. They continue their now leisurely courses in wide braiding channels through the plains. At the point of emergence from the mountains the rivers have formed at certain places sets of river terraces as regional occurrences, caused by differential uplift in the later Pleistocene and Holocene.

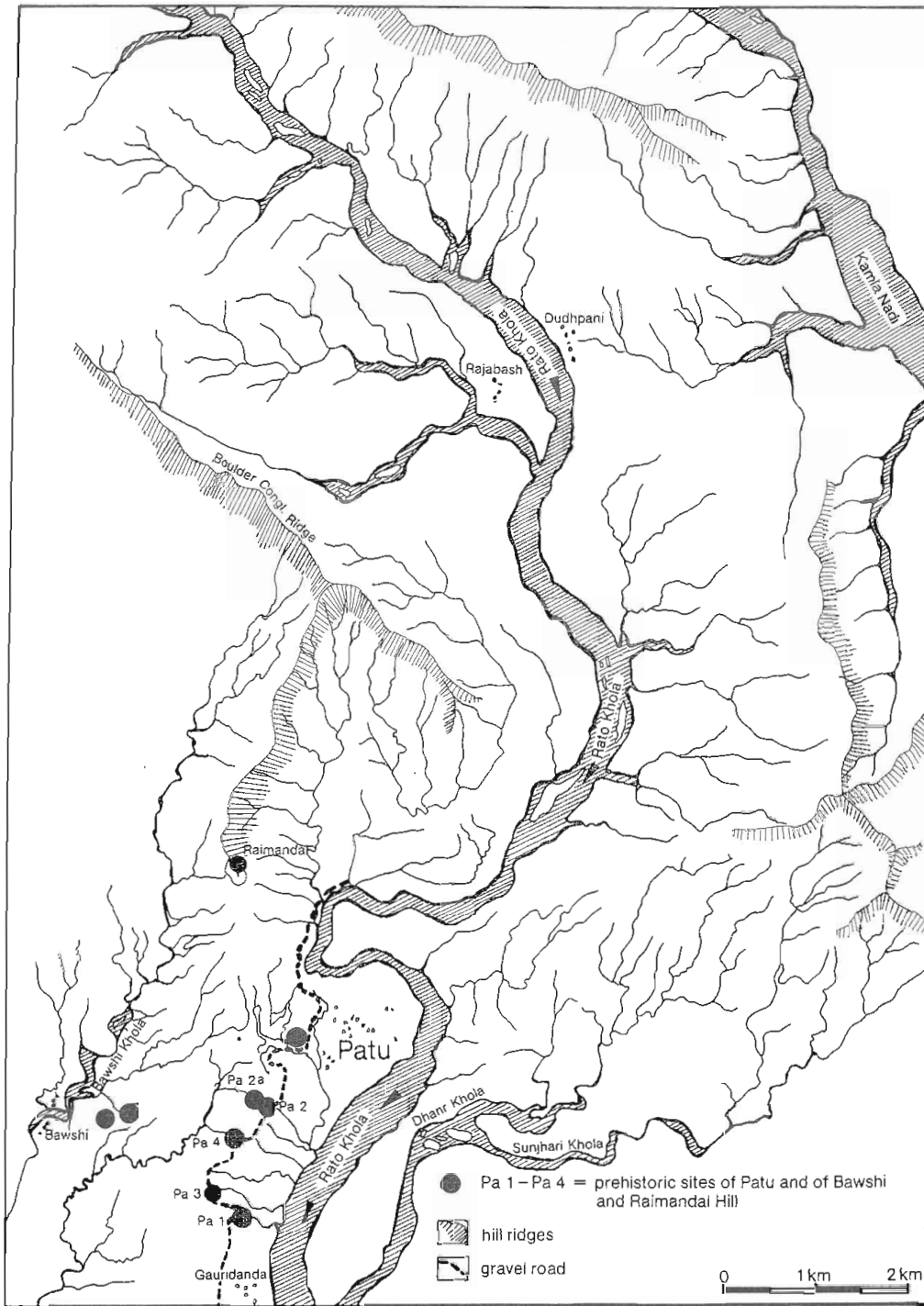


Fig. 169. Map of the Rato Khola area (after Corvinus 1987).

The Rato Khola thus has formed a number of terraces along its bank (Fig.170). Five terrace levels can be distinguished which can be divided into two sets. The lower, younger set of terraces comprises those at 10 m, 15 m and 40 m above river level and consists of fluvial gravels and sands which overlie unconformably Upper Siwalik rocks of conglomerates and sandstones. A grey topsoil has developed on the 40 m terrace. No prehistoric findings have been made on these terraces.

The higher set of terraces comprises those at 60 m to 90 m above river level. They are found only on the right (western) side of the Rato Khola and consist of fluvial gravels and silts, overlying Upper Siwalik bedrock. These terraces have developed a red soil on their surface and are considerably older than the lower, Holocene set. They probably belong to the Late Pleistocene, and the red soil which covers their surfaces seems to have been developing since a warmer interstadial in the Late Pleistocene, though according to estimations by Bronger (pers. comm.) they have been developing since the turn of the Pleistocene to the Holocene.

The deposits of the higher terraces (Fig.171 and 172) are well exposed along the road to Sindhuli. A red-brown silt about 1.5 to 3 m thick is exposed on the terrace surfaces, the top of which has deeply weathered into a red soil (Fig.172,1)). The silt is overlying a 4-5 m fluvial cobble gravel, which in turn overlies steeply dipping conglomerate beds of the Upper Siwaliks. These older terraces have been considerably dissected by strong recent erosion, and wherever the forests are cut away a badland topography has developed.

The occupation site of Patu was discovered on one of these higher terraces, the one 60 m above the Rato Khola, where it was exposed by the recent erosion (Pl.236/1). Once the whole area was thickly covered by forests, but now the forests are being cut by the local people, so that the soils are eroding away. The adjoining sites of Patu 2 and Patu 2a constituted a factory site of a group of people who lived on these terraces in a forest setting in early Holocene times. The artefacts became embedded in the upper part of the alluvial silt within the red soil, not as a result of being buried by alluvial activity but of bioturbation, mostly induced by termite activity in the forest ground over the last 7000 years. All the artefacts which one sees now on the surface are the residue of the buried occupation floor, having been exposed by erosion.

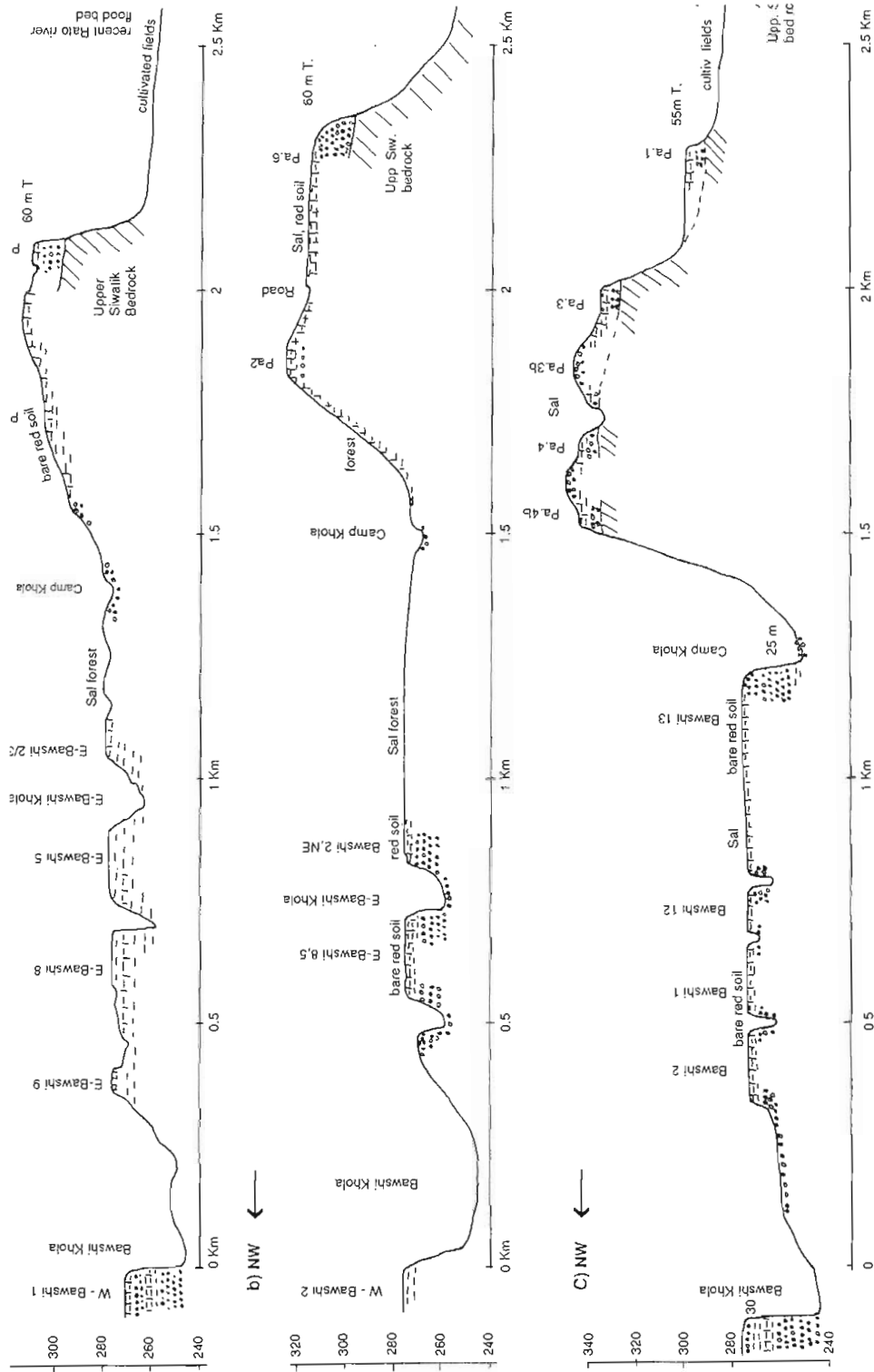
The main site of Patu

The main site of Patu (Pa2 and Pa2a) (Fig.173 and Fig.174) consists of two artefact concentrations, Patu 2 and Patu 2a, which are divided by a deep gully. They belong, however, together, having once formed one large occupation floor. Heavy erosion in rather recent times has not only dissected the site but has exposed a large part of the original site.

All stones on the exposed site are manuports that were carried up from available sources of quartzite cobbles and boulders in the surrounding streams. At the factory site, a special tool kit was made from these quartzite cobbles. The occupation floor contains a great variety of debris, split and broken-up cobbles, cobble fragments and other waste in all stages of tool manufacture, together with flakes, tools and a few cores.

The site slopes gently to the west, from the sterile forest soil in the east down to where the underlying gravel starts being exposed (Fig.175 and 176). On the eroding red soil on the slope a thick scatter of artefacts and manuports can be seen. At first sight, it seems that the scatter of artefacts is surficial. But they actually derive from the upper part of the red soil, the part heavily bioturbated by termite activity.

The two sites of Patu 2a and Patu 2 were plotted into 10 m squares (Fig.173 and 174). From these 10 m square plottings, selective collections were made and numbered according to their squares. The black dots in Fig.177 are selected tools and flakes and the white dots are cobbles (manuports). A number of 1 m squares in Patu 2a were selected for special plotting (Tr.I-V in Pa 2a, indicated in Fig.173 and 177). From these areas all artefacts and all stones were plotted, numbered and lifted out (Fig.178), all black dots being



Terrace Profiles across the Bawshi and Rato Khola rivers. (with sites indicated).

Fig. 170. Cross sections through the terraces of the Rato Khola (above) and the Bawshi Khola (see also Fig. 193).

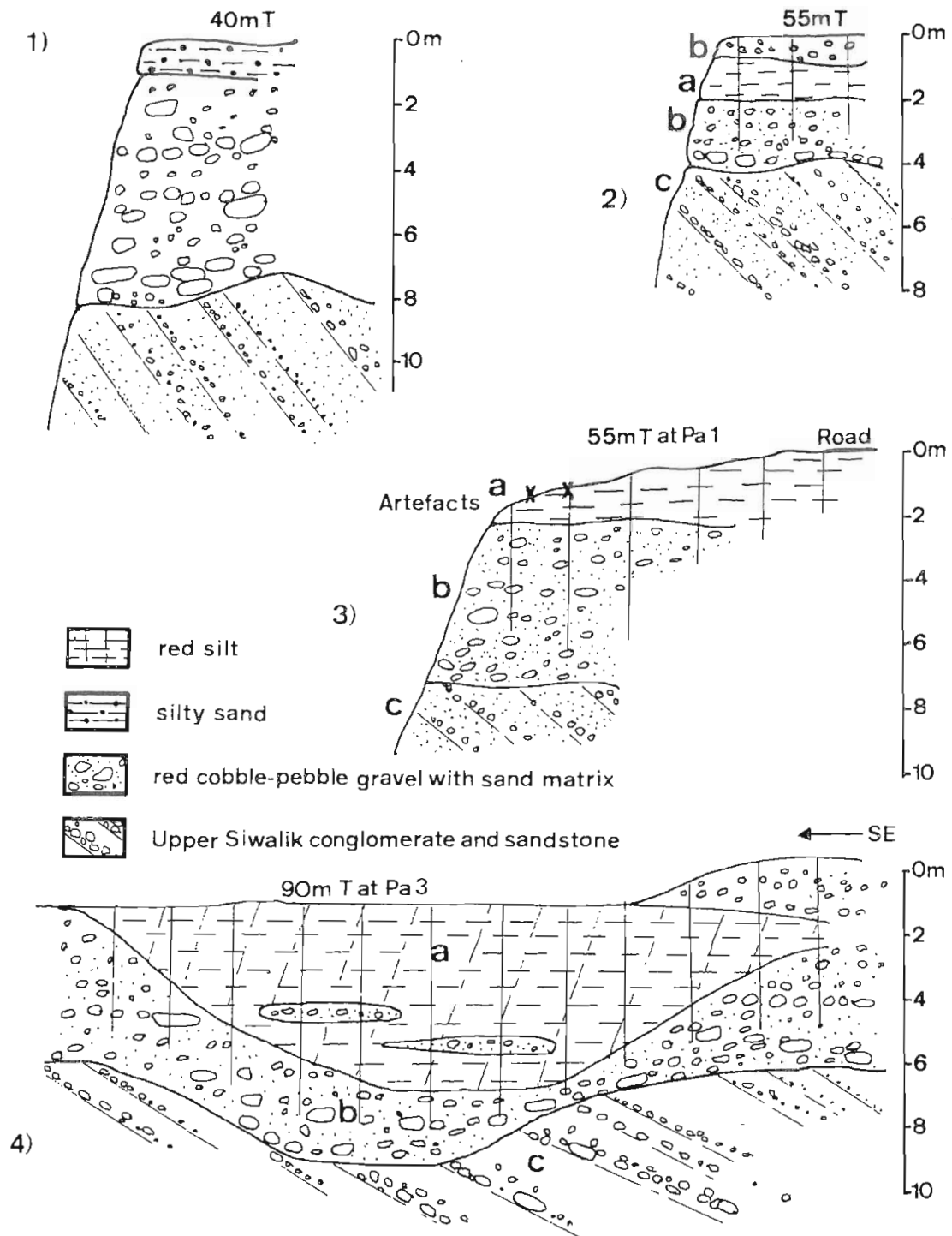


Fig. 171. 40-50m terrace deposits of the Raro Khola at locality Pa1 and Pa3., overlying unconformably Upper Siwalik bedrock. 1. The 40m terrace with a grey silt above a grey cobble gravel. 2. The red 55m terrace along the road. 3. the red 55m terrace at locality Pa1 (X = artefacts). 4. The red 90m terrace at locality Pa3 (after Corvinus 1987).

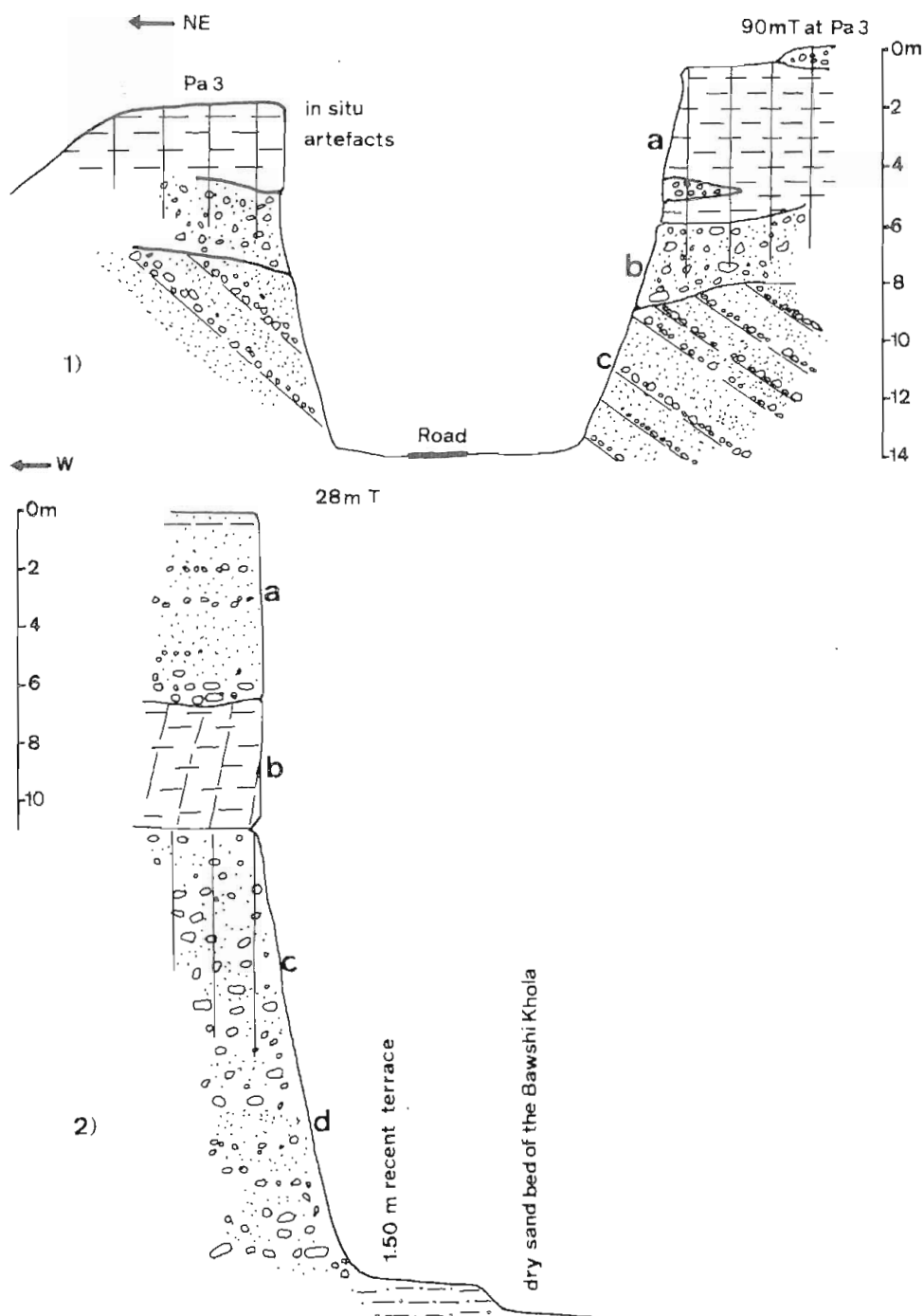


Fig. 172. The 90m terrace cliff at locality Pa3 and the cliff at Bawshi Khola west (after Corvinus 1987). (Legend for 1 as in Fig. 171; legend for 2: a: yellow-grey gravel and sand, on the top some silt, b: deep-red silt, c: red patinated cobble gravel, d: yellow to reddish cobble gravel.

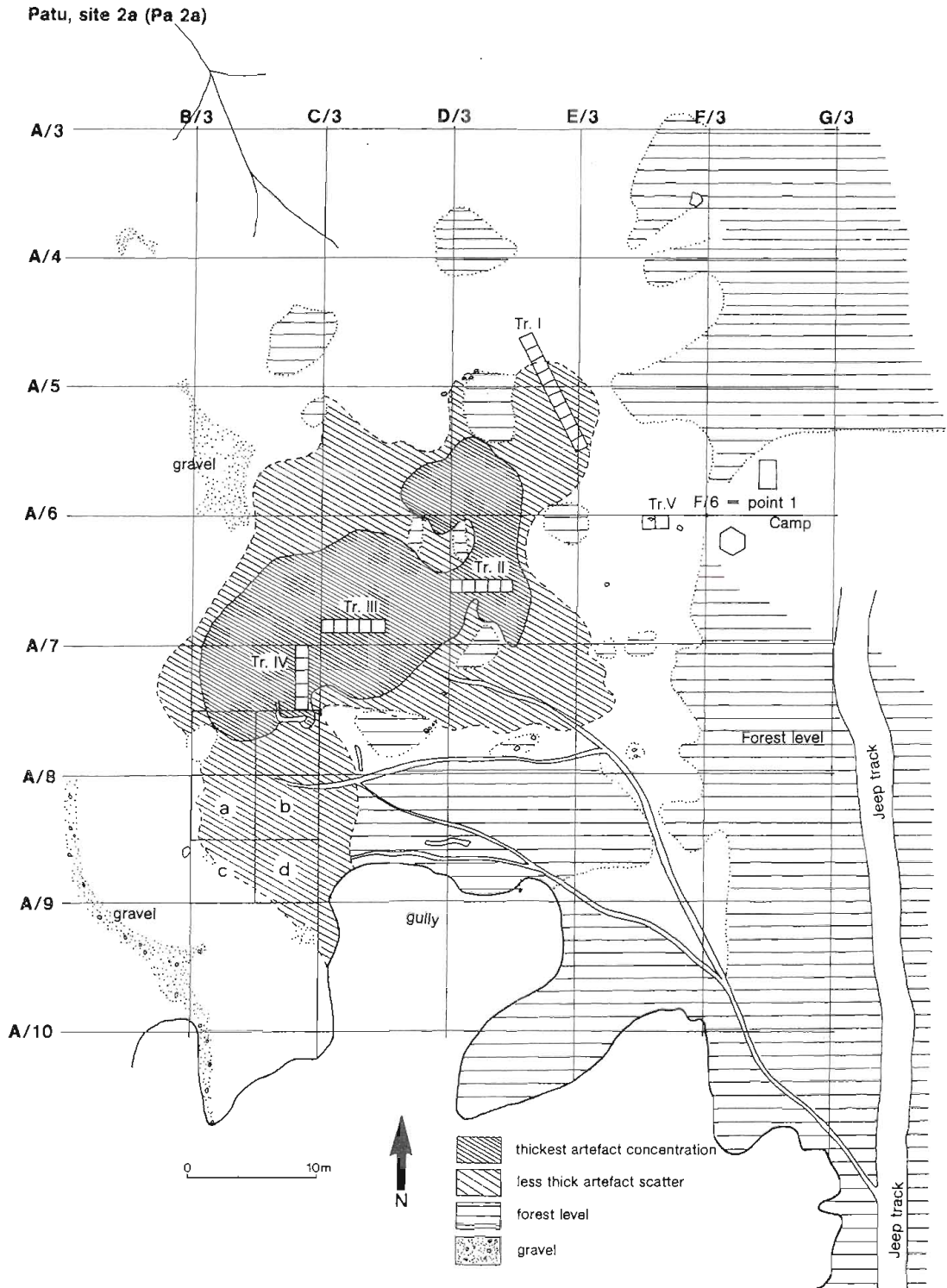


Fig. 173. Map of the main site of Patu 2a (Pa2a) (after Corvinus 1987).

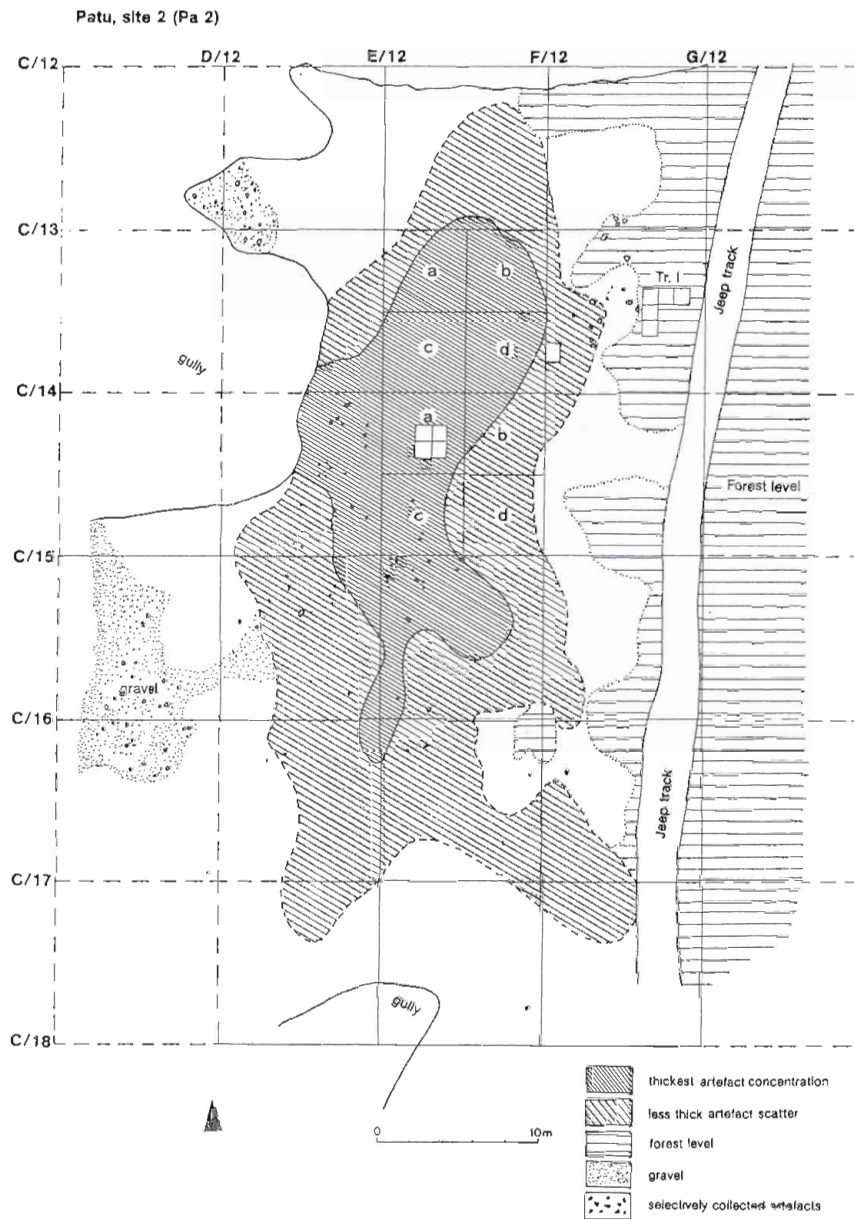


Fig. 174. Map of the main site of Patu 2 (Pa2) (after Corvinus 1987).

tools, flakes, waste flakes and chips and all white dots broken and split cobbles and fragments of cobbles. The stone waste was counted and examined and then catalogued and tabularised in the field. This was done in order to gain a better understanding of the technique of the stone-knapping.

At Patu 2, the 10 m squares of E/13 and E/14 were analysed in detail (Fig.174), and all artefacts were numbered and collected in the quadrants a,b,c and d, while a few 1 m squares in E/13d, E/13c and E/14a were plotted separately and all artefacts and all stones collected (Fig.179).

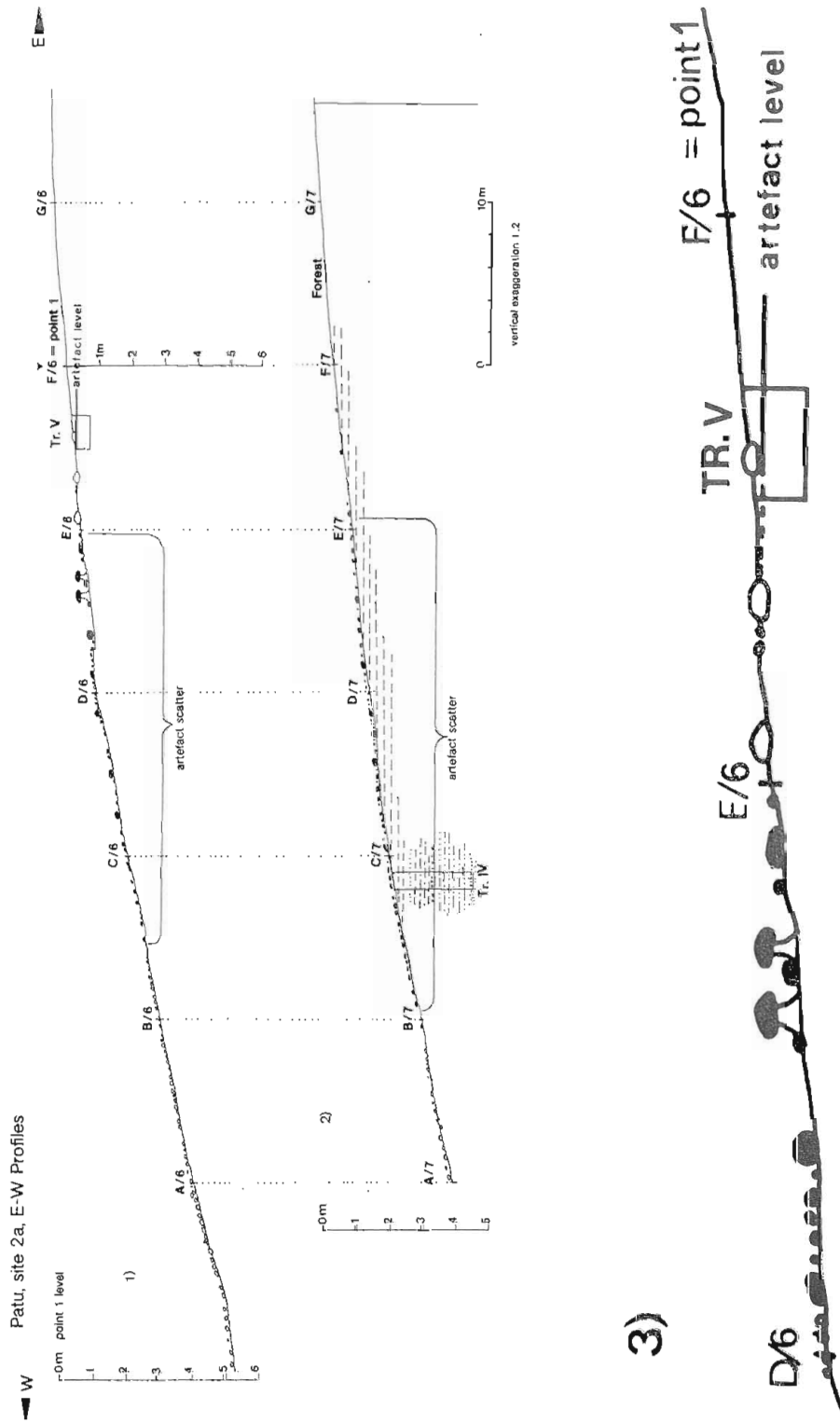


Fig. 175. East-West profile over site Pa2a (after Corvinus 1987, see legend there at Fig. 7).

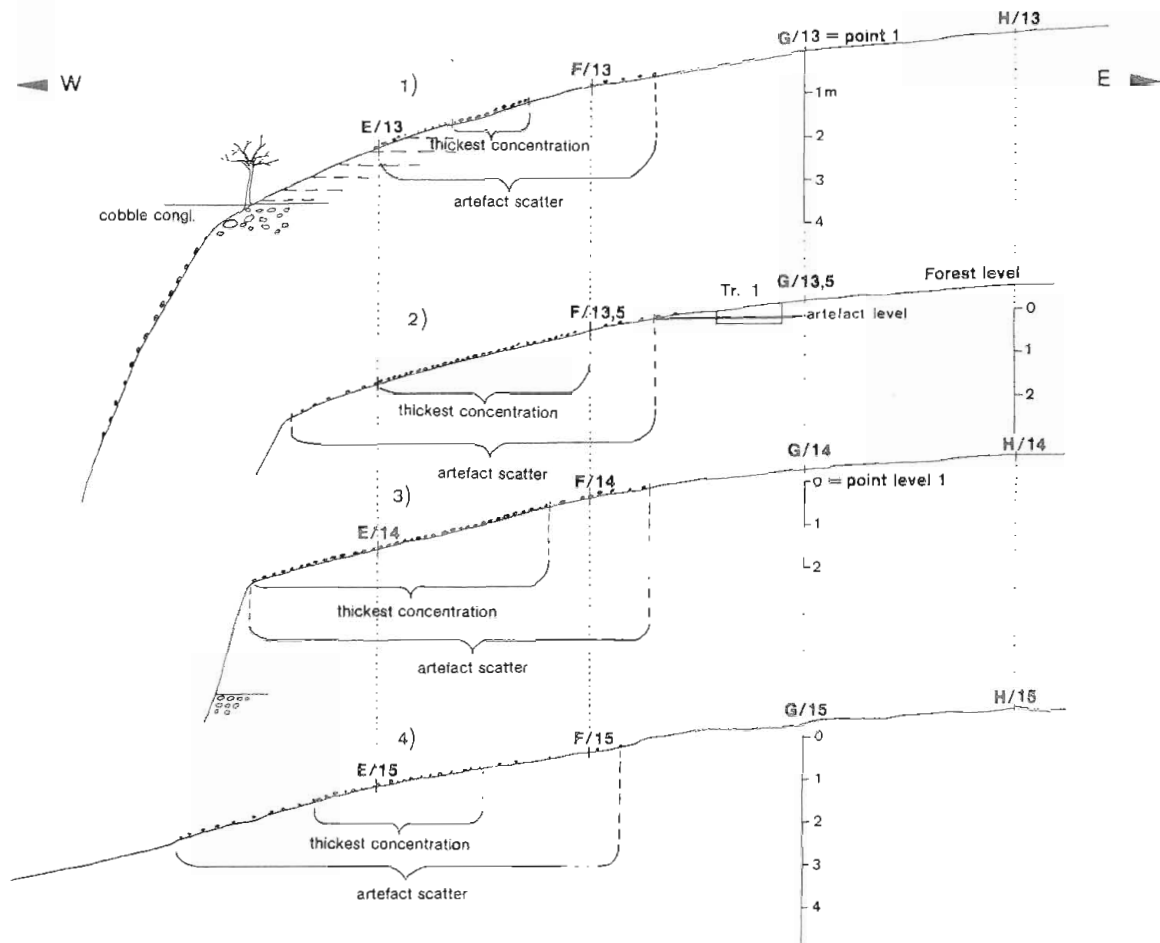


Fig. 176. East-west profile over site Pa2 along several lines, showing the artefact scatter slope downwards from the eroded artefact level (after Corvinus 1987).

The survey has shown that there are areas of differing knapping specialities: certain areas are specially rich in small flakes and chips, while others have a denser concentration of large split and further worked cobbles and cobble waste along with a lower percentage of small debris. It seems that different stages of stone-knapping and tool manufacture were carried out at different spots. Many flakes are scattered as by-products of tool-manufacture, for example, in the northern area of Pa2a, in the 5 m square c of the 10 m square C/5 (c south and centre) (Pl.236/2). In D/5-c south and D/6-a north there are, besides manufacturing flakes, especially abundant quantities of small chips. Many small flakes and chips are also scattered in C/6-d south and C/7-c north, as well as in the concentration north of T.II, in D/6-a and C/6-b. The thickest overall concentration of artefacts is in the 10 m square C/6-d, though there are, in comparison to other squares, fewer tools and manufacturing flakes but plenty of split cobbles and cobble waste.

Interesting is also the observation that at some spots one finds accumulations of perfectly rounded cobbles of oval-flat or round-flattish shape with sizes of 7-10 cm—for example, in D/5 (Pl.237/1). It is not clear for what use these perfectly rounded cobbles were collected. Most of the imported cobbles were, however, either broken up or split, the first stage being that of being split in two halves (Pl.237/1). Such cobble waste makes up the highest percentage everywhere.

Patu, site Pa 2a Area of artefact concentration

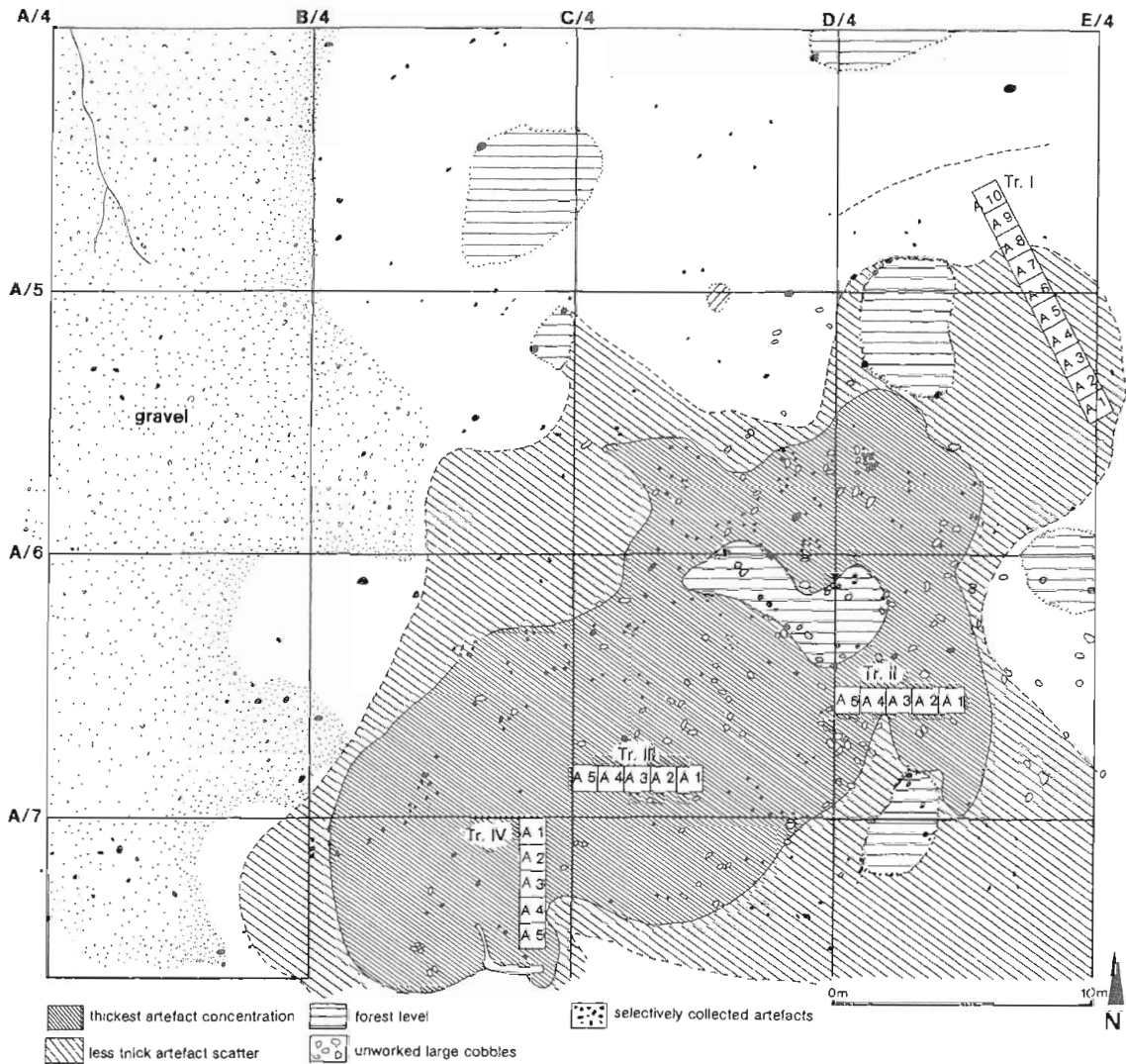


Fig. 177. Enlarged map of site Patu 2a (Pa2a). The black dots are selectively collected artefacts, the white dots are quartzite cobbles (after Corvinus 1987).

Another interesting observation is that quite a number of very big cobbles and even boulders, with average sizes of up to 30 cm and more, were brought to the site (Pl.236/1). They are all of a good quality of quartzite, particularly of a banded type which splits remarkably well into parallel planes. They seem to have been brought in as raw material for the manufacture of the heavy choppers and large corescrapers.

No flakes or waste pieces could be fitted together. But waste pieces, chips and flakes of the same original cobble lie often close to each other in the same area.

Some test cuttings were sunk into the artefact surface in order to obtain a view of the underlying sediment (Pl.237/2). The photo shows Test Pit II, from which all surface artefacts were plotted and collected. Below it nothing was found. The red silt below the surface, as seen in Test Pit IV, is 2 m thick and without any structure, below which a pebble gravel is encountered (see Fig.6 in Corvinus 1987).

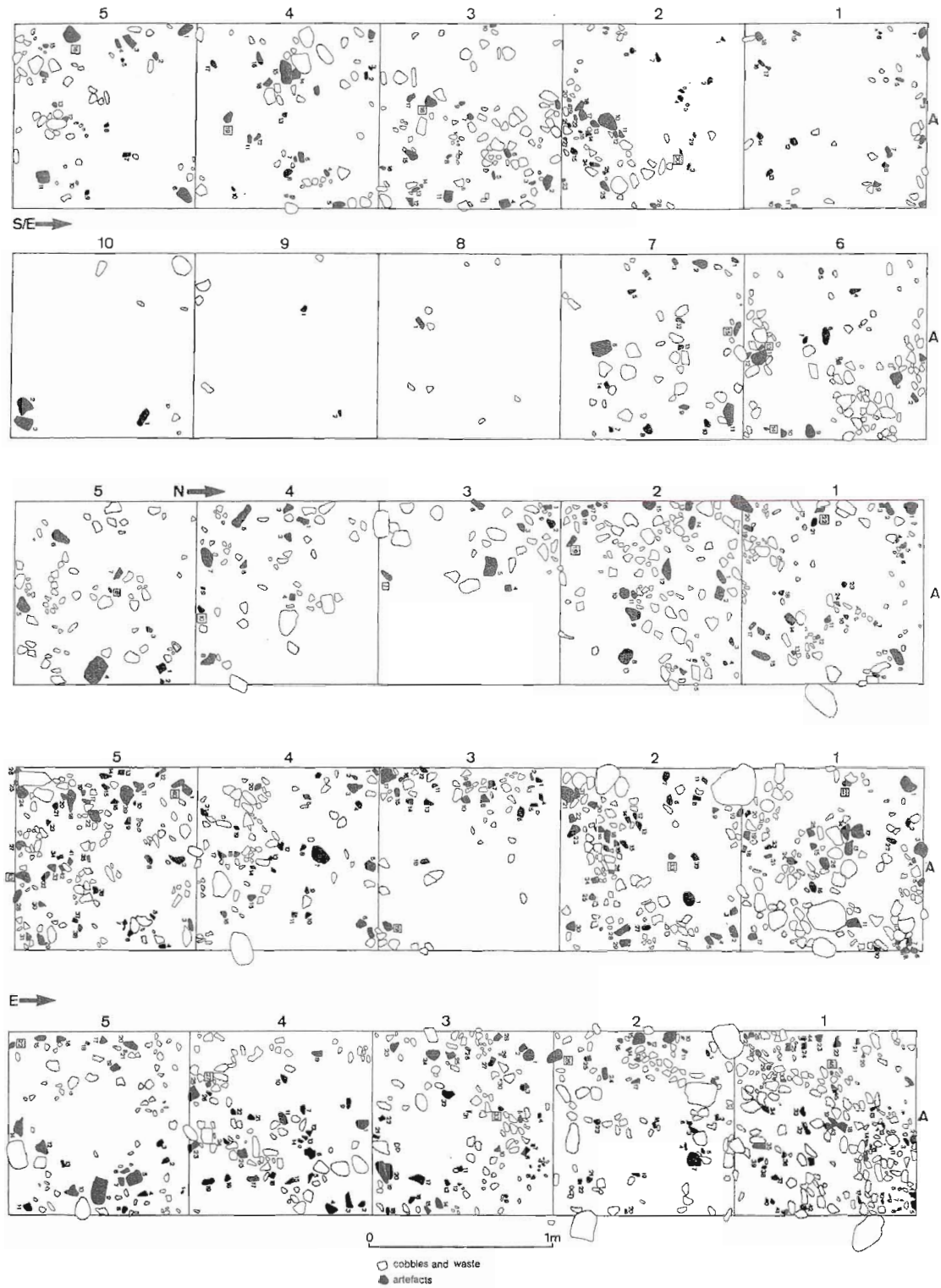


Fig. 178. Plotting of surface artefacts of Tr.I (the top two), Tr.II (3rd row), Tr.III (4th row) and Tr.IV (bottom), (after Corvinus 1987).

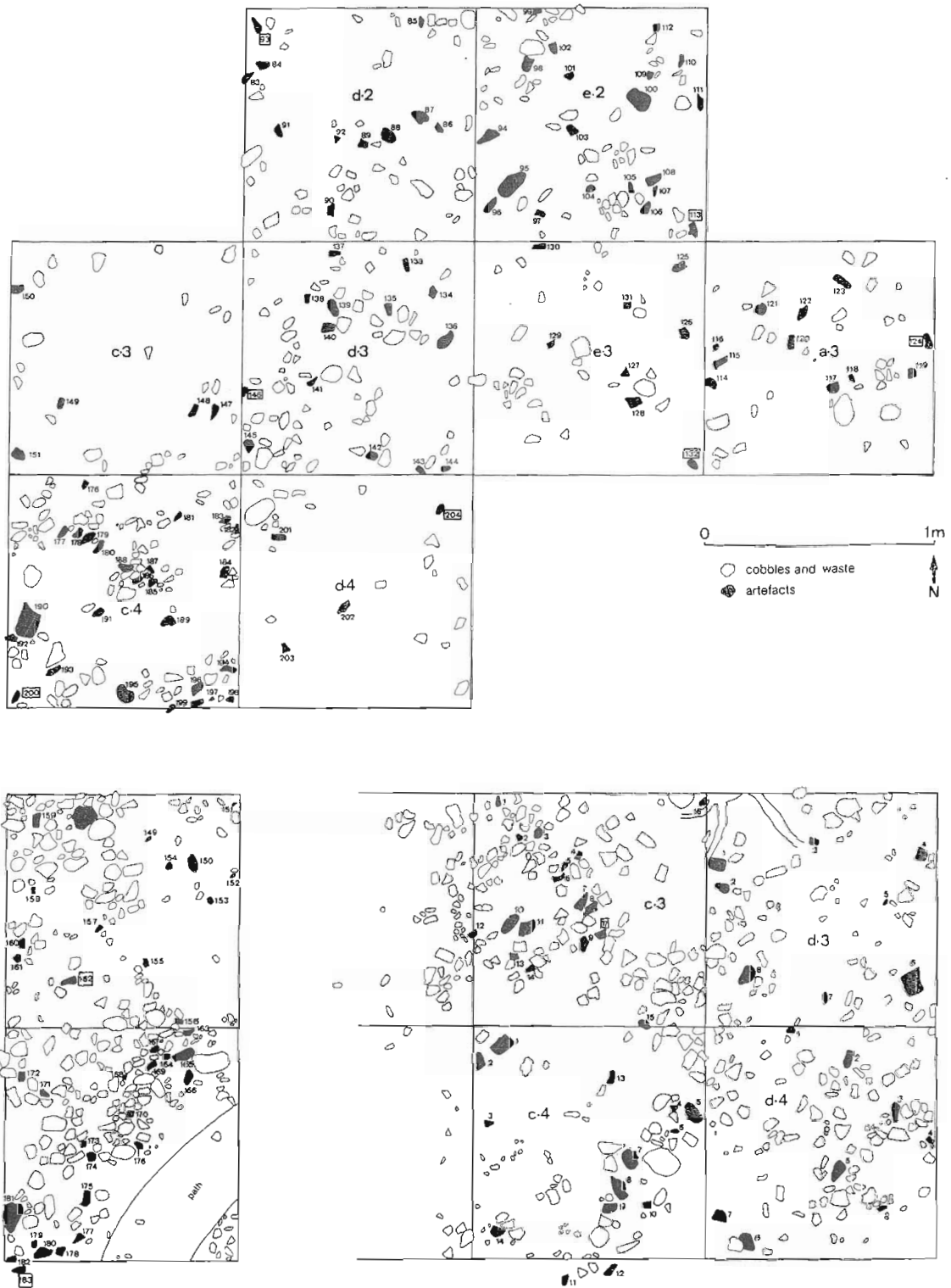


Fig. 179. Plotting of surface artefacts within squares E13d (top), E13c (bottom left) and E14a (bottom right).

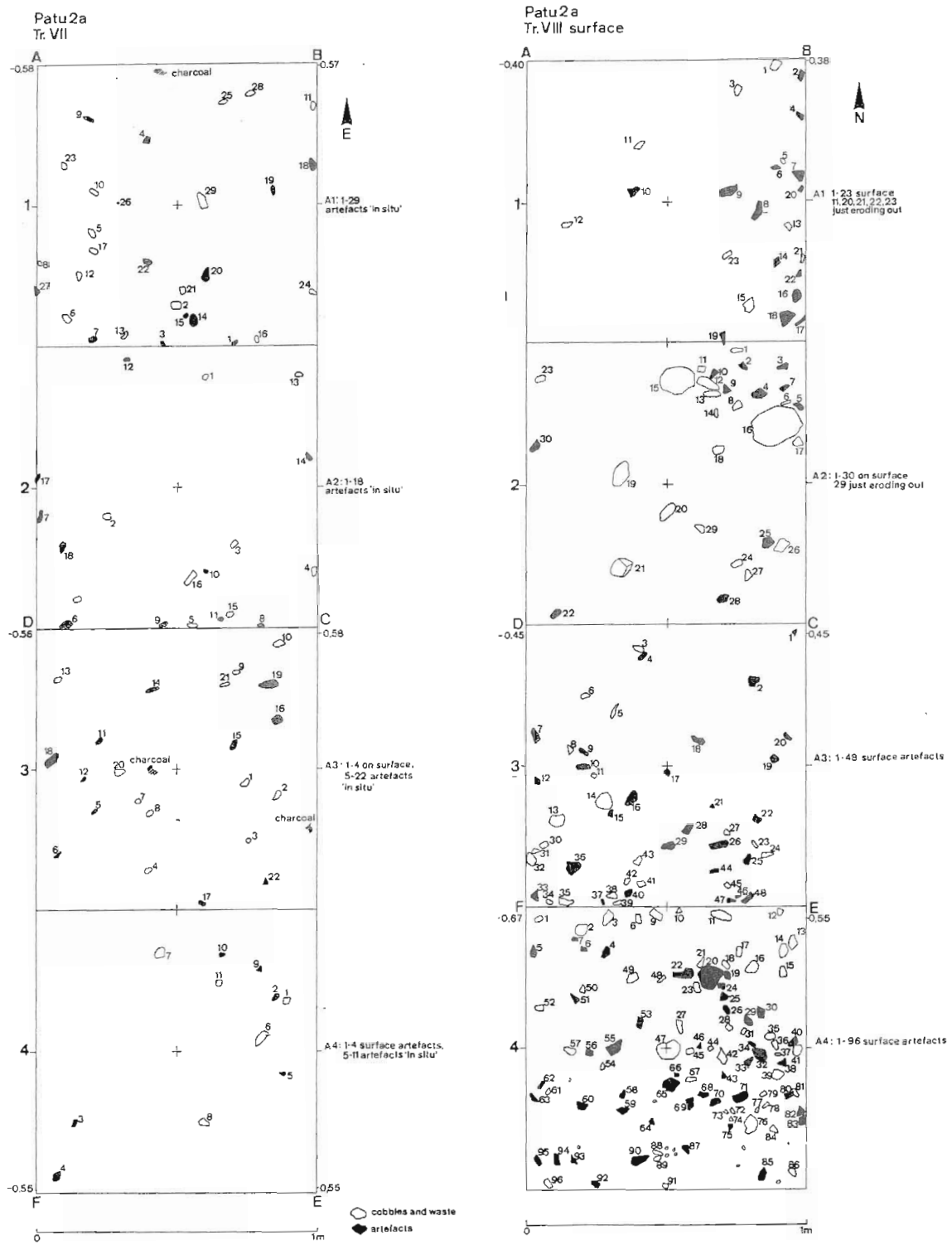


Fig. 180. Plotting of surface artefacts of rest trench VII (left) and VIII (right) at Pa2a (after Corvinus 1989).

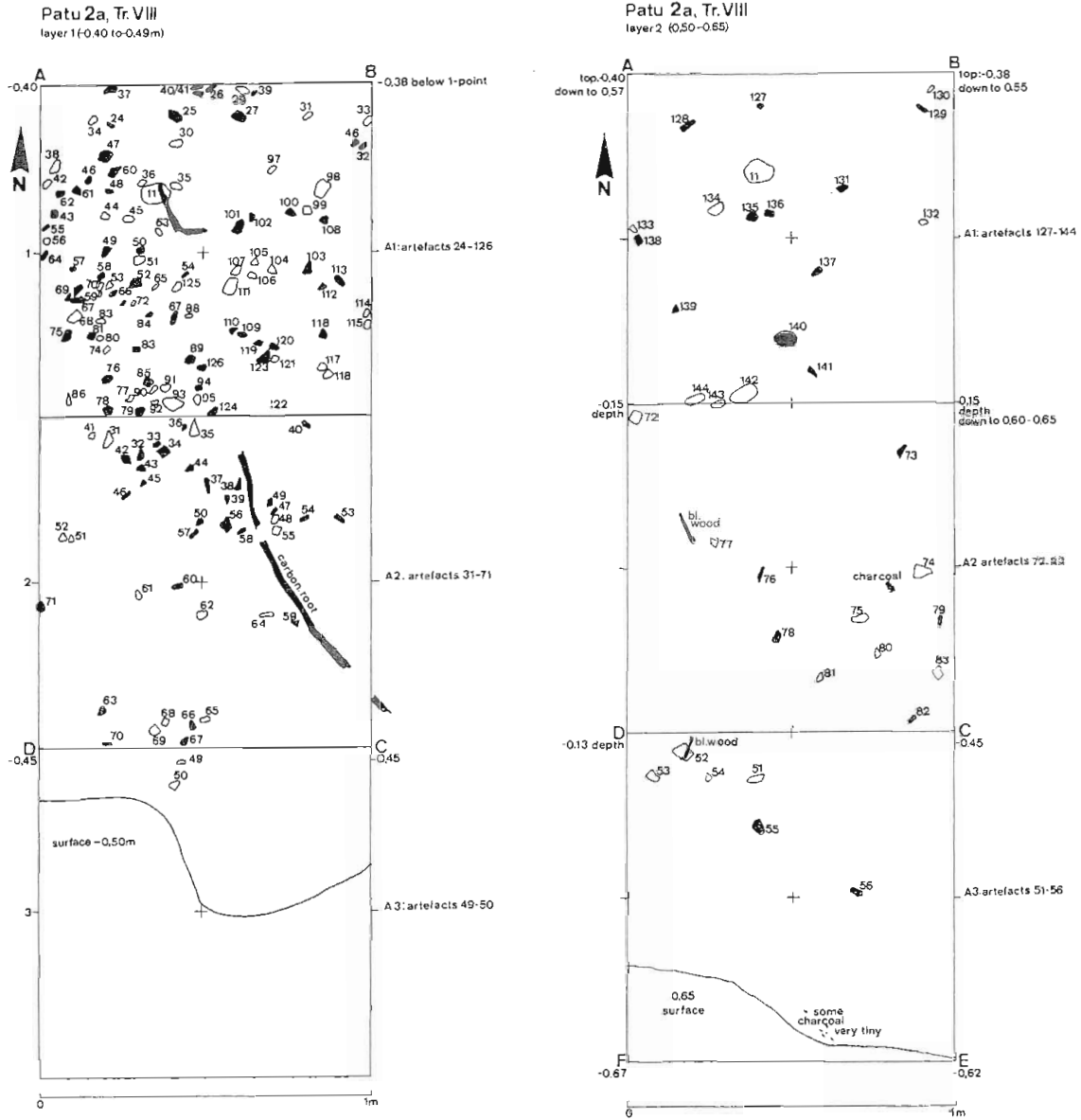


Fig. 181. Test trench VIII at Pa2a, plotting of layer 1 (left) and layer 2 (right) (after Corvinus 1989).

A few test pits (Fig.180 and 181) were put down also on the higher, original terrace level in the forest at Patu 2a, to the east of test Pit II, in order to determine the actual level of the now exposed artefact horizon. (More data on the cuttings can be found in Corvinus 1987 and 1989). It was discovered that a horizon of artefacts some 15-20 cm thick exists 0.80 to 1 m below the original, non-eroded, forested terrace surface (Fig.176). It was an occupation floor but disturbed by bioturbation.

The people of Patu lived on the 60m terrace surface, which was in the process of being rubified. Later, after the occupation, the floor has been disturbed considerably by bioturbating activities of burrowing animals and, more significantly, by termite constructions, which can reach down to a depth of 2 metres below surface.

Termite activity is high on all the red terraces around Patu. The termite mounds can reach a height of more than 2 m (Pl.237/3). There are about seven living and dead mounds with an average height of 1.50 m within a radius of 60 by 60 metres. The soil of the upper 1 to 2 m is in a state of perpetual movement over time. Mounds can be inhabited for 20 to 40 years, and can be repeatedly recolonized over the centuries (Goudie 1988). Such continuous mound formation can obliterate existing sedimentary structures in the upper part of alluvial deposits. It can also cause the relative downward movement of coarse particles such as human artefacts, thereby creating the potential for confusion if the artefacts are used for stratigraphic dating purposes (Moeyersons 1985; Crossley 1984). This is what must have happened at the Patu sites. Artefacts must have moved downwards from their original floor on the surface of the terrace by such continuous termite activity over the last few thousand years, which is the reason why no occupation horizon as such is seen anymore and why the recent forest surface is empty of artefacts.

Earthworms also play a major role in modifying the surface processes by burrowing and cast activities. In the tropics this activity can go down to 70 cm, for example in South Africa (Reinicke 1983). Such burrowing could be observed at the test cutting at Mashot in the Dang area (see above). The amount of soil turned over in the form of cast production in woodland environments in India has been measured to be 10 kg per square metre per year (Krishnamoorthy 1985). It is obvious that such burrowing, cast production and mound construction activity over a longer period causes a tremendous amount of soil translocation and disturbance of any original structure.

The assemblage of artefacts at Patu has been called the Patu industry after the village Patu nearby. The site has yielded some first ¹⁴C dates from charcoal found at the occupation level at depths of 0.50 to 0.85 m below the surface: 6,865 ± 110, 6,695 ± 155 and 7,045 ± 110 BP (Gey 1989). These are minimum ages, as it is not clear whether the charcoal was contemporaneous with the occupation floor (since there are no fire-places) or whether it was younger in age, in which case it may have been brought down by burrowing animals from a later forest fire. The occupation of the Patu people must have occurred before 7,000 BP.

The typology of the Patu industry

The Patu industry has a large number of macrolithic tool types, made almost entirely (99.2 %) of quartzite. It is predominantly a cobble industry whose tools were made from large quartzite cobbles which were available in the neighbouring riverbeds. The tool kit was made in a fashion unique for Patu. Large quartzite cobbles were mostly split for further manufacture, and therefore a particular kind of banded quartzite which split easily along joint planes, was used.

The artefact composition of all 2590 collected artefacts is shown in Table 8a,b and in Fig.182. The table reveals clearly the bias of the collection: only 6.5 % are tools and utilised artefacts versus 93.5 % of waste (flakes, cores, other waste) in the excavation (Table 8a), compared to respectively 75 % (tools and utilised artefacts) versus 25 % (waste) in the selected collection. The „all collected, plotted“ areas of Pa2a and Pa2 containing 1,572 artefacts (not counting the excavated artefacts) (Table 8b), also show a less biased percentage: 24.5 % tools and utilised pieces versus 75.5 % waste:

Tab. 8a: Patu, Artefact Composition.

Artefact Type	Patu 2a Plotted		Patu 2 Plotted		Patu Excavated		Patu Selected		Patu 1 & Patu 3		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Tools	136	15.8	69	9.7	21	4	217	54	16	18.4	459	17.7
Utilised Flakes	98	11.4	51	7.2	10	1.9	76	18.9	4	4.6	239	9.2
Utilised Pieces	13	1.5	19	2.7	3	0.6	8	2	1	1.1	44	1.7
Flakes	447	51.8	366	51.7	224	42.3	69	17.2	41	47.1	1147	44.3
Waste	147	17	198	28	267	50.5	21	5.2	21	24.1	654	25.3
Cores	23	2.7	5	0.7	4	0.8	11	2.7	4	4.6	47	1.8
Total	864	33.35	708	27.33	529	20.42	402	15.52	87	3.35	2590	99.97

Tab. 8b: Patu, Artefact Composition.

Artefact Type	Plotted					Selected				
	Pa.2a	Pa.2	Exc.	Total	%	sel	Pa1&3	Total	%	
Tools	136	69	21	226	10.8	217	16	233	47.6	
Utilised Flakes	98	51	10	159	7.6	76	4	80	16.4	
Utilised Pieces	13	19	3	35	1.7	8	1	9	1.8	
Flakes	447	366	224	1037	49.4	69	41	110	22.5	
Waste	147	198	267	612	29.0	21	21	42	8.6	
Cores	23	5	4	32	1.5	11	4	15	3.0	
Total				2101	100			489	99.9	

The percentages shown in Table 8b are for the plotted areas, from which all artefacts were collected, and for the test pits. The bias is clearly documented in the tool category of the selected group (47.6 %) versus that of the plotted and excavated area (10.8 %), the waste being much higher in the latter than in the former.

Tools contra waste of the 1,576 artefacts of the „all- collected, plotted“ areas of Patu 2a and Patu 2:

Tools and utilised:	205 = 13.0 % tools
	149 = 9.5 % utilised flakes
	32 = 2.0 % utilised pieces
	386 = 24.5 % tools and utilised

Waste flakes and other waste:	813 = 51.7 % flakes
	345 = 22.0 % other waste
	32 = 1.8 % cotes
	1,190 = 75.5 % waste

The raw material of the Patu assemblage (Table 9) is almost entirely quartzite (99.2 %, Fig.183).

The tools consist of heavy-duty choppers and cotescrapers, which are almost all unifacially fashioned, and of very well-made adzes, uniface and scrapers. Table 10 displays the tool composition of the Pa2a and Pa2 site, the test excavations, the selected group and the Pa1 and Pa3 localities. It shows that chop-

pers form the highest percentage (22.2 %), followed by corescrapers (19 %) scrapers (19 %), and adzes (18.1 %). Typical sumarraliths account for only 1.3 %; unifaces for 6.3 %.

The component represented by cobble tools stands quite high (44.7 %) against the finer-made group of adzes, knives, points, tranchers and burins (23.3 %), while the intermediate tool group of scrapers, unifaces and bifacial pieces form 26.4 %. In the first tool category in Table 10, the adzes make up the absolute majority, while in the heavy cobble tool group it is the choppers and corescrapers which do so. The well-made adzes are a very distinct group, representing tools for finer work on wood and, more importantly, bamboo, while the cobble tool group was certainly used for a much heavier type of work. The scrapers, which is a rather motley group of implements, also is fairly abundant and would have been used for a variety of functions other than heavy work and finer bamboo work.

Tab. 9: Patu, Raw Material.

	Patu 2a Plotted		Patu 2 Plotted		Patu Excavated Trenches		Patu Selected		Patu 1 & Patu 3		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Quartzite	852	98.6	707	99.9	525	99.2	400	99.5	85	97.7	2569	99.1
Quartz	11	1.3	1	0.1	1	0.2	2	0.5	2	2.3	17	6.65
Chert	-	-	-	-	1	0.2	-	-	-	-	1	0.05
Other	1	0.1	-	-	2	0.4	-	-	-	-	3	0.11
Total	864		708		529		402		87		2590	

Tab. 10: Patu, Tool Composition

Tool Type	Patu 2a Plotted	Patu 2a Plotted	Excavated	Selected	Patu 1 & 3	Total	%		
Adzes	21	9	1	47	5	83	18.1	107 (23.3%)	Fine Tool Group
Knives	3	1	-	15	-	19	4.1		
Points	1	-	-	1	-	2	0.4		
Tranchers	-	2	-	-	-	2	0.4		
Burins	1	-	-	-	-	1	0.2		
Scrapers	28	12	3	42	2	87	19	121 (26.4%)	Intermediate Tool Group
Unifaces	6	3	-	18	2	29	6.3		
Bifacial pieces	2	-	-	3	-	5	1.1		
Choppers	37	22	4	35	4	102	22.2	205 (44.7%)	Cobble Tool Group
Corescrapers	29	18	6	32	2	87	19		
Sumarraliths	4	-	-	2	-	6	1.3		
Discoids	-	1	-	6	1	8	1.7		
Spheroids	1	-	-	-	-	1	0.2		
Worked Cobbles	1	-	-	-	-	1	0.2		
Hammerstones	-	-	5	12	-	17	3.7		
Anvils	-	-	1	4	-	5	1.1		
Grinding stone	-	-	1	-	-	1	0.2		
Polished tools	2	1	-	-	-	3	0.7		
Total	136	69	21	217	16	459			

Tab. 11: Patu, Choppers (102).

	Patu 2a Surface	Patu 2 Surface	Patu 2a & 2 Excavated	Patu 1 Excavated	Patu 3 Excavated	Total	%
Initial Form							
Flake	2	-	-	-	-	2	2%
Slice	-	-	-	-	-	-	-
Split cobble	16	7	1	-	1	25	24.5%
Cobble	48	21	2	2	1	74	72.5%
Chunk	-	-	1	-	-	1	1%
Flaking							
Unifacial	5	-	1	-	-	6	5.9%
Unifacial, from cobble surface	54	27	3	2	2	88	86.3%
Bifacial, from cobble surface	6	1	-	-	-	7	6.7%
Partly bifacial from cobble	1	-	-	-	-	-	1%
Trimming							
Srep retouch	48	18	2	1	1	70	68.6%
Primary flaking	13	8	1	1	-	23	22.5%
Shallow flaking	5	2	1	-	1	9	8.8%
Type							
Pointed	2	-	-	-	-	2	2%
Round	25	9	-	-	-	34	33.3%
Side	23	8	1	-	2	34	33.3%
End	9	4	1	-	-	14	13.7%
Side & end	3	5	-	2	-	10	9.8%
Other	1	1	1	-	-	3	2.9%
Broken choper	3	1	1	-	-	5	4.9%
Edge Retouch							
All around	7	8	-	-	1	16	15.7%
75%	22	7	-	1	-	30	29.4%
60%	8	3	-	1	-	12	11.8%
50%	23	6	1	-	-	30	29.4%
30%	1	3	2	-	1	7	6.7%
20%	5	1	1	-	-	7	6.7%
Edge Use							
1 edge	38	16	3	-	2	59	15.7%
2 edge	4	1	-	-	-	5	4.9%
1 lateral edge & apex	10	5	-	2	-	17	15.7%
2 lateral edge & apex	1	1	-	-	-	2	2%
Only apex	7	3	1	-	-	11	10.8%
All around	-	1	-	-	-	1	1%
1 edge battered	5	-	-	-	-	5	4.9%
1 edge utilised & battered	1	-	-	-	-	1	1%
Apex and 1 edge battered	-	-	-	-	-	1	1%
Cortex %							
No cortex	-	-	1	-	-	1	1%
<20%	2	-	-	-	-	2	2%
20%	2	1	-	-	-	3	2.9%
30%	12	1	1	-	-	14	13.7%
50%	39	19	1	1	1	61	59.8%
75%	11	7	1	1	1	21	20.6%
Gloss	3	-	-	-	-	3	2.9%

The unifaces and the few bifacial pieces actually belong to the cobble tool group, as they were mainly made on cobbles. But the unifaces combine elements of both groups, in having rather well-trimmed, step-retouched lateral edges (one of them exhibits the typical phytolithic gloss at its edge, which is so common on the adzes).

It is interesting that there is such a large component of cobble tools in association with the adzes; or, the other way around, that there is such a high percentage of adzes in association with cobble tools. It is obvious that it was not only a manufacturing community of heavy cobble tools at Patu, but that adzes formed a basic part of the requirements of the people of Patu for a very different set of lighter types of work. This would indicate that the site was also a home base for the Patu 2a and Patu 2 occupants, not only for manufacturing the required tools, but also for using them at the site.

Tab. 12: Patu, Corescrapers (87).

	Patu 2a Surface	Patu 2 Surface	Patu 2a & 2 Excavated	Patu 1 Excavated	Patu 3 Excavated	Total	%
Initial Form							
Flake	1	-	-	-	-	1	1.1%
Slice	1	1	-	-	-	2	2.4%
Split cobble	21	10	3	-	-	34	39%
Cobble	30	14	1	1	1	47	54%
Indeterminate	1	-	-	-	-	1	1.1%
Chunk	-	-	2	-	-	2	2.4%
Flaking							
Unifacial	9	3	-	-	-	12	13.8%
Unifacial, from cobble surface	40	21	6	1	1	69	79.3%
Partly bifacial	3	1	-	-	-	4	4.6%
Partly bifacial, from cobble surface	1	-	-	-	-	1	1.1%
Trifacial	1	-	-	-	-	1	1.1%
Trimming							
Step rerouch	51	22	4	1	-	78	89.6%
Primary flaking	2	-	2	-	1	5	5.7%
Shallow flaking	1	3	-	-	-	4	4.5%
Use							
Lateral Edge:							
3 edges utilised	1	-	-	-	-	1	1.1%
1 edge utilised	33	19	4	1	1	58	66.7%
2 edges utilised	5	3	-	-	-	8	9.2%
1 edge battered	2	-	1	-	-	3	3.5%
Apex and 1 edge utilised	7	3	1	-	-	11	12.6%
Apex and 2 edges utilised	2	-	-	-	-	2	2.3%
Only Apex	1	-	-	-	-	1	1.1%
1 edge battered & 1 edge utilised	3	-	-	-	-	3	3.4%
Cortex %							
No cortex	3	-	-	-	-	3	3.5%
<20%	2	2	-	-	-	4	4.5%
20%	4	1	2	-	-	7	8%
30%	8	6	-	-	-	14	16%
50%	23	11	3	-	-	37	42.5%
75%	13	5	1	1	1	21	24%
„Orange flake“	1	-	-	-	-	1	1.1%
Gloss	2	-	-	-	-	2	2.3%

Each tool category will be described below, accompanied by a descriptive chart.

The cobble tool group: The 102 choppers (22.2 %) are of great diversity. Table 11 shows the characteristics of the choppers. There are two pointed choppers, which form a small minority, whereas the majority are round unifacial choppers (33.3 %) and unifacial side-choppers (34.3 %), while 13.7 % are end-choppers and 10 % are end-cum-side-choppers. The vast majority of choppers (92 %) are unifacially trimmed, showing larger primary flakes and smaller step flakes along the edges. Some 69 % of the total have step-flaking on their edges. The angles of the edges do not normally exceed 70 degrees. 97 % are made on cobbles, and 80.4 % retain 50 % or more of cortex. On a number of specimens one can observe strong battering marks, probably caused by heavy use (bashing, etc.) which blunted the edge considerably. In almost 16 % of the choppers the edge is around the entire periphery, in 30 % it extends $\frac{3}{4}$ the way around the periphery, and in more than 40 % the edge goes halfway around.

A characteristic and common type at Patu is a round, unifacial chopper (Pl.28 and Pl.29/1) made on a round cobble by unifacial flaking only on one side. The lower side is left entirely of cortex. The working edge runs around the entire circumference or only part of it. The Gidhiniya site in Tui, too, has a good percentage of such choppers. Particularly interesting are a number of miniature unifacial choppers of round shape (Pl.31/5).

Other unifacial chopper types are oval in shape (Pl.30/3) with the edge around the greater part of the circumference. Others are elongate (Pl.30/1) and have either one lateral edge (Pl.30/2) or two lateral edges (Pl.30/1). These elongate forms could also be classified as unifactes, when they have a perfect elongate-oval shape. End-choppers are not so common. They were made on elongate cobbles, on which one end was unifacially trimmed into an edge. The end-chopper in Pl.31/1 is a special kind, made on a flat split slice; it is entirely untrimmed except for the unifacial distal edge.

Corescrapers (87 specimens, forming 19 % of the tool kit) are also very common. These unifacial tools are in 93 % cases made on cobbles and split cobbles (Table 12) though one is made on a large flake and two on a slice. They have in 93.1 % of the cases a very steep unifacial edge along one side, with a working angle exceeding 80 degrees usually vertical, while the rest of the tool consists of cortex (66 % have cortex on more than 50 % of their surface). Fine stepretouch was executed along the steep lateral working edge. As with the choppers, heavy battering marks can often be observed on the edges. A most typical corescraper is shown in Pl.32/2. There are also a few small tools made on small cobbles or chunks and displaying steep or vertical edges (Pl.31/2-4). The majority (66.7 %) have one lateral edge, but some (9.2 %) have two lateral edges parallel to each other, while others have, besides one or two lateral edges, an additional edge at the distal end.

Sumatraliths (6 specimen), too, are present (Table 13). In 83 % of the cases they are made on split cobbles and are unifacially trimmed with steep, almost vertical edges flaked from the completely flat base of the split cobble face. All of them show stepretouch at their edges, which runs all around or three-quarters the way around the circumference. Pl.33 is a typical sumatralith, in retaining cortex on the upper face and having steep edges on all sides, while the flat, lower face consists entirely of cortex or, in our cases, of a split surface. The tool in Pl.32/1 is a special form of a sumatralith or a pushplane, which is triangular in cross-section and having three steep lateral working edges and a completely flat lower split surface, with no cortex left on the entire tool.

A number of discoidal and spheroidal tools are present, too, trimmed either all over the spheroidal surface or, more commonly, unifacially or bifacially to form a discoidal edge. Two specimens are made on flakes, one on a slice, and the rest are made on cobbles.

The intermediate group of unifactes and scrapers: Other completely unifacial forms are the 29 unifactes, (Pl.34 and 38/2) which make up 6.3 % of the tool kit (Table 14). They have neither the very steep edges of sumatraliths nor a distal adze edge. They are completely unifacially trimmed (except 3 specimens which have minimal scars on the lower face), retaining a cortical lower face or a flat, split surface, for

example in Pl.34. They are usually oval in shape and one or both of the lateral edges may be utilised together with the apex. Two unifaces are on a flake, two are on a slice, and the rest are on cobbles (51.7 %) or split cobbles (34.5 %). The edge trimming is in almost 60 % all around the circumference. Two unifaces have on part of one edge a little trimming also on the cortical lower face. Table 14 shows the characteristic features of the unifaces. Good examples are Pl.192 and the fine pointed specimen in Pl.194/1, which is not made on a cobble, but on a large side-flake with a large cortex platform. The flake face is left entirely unrimmed. A small uniface or unifacial tool (Pl.194/2) was made on a small cobble.

Tab. 13: Patu, Sumatraliths (6).

	Patu 2a Surface	Patu 2 Surface	Patu 2a & 2 Excavated	Patu 1 Excavated	Patu 3 Excavated	Total	%
Initial Form							
Flake	-	-	-	-	-	-	-
Slice	-	1	-	-	-	1	17%
Split cobble	5	-	-	-	-	5	83%
Cobble	-	-	-	-	-	-	-
Flaking							
Unifacial	4	1	-	-	-	5	83%
Unifacial, from cobble surface	-	-	-	-	-	-	-
Partly bifacial	1	-	-	-	-	1	17%
Trimming							
Step retouch	5	1	-	-	-	6	100%
Primary flaking	-	-	-	-	-	-	-
Shallow flaking	-	1	-	-	-	-	-
Edge Trimming							
All around	2	1	-	-	-	3	50%
75%	3	-	-	-	-	3	50%
50%	-	-	-	-	-	-	-
Edge Use							
1 lateral edge	-	-	-	-	-	-	-
2 lateral edges	3	-	-	-	-	4	66%
1 lateral edge & apex	1	-	-	-	-	1	17%
2 lateral edges & apex	-	1	-	-	-	1	17%
Cortex %							
No cortex	1	-	-	-	-	1	17%
<20%	2	-	-	-	-	2	33%
20%	-	1	-	-	-	1	17%
30%	1	-	-	-	-	1	17%
50%	1	-	-	-	-	1	17%

Scrapers (87, Table 15), too, are common (Pl.35 and 36), making up 19 % of all tools. They exhibit a great variety in form and edge shape. Table 15 shows the characteristic features of the scrapers. Most (41.5 %) are made on flakes (Pl.35/2 and Pl.36/2,3), on split cobbles (20.6 %), such as the tool in Pl.194/2, on slices (Pl.35/1 and Pl.36/1 and Pl.64/2), or even on chunks (Pl.35/3). Some 65.5 % are uniaxially trimmed, which is in accordance with the overall trimming procedure employed in making the cobble tools of Patu, while 33 % are bifacial. The majority (76 %) have stepretouch on the platform edge or working edge. Cortical remains of the original cobble are left on the dorsal face of most of the scrapers (65 %), only 30 % have no cortex. Some 43 % have been utilised along one lateral edge, 19.5 % at the

apex or point and 37 % both on the apex and on one lateral edge. On three specimens a distinct gloss similar to the gloss on the adzes can be observed at the working edge, as on the fine scraper in Pl.36/1. Occasionally heavy battering usemarks (in 8 % of the specimens) are visible at the working edge for example on the scraper in Pl. 36/3, which is uncommon on scrapers at Patu, but is often present on choppers and corescrapers. These must have been utilised for particularly heavy work. The large scraper of Pl.35/1 is made on a large slice, then radially flaked and retouched along a convex edge. Pl.35/2 and Pl.39/2 show two very well-made pointed scrapers, which are rare. The fine, pointed scraper in Pl.39/2 is noteworthy for its delicate finish. It was made on a split piece or slice, so that it has a completely flat ventral face, which was retouched at the proximal tip, maybe for hafting purposes. The narrow chisel-like scraper on Pl.35/3 was made on a split chunk.

Tab. 14: Patu, Unifaces (29).

	Patu 2a Surface	Patu 2 Surface	Patu 2a & 2 Excavated	Patu 1 Excavated	Patu 3 Excavated	Total	%
Initial Form							
Flake	1	1	-	-	-	2	6.9%
Slice	2	-	-	-	-	2	6.9%
Split cobble	8	2	-	-	-	10	34.5%
Cobble	7	6	-	2	-	15	51.7%
Indeterminate	-	-	-	-	-	-	-%
Flaking							
Unifacial	3	1	-	-	-	4	13.8%
Unifacial, from cobble surface	12	8	-	-	2	22	76%
Partly bifacial	2	-	-	-	-	2	4.9%
Partly bifacial, from cobble surface	1	-	-	-	-	1	3.5%
Trimming							
Step retouch	11	8	-	-	2	21	72%
Primary flaking	3	-	-	-	-	3	10.3%
Shallow flaking	4	1	-	-	-	5	17.2%
Edge Trimming							
All around	10	5	-	-	2	17	58.6%
75%	6	4	-	-	-	10	34.5%
50%	2	-	-	-	-	2	6.9%
Edge Use							
1 lateral edge	2	-	-	-	-	2	6.9%
2 lateral edges	4	2	-	-	-	6	20.7%
1 lateral edge & apex	4	2	-	-	2	8	27.6%
2 lateral edges & apex	5	5	-	-	-	10	34.5%
Only apex	1	-	-	-	-	1	3.5%
All around	-	-	-	-	-	-	-
Apex and 1 edge battered	2	-	-	-	-	2	6.9%
Cortex %							
No cortex	2	-	-	-	-	2	6.9%
<20%	1	1	-	-	-	2	6.9%
20%	-	-	-	-	-	-	-
30%	1	-	-	-	-	1	3.5%
50%	12	8	-	-	2	22	75.9%
75%	1	-	-	-	-	1	3.5%
Cortical platform	1	-	-	-	-	1	3.5%
Gloss							
	-	-	-	-	-	2	3.5%

Tab. 15: Patu, Scrapers (87).

	Patu 2a Surface	Patu 2 Surface	Patu 2a & 2 Excavated	Patu 1 Excavated	Patu 3 Excavated	Total	%
Initial Form							
Flake	28	6	-	-	2	36	41.5%
Slice	11	7	-	-	-	18	20.6%
Split cobble	14	4	-	-	-	18	20.6%
Cobble	5	1	1	-	-	7	8%
Indeterminate	1	1	-	-	-	2	2.5%
Chunk	2	2	2	-	-	6	7%
Flaking							
Unifacial	27	11	-	-	2	40	46%
Unifacial, from cobble surface	12	2	3	-	-	17	19.5%
Bifacial	22	7	-	-	-	29	33.3%
No trimming	-	1	-	-	-	1	1.1%
Trimming							
Step retouch	49	12	3	-	2	66	76%
Primary flaking	1	2	-	-	-	3	3.4%
Shallow flaking	11	6	-	-	-	17	19.5%
No step retouch	-	1	-	-	-	1	1.1%
Use							
Apex:							
Utilised	10	5	-	-	-	16	18.4%
Battered	1	-	-	-	-	1	1.1%
Lateral Edge:							
Utilised	27	8	-	-	-	35	40.2%
Utilised & battered	1	-	1	-	-	2	2.4%
Battered	1	-	-	-	-	1	1.1%
Apex and lateral edge:							
Utilised	16	8	2	-	1	27	31%
Utilised & battered	5	-	-	-	-	5	6.2%
Cortex %							
No cortex	21	5	-	-	-	26	30%
<20%	19	6	-	-	2	27	31%
20%	4	2	1	-	-	7	8%
30%	4	4	-	-	-	8	9.2%
50%	10	3	2	-	-	15	17.2%
Cortical platform	3	1	-	-	-	4	4.6%
Gloss	3	-	-	-	-	3	3.4%

There are also bifacially worked pieces (1.1%), undiagnostic tools, made on cobbles. Two or three may have been broken adzes, as the distal end has broken off. The others may have been used as corescrapers or cutting tools.

The adzes and the knife tool group of Patu: This group is represented by well-made implements seemingly manufactured for the finer processes of cutting and scraping and for work on plants and bamboo, as indicated by the presence of fine step-retouched distal and lateral edges and by the gloss we find on so many of the adzes.

The most interesting tool types are those belonging to the adzes and adze-like implements at Patu, which account for 18.1% of the tool kit (Pl.38-59). Adzes are identified here as those tools which have a distinct distal working edge, an asymmetrical section, are trimmed unifacially or bifacially and are intensely utilised, exhibiting usemarks of chipping and/or of a deep gloss.

Table 16 shows the characteristic features of the adzes (83). The majority (72 %) were made on large flakes and 12 % on cobbles or split cobbles. Only 29 % are unifacially trimmed, while most of them have been shaped by bifacial trimming. Some 46 % display no cortex on their surface at all. Besides the distal adze edge, the majority of adzes also have one or two additional lateral edges: in almost 46 % of the cases there is one lateral edge, and in 19 % there are two lateral edges, as well as a number of battered edges. Not more than 14.4 % of the adzes seem to have been utilised only on the distal edge. Important to note, too, is the high percentage of gloss (45.8 %) on the adzes. In the following pages this important and unique tool group will be documented in detail.

Tab. 16: Patu, Adzes (83).

	Patu 2a Surface	Patu 2 Surface	Patu 2a & 2 Excavated	Patu 1 Excavated	Patu 3 Excavated	Total	%
Initial Form							
Flake	38	19	-	-	3	60	72%
Slice	5	1	-	-	-	6	7.5%
Split cobble	5	-	1	-	1	7	8.5%
Cobble	-	3	-	-	-	3	3.5%
Indeterminate	4	2	-	1	-	7	8.5%
Flaking							
Unifacial	17	6	1	-	-	24	29%
Bifacial	35	19	-	1	4	59	71%
Trimming							
Step retouch	42	19	1	1	4	67	80%
Primary flaking	4	3	-	-	-	7	8.4%
Shallow flaking	5	3	-	-	-	8	9.6%
No step retouch	1	-	-	-	-	1	1.2%
Adze Edge							
Unifacial	19	9	1	-	2	31	37.3%
Bifacial	15	6	-	1	2	24	29%
Flake face	13	6	-	-	-	19	22.9%
No trimming	5	3	-	-	-	8	9.6%
Indeterminate	-	1	-	-	-	1	1.2%
Lateral Use							
1 edge utilised	18	16	1	-	3	38	45.8%
2 edges utilised	12	3	-	1	-	16	19.2%
1 edge utilised & battered	4	1	-	-	-	5	6%
1 edge battered	5	-	-	-	-	5	6%
1 edge battered & 1 edge utilised	2	-	-	-	-	2	2.4%
Indeterminate	2	2	-	-	-	5	6%
Not utilised	9	3	-	-	1	12	14.4%
Cortex %							
No cortex	23	11	1	-	3	38	45.8%
<20%	19	9	-	1	-	29	34.9%
20%	5	-	-	-	1	6	7.2%
30%	-	2	-	-	-	2	2.4%
50%	-	-	-	-	-	-	-
75%	-	-	-	-	-	-	-
Cortical platform	3	2	-	-	-	5	6
„Orange flake“	2	1	-	-	-	3	3.6%
Gloss	27	10	-	-	1	38	45.8%

The Patu adzes have a wide range of forms. They were mostly made on flakes, as in Pl.38/2, Pl.49/1 or Pl.50/1-2, but also on thin slices (7.5 %) (Pl.38/1, Pl.40/2 and 49/2), or on split cobble segments (8.5 %), (Pl.41/1 and Pl.42/1). Very few were made on cobbles (Pl.41/2). The majority (71 %) of adzes are trimmed bifacially, either entirely (Pl.39/1, Pl.40/1, Pl.44/1-2, Pl.45, Pl.46, Pl.47/1-2) or partly (Pl.38/1, Pl.48/1, Pl.49/1,2), though some are completely unifacial (29 %) (Pl.38/2, Pl.40/2). Step-retouch and step-flaking on the edges is very common (80.7 %).

The most conspicuous feature of adzes is that they possess a distinct distal edge, which was the main functional edge, and which has an enormous range of shapes. This edge can be straight (Pl.40/1, Pl.41/2, Pl.48/1-2, Pl.50/2, Pl.51), or straight but oblique to the longitudinal axis (Pl.40/2), Pl.52/1, Pl.53/2, Pl.54/1), or convex-round (Pl.42/1, Pl.43, Pl.45, Pl.46, Pl.55/2) or a divergent cleaver-like straight edge (Pl.40/1 and Pl.193), or angled (Pl.41, Pl.49/1, Pl.50/1).

The distal edge is in most cases unifacial (37 %), (Pl.40/2, Pl.44/1, Pl.48/1-2, Pl.49/1-2 and Pl.50/1), but can also be bifacial (29 %), (Pl.39/1, Pl.41/2, Pl.43/1, Pl.46). Usemarks are common on the distal edge, and the retouch stems not only from shaping the edge, but also from use (Pl.54/2, Pl.55/1). The butt is usually trimmed too, probably for hafting, but sometimes it retains cortex (Pl.39/1, Pl.40/1, Pl.48/1).

Most adzes (46 %) have no cortex left from the original cobble, only a few retain cortex on one surface (Pl.40/1, Pl.41/2).

The adzes have often, in 65 % of the cases, an additional lateral edge trimmed by fine step-flakes (Pl.39/1, Pl.46, Pl.47/1-2). A number of them have some step-flaking on the usually untrimmed ventral face of the butt (Pl.41/1, Pl.42/2), maybe to offer a better grip for hafting.

There is also a great variation in shape: triangular forms (Pl.44/1) with pointed butts, which were probably hafted (Pl.53/2, Pl.56/1), alternate with rectangular forms with square butts (Pl.47/2, Pl.53/1, Pl.55/2) or with elongate-oval shapes and a rounded butt (Pl.38/1, Pl.39/1) which often have an additional lateral convex edge, or adzes with round, convergent, steeply retouched butts (Pl.40/1, Pl.41/1). Some have a trapezoidal shape (Pl.40/2, Pl.193).

Others have curiously oblique butts, for example the adze in Pl.45, which was made on a slice, or the specimen in Pl.46, made on a flake. Still others again are split along their longitudinal axis either by accident or intentionally, and they have either a chisel-like edge at the distal end (Pl.57) or a utilised trimmed lateral edge (Pl.58/1-2, Pl.59/1). These last two tools were made on a slice whose face was completely unretouched. The Nr. 1 in Pl.59 has gloss at the distal edge.

One interesting tool illustrated in Pl.42/1 is a unifacial implement with a completely flat, untrimmed lower face, while the upper face was carefully trimmed over the entire surface. The butt is convergent, probably for hafting, and the distal edge, broad and asymmetrically round, merges into both lateral edges, one convex and the other concavo-convex. Both edges are steeply retouched, like sumatralith edges.

There are a few extremely well-made oval tools which fall outside the range of adzes, as they have no pronounced transversal edge at the distal end. They are oval or elongate-oval in shape, having a unifacial or bifacial edge around the entire circumference. They are made on thin slices of quartzite with little work on the lower flat surface (Pl.38/1) or else are trimmed bifacially all around the edge, leaving the flat surface of the slice in the centre (Pl.60). This ovate tool, the only of its kind, has an intensively utilised and battered left edge, while the right edge was blunred by many step flakes. The distal and proximal ends, too, have been utilised.

Also interesting are a few miniature adzes (Pl.61/1-3) which may have been used as small chisels. They were made on thin slices (Pl.61/1,3) or flakes.

A very characteristic feature of many of the adzes is the presence of a highly distinct gloss at their distal working edges, indicated by the interrupted line in the drawings (Pls.43,45,46,47/1-2,53/1-2,55/2,56/1). As much as 46 % of all adzes (38 out of 83 adzes) have gloss in a more or less pronounced way. This gloss

stems from long, continuous usage, probably as a result of work on bamboo. It extends sometimes over quite a large portion of the distal end of the tool on both faces. We ourselves experimented in obtaining such a gloss from bamboo work, but even after three hours we did not succeed in any sign of gloss, and it may be presumed, that the gloss results after long weeks of bamboo work.

Considering the heavy gloss on so many of the adzes it seems probable that the people of Patu were living in a jungle habitat with plenty of bamboo available, of which they made abundant use. Bamboo is still very common in the forested Siwalik Hills today, and it is known that some tribal groups of hunting people (Bista 1980, p.194) have lived up to recent times in the jungles, using bamboo for their daily needs, not only for huts and fences but also for mats, baskets and household utensils.

Interesting is also the fact that short axes (Pl.29/2), like the „hache courte“ of the Hoabinhian are present, but they are very rare at Patu.

Tab. 17: Patu, knives (19).

	Patu 2a Surface	Patu 2 Surface	Patu 2a & 2 Excavated	Patu 1 Excavated	Patu 3 Excavated	Total	%
Initial Form							
Flake	12	3	-	-	-	15	79%
Slice	3	-	-	-	-	3	15.8%
Split cobble	1	-	-	-	-	1	5.3%
Flaking							
Unifacial	9	2	-	-	-	11	58%
Unifacial from cobble surface	-	1	-	-	-	1	5.3%
Bifacial	6	1	-	-	-	7	36.8%
Trimming							
Step retouch	8	2	-	-	-	10	52.6%
Primary flaking	3	1	-	-	-	4	21.1%
Shallow flaking	4	-	-	-	-	4	21%
No step retouch	1	-	-	-	-	1	5.3%
Lateral Edge Trimming							
Unretouched	2	-	-	-	-	2	10.5%
Unifacial from flake face	2	1	-	-	-	3	15.8%
Unifacial from cortex face	1	1	-	-	-	2	10.5%
Unifacial from slice face	2	1	-	-	-	3	15.8%
Unifacial from flake face, cortex opposite	6	-	-	-	-	6	31.6%
Unifacial from cortex face, cortex opp.	-	1	-	-	-	1	5.3%
Bifacial	2	-	-	-	-	2	10.5%
Cortex %							
No cortex	4	1	-	-	-	5	26.3%
<20%	5	-	-	-	-	5	26.3%
20%	2	1	-	-	-	2	10.5%
30%	1	-	-	-	-	1	5.3%
50%	-	1	-	-	-	1	5.3%
Cortical platform	1	-	-	-	-	1	5.3
„Orange flake“	3	1	-	-	-	4	21.1%
Gloss	3	-	-	-	-	3	15.8%

The 19 knives at Patu (4.1 % of the tool kit) are large tools with a cutting edge on the left side whereas the right side is blunt, either naturally or by trimming. Table 17 shows the characteristics of this group. The majority of knives at Patu (79 %) are made on flakes which were usually trimmed unifacially (63.3 %). The lateral knife edge is mainly unifacially trimmed (79 %), but 10.5 % are bifacially trimmed,

while 10.5 % display an untrimmed edge. Three of the knives have gloss, two on their lateral edge and one on its distal edge. The latter is actually an adze with a gloss-covered distal edge, but it has an additional sharp lateral knife edge as well. The tool in Pl.37/2 is interesting: it was manufactured from an 11cm-long cobble, and one can see on both the distal and proximal end the cortex of the cobble. The left side is a sharp, slightly convex, well-trimmed edge, while the right side is blunted. The knife-like tool (Pl.37/1) is a very delicate implement. It was made from a very thin slice of white quartzite and trimmed only on the upper face, the lower face being entirely untrimmed. The left sharp edge is serrated; the right side is steeply blunted.

One tool must be mentioned as an isolated find. It is a small, very corroded axe (Pl.56/2) with a round, broad distal edge which seems to have been polished or ground before corrosion. Weathering has left nothing of the original polish. It is not made of the local quartzite but of an unknown material. It is so weathered, in fact, that the material cannot be identified. It may have been brought in as a foreign tool.

Three other tools fall outside the normal range. They are grinders or polishers which were used either for grinding or pounding (Pl.192/2), with both surfaces ground to a smooth surface, or as polishers, which are oval or cylindrical pieces smoothed along the cylindrical length of the tool, and especially at the blunt end, which has striation marks, as the tool in Pl.195/2, with a smooth, round polished end. These tools are not ground-edged tools or polished axes.

Only a very low percentage of small, light-duty tools are present at the site. Of the flakes, few show retouch and/or use as scrapers. One thin flake-like artefact has a tranchet at the distal edge with slight usemarks at the tranchet edge and at the side (Pl.62/4). A number of other flakes (9.2 %) show utilisation marks either at their sides (Pl.62/1, Pl.64/1 and Pl.195/4 and 196/4), at their straight distal edge (Pl.194/3), at their pointed end (Pl.63/2-3 and Pl.195/3-5), along a convex edge (Pl.196/2 and Pl.64/2) or along a straight distal edge opposite the platform (Pl.197/5). There are also a number of snapped flakes (1.9 %), all of which seem to have been intentionally snapped and then utilised (Pl.197/4). Split flakes, i.e. flakes split along their long axis, such as the flake in Pl.63/1, are quite numerous (17 %). Most of them, however, were accidentally split during knapping due to the texture of the quartzite with its cleavage planes. But they often have been utilised. In the case of the snapped flake (Pl.196/4), the snapped nature is accidental, caused by a cleavage plane in the rock which runs perpendicular to the plane of the flake.

The flakes: The description of the tool kit of Patu has revealed that the majority of the implements are large cobble tools and that there are only a few small, light-duty flake tools. On the other hand, there is a large percentage of flakes which have not been utilised. There are not many well-shaped or „intentional“ flakes and very few cores (only 1.8 %). Pl.195/3-5 and Pl.196/2-3,5-6 show a few of the better-shaped flakes. It seems that the production of light-duty flake tools played a minor role in the tool kit. Waste flakes form the majority of the assemblage (44 % of the whole collection and 49.4 % of the plotted collection). The flakes seem to be manufacturing debris, by-products of the production of the large tools.

In order to verify this assumption the flakes were subjected to an analysis of their quantitative and qualitative characteristics, as shown in the diagrams of Fig.184 to 191. In this analysis, only the „all collected“ artefacts of the plotted areas of Pa2a and Pa2 and those from the test cuttings were considered, a total of 2,101 artefacts, including 1,196 flakes.

The results of the qualitative analysis of the 1,196 flakes are shown in the bar diagrams (Fig.184 to 187). The overwhelmingly dominant type of striking platform of the Patu flakes is the cortex platform (80 %) (Fig.184, Pl.196/1,4-7 and Pl.197/1,3-5), while plain platforms are only present in 12 % of the cases (Pl.196/2, Pl.197/2), and the presence of faceted platforms is negligible. Dorsal cortex (Fig.185) is absent on more than 70 % of the flakes; „orange“ flakes, (e.g. Pl.197/1), having a slice of cortex along either the left or right side, make up 7-8 % of the cases. These flakes seem to have been detached during the beginning stages of the manufacture of choppers and corescrapers. A substantial percentage of flakes were detached from rather flat cobbles, as they show cortex at the proximal end of the platform and at the dis-

tal end, opposite the platform as well (Pl.197/2 and Pl.62/2). 2-4 % of the flakes have such cortex opposite the platform. More than 50 % of the flakes show a characteristic stepretouch on the dorsal face at the platform edge (Fig.186), which is a typical feature of the Patu flakes (Pl.196/4,6, Pl.197/3-5, Pl.62/2,5 and Pl.64/3).

Fig.187 registers the flaking direction of scars on the dorsal face. Unidirectional flaking by far represents the majority (50 % in the plotted areas, 65 % in the excavated area), showing that at least half of the flakes have previous scars in the same direction as the flake itself, mostly struck from cortex platforms, which is in accordance with the high percentage of cortex platforms in Fig.184.

The quantitative analysis is reflected in line diagrams presenting the length of flakes, their B/L and Th/B ratios and their platform angles. The diagram of lengths (Fig.188) shows a majority of medium-sized flakes (between 30 and 69 mm) in the „all plotted“ category, with 73 to 80 % peaking at 40 mm, while the flakes smaller than 30 mm account only for 9 to 11%, and the flakes larger than 70 mm between 9 and 15 %. It is interesting that, on the other hand, the test cuttings show a much higher percentage of flakes of the small size range, below 30 mm (42 %), with a peak in the 20 to 29 mm range. Though everything was collected in the plotted areas of Pa2a and Pa2, their surfaces had been disturbed so that the smallest size of flakes was most probably washed away.

The B/L ratios of the flakes (Fig.190) imply an absence of blades and elongated flakes (less than 0.4) and rare narrow forms (below 0.5). The majority of flakes have ratios between 0.6 and 0.8, their width being around two-thirds of the length. The Th/B ratios (Fig.189) indicate that 58 % are thinner than 0.4—with a peak at 0.3 to 0.4. The platform angles of the Patu flakes (Fig.191) average out to between 105° and 115°; 50 % have angles smaller than 110°. In the excavated sample, the trend is again towards a smaller range: 20 % have narrow angles of 90°.

The high percentage of flakes with a cortical striking platform, the high percentages of stepretouch at the platform edge and unidirectional dorsal flaking scars, and such features as cortex opposite the platform and along the side of flakes („orange“ flakes) indicate in my opinion that the majority of the Patu flakes are the product of the manufacture of the large cobble tools, as well as of the process of resharpening the edges and reshaping the tools. The small, thin flakes, which must have been the manufacturing debris of the finer tools, the adzes, are rare. This is not astonishing on a surface site, as such flakes must have been washed away by erosion over the period of exposure. They are present in the test cuttings where the percentage of small flakes of less than 30 mm is considerably higher (42.7 %) compared to the plotted surface flakes (9- 11 %). The site must have been a factory site, mainly for the production of cobble tools and adzes, while the production of small light-duty flake tools seems to have been less important. The rarity of cores is significant in this regard, too. There are no discoidal or any other prepared cotes except for a few simple single-platform or double-platform cores (Pl.195/1).

Though cores are very few in number, hammerstones and anvils are quite abundant. Hammerstones are on hard quartzite cobbles of round to oval shape which show heavy battering marks as well as negatives of chips at their ends. A number of smaller hammerstones are perfectly rounded and bear slight hammering marks, probably from finer retouching work. It is also interesting to note the remarkable abundance of perfectly flat round-to-oval stones. At one place in square D/5-c there is a „collection“ of such stones (Pl.237/1). A number of anvils possess a variety of indentured marks in the form of point-like and lined notches and tills (Pl.238/1). Apart from the tools and flakes, the floor is littered with all sorts of manufacturing debris, including split cobbles, chunks, chips, fractured cobbles and slices (Pl.63/5).

Apart from the analysis of the artefacts from the site, an analysis of the non-collected waste from the plotted areas was carried out (Table 18). A count of 2,861 pieces of total waste was made over 31 m². This was done in order to show the great variety of waste among the fractured, split and smashed stones of the manuports brought up to the site, indicating intense activity at the site. After analysis in the field, these pieces were left on the surface.

Tab. 18: Patu, uncollected waste from surface of trench I to IV (in numbers).

	Unfractured cobbles		Split cobbles			Slices			Cobble chunks with cortex		Cobble chunks without cortex		Chips	Flake Fr. with cortex	Flake Fr. without cortex	Sum
	Round	Flat	Cobble halves	Cobble quarters	Cobble corner	Full slice	Slice fragment	"Orange" slice	Unworked	Undefinable working	Unworked	Undefinable working				
Trench I	7	12	28	43	38	1	7	6	153	3	62	1	69	45	11	486
Trench II	2	6	15	13	10	-	11	5	147	4	89	2	148	72	8	532
Trench III	1	7	15	21	11	1	14	3	28	8	164	4	170	23	4	727
Trench IV	6	2	10	12	8	-	7	5	129	2	75	5	51	18	5	335
E13c	5	1	10	12	8	-	5	-	156	1	113	3	79	26	6	425
E14a	2	2	15	24	10	-	8	3	175	2	56	1	40	15	3	356
Total	23	30	93	125	85	2	52	22	1041	20	559	16	557	199	37	2861
%	0.8	1.0	3.3	4.4	3.0	0.07	1.8	0.8	36.5	0.7	19.5	0.6	19.5	7.0	1.3	

Flat unfractured cobbles are more numerous than thick ones being more useful for the particular tool-making at Patu. Amongst the split cobbles the cobble halves (singly split) and cobble quarters are very numerous. They could be used for further work. It has been seen in the analysis of the artefacts that cobble slices (1.9 %), (Pl.63/5) were used considerably for making tools, particularly adzes. Only two fully unworked slices were found in the plotted non-collected waste, which could be used for further work, while a number of broken slice fragments are present. Undiagnostic chunks of cobbles with some cortex are the most numerous waste (almost 37 %, 1,041 pieces) next to the undiagnostic chunks without cortex (almost 20 %, 559 pieces). Small undiagnostic chips (557 pieces) represent 19.5 %. The waste from these 31 square metres indicates clearly that manuports in the form of round river cobbles were brought to the site, where they were used intensely, being split and fractured, their debris being left on the surface of the site.

All these combined features indicate a work-cum-camp site at Patu.

The stone-knapping technique at Patu was not only studied by analysing the Patu artefact assemblage but also by own experiments with the available raw material in the field. It was evident from the waste at the site, and from the artefacts as well, that splitting large quartzite cobbles along their natural cleavage planes was a common and well-known practice of the Patu people before manufacturing their tool kit. Our own experiments in splitting large cobbles gave us some idea of how it was done. Heating cobbles in fire and then splitting them did not prove successful: the splitting was uneven and the stone became brittle. Trying to split large cobbles with a hard hammer, too, proved unsatisfactory. The only way to produce the same flat split faces as the ones at the site was by throwing large quartzite cobbles against very large boulders on the ground, a rather haphazard but successful operation (Pl.238/2). The split cobble parts (seen on the ground in the photo, also in Pl.240/1) then could be further worked

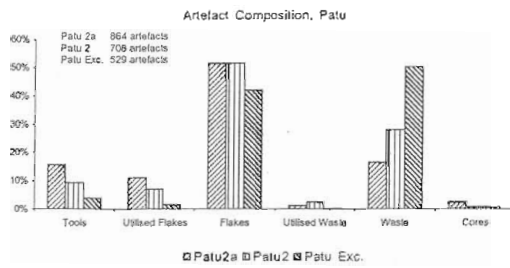


Fig. 182. Artefact composition of Pa2a and Pa2, with Table 5.

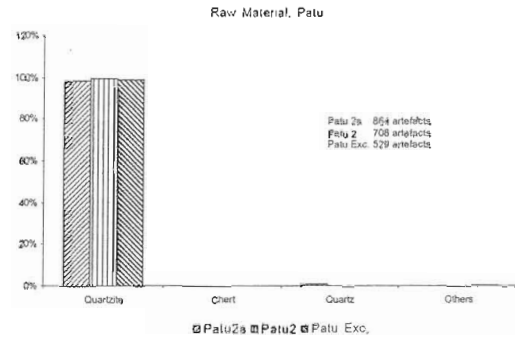


Fig. 183. Raw material of Patu assemblage, with Table 9.

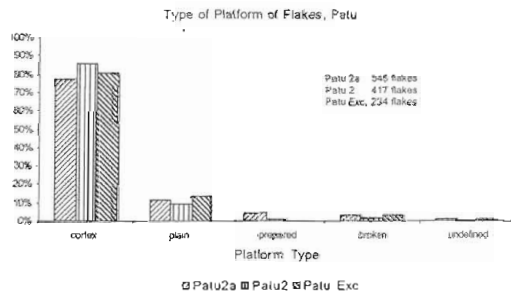


Fig. 184. Type of platform of Patu flakes.

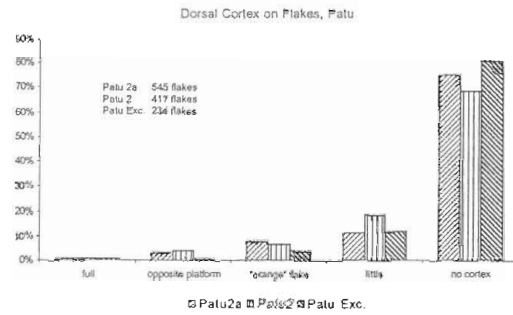


Fig. 185. Dorsal cortex on Patu flakes.

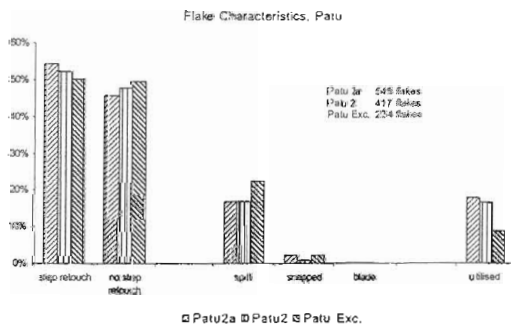


Fig. 186. Characteristics of Patu flakes.

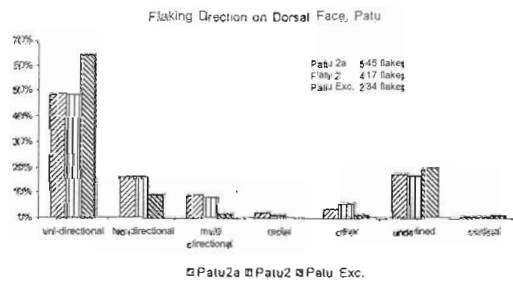


Fig. 187. Flake directions of scars on dorsal faces of Patu flakes.

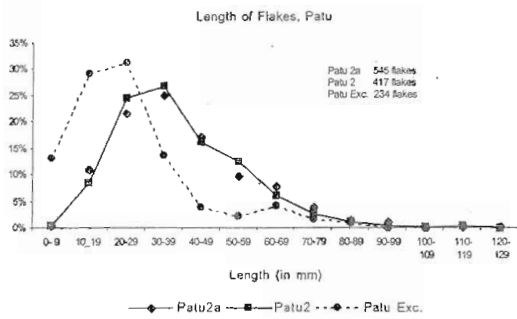


Fig. 188. Length of Patu flakes.

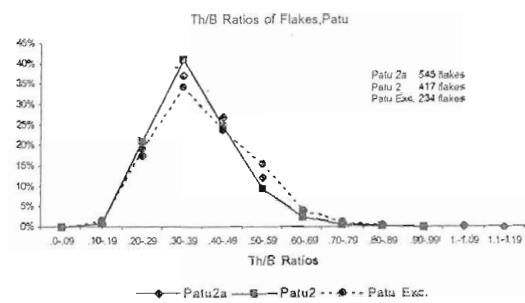


Fig. 189. Th/B ratios of Patu flakes.

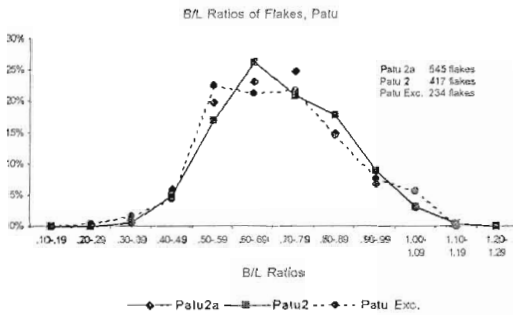


Fig. 190. B/L ratios of Patu flakes.

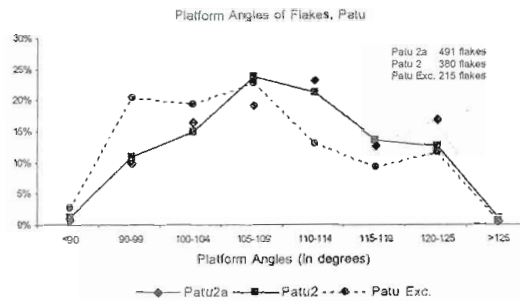


Fig. 191. Angle of platforms of Patu flakes.

into corescrapers and choppers by using hard hammers and producing the working edges from the split surface. Choppers and corescrapers could also be fashioned directly from flat, rounded cobbles.

Several methods were used for tool manufacture after splitting cobbles by the block-on-block method or using well-chosen rounded cobbles.

The block-on-block method: In order to produce large flakes or slices or to reduce a large cobble to a required smaller size, a handy oval cobble of a size of at least 15-20 cm or slightly more (a common size amongst the available cobbles in the nearby streams) is hit against the rounded edge of a boulder on the ground (Pl.239/1, the person in the middle). Large flakes fly off, all with a cortex platform. Some of the flakes have good shapes and may be used further. The reduced cobble then can be worked by the stone-hammer method to the required shape. The block-on-block method produces percussion marks on the boulder-anvil on the ground. In square B/7-c we found a very large, white quartzite stone, which must have been used as an anvil, and which shows a number of heavy percussion marks 1-2 cm in diameter. These must have been caused by big hammers manipulated with both hands, or by the method of splitting large cobbles against the boulder.

The hard stone-hammer/anvil method is used in order to produce large cobble tools (Pl.239/2, the person in the middle). A well-chosen quartzite hammer of a particularly hard variety, preferably of oval shape and fitting well into the hand, is used for striking off larger and then smaller flakes

unifacially from the natural, flat cortex surface of a cobble or from the split surface of a cobble. This produces the shape required for the chopper, corescraper or any other cobble tool. As a platform for such heavy work, a flat boulder on the ground is used as an anvil. Most of the waste flakes which come off during this work have cortex platforms, and this is also the prevailing case with the flakes on the site.

The free stone-hammer method is used in order to produce the required edge on a cobble tool or to resharpen blunted edges (Pl.239/2, the person on the left). The tool is held in the left hand, and a smaller hard hammer with a rounded end is used to strike off small flakes or step-flakes along the edge (the latter are produced by holding the left fingers pressed on the underside of the tool).

The fine stone-hammer/anvil method is used for the production of small flakes and for finer stone-knapping. A small anvil is used on the ground and a small, round-edged hammerstone is used to flake off controlled flakes from a small cobble, split cobble or flake-tool which is placed on the anvil. This method is similar to the second one, which involves, however, large hammers for heavier work, while this method requires only small hammers for fine stone-working to produce a more controlled flaking. Instead of the anvil on the ground, and preferably so, one can use also one's own thigh as a platform.

After heavy work (such as chopping trees and other heavy wood working) has blunted the edge of a large cobble tool, the edge is resharpened with a big hammerstone by the third method. The hammerstones usually show percussion marks from the work. Sometimes, if the work is heavy, chips come off at the hammering point. Such marks and chip scars can be seen on many hammerstones at the site and also on the hammers used in our own experiments. Perfect hammers are not easily found, they must have the right weight and shape, and must be very hard without any cleavage planes.

The heavy-duty cobble tools of Patu were in all probability used for heavy woodworking in a forest environment. Our own experiments with tools made by the above-mentioned methods made us understand the purposes these heavy tools might have been used for. We produced a few choppers and corescrapers, like the ones found on the site (Pl.240/1). We then felled a medium-sized tree with the sharp edge of a self-made chopper, which is such a frequent type of tool at the site. It took us not more than half an hour to chop a tree trunk 13-15 cm in diameter (Pl.240/2). The edge of the stone tool was quickly blunted by this work and had to be resharpened, which was done by the free stone-hammer method. We also cut wooden branches 3-5 cm in diameter in order to make a fence around our camp. We cut the branches with the sharp edges of flakes or a knife on a flat anvil (Pl.239/2, the person on the right). This produced an irregular pseudoretouch on the utilised flakes, and utilised flakes were identified by its presence. We also made sharp points on digging sticks (Pl.241/1). Such work produced elongate cutting rills on the anvil and heavy blunting marks on the tool, and in addition tiny chips broke off at the edge of the cutting tool when it hits the stone through the wood. Similar blunting marks and chip scars could be commonly found on the cutting tools at the site. A dull, blunted appearance, caused by the wood-cutting, can be seen at the edge of the tool, too.

We also carried out bark-scraping work on the branches with the small, sharp edges of the flakes. This left no distinguishable traces on the flakes, even after one hour of work, though longer use would certainly have been visible on the edge. We finally tried stripping bamboo with small, sharp adzes. The adzes and adze-like tools were perfect for such work. We cut thin strips from the bamboo and then softened them by continuous soft scraping with a somewhat blunter edge such as that of an adze. It is possible to make the bamboo strips so pliable and soft that they can be used for watertight vessels, baskets and mats, and even clothing. This is even done now, though with modern tools, by small groups of indigenous people still living in the forests and sustaining themselves by hunting and foraging (Rimal, pers.comm). Such work is probably responsible for the pronounced gloss on many of the adzes after very long use.

Our experiments showed us that the occupants of the Patu site predominantly used their tools for working with wood and bamboo in forests. Their main requirements were tools for heavy to fine woodwork, for which they used the choppers and corescrapers, and the finer scrapers and utilised flakes respectively,

and the adzes and adze-like tools for bamboo work, while the knives, and probably many of the sharp flakes, must have been used for other cutting work, such as meat and other food.

2.4.2. The neighbourhood: The Bawshi Sites

Sites and artefacts

The entire neighbourhood around the main factory site of Patu 2 and Patu 2a was occupied by the same people, within a radius of about 10 sq.km (Corvinus 1989). Two rivers, the Rato River and the smaller Bawshi to the west, formed the boundary of their „territory“. Artefacts were found on most of the terrace surfaces in this area between the two rivers. These localities, however, seem not to have been factory sites, unlike Patu 2 and 2a, but rather smaller activity spots and small campsites. The artefacts are all eroding out from the upper horizon of the red soil on the 30 m Bawshi terrace (Pl.241/2) and can be found now washed out on the slopes and the lower surfaces. Their original placement was in the top part of the alluvium.

If we continue walking south and north from the main camp-cum-factory site of Pa 2a and Pa 2 along the highest terrace of the Rato Khola, we encounter a number of smaller localities, all belonging to the same cultural unit of the Patu main site. All these localities, called Patu 4 to Patu 11 and Patu SW, occur on the same 60-80 m high red terrace system as site Pa 2, bordering, as a fringe of highly elevated terraces, the Rato River (Pl.256). They have yielded some interesting material. Their artefacts derive, like those at all the other sites, from the upper part of the eroded red soil of the terraces. Of these terraces, Pa 5, Pa 6 and Pa 7 (Fig.192) (see also Fig.170b) and Pa SW in the north are quite rich in artefacts. The artefacts occur at the edge of the 60-80 m terraces, bordering the Rato River (seen in Pl.256 at left on top of the terrace). The only „hache courte“ found in the Patu area, comes from Pa 5c (Pl.29/2). Other examples of the tools are some interesting miniature adzes (Pl.61/1) from Pa 5c, some adzes with a pointed butt and straight, oblique distal edge from Pa. 6 (Pl.53/2, and Pl.54/1), a split adze with gloss at the distal edge from Pa 7 (Pl.59/1) and a round unifacial chopper from Pa 3 (Pl.29/1).

To the west and northwest of the main Patu 2 site, the area between Pa 2 and the Bawshi Khola consists of wide expanses of fluvial terraces with an average height of 30 m above the Bawshi Khola, all topped by red soil surfaces. The area once was fully covered by sal forests (*Shorea robusta*), which in the last decades have been thinned out by deforestation, leaving wide open areas of bare red soil (Pl.242/1) with many artefacts exposed (site Bawshi 1).

The map of Fig.193 shows the extent of the occupation sites. The lines a), b) and c) indicate the three cross profiles drawn in Fig.170. Line a) is the northern line, crossing through Pa 5N and Pa 8 and through the E-Bawshi localities, east of the Bawshi Khola; line b) shows the cross section through the main site of Patu 2 and 2a and through the localities of E-Bawshi 2N to the W-Bawshi 2 localities; and line c) shows the cross profile from localities Pa 3 and 4 on the 90 m Rato River terrace through to the localities of Bawshi 13,12,1 and 2. All these localities, from Bawshi 13 in the south to E-Bawshi 10 in the north, at a distance of about 2 km from the former, display scatters of artefacts of varying richness.

The terrace surfaces are heavily dissected by erosion (Pl.241/2), and only remnants of the original occupation places have been left intact. Artefacts are found everywhere where the erosion has cut into the terraces. The occupation of Mesolithic Patu was very extensive indeed. The entire area between the two rivers at the foot of the Siwalik Hills (which one sees in the background of Pl.242/2) must have been the area of activity and hunting ground of the people of Patu. They lived on the surface of the terraces, which at the time of their occupation was still undissected.

An interesting observation is that most of the finest flat bifacial cutting and scraping tools and adzes, especially those with a gloss on their edges, were not found at the main Patu 2 and 2a site itself, but in the near surroundings and at the Bawshi localities between the two rivers. Patu 2 and 2a was the factory

for the manufacture of the stone tools, while much of the other working activity took place in the neighbourhood.

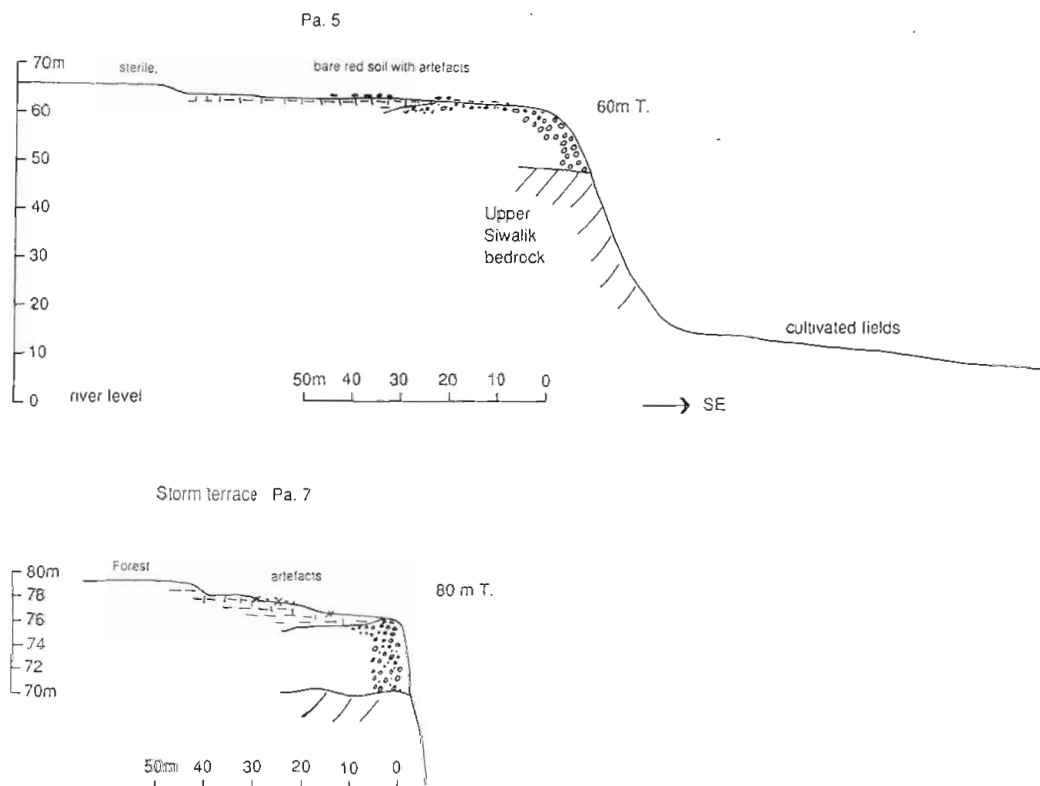


Fig. 192. Sections at localities Pa5 (above) and Pa7 (below) on the 60m and 80m red terraces of the Rato Khola (after Corvinus 1989).

Some of the richest localities between the rivers are localities Bawshi 1S and Bawshi 13, situated on the 30 m red terrace of the Bawshi Khola, but quite removed from the stream itself (Fig.194) (see also Fig.170c and Fig.193). Localities Bawshi 1 (Pl.242/1), Bawshi 2S and Bawshi 3S, exposes the bare red occupation surface by erosion, while the uneroded forest surface (in the back of the photo) is still intact. At Bawshi 1 locality, at the c)-line in Fig.193, many tools were found: corescrapers, sumatraliths (Pl.33/1a,b), choppers for heavy woodworking and a surprising number of adzes for the lighter work (Pl.53/1, Pl.47/2), the figured ones having a gloss along their distal edges. The sumatralith in Pl.33 is in the Hoabinhian fashion. It was found at Bawshi 1-SW corner in two pieces lying close to each other. The artefacts are only found on the bare red surface, which stretches for 700 m from southwest to northeast. Below the red soil fluvial gravels are exposed, as seen in a gully bordering the site. No artefacts are found on the uneroded forest surface. That indicates that erosion has exposed the occupation surface in the uppermost part of the red soil below the forest cover.

The situation of a small locality west of the main site Pa2a, called Bawshi 13, is similar to that of Bawshi 1. The artefacts are in the process of eroding out from the red soil, which at this place is exposed by erosion, while the surrounding area is still covered with forest. This site proved to be particularly abundant in adzes. A 3 × 3 m area was cleaned (Fig.195) with all plotted 29 artefacts being collected. This small area contains 17 adzes of which 9 have a gloss at the edge. Some specific work with adzes was carried out here, which produced an intensive gloss on the edges.



Fig. 193. Map of Bawshi-Rato River area, with sites indicated. The lines a), b) and c) indicate the three cross sections of Fig. 170; line a), in the north, cuts through Pa5 and Pa8 and the E-Bawshi localities; line b) crosses through the main site of Pa2 and 2a to the E-Bawshi localities on the 30m terrace; line c) shows the cross profile from Pa3 and Pa4 on the 90m Rato River terrace to the main Bawshi sites on the 30m terrace (after Corvinus 1989).

Localities E-Bawshi 2 to E-Bawshi 7 are situated in the upstream area of the east side of the Bawshi (cross section a) in Fig.193) at the edge of the terraces, which have been deeply cut by recent gullying. These localities have yielded only a few tools, mainly adzes (Pl.48/1, Pl.59/2) together with some stone debris. From locality E-Bawshi 6 the most delicate adze was recovered (Pl.51); it shows gloss at the butt edge and battering marks at the distal edge. Evidently the narrow, convex proximal edge was the main functional part.

In the same upstream area of the Bawshi, deep erosional cutting has developed a badland topography at localities E-Bawshi 8 (Pl.242/2) and E-Bawshi 9 (Pl.241/2), and only remnants of the original wide terrace surfaces remain. At locality E-Bawshi 8, on the left terrace remnant (in Pl.242/2), particularly well-made artefacts were found, especially a number of sharp knives and unifaces (Pl.34) and a few choppers but no adzes, while just a little further north on the next terrace block (in the background in Pl.242/2) only adzes were found, including a miniature adze (Pl.61/2). In locality E-Bawshi 9 near-by (Pl.241/2), the terrace surface has a deep-red top soil containing artefacts, and below it a buried red soil has been exposed, too. The few artefacts collected from here, consist of a number of adzes with gloss, together with two unifaces. The artefacts here (for example, the uniface in Pl.34, or the miniature adze of Pl.61/2) were found on the bare red soil surfaces of the terrace remnants, as well as washed down into the dissected badlands. The people of Bawshi lived on the terrace surfaces before the terraces were destroyed by erosion. This clearly indicates that the badland formation postdates the time of the occupation and is a young historical event, probably caused by recent deforestation.

The western side of the Bawshi Khola, opposite the localities E-Bawshi 8 and 9, has exposed only few remnants of a red terrace with a buried red soil (Pl.255/2), and only little artefact material was encountered (Localities 1W and 2W, see map Fig.193). Nothing was collected.

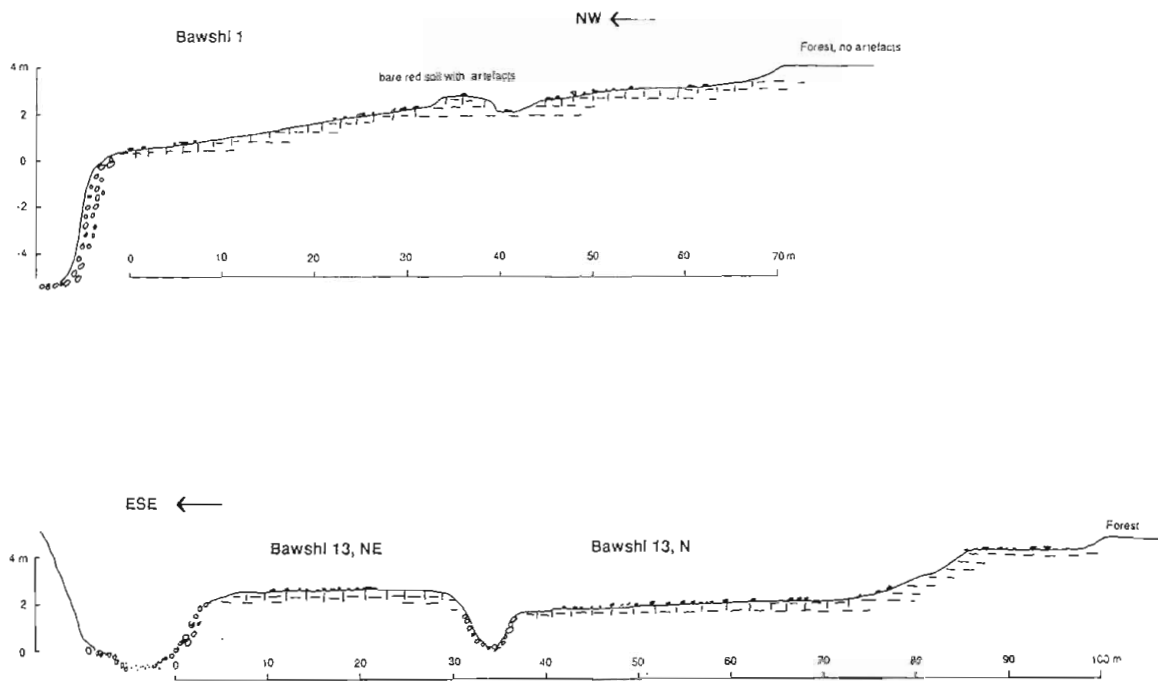


Fig. 194. Profile of localities Bawshi 1 and Bawshi 13 on the eroded edge of the red 30m terrace of the Bawshi Khola (after Corvinus 1989).

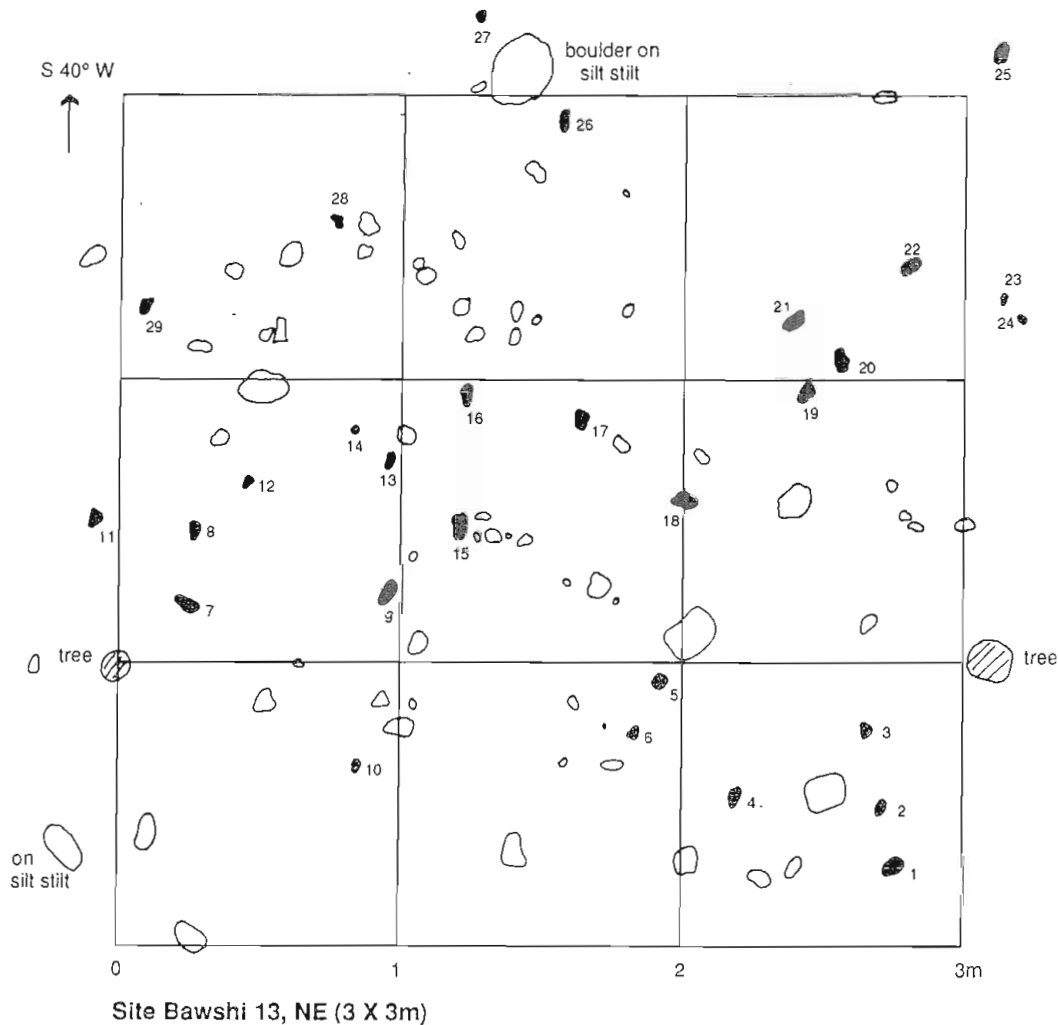


Fig. 195. Plotting of 3x3m at site Bawshi 13 NE (after Corvinus 1989).

Geological implications and the changing environment

All localities in the upstream Bawshi area are connected with the 30 m red terrace surfaces of the Bawshi (measured from the stream level). The main factory sites of Patu 2a and Patu 2, on the other hand, together with the few other localities directly east and north of Pa2a, are connected with the higher 60-80 m red terraces of the Rato River. The Rato River formed considerably higher terraces than the Bawshi Khola (Fig.170).

An interesting observation is that the highest river terraces along the Bawshi Khola have altogether a lower height (of maximally 30 m) than those of the Rato River (Fig.170). The three cross sections in Fig.170 a, b and c, are shown on the map of the Bawshi-Rato Khola area (Fig.193). Both sets of terraces have a deeply weathered red soil cover of an average thickness of 1.5-2.5 m. Yet it appears that both, the 30 m red terraces of the Bawshi stream, and the 60-80 m terraces of the Rato River, are of the same age. This phenomenon has to be explained. Both sets bear the same cultural material in their uppermost red

soil. The formation of the red soils on these terraces is probably of Late Pleistocene age³. Both sets and their red soil cover seem to belong to this age because the thickness and appearance of the red soils of both are similar, and both cover fluvial silt and gravel deposits. The base level of both rivers in the Terai is the same: 240 m. It is possible that the eastern terraces of the Raro Khola were subjected to a post-Pleistocene uplift, along a fault running north to south along the Camp Khola.

Another observation is that the fluvial deposits in the downstream area of the Bawshi consist predominantly of gravels, while in the upstream area they consist mainly of silts and clays (Fig.170), which is not what one would expect at such a place. A further difference is, that the terraces along the Bawshi Khola are well preserved, with widths of more than 1 km (though badly dissected), whereas the high terraces of the Rato River are not very extensive and have broken up laterally.

A contrasting feature is also that the fluvial terrace deposits of the 30 m terraces of the Bawshi are thicker than those of the Raro River (Fig.170). At the Rato River, the deposits of the high terraces are about 10 m thick (Fig.192) and overlie unconformably Upper Siwalik bedrock. Along the Bawshi Khola, however, the fluvial deposits are at least 30m and more in thickness, with up to 30 m of basal gravel and 5 m of silts and clays, even though the Bawshi has cut its bed less deep than the Rato River. Bedrock is not encountered at the base at river level, but buried below it. Bedrock along the Rato River, on the other hand, reaches almost up to a height of 50 m above the river level at Pa 2. These contrasting phenomena—differential features of morphology and sedimentology can be explained only by tectonic disturbances. A fault of NE-SW direction along the Camp Khola (Fig.170 and map Fig.193) can be envisaged, with a downward movement of the Bawshi area or an upward movement of the Rato area. Such faulting must have been very recent, in Holocene times, either contemporaneous with the Patu occupation some 7,000 years ago, or even after the occupation ended.

Opposite the little hamlet of Biankure, on the west bank of the Bawshi Khola, the vertical cliff, 30 m in height, seen in Pl.255/2, deserves mention. It exposes above basal cobble gravels, a buried red soil on a yellow silt layer, which in turn is overlain by gravels, coarse sands and silts. The 30m terrace surface is weathered, as everywhere else along the Bawshi, into a red soil. Red soil weathering is an indication of a warm, humid climate. The question is whether the buried red soil is an older weathering horizon or only a soil sediment.

2.4.3. Concluding remarks

Of all sites in Nepal, Patu, together with Bawshi, is by far the richest and most extensive site, richest in tools and richest in other artefacts. It is unique in its cultural material. It is a Mesolithic but macrolithic industry; there is no microlithic element in the tool kit. No other site in Nepal or in India, as far as I know beats any similarity with Patu. Its tool kit is made up of heavy-duty implements corescrapers and choppers which were presumably meant for heavy woodworking in association with a class of medium heavy-duty tools, such as adzes, scrapers and knife-like tools and points for the production of finer wood and bamboo work. A smaller flake-tool component is almost non-existent. Utilised flakes are not more than 9%.

The combination of such tool types as unifacial and bifacial adzes with the heavy-duty cobble tools of choppers and corescrapers is particularly noteworthy. Choppers are found in many industries in Asia, in the Soan in neighbouring northwest India and in other industries in southeast Asia, from earlier Palaeolithic times onwards. In northwest India, which will be discussed later, the Soan culture features a heavy-du-

³ Not, that is, of Holocene age, the age of the cultural material in its uppermost part. The occupation on the Pleistocene terraces took place in Holocene times, and the artefacts on the surface became embedded as a result of bioturbation of termites, ants and roots in the uppermost part of the soil.

ty cobble tool assemblage with choppers, but not in association with adzes. The Soan is supposed to be of a much earlier age within the Pleistocene (I personally disagree with it). There is no stratigraphical evidence for this assumption, which is still controversial.

The choppers and corescrapers from Patu do not compare well with the Palaeolithic cobble tools from northwestern India, the Patu choppers being well-made tools with fine unifacial step-trimming along the edges. Corescrapers are not found in the Indian Soan. They are present, however, made in almost the same fashion as in Patu, in the Kanchanaburi Province in Thailand, for example at Say Yok (van Heekeren and Knuth 1967). Pookajorn (1979), who found similar tools in cave sites in western Thailand, calls them lower Hoabinhian and has some dates for these tools pointing to the transition from the Pleistocene to the Holocene. But nowhere are corescrapers found in association with similar types of flat adzes, as at Patu.

In Nepal, choppers and corescrapers are not only part and parcel of the Early Holocene at Patu but go back into the Pleistocene as far back as the Middle Palaeolithic, though not into the Early Palaeolithic, and are never, except in Patu, in association with adzes elsewhere. Adzes are unique to Patu.

The Mesolithic population of Patu lived at the very foot of the Himalayan mountains on 60-80m high terraces above where the Rato River emerges from the mountains into the plains. The occupation of Patu took place during the period red soil was forming on the terraces after the end of the Pleistocene. The climate along the front of the Himalayas is even today a particularly humid and warm one, due to its intense rainfalls. The environment in the Early Holocene must have been very forested, as it is today, and even more so, given the recent, man-induced destruction of the forests. The unique type of chopper-corescraper-adze tool combination of Patu is, therefore, probably a special adaptation to life in subtropical forests. Chopper/chopping tools in East Asia are supposed to be an adaptation to life in rainforests (Watanabe 1985). The prominent tool group of adzes at Patu also reflects work in a forested environment. In this respect the Patu industry is comparable with the Hoabinhian in tropical to subtropical southeast Asia. It can be connected to the Hoabinhian people, perhaps, by the observation that they both shared a similar subsistence pattern in a dense forest habitat and using a distinct tool kit, made according to a specialised technology. The industry of Patu, technologically similar in some aspects to the Hoabinhian of southeast Asia, is nevertheless regarded as a separate industrial complex specific to Nepal.

Habitation in deep forests of a subtropical nature, as at Patu, is not envisaged at other sites in Nepal. The earlier sites in Dang-Deokhuri, apart from the Neolithic, were inhabited during cooler periods of the Pleistocene, especially the abundant occupations of the Brakhuti industry.

Patu is an important link between the earlier occupations in the mountains (Dang-Deokhuri) during the cool Pleistocene and the later post-Pleistocene adaptations to forest habitats in the plains, and serves as an indicator of regional adaptations to climatic changes.

VI. The chronological sequence of culture in their stratigraphical context

After having described in detail the cultural material areawise, this chapter will deal with the chronological succession of the sites and their stratigraphical context.

Table 19 lists the prehistorical industries in their chronological succession while Tables 20 and 21 describe the stratigraphical sequence with the sediments in which the sites were embedded. The cultural heritage, so far encountered in Nepal, embraces all Palaeolithic periods, from the Early Palaeolithic to the Neolithic.

1. The Early Palaeolithic (the Acheulian of Gadari and Satpati and the Early Palaeolithic of Tui-Brakhuti)

Prehistoric man had occupied the Dun valleys from Early Palaeolithic times onwards. The oldest Palaeolithic industry in the Duns, that of a small assemblage of handaxes and cleavers, discovered in 1990, is embedded in the lowest part of the alluvium, above Siwalik bedrock near Gadari on the southern side of the Babai river.

The stratigraphic horizon is a basal rubble gravel of pebbles and cobbles overlying the irregularly eroded bedrock of Siwaliks. This horizon constitutes the remains of the earliest alluvial fill of the Dang Dun valley. After a considerable gap in time the Acheulian horizon in turn was overlain by the clay/silt succession of the Babai Formation and became exposed only recently by the deep badland erosion after deforestation in the Duns.

The stratigraphic situation of the Gadari handaxe site is clear. It is the earliest, oldest deposit of the Dang Dun, filling hollows in the underlying bedrock. The Acheulian horizon belongs to a time before the major alluvial aggradation of the valley, but after the end of the tectonic formation of the intermontane Dun valleys. When exactly the Dun valleys came into existence is not clear, but it was probably somewhere in the Early Pleistocene. The presence of Acheulian tools in the lowest alluvial level suggests an at least Middle Pleistocene age for this lowest horizon if not earlier.

An Early Palaeolithic occupation comes also from a similar stratigraphic context, the basal gravel of the Babai Formation in the Tui valley (at Brakhuti W, Rajje, etc). This industry seems to belong to the Early Palaeolithic, though it does not contain handaxes. It is an assemblage of very large, almost huge flakes and cores and one large uniface and must have been a workshop. It was recovered *in situ* from within a basal fluvial gravel of well-rounded quartzite cobbles and boulders. Here, the gravel overlies bedrock directly. It is, however, very different in character from the Gadari basal horizon. The gravel consists of large and very well-rounded cobbles and boulders of quartzite with no intermixture of Siwalik rocks whatsoever.

It is difficult to ascertain whether the basal gravel of the Tui valley is contemporaneous with the basal rubble horizon of Gadari in Dang or not, though they both constitute the oldest deposits. In the Tui valley the gravel forms large lenticular sediment bodies at various places as the lowest member of the Babai Formation and is overlain, like at Dang, unconformably by the deposits of the Babai Formation.

Tab. 19: Chronological Sequence of Industries in Nepal.

Period-	Dang-Deokhuri Basins West Nepal	Lumbini District Central Nepal	Mahottari District East Nepal	Stratigraphical context
H O L O C E N E	Neolithic remains of polished axes, lithic artefacts, cord-marked pottery at Gadari (Dang) and at Brakhuti W (Tui)			In grey soil on the higher terrace top. Date at Gadari (Dang) 1600 BP
	> ↑	Chabeni industry: Mesolithic assemblage of unifacial adzes, choppers and corescrapers with flakes, at Chabeni	Paru industry: Mesolithic assemblage of adzes, choppers, corescrapers and flakes at Patu, Rato river	Chabeni: alluvial 20m terrace at Siwalik hill foot Patu: in red soil of the 60-80m terrace, 7 ka BP
L A T E	Microolithic industry of chert, quartz, quartzite, at Lamahi and Bhatarkund (Deokhuri valley) and Ammapur (Tui valley)			In subsurface of colluvial silts of the Gidhniya Formation
P L E I S T O C E N E	Brakhuti industry: Chopper-corescraper-flake assemblage made of quartzite, at Brakhuti, etc. (Tui), Gadari, Gairakhuti etc. (Dang), Lalmatiya etc. (Deokhuri)	Choppers from Ramnagar, Chitwan Dun	Flakes and choppers from Raimandal Hill, Rato area Flakes, choppers from Gaighat, East Nepal	Upper levels of Upper Member of Babai Formation and Gidhniya Formation in the Dun valleys, and the 60-90m terraces of Mashor, Arjun and Rapti rivers in the Siwaliks, W-Nepal, and in E-Nepal
	Gidhniya assemblage (Tui)			In lower part of colluvial silt of the Gidhniya Formation
M I D D L E	End-chopper industry with flakes, made of quartzite, at Sanpmarg (East Deokhuri)			In a palaeosol in Upper Member of Babai F., 5m below 25m terrace surface of the Babai river
	Arjun 3 industry (Deokhuri): A Middle Palaeolithic industry with blades, points, scrapers and levallois-prepared cores; also Masuria 4 site			At base of the 8m alluvial silt of the 30m Arjun river terrace; Base of Upper Member of Babai Formation
	Large flake-core industry with a uniface, near Brakhuti (Tui valley)			In a basal cobble-boulder gravel, overlying bedrock; basal Babai Formation
	Gadari handaxe industry (Dang valley): with handaxes, cleavers and flakes			In a basal rubble above bedrock, basal Babai Formation
		Satpati handaxe site, at Satpati village, W of Narayani river		In folded sandstones of the uppermost Upper Siwaliks, uplifted by the last Himalayan tectonic event at the HFT

The stratigraphical position of this unique industry suggests, like at Dang, an early age, before the major alluviation of the valley. The artefacts are completely unrolled, unworn and fresh, and they have only very recently been exposed by erosion.

In both cases the two Early Palaeolithic sites of the Dang area lie at the base of the alluvial filling of the valleys. But the question arises, whether older Early Palaeolithic artefacts could be found in earlier positions i.e. in the Siwalik sediments themselves. The Upper Siwalik deposits belong within the time range where Early Palaeolithic man could have existed in Asia, though we have no definite proof of that. The search for artefacts was always a part of the geological-palaeontological investigations in the Siwaliks of this

Tab. 20: Quaternary Stratigraphy of Dang-Deokhuti tectonic valley and associated Prehistoric Sites. Dang, Tui and Deokhuti Dun valleys in western Nepal.

	Period	Sedimentary Deposits	Associated Sites	Associated Dates
H O L O C E N E	Recent	Recent flood plain deposits of sand and flood loams	Neolithic occupation in grey top soil of higher terraces	
	Sitalpur Formation	-----Erosion----- Younger alluvium, 10-15m level, with lignites, black and dark-grey clays of swamp environment, and sands, reaching below river level	No prehistoric record	¹⁴ C dates of 3 lignites at Sitalpur: 13270 ± 190 BP at 1,8m below surface 15320 ± 280 BP at 3,3m below surface
L A T E	Gidhiniya Formation	-----Downcutting----- Yellow-reddish, unstructured silts of colluvial hillwash deposits as fans on the hill slopes and foot of hills	Microlithic Industries in subsurface; Brakhuti Industry in upper part (Saskhuti); Gidhiniya Industry in lower part of colluvial deposits	OSL date of 15.72 ± 2.14 ka 0,6m below colluvial surface at Gadari
	Babai Formation	Red soil formation on surface of older alluvium Older alluvium, up to 30m level above river, with succession of stratified clays and silts of lacustrine and fluvial origine and intercalated lenses of gravels	Numerous occupations of the Brakhuti Industry in silts of the upper part of the Upper Member (Gadari, Brakhuti W, Garakhuti) Sanpmarg Industry in Palaeosol of Upper Member	¹⁴ C date: 17270 ± 120 BP 3m below Gadari Flake site; OSL dates: 23.28 ± 4.13 ka 0,6m below Gadari Flake site 32.91 ± 4.21 ka of palaeosol of Sanpmarg site, 5,9m below surface
M I D D L E	Basal Gravel	-----Erosion----- About 1 to 2m fluvial rubble of quartzites and Siwalik sandstone pebbles and cobbles as basal deposit overlying irregularly dissected Siwalik bedrock	Arjun 3 Middle Palaeolithic industry in base of Upper Member Early Palaeolithic, 1. Acheulian Industry of handaxes at Gadari/Dang 2. Early Palaeolithic industry of huge flakes and cores in Tui valley	67.15 ± 6.69 ka of silt of Arjun 3 site, 6,0m below surface
	Siwalik	-----Unconformity----- Siwalik sandstones and mudstones	Acheulian Industry at Sarpati in folded Upper Siwaliks	Upper Siwalik

project, but nothing was found for years. In November 2001, searching again a certain area within the Upper Boulder Conglomerate of the Surai Khola sequence, five very rounded large artefacts were found amongst the thousands of cobbles, which seemed to be worked by man. They look perfectly genuine, yet for the present an open mind is observed. In Pakistan, Rendell & Dennell (1985) and Dennell & Rendell (1988) claim to have evidence of Early Palaeolithic tools in the Siwaliks, though this is still controversial (see chapter VII.1). But in 1997, by chance a unique evidence of Acheulian bifaces came to light, from within folded sediments of the Siwaliks at the Main Frontal Himalayan Thrust.

This oldest Early Palaeolithic site is the site of Sarpati in Lumbini Zone (see chapter V.2.3.), where a few handaxes and flakes have been recovered from alluvial sandstone which was folded and uplifted in the

Tab. 21: Quaternary Stratigraphy of River Terraces (Dang and Mahottari Districts) and associated Prehistoric Sites.

A. Mashot and Arjun inner Terraces, western Nepal.

	Period	Sedimentary Deposits	Associated Sites
H O L O C E N E L A T E P L E I S T O C E N E	Recent	Recent flood plain deposits of sands and gravels	
	Younger alluvium	Lower river terraces of 10m height above river level, with younger alluvium of fluvial sands, gravels and grey, humic top soil under cultivated fields	No prehistoric record
		-----Uplift, erosion-----	
	Older alluvium	Higher river terraces of upto 60 and 90m above river level; consisting of fluvial silts and sands above cobbly gravels, overlying eroded rock benches of Siwalik bedrock; Red soil formation on terrace surfaces	Numerous assemblages of the Brakhuri Industry, embedded in red soils on the 60 to 90m terraces at Mashot, Beldamar, Oj, Lauki, Saunri, Kakraha
		-----Unconformity-----	
	Siwalik	Bedrock of Siwalik sediments	

B. Rato Khola outer Terraces

Sedimentary Deposits	Associated Sites
Recent flood plain deposits of sands and gravels	

Lower river terrace deposits of 20 and 45m height above river level with gravels and sands covered by grey top soil, under cultivated fields; resting on Upper Siwalik conglomerates	No prehistoric record

Higher terraces of 55 to 90m above Rato river, cut into rock benches of uppermost Siwaliks. Deposits consist of basal gravels, overlain by sands and silts on which a red soil has developed	Patu Industry of adzes, corescrapers, flakes, in uppermost level of highest terraces. ¹⁴ C dates: ~ 7 ka BP, though the terraces are of Late Pleistocene age

Bedrock of Upper Siwalik conglomerates and fossiliferous sandstones	

latest phase of the Himalayan orogeny. The bifaces consist of well fashioned handaxes in the Indian tradition and belong, if not to an advanced stage, to a developed stage of biface manufacture. The Sarpati handaxes have witnessed the uplift of the Siwalik range, after they were deposited, while the Gadari handaxes were embedded directly after the Siwalik folding in the oldest post-Siwalik deposits. Sarpati, thus is the oldest prehistoric settlement in Nepal and dates from before the last tectonic event.

2. The Middle Palaeolithic (Arjun 3, Masuriya)

Subsequently there is a long time lapse before we again find evidence of occupation in the Dun valleys. The Arjun 3 Middle Palaeolithic assemblage, in the Deokhuri valley, has its position at the base of an 8 m silt of the Upper Babai Formation on the Arjun river terrace, verified by a few test cuttings. An Eemian age is suggested for the occupation.

The Arjun 3 site is the only typical Middle Palaeolithic occupation in Nepal so far, containing blades, points, levallois cores and prepared flakes. There is however, another site with a levallois-prepared flake industry, but lacking blades and points, Masuriya 4, not far from Arjun 3. This site has a different geological setting, being associated with the colluvial hillwash deposits of the Gidhiniya Formation on the slope. Sites of this period in the surveyed area are, however, rare. They are either not yet exposed by erosion or the valleys were sparsely occupied during the Middle Palaeolithic.

3. The Sanpmarg assemblage

Almost all the other sites in the surveyed area derive from the silts of the Upper Member of the Upper Babai Formation, forming the 25-30 m terraces in the Dun valleys, and belonging to the Brakhuti industry. Exceptions are the sites of Sanpmarg and Gidhiniya. The Sanpmarg site in the eastern-most part of the Deokhuri valley is later than the Arjun 3 site but earlier than the Brakhuti sites. It is an end-chopper assemblage situated on a buried palaeosol within the Upper Member of the Babai Formation, which is being exposed by erosion 5 metres below the 22 m terrace surface of the Rapti River. The people responsible for the end-choppers of Sanpmarg had occupied the palaeo-surface in the Late Pleistocene somewhere between 34 to 43 ka. This later became buried by the upper yellow silt. The dates have been obtained from the sediments at the palaeosol and just above it by the IR-OSL method.

4. The Late Palaeolithic (the Brakhuti industry and the Gidhiniya facies)

A more continuous occupation is apparent from the later Pleistocene onwards. The majority of localities derives from the uppermost levels of the Babai beds and belong to a younger Palaeolithic industry. This industry, called the Brakhuti industry (from the type site near Brakhuti village in the Tui valley), exhibits everywhere where it is found similar cultural features, comprising a heavy-duty tool component of unifacial choppers and corescrapers, with rather unrefined, unretouched flakes, but with only a few flake tools. The flakes are always associated with large cobble tools of choppers and corescrapers, and the flakes seem to be predominantly manufacturing flakes for the large cobble tools.

Everywhere these sites are found in more or less the same stratigraphical context, either within the colluvial hillwash deposits or in the upper part of the sediments of the Upper Member of the Babai Formation on the higher (ca. 25 m) terraces. As the sites always exhibit the same characteristic artefact assemblage, they definitely belong to the same period, the same time, the same people.

Collectively these sites belong to groups of hominids who all had very similar lithic requirements and manufacturing techniques: they needed heavy-duty tools of choppers and corescrapers which are associated with a rough flake assemblage of a very distinct technique. It seems apparent that their tool kit reflects wood and bamboo work.

One of the richest sites of this period is the Gadari Flake Site in the Dang valley, situated in the pedogenised upper silt layer at the top of the 25 m terrace. The Gadari Flake Site has yielded a provisional OSL date of 20-24 ka.

The type site of this Late Palaeolithic industry, the Brakhuti industry, is the Brakhuti West Site in the Tui valley, where an extremely rich factory-cum-camping site was embedded in the top horizon of the 25 m terrace. A test cutting verified the artefact horizon at this level. This industry is not comparable to the Upper Palaeolithic of Europe or Africa, or even India. It is peculiar to Nepal (and maybe to neighbouring Siwalik areas). It is dominated by large cobble tools of choppers and corescrapers and by an associated flake tool assemblage made in a specially adapted-stone knapping process. The OSL dating of the Gadari site to around 20-24 ka for the artefact-bearing sediment provides a provisional age for the end phase of the alluvium of the 25 m terrace, and is applicable to the Brakhuti W site as well. According to these dates the time of occupation of these groups of people was the later part of the Late Pleistocene.

The Gidhiniya site, which seems to be typologically an earlier facies of the Brakhuti industry, comes from a stratigraphically slightly lower level, i.e. from a rubble horizon above bedrock which was buried by colluvial silts of the Gidhiniya Formation. As the silts of the Gidhiniya Formation are contemporaneous with the Upper Member of the Babai Formation, the site belongs within the Late Pleistocene. But most probably it is of a slightly older period than the majority of Brakhuti sites, as it is buried by the colluvial silts.

Apart from the prehistoric sites in the wide Dun valleys, where the older alluvial terrace surfaces do not exceed heights of 30 to 35 m above the river, occupation sites were also recorded on the high river terraces in the narrow valleys of the rivers cutting through the Siwaliks, which are considerably higher than the Dun terraces.

Only a few valleys were surveyed, including the Mashot and the Arjun rivers. This was done in order to determine whether these high level river terraces were occupied, too, and if, when. These high terraces seem to have been formed during the same period as the 25 to 30 m high terraces of the Dun valleys. Their higher elevation is explained by continued uplift of the Siwalik ranges after their formation. The Dang basin has an elevation 400 m higher than the Deokhuri basin. The rivers in the Siwalik range separating the Dang from the Deokhuri valley, have therefore incised themselves deeply into their valleys before entering the Deokhuri base level, thereby forming terraces of a maximum height of 90 m. They are all capped by a red soil several metres thick. All sites on these high terraces of the Mashot, Arjun and Rapti rivers belong to the Late Palaeolithic Brakhuti industry. Their characteristics are corescrapers and choppers and the same type of flakes as at Brakhuti W in the Tui valley, the Gadari flake site in the the Dang valley and the Lalmatiya site in the Deokhuri valley.

5. The Microlithic (Ammapur, Lamahi, Bhatarkund)

A number of sites in all three valleys are of microlithic industries (Lamahi and Bhatarkund in Deokhuri, Ammapur in Tui, Daingaon in Dang), and they exhibit elements of the Indian microlithic tradition without pottery, with backed lunates and thumbnail-scrapers and retouched bladelets. All sites were found in the subsurface of the uppermost silt horizons, either on the surfaces of the higher alluvial terraces or on the surfaces of the colluvial hillwash fans, like Ammapur. We have no dates yet for the microlithic assemblages.

The sites must have been camp sites of small size, sometimes in clusters, like at Ammapur and Lamahi, or like at Bhatarkund of larger extent. They have all been very disturbed by the surface erosion. Through comparisons of the three sites (described in chapter V.2.1.3. under Bhatarkund) it becomes apparent, that they all are part of the same cultural unit belonging to people with similar technological expertise. Variability in the tool types between the sites point to differing requirements.

6. The Mesolithic (the Patu Industry and the Chabeni site)

Two important site complexes have been described under this setting. One in Eastern Nepal at the emergence of the Rato Khola into the Terai and the other in Central Nepal west of the emergence of the Narayani River.

At the emergence of the Rato River a series of pronounced river terraces were formed. Prehistoric people of a Mesolithic (but not microlithic) culture have occupied the higher river terraces in the Early Holocene some 7000 years ago (Corvinus 1987, 1989). The occupation area of these people was very extensive: factory sites, camp sites, working sites and smaller activity spots are distributed over an area of 2 by 3 kilometres, extending over the higher 50 m to 70 m red terraces between the Rato River and the smaller Bawshi stream. It is the most extensive site complex of all the sites so far discovered in Nepal. The cultural material of these sites belong to one cultural unit only, that of a Mesolithic, macrolithic culture with bifacial and unifacial adzes, choppers, corescrapers and flakes. The industry, called the Patu industry from its type site near Patu village, is a unique assemblage and has been found at no other place in Nepal. It has no affinity with the Indian Mesolithic (which is of microlithic type) but is a tool assemblage, more akin to the Hoabinhian in Southeast Asia.

The people of the Patu industry have occupied only the higher terraces which have a red soil cover, not the lower, much younger terraces of 40 m and 20 m, which have no red soil cover. Several test cuttings have revealed that the actual occupation horizon was just below the recent forest cover in the top part of the red soil.

Another Mesolithic site of macrolithic type is that of Chabeni on terraces of the Narayani River at the foot of the Himalayas at Chabeni in Lumbini district. It contains an industry of unifacial adzes (though unlike the adzes from Patu), which occur eroding out from the higher terrace. But here the terrace formation is quite different from that at Patu. The terrace with the adze site, though the highest in the area, is not highly elevated like at Patu, but forms an extensive, low terrace of 15 m to 20 metres above the Terai plain and is not capped by a red soil. Uplift of the terraces in Later Pleistocene times was negligible in comparison to the Patu terraces on the Rato river.

7. The Neolithic

The youngest prehistoric occupation of the Dang-Deokhuri area was by people of the Neolithic period who left their remains of polished stone axes and cord-marked pottery as evidence of their presence in the Dang basin and the Tui valley. The remains are very scanty, and quite scattered by erosion. Examples are at Gadari in Dang and in the Tui valley where they have been found in a grey, humic soil on the 20-25 m terrace above the River, but the erosion has destroyed most of the original localities and washed the artefacts into recent erosion gullies.

8. Conclusions

The sites discovered in Dang-Deokhuri thus show an unexpectedly wide range of cultures. From an area previously a blank as far as the prehistoric record of Nepal was concerned now proves to be a region with a rich prehistoric heritage, as evidenced in the Dang and Deokhuri Dun valleys and in the eastern Siwaliks.

The Early Palaeolithic period is represented by sites of Acheulian assemblages: the Sarpati Acheulian site in Upper Siwalik context, the Gadati handaxe site and the Jalkundi biface site in basal deposits of the Dun alluvium, and with sites of an assemblage with huge flakes and cores at Brakhuri W and Rajje in ba-

sal bouldergravel. The Middle Palaeolithic period is represented by the Arjun 3 and Masuriya 4 assemblages and the Late Palaeolithic by the Brakhuti industry. The latter is present with many sites and various facies in all the Dun valleys as well as in the narrow river valleys of the Mashot and Arjun rivers. Intermediate between the Middle and the Late Palaeolithic industries are the assemblages of Gidhiniya and Sanpmarg, and probably the Oj, Saunri and Lauki sites. The occupation in the Dang-Deokhuri area continues with microlithic and Neolithic sites, while in the east the macrolithic Mesolithic site of Patu is found, akin to the Hoabinhian in Southeast Asia.

VII. Discussion on the stratigraphical, archaeological and environmental data and its interpretation

1. The geological set-up

The wealth of prehistoric occupational sites, discovered and surveyed during the many years of research in Nepal, a hitherto virgin country in regard to prehistoric remains, has surpassed all expectations. The majority were all found within sediments of the tectonically formed Dun valleys in the Siwalik foothills of the Himalayas. These intermontane Dun valleys (Fig.5), discussed in chapter III.1, were filled in post-Siwalik times with thick deposits of alluvial and colluvial sediments which not only reflect climatic fluctuations during their aggradation in the Pleistocene but have also been influenced by repeated tectonic events. Furthermore, they contain the remains of many groups of occupants of the prehistoric periods. The abundant prehistoric sites (more than one hundred) discovered during the years of investigation have been exposed by heavy recent erosion, caused mainly by deforestation. The erosion is of a box-like type and has dissected these deposits into deep badlands, destroying the once intact terrace surface, and exposing the alluvial deposits down to bedrock. With the downcutting of the sediments, prehistoric cultural material embedded within the sediments became exposed as well. The detailed survey of the exposed Quaternary sediments in the Dun valleys unfolded the stratigraphy and geological history behind the manifold occupations from the time of the start of the infill after the last tectonic uplift. When this last tectonic event had taken place is not yet known in Nepal, but data from India (Azzaroli et al. 1982; Nanda 2001) place these movements, which vary from place to place, into the Early Pleistocene. This would give us a basic date line for the earliest inhabitants of the Early Palaeolithic in the Dun valleys.

2. The Quaternary stratigraphy in the Dun valleys and their palaeoenvironmental implications

The results of all data gathered during the stratigraphical and geological investigations of the deposits in which the cultural material is embedded, are summarized in a columnar composite section (Fig.10) and a schematic cross-profile (Fig.11 and 12). These investigations have established the geological history of the Dun deposits and their cultural contents within their stratigraphical context, and in addition have provided initial insight into their antiquity, in the form of provisional luminescence datings.

The three new formations, the Babai, Gidhiniya and Sitalpur Formations, have been described in detail in chapter III.2. The Babai and the Gidhiniya formations are Pleistocene, while the Sitalpur Formation is of terminal Pleistocene and early Holocene age, based on TL, OSL and C14 datings (compare also Table 20 and 21).

The base of the Babai Formation which starts with basal gravel and rubble horizons is signalled by the presence of Early Palaeolithic and Acheulian cultural remains. Before the Acheulian occupation the rivers

carried heavy loads of channel gravel, which they nowadays do not. They must have deposited them during a climatic phase of greater aridity when the rivers subsided and shed their loads. That was the time when Early Palaeolithic man ventured into the valleys, probably assisted by a much less vegetated landscape in a drier, cooler climate, belonging to one of the older glacial periods, presumably in the Early Pleistocene. These earliest people lived on the riverbanks, as they did before their migration from India.

An unconformity spanning a considerable time gap separates the Acheulian level from the following overlying clayey and silty deposits. A long period of stabilisation or, instead, of repeated cut- and fill episodes whose remains have not survived must have followed the earliest occupation of the Acheulian people. We do not know anything about this time.

The following deposits, belonging to the Lower Member of the Babai Formation are of predominantly lacustrine character and would therefore point to a more humid climate which guaranteed the deposition of lake sediments, maybe in connection with tectonic movements, blocking the valleys. No archaeological remains are found in these deposits. The climatic conditions during this period, having been wetter and warmer, must have helped to develop a denser, tropical vegetation at the Himalayan front which was not favourable for human occupation. Calcretites are not encountered in these clays and silts. The deposits are capped, in places, by a red palaeosol, indicating a stable land surface and a break in aggradation. One could suggest an interglacial phase for the time of deposition (maybe stage 5 or even earlier).

After this second unconformity, well-stratified fluvial sediments of the Upper Member of the Babai Beds were laid down which show various degrees of calcretisation and contain calcrete concretions. The sometimes heavy calcrete formation, especially in the upper part, points to an arid, colder climate during and after the deposition of the beds of the Upper Member.

During the time of deposition of the Upper Member, prehistoric occupation began again and increased towards the upper end. The beginning of this period is marked by the appearance of a Middle Palaeolithic occupation, that of Arjun 3, which is the only site found deep within the sediments, 8-9 m below the surface of the 30 m terrace of the Arjun River. Geological interpretation would place the site into the Eemian (or stage 5), when the climatic conditions became less humid and warm, and less vegetated, and probably more conducive to man's penetrating into the otherwise densely forested mountains, while OSL datings from the site (with provisional ages around 70 ka for these sediments) would date it to the beginning of the last glacial period.

At places buried palaeosols interrupt the sequence, for example at Sanpmarg in the Deokhuri valley. The buried Sanpmarg palaeosol with its slightly calcified but red surface contains the Sanpmarg end-chopper industry, which was dated to somewhere between 43 ka and 33 ka. These data indicate a phase of slightly milder interstadial conditions, during the time of occupation of the chopper people, maybe somewhere in stage 3.

The Upper Member of the Babai Formation is better preserved and more easily recognisable in the Tui and Dang valleys, especially in the Gadari area in Dang. In the Deokhuri valley, the sediments are best exposed at Nimbukhuti. The upper part of the Upper Member of the Babai Beds is represented almost everywhere by stratified yellow silts with abundant calcrete concretions. These silts contain at many places, again especially in Tui and Dang, assemblages of the Late Palaeolithic Brakhuti industry. An OSL date of about 23 ka was obtained from the silt of the Gadari Flake Site in the Dang valley, placing the occupation into the coldest phase of the last glacial period.

The Gidhiniya Formation, described in chapter III.2.1., are hillwash deposits of fine-grained detritus derived from the weathering of the mud- and claystones of the Lower Siwalik rocks. They have posed initial interpretational problems as they were first thought to be loess having been deposited by aeolian action on the slopes of the valleys. But later detailed studies in the field and also in the laboratory (Rajaguru and S. Mishra, pers. comm.) have shown that they are not of aeolian origin.

The colluviation on the slopes seems to have started just after the first strong arid phase (stage 4) of the last glacial period and continued to the end of the Pleistocene, being contemporaneous with the Upper Member of the Babai Formation: We have, on the one hand, the early Late Palaeolithic industry of the Gidhiniya site underlying part of the colluvium at Gidhiniya in the Tui valley, and a TL date of about 32 ka for these colluvial silts near the site (Zöller 2002). And we have, on the other hand, a microlithic industry in the very top part of the colluvial silt at Ammapur 4. This would give us a time-frame between the middle part of the Late Pleistocene (stage 3) to the terminal Late Pleistocene, somewhere transitional between stage 2 and 1, for the colluvial slope wash deposits (see also the OSL date of Sample B of Gadari, chapter V.2.1.2.).

The conclusion is that the colluvial hillwash deposits in the Dun valleys are Late Pleistocene sediments of weathered detritus of the Lower Siwalik mudstones which accumulated during arid phases of the last glacial period and have been transported by gentle hillwash processes downwards into shallow basins both on the slopes and at the foot of the slopes.

Alluviation and colluviation stops after this, and the red oxisols seen at many places covering the surface, point to a prolonged period of stabilisation.

Deep incision took place after this time, somewhere after about 20 ka, probably caused by tectonics (see Fig.11 and 12). The deposits of the Sitalpur Formation reach far below the recent river level. Drillings by the Oil and Gas Commission confirmed this. The deposits above river level give evidence of rather rapid changes in the climate from arid periods to more humid and warmer climatic phases and back to arid periods. During a more humid phase the valleys experienced the formation of ponds and swamps, indicated by extensive black clays, diatomites and lignites, from which C14 dates have been obtained, providing ages between 13 ka and 15 ka, a period when climatic conditions started to ameliorate. No archaeological remains have been recorded so far from the Sitalpur Beds.

Fig.49 has summarized in a schematic profile the geological and cultural events and attempts an interpretation of the environmental and climatic changes in the Dang/Deokhuri Dun valleys (modeled after the Tui valley). The scenario begins after the tectonic formation of the Dun valleys, when the alluvial infilling process starts. As evidenced in the Tui valley and partly in the Dang valley, strong fluvial activity fills bedrock basins at the base, somewhere in the Early Pleistocene, with well-rounded quartzite cobble gravel, belonging to the basal beds of the Babai Formation. The Early Palaeolithic artefacts found in the gravel belong most probably to a late Early or early Middle Pleistocene period, which experienced a cool and dry climate during an earlier glacial (a. in the profile of Fig.49). This is followed, after a long break (seen almost everywhere where recent erosion has cut down deep enough into the alluvium), by clayey lacustrine deposits of the Lower Member of the Babai Formation. A palaeosol on the contact to the upper beds reflects the presence of a stabilised land surface. Here the stage seems to have been set by a wetter climate, maybe belonging to the last interglacial or even earlier (b. in Fig.49). Cultural material is not found in it.

An unconformity separates this unit from the overlying fluvial sediments of the Upper Babai Member with gravels and kankarised silts, which point to a drier, cooler climatic setting during this phase, which may belong to stage 4 (see C2 in Fig.49). A Middle Palaeolithic industry was found at the base, probably belonging to a time of transition from humid to drier, cooler climatic conditions (C1 in Fig.49).

At some places (for example at the Sanpmarg site) a palaeosol interrupts this upper sequence (C3 in Fig.49). The top of the Upper Babai Member with the Brakhuti industry embedded in it, consists of kankarised silts. It has been dated provisionally to the later part of the Late Pleistocene (around 20-24 ka) and points to the cold, dry last phase (stage 2) of the last glacial period.

The silty hillwash deposits of the Gidhiniya Formation on the hill slopes (d in Fig.49) contain an early facies of the Brakhuti industry at the base (at Gidhiniya) and a microlithic industry at the very top (at

Ammapat). The deposits are contemporaneous with the Upper Babai Beds. After deep incision the alluvial sediments of the Sitalpur Formation were deposited as a young terrace (compare Fig.12).

3. The chronology of the prehistoric finds, a preliminary interpretation

The abundance of prehistoric sites of all cultural periods, from the Early Palaeolithic to the Neolithic period, which came to light during the survey indicated that prehistoric man had lived extensively in the Siwalik Hills. The chronological sequence of cultures is described in chapter VI.1. and is listed in Table 19.

The unexpected discovery of an Early Palaeolithic handaxe culture at Gadari in the basal alluvium of the Dang valley provided evidence that the cultural heritage in the Nepal Himalayas not only goes back to the Early Palaeolithic, but that Early Man ventured from the river valleys in Peninsular India right into the Himalayan mountains. As the basal aggradation of the Dun valleys must have commenced at least in the early Middle Pleistocene, but more probably in the Early Pleistocene, the stratigraphic position of these tools at the base of the alluvium suggest a time just after the Dun formation, but before the beginning of the major Dun valley alluviation. In India, scholars are still debating the date of the beginning of the Acheulian there, and the Nepal evidence may give a new insight into the dating problem.

The Acheulian toolmakers were living right on the ancient riverbank: water-cut rills on the bedrock next to the exposed tools point to this fact. From handaxe sites in India we know that handaxe occupation sites are almost always located on the banks of actively flowing rivers. This is clearly evidenced here, too. The basal rubble has filled shallow, rocky hollows in the ancient river channel, along which man lived.

The handaxes from the Gadari site in Dang were the very first handaxes ever found in Nepal. The rubble bed, and the tools in it, was probably covered by sediments soon after the occupation, so that the artefacts were preserved, though the covering sediments themselves did not. The unconformity between the Acheulian and the later infill of the alluvial deposits which cover them may have somewhat affected the Acheulian horizon, but not to a great degree, as they are still *in situ*. But maybe a slight erosional disturbance after they became embedded answers the question why not many artefacts were found at the Gadari handaxe site.

Interesting is that another Early Palaeolithic site, however with no bifaces, was found in similar basal deposits of the alluvial fill in the Tui valley, described in chapter V.2.1.1.

Early Palaeolithic occupations are not abundant in the investigated areas. This observation is not surprising if one considers the fact that the tools are positioned at the very base of the Dun valley aggradation, and buried under the entire alluvium. Whether Early Palaeolithic man was a frequent migrant to the foothills of the Himalayas is difficult to ascertain. He was certainly not discouraged from venturing into the Himalayan mountains from the Gangetic Plain, probably in search of new resources in a very different environment.

Even more interesting is that a third, and uniquely situated, Early Palaeolithic site, that of the Acheulian bifaces of Satpati in southern central Nepal, was discovered much later, which is not connected with the Dun valleys or with any other post-Siwalik sediments. Positioned within folded Upper Siwalik sediments in the Siwalik hills, described in chapter V.2.3., the Acheulian horizon has experienced the last Siwalik uprising and became folded and uplifted with the sediments. It is, thus, the oldest Palaeolithic site in Nepal. When this event occurred is not clear, but scholars in Pakistan and India have, somewhat vaguely, placed the last deposition of folded molasse sediments into the Late Pliocene or Early Pleistocene, somewhere at 1.6 m.y. (Azzaroli et al. 1982). Nanda recently (2001) says that the coarse deposits of the Boulder Conglomerates make their first appearance between 1.72 and 0.63 m.y. in different areas in India. One could assume an age as early as that for the Satpati handaxes. On the other hand the tools are very

well-made and are not of an early, crude type. It would therefore be important to find a way of dating the deposits of the Satpari hill, by palaeo-magnetic or radiometric methods. The stratigraphic context of the sediments, when compared with the studied sections at the Surai Khola and Rato Khola Siwaliks (Corvinus and Rimal 2001), seem to point to a time when the uppermost series of the Boulder Conglomerates were deposited, somewhere during the Early Pleistocene.

In this respect the findings of a few probable artefacts of Early Palaeolithic type, recently found from another Upper Siwalik context, is of importance. They derive from a coarse conglomerate outcrop of the Boulder Conglomerate in the Surai Khola area in Dang (see chapter V.2.2.) and point, like Satpari, to the probability that Early Palaeolithic man was present during the time of deposition of the upper part of the Upper Siwalik sediments, and their cultural remains became folded and uplifted with the latest major tectonic events.

After a considerable time gap, discussed below, the occupation site of Arjun 3 (described in chapter V.2.1.3.) testifies to the presence of a Middle Palaeolithic industry in the Deokhuri valley, *in situ* within a thick alluvial silt. For this industry few provisional OSL dates for sediments are available pointing to a minimum age of ca. 65 ka for the underlying artefact horizon (see Kadereit, Wagner & Corvinus in appendix II, samples HDS-297 and HDS-298). Since this is the only Middle Palaeolithic site in securely stratigraphical context in Nepal, it is particularly important to consider the stratigraphical and geological data in conjunction with the numeric ages. The typology of the cultural material would point to a rather older age than indicated by the OSL ages.

Another securely stratified *in situ* site is the artefact horizon at Sanpmarg, on the Rapti River in the eastern Deokhuri valley (see chapter V.2.1.3.). The interesting situation here is that the assemblage of the large unifacial choppers derive from a buried red palaeosol horizon, 5 m below the terrace surface indicating a time of land stabilisation during a slight amelioration of the climate. The terrace itself is capped by a younger red oxisol. A first OSL age from the red palaeosol containing the artefact site yielded a date of 33 ± 4 ka (HDS-291), while an overlying yellow alluvial sand produced a maximum age of 42 ± 5 ka, which is due to insufficient bleaching of the sediment prior to deposition.

Later still the cultural chronology continues (and, which is most important, placed stratigraphically in still younger deposits) with many sites of a Late Palaeolithic industry, called the Brakhuti industry (see chapter V.2.1.1.), found all over the entire area, not only in the Dun valleys but also on high river terraces in the entrenched valleys of the Siwaliks. They are always found *in situ* in defined horizons in silts within the top part of the alluvial terrace deposits and the colluvial hillwash deposits.

The sites are very abundant in the investigated area. The population was much denser than during the earlier Palaeolithic periods. And this in turn points to an environment during the time of occupation that must have been favourable, cooler and drier than today, and with a much less dense vegetation cover as well, probably a more open woodland with a temperate forest. The tool kit of the Brakhuti industry points to woodworking activities and this would imply a wooded environment in the coldest period of the last glacial, compare OSL-maximum age of ca. 23 ± 4 ka for sample HDS-297 at the Gadari site complex (age overestimation possible due to insufficient bleaching of the sediment prior to deposition) and OSL-age of ca. 16 ± 2 ka for sample HDS-298 (giving a minimum age for the flake site, as the dated hillwash deposits of the Gidhiniya Formation are partly contemporaneous and partly slightly younger than the sediments of the upper Babai formation containing the Gadari flake artefact horizon).

An interesting implication is that the Brakhuti industry, with its special Nepali stone-knapping features unconnected with any Indian Late Palaeolithic industry, was a culture which seems to have flourished during the coldest part of the last glacial period, if we presume a date between 16 ± 2 ka and 23 ± 4 ka by OSL to be correct (on a 2-sigma error-level the ages are not discriminable anyway). Where did these people come from, if not from India? And where did they disappear to, since they were followed, in the Dang area, by a microlithic culture with Indian affinities? Could they be the predecessors of the people of

Patu (see also Freund 1991), who still used the heavy duty tools but in combination with the additional tool kit of adzes?

These questions have not been answered. Only future survey in the areas between Dang and Patu and new findings of the Brakhuti industry in areas outside the Dang-Deokhuri area will eventually give answers. In this respect it is interesting to mention a few findings in the Chitwan Dun valley on high, red terraces of the Narayani River near Ramnagar (see Table 19) in Central southern Nepal, west of Patu, and a few choppers and flakes in the Gaighat area (see Table 19) in far eastern Nepal.

Unpublished new data concerning Late Palaeolithic or Early Holocene industries are coming from Tibet and Ladakh, beyond the high Himalayan passes, to give us food for thought.

The Brakhuti industry is not only found within the upper part of the higher alluvial terrace deposits of the Babai Formation, but also within the colluvial hillwash deposits of the Gidhiniya Formation. According to all observed geological evidence, these colluvial deposits are more or less contemporaneous with the upper part of the alluvial deposits of the Upper Babai Beds. The archaeological evidence seems to confirm this assumption. At Ammapur 4 in the Tui valley a microlithic site was embedded in the topmost part of these colluvial silt deposits. The end phase of the colluvium, therefore, is associated with a microlithic industry, whose tool types correlate well with an early microlithic stage of the terminal Pleistocene found in India.

At another place in the Tui valley, at the Saskhuti S site, an assemblage of the Brakhuti industry is found *in situ* within the silts of such a colluvial fan, buried 0,5 m or more below the very eroded surface of the fan, well within the colluvial silt. This indicates that the Brakhuti industry is contained not only in the upper part of the alluvial terrace deposits of the Babai Formation, but in the colluvial slopewash silts of the Gidhiniya Formation as well, pointing to contemporaneity of both.

The site of Gidhiniya in the Tui valley as well is connected with the colluvial deposits. This rich occupation site, with an artefact assemblage depicting somewhat earlier typological features than the Brakhuti industry, proved particularly important because of its stratigraphic position, at the base of the colluvium, a position indicating that the artefact floor is older than the covering colluvial silt fan.

The very end of the alluviation of the Babai Beds and the colluviation of the Gidhiniya deposits is signalled by the presence of microlithic occupations, which seem to be contained in the top horizon of both. We have no absolute dates yet from the microlithic assemblages apart from the stratigraphical position. It is not yet clear whether the occupation was within the very top part (as evidenced at Ammapur) or also on top of the colluvial surface, which seems to have been the case at Bhatarkund. If the supposition regarding Bhatarkund is true the occupation, at least at Bhatarkund, could have continued into the Early Holocene at any time after the end of the colluviation and the Babai alluviation. Here only absolute dating methods can solve the question of age and chronological sequence.

Some points regarding the cultural material in the Dang-Deokhuri area have also been discussed in chapter V.2.1.5.

During the Early Holocene people of a unique Mesolithic culture of a macrolithic, non-microlithic nature have occupied high terraces of rivers emerging from the mountains into the Terai plains in Eastern Nepal (at Patu, see chapter V.2.4.) and Central Nepal (at Chabeni, see chapter V.2.3.). The tool kit of heavy-duty cobble tools in association with beautiful adzes of the Patu industry is rather akin to the Hoabinhian of Southeast Asia and not comparable with the Mesolithic of neighbouring India. The tool kit of heavy duty tools and adzes with pronounced gloss indicate a forest habitat with wood- and bamboo work. Such sites have not been encountered in India.

The Patu industry of adzes is a new culture for South Asia. Interesting is that similar adze sites have not (yet?) been discovered in other areas in Nepal, even not at Chabeni. It is significant that in the culturally rich Dang-Deokhuri area no such sites were located, in spite of the intensive survey there. Unless

in future more data may come to light one can only speculate on the assumption that the Patu industry is a cultural expression unique for eastern Nepal.

The remains of the Neolithic period are sparse, due to erosional destruction, and are found only in the grey top soils. The Neolithic period is not scope of this book. The discovered localities have been recorded and described. A more detailed survey must be left for future workers. The previously recorded Neolithic adzes, from various surface localities (Bannerjee & Sharma 1969; Sharma 1983) have to be discussed in the light of this author's new recordings.

It is hoped that future scholars will continue the studies in this field, including various other necessary aspects, so that it will lead eventually to a more fully understood interpretation of the ages and the changing climate and environment during the time of the first prehistoric settlers in Nepal.

VIII. Comparison with cultural traditions outside Nepal

1. Comparison with the Palaeolithic record of Northwest India and North Pakistan at the Himalayan front

The earliest occupation sites in Nepal are marked by handaxes. Sites are rare, and only two sites have so far been recorded, one in Dang Dun and the other at Satpati in folded Siwalik sediments. A third Early Palaeolithic site, without handaxes is in basal gravels in the Tui valley. These definite, though scanty records of Early Paleolithic remains in Nepal indicate that Lower Paleolithic populations crossed the Ganges Plain and migrated into the Himalayan foothills as early as at least the Middle Pleistocene. An accurate age cannot yet be given to these assemblages. But handaxe production is thought to have ended by about 100,000 years ago in Africa and probably also in India. Such datum line may give an indication of the upper age limit of the oldest definite occupations of prehistoric man in Nepal during the early post-Siwalik alluviation of the Dun valleys.

It is possible that the mountains during the time of their occupation may not have been as high as they are today, but they certainly existed, given that the bifaces of the Gadari site are stratigraphically positioned at the base of the alluvial fill of the Dun valleys and postdate the Siwalik tectonics. Sali (1990a) comments on movements of Acheulian people in Kashmir in Middle Pleistocene times, saying that the Pir Panjal mountains were much lower at that time (1,800 m) than today (4,700 m), which permitted movements of men and animals from the plains to the hills.

The occurrence of handaxes in the Siwalik Hills in Nepal points to connections with the handaxe cultures in India, where they are abundant. It is the northeasternmost occurrence of handaxes on the Indian subcontinent, and situated well within the lower Himalayan mountain ranges. Climate and vegetation must have been favourable during those migrations, which may have occurred during the last, but one glacial period when the Himalayan front was not so densely forested as it must have been during interglacial periods. The high Himalayan snow range beyond it formed the impenetrable northern boundary of the extension of the handaxe cultures of the African and Indian tradition (Corvinus 2004), preventing them from moving to eastern Asia.

In India the Acheulian handaxe tradition is widely distributed in the subcontinent south of the Indo-Gangetic Plain (see next chapter). The northernmost occurrences of Acheulian bifaces south of the Ganges Plain are those recorded recently by A.K. Sharma (1993) just south of Delhi. Northwest India, along the Himalayan foothills in Himachal Pradesh and Haryana, is the area of the chopper-dominated Soan industry, defined by de Terra and Paterson in 1939. Acheulian bifaces are rare, but they have been reported by Mohapatra (1981, 1982), though not in any stratified context, in the area north of Hoshiarpur and near Pinjor north of Chandigarh (Kumar 1995). Sharma (1977) also reports handaxes and cleavers from Upper Siwalik conglomerates 10 km northwest of Chandigarh near Mullanpur, but Mohapatra (1981) refutes these discoveries as without substance.

Rendell & Dennell (1989) have resumed investigations in the Potwar area in the Himalayan foothills of Pakistan, where the Soan River valley is the type location of the Soan culture (de Terra and Paterson 1939). They have reported Acheulian occurrences, including handaxes *in situ* in geological context, dated to between 700,000 and 400,000 years ago (Rendell & Dennell 1985). This area has (ever since de Terra and Paterson) always been described as being the home of populations who manufactured the Soan chopper/chopping tools. This concept has to be reconsidered now in the light of the recent discoveries by Mohapatra and Rendell and Dennell.

Artefacts of the Soan tradition have been reported in the foothills along the Himalayas in Northwest India after de Terra and Paterson by a number of researchers (Sen 1955; Lal 1956, 1979/80; Joshi 1968; Sharma 1977; Mohapatra 1966). The Early Soan, as described by Sen (1955) and Mohapatra (1966), consists of mainly unifacial but also bifacial choppers, of medium size and usually round shape, which exhibit occasionally well-controlled flaking. They are associated with simple, unrefined and unretouched flakes with wide platform angles. Their platforms are unprepared, Sen mentions them to be predominantly cortical, while the dorsal faces, too, often retain much cortex. The Early Soan is thought to be of an Early Palaeolithic age, though there is no stratigraphic control. Artefacts are recorded from the surface of the higher river terraces along the Beas, Banganga, Sirsa and other rivers.

Mohapatra (1966) describes an advanced Soan industry from the Sirsa valley, also from the surface, comprising small and well-trimmed, usually round choppers, bifacial discoids, a fine uniface, prepared flakes and thick blades. He records another industry, made of chert rather than of quartzite, that includes prepared but unretouched flakes, again in association with large choppers. He describes this latter industry as "a regional manifestation of the Soan pebble tool tradition at its very late stage," (Mohapatra 1966, 229). All these occurrences were without Acheulian bifaces, though Gaillard (1993, 1994) regards some of the large flake tools from the Beas terraces as cleavers.

Mohapatra later (1981, 1990) records handaxes along the Siwalik foothills near Hoshiarpur and Pinjor. In the Hoshiarpur Siwaliks he reports bifaces on "various types of Siwalik surfaces (Upper Siwalik formations Tatrot, Pinjor and Boulder Conglomerate) in handful numbers lacking any stratified context," (Mohapatra 1981, 434) on both sides of the crestline. While "Soanian artefacts are either few or absent where Acheulian ones are numerous," Soanian artefacts are found abundantly in the adjacent Dun valleys, with no Acheulian element at all. He therefore, speaks in terms of two distinct ecozones, one for the Acheulian and one for the Soanian, and opines that "the Acheulian penetration appears to have taken place much later than the period of the Early Soanian," though no sites were found in a stratified context. Mohapatra (1981, 435) and Lal (1979/80, 8) comments that "the handaxe-cleaver element is not indigenous to the area but represents an intrusion," from outside into the chopper-dominated Soan culture along the Himalayan mountains. Kumar (1995, 7) comments, however, that "in the whole frontal region both these traditions ... flourished side by side," and thus that the Acheulian element is not an intruder in the region. Unfortunately there is no stratigraphic control on these records of handaxes along the foothills in Northwest India. Hopefully future research will yield datable occurrences and establish a chronological framework for the Indian Himalayan foothills.

In Nepal the evidence is quite different, the most important fact being that the recorded industries are mostly stratigraphically controlled and that a chronological order can be more or less securely established. Such evidence indicates that the Acheulian handaxe element is confined not only to the stratigraphically oldest horizon in the post-Siwalik sediments of the Duns, but is also contained within folded Siwalik sediments before the last Siwalik uplift. The handaxes are not associated with choppers, though the assemblage is still scanty.

Assemblages containing choppers, corescrapers and simple unretouched flakes (they are not described here as Soan, though they resemble it to some extent) become very common only in later periods stratigraphically higher up in the sedimentary Dun deposits. Corescrapers, as this author has described them from

Nepal, seem to be absent in Northwest India. The earliest occurrence in Nepal of choppers of the Soan type is in a Middle Palaeolithic assemblage at Arjun 3 in the Deokhuri Dun, where they occur together with a prepared flake- and blade industry of a levallois technique. This industry is found in stratigraphic context, in sediments much younger than the Acheulian level. All later industries in Nepal contain, as definite elements, unifacial choppers and corescrapers, and they seem to continue even into the Holocene, as evidenced at Patu in East Nepal, where they occur in association with Hoabinhian-like adzes (Corvinus 1987, 1989).

The Brakhuti industry of choppers and corescrapers, always in association with simple, unrefined and unretouched flakes, is the most common industry in the Dun valleys in Nepal. According to the stratigraphical level in the Dun sediments it is of a Late Pleistocene age. The chopper-corescraper element is, in the author's opinion, an indication of the special requirement of heavy-duty tools in a forested habitat along the Himalayan front and in the intermontane Dun valleys within the Siwalik foothills during the Late Pleistocene and Early Holocene.

The „Early“ Palaeolithic chopper industry of the Banganga- Beas valleys is essentially a unifacial industry (Lal 1979/80). So is the Late Pleistocene chopper-corescraper industry in Nepal. There are very few bifacial choppers, and the corescrapers are always unifacial. The major question is whether the Early Soan industry of Northwest India is indeed of an Early Paleolithic age, since it has never been found in a stratified context. The pebble/cobble tool assemblages have, ever since de Terra & Paterson's work in 1939, always been considered to be earlier than other industries in India, and this idea persists up to now. But the question whether it preceded the Acheulian, or whether it was in reality much younger than the Lower Palaeolithic industries remains speculative. Cobble tools have been found in peninsular India in an Acheulian context (Soundara Rajan 1952; Sen & Ghosh 1960; Botiskovsky 1978; Sankalia 1978; Paddayya 1982; Jayaswal 1982; Corvinus 1983; Misra 1994) and in later contexts. In Southeast Asia they form a common tool type from the Pleistocene into Holocene times. It is time to redefine the Soanian culture or industry in India and search for stratified contexts.

In the Pabbi Hills of Pakistan Dennell et al. (1991) and Hutcombe et al. (1989) have recorded a pre-Acheulian, Lower Pleistocene industry of little standardisation and little retouch, which they believe to resemble the Soan tradition, though they do not, rightly, classify it as such. The investigators claim that this industry is of a Lower Pleistocene age between 1 and 2 million years, on the grounds that the artefacts were found, like the fossils, on erosional surfaces of fossiliferous Upper Siwalik deposits which date back to between 0.7 and 2 m.y. None have come from an *in situ* context. No other, younger deposits seem to have been present. Therefore it is noted "that some of the stone artefacts have eroded from the fossil-bearing horizon and are thus between 1 and 2 m.y. old., (Dennell et al. 1991, 58). In the absence of profiles or sections the reader is left in doubt about the geomorphological situation. The investigators record that the artefacts from the older erosional surfaces consist "predominantly (of) flaked pebbles, cortical flakes, disc cores and flakes with 25 % of their cortex remaining., (p.53). It does not appear that there are formal tools, bifaces, blades and prepared cores, and it is uncertain whether there are choppers as traditionally defined.

A conglomerate which is exposed at several places along the hill flank "contains quartzite stones large enough (average 6 cm) to be used for making stone tools., (Dennell et al. 1991,58). This restricted size range seems too small for producing Early Paleolithic stone tools. The investigators admit that the artefacts are not necessarily as old as the conglomerate and that "the stone tools could easily have been made and discarded at conglomerate exposures long after the conglomerate was deposited., (p.60). Nevertheless they believe that the artefacts derive from the fossil-bearing Siwalik strata. This is an assumption so often erroneously made. In Java, artefacts have been incorrectly associated for decades with older fossil horizons, having been found on the surface above the fossil beds.

Mohapatra (1981) reports Acheulian handaxes on Upper Siwalik surfaces on the hill slopes in the Hoshiarpur Siwaliks, but lacking any stratified context, and he does not conclude that the bifaces come from

the Upper Siwalik deposits. In Nepal, the author has also found quartzite artefacts of flakes and cores/co-rescrapers on surfaces of Siwalik outcrops on slopes and even on hilltops (for example on Upper Siwalik pebbly sandstones at Raimandal Hill in East Nepal), and on a hill of Lower Siwalik strata south of Sanpmarg in Deokhuri Dun. These artefacts certainly did not derive from the Siwalik deposits, even if one site was on Upper Siwalik strata. No other, younger deposits could have been deposited on these hilltops. The author concluded that these artefacts are surface finds, maybe of a rather young age.

Dennell et al. (1988a, 1988b) also reported a few artefacts *in situ* in a gritstone, thought to be older than 1.9 m.y. near Riwat on the Soan, southeast of Rawalpindi. The gritstone horizon from which these artefacts were protruding is within the Upper Siwalik sequence of the gently dipping southern limb of the Soan anticline. Horizontal beds, including an ash layer dated 1.6 ± 0.18 m.y., overlie the Upper Siwalik beds, not on the artefact-bearing southern limb but on the steeply dipping northern limb of the Soan anticline 5 km away, therefore the underlying dipping beds must be older than 1.6 m.y. But can the artefact-bearing horizon on the southern limb really be correlated with the dated strata of the northern limb 5 km away? The section with the artefact-bearing horizon has reversed polarity and must therefore be older than 0.7 m.y. The folding of the Soan anticline is supposed to have happened between 2.1 and 1.9 m.y. according to Johnson et al. (1982), so that the sediments of the anticline, including the artefact-bearing horizon, must have a minimum age of 1.9 m.y. And as the strata just below the artefact-bearing horizon has normal polarity, and is thought to be of the 2.01 m.y. old Reunion Event the authors come to the conclusion that the few artefacts are 2 m.y. old. It is indeed very complicated, but somehow convincing, were it not for the fact that 5 km is a long distance. The geological situation of the artefact-bearing horizon, too, appears convincing, according to the photographs in the book, indicating that it is not a re-worked horizon. But are the few artefacts (in fact, only three) really man-made beyond a doubt?

The evidences from Pakistan certainly challenges traditional notions about the "out of Africa" model. Similar questions have haunted this author during her eleven years of geological and prehistorical research in the Nepal Siwaliks. No definite evidence of artefacts within the Upper Siwalik deposits in the investigated area of Dang-Deokhuri has come to light for a long time, until recently a few rounded specimens were found, resembling human artefacts (see chapter V.2.2.), within a conglomerate bed in the Boulder Conglomerate of the uppermost Siwaliks at Surai Khola (Corvinus & Rimal 2001). This is certainly not due to a lack of searching during the altogether 22 months of fieldwork in these 11 years. On the other hand, Rendell and Dennell's (1989) data are equally the outcome of six years of research including twelve months of fieldwork. But they will certainly allow us our doubts until other convincing data come from other areas in South Asia. There simply has not been enough research done as yet in South Asia as it has been in East Africa, and research missions like the British team work in Pakistan, are much needed.

On the other hand, there is evidence in Nepal, too, of genuine handaxes within folded Upper Siwalik sediments, that of the Satpati biface assemblage in the Satpati hill range. It was a chance find and not the outcome of a systematic search for Acheulian bifaces in Siwalik sediments. Since the discovery of this Acheulian industry in uppermost Siwalik deposits the author no longer refutes the occurrence of Early Palaeolithic artefacts within the Upper Siwaliks, but precise dates are still outstanding.

What we can ascertain after more than a decade of research is that the foothills in Nepal were occupied from the Early Palaeolithic onwards through various prehistoric periods of the Palaeolithic, Mesolithic and Neolithic. Whether these occupations were continuous or sporadic, interrupted by long gaps of non-occupation, cannot be said at the moment. As far as the data reveal at present, it seems that Early Palaeolithic occupants were migrants, who moved up from further south in the Indian subcontinent only from time to time during the Early Palaeolithic. This was probably sometime during the early Middle Pleistocene, or even the later Lower Pleistocene, and probably during a cooler climatic period which permitted groups to cross the otherwise probably densely forested Indo-Gangetic Plain.

The relationship between Acheulian occurrences in Nepal and those from the foothills in Northwest India and the Pakistan Siwaliks needs to be further investigated.

2. Comparison with Peninsular India

2.1. The Acheulian cultures

The Lower Palaeolithic period is represented in Nepal, as noted before, only by few occurrences. Though the sites are few in number they tell us, that Acheulian hominids did not hesitate to colonise the mountainous region and were able to adapt to this new ecozone. It appears that they entered the hills when the climate was on the whole drier and the vegetation less dense than today, so that movements were possible through the foothills. They may have migrated from the plains into the mountains in search of better food resources in times of extended dryness resulting in a shortage of water and food in the plains.

In India, Acheulian man had adapted themselves to a wide range of ecozones: the semi-arid desert, the Gujarat alluvial plains, the sub-humid moist-to-dry deciduous woodlands of Central India, the Deccan Plateau and the Chota Nagpur Plateau, the Eastern Ghats and the southeastern coast. They seem to have avoided, however, densely forested areas, because no Acheulian occurrences have been found in the heavy rainfall areas along the Western Ghats. The Acheulian occurrences in the Siwaliks in Nepal, however, would indicate that the area of heavy rainfall along the Himalyan foothills, though not quite as wet as the Western Ghats, was not avoided by Acheulian man during periods of drier climate.

In Central India Acheulian hominids also lived in rock shelters and caves for example at Bhimbetka on the margins of the Vindhya Hills (Misra 1978, 1985b). Sediment analysis has shown that conditions during the Late Acheulian period were as humid or even more humid than today in Central India. Early man seasonally occupied rock shelters at Bhimbetka, where there are perennial streams even today. They may have occupied rock shelters in the rainy season and open air sites along the rivers in the dry winter.

In Rajasthan, Acheulian man camped near lakes and riverbanks in the area of Didwana, indicating that it was more humid at that time than its present semi-desert state. Our knowledge about climatic changes and human responses to them during the Middle Pleistocene in the Indian subcontinent is limited, the best evidence coming from the semi-arid zone of Rajasthan, near Didwana (Misra & Rajaguru 1986). In the Early Pleistocene, large streams from the Himalayas flowed through Rajasthan (but there is no evidence of man), leading to aggradation of thick gravel beds. Later an uplift of the gravels and rejuvenation of the landscape occurred, with new shallow streams flowing in wide flood plains covered with ponds and shallow lakes. Acheulian man at Didwana lived on such lakes. The climate at that time was fluctuating between dry/cool and wet/warm. During the wet/warm periods the dunes stabilised, and that is when man occupied them. A U/Th date at the base of the Lower Palaeolithic deposit gave an age of $390\text{ka} \pm 50\text{ka}$.

In other parts of India, Acheulian tools are always connected with gravels on riverbanks. These gravels are believed to have been deposited in a period of semi-arid climate with intermittent, erratic rainfall and sparse-to-absent vegetation cover (Williams and Royce 1983). Acheulian tools are not found in the overlying fine silty sediments laid down in a low-energy environment which could not carry coarser material, including stone artefacts. Therefore Misra (1989) opines that „Acheulian occupations contemporary with the deposition of fine sediments have to be searched for in areas outside fluvial deposits“. Such sites are found at Adamgarh (Central India), in Andhra (Hunsgi) and at Kuliana.

At Adamgarh, south of Hoshangabad, Central India, Acheulian tools (Joshi 1978) were found in and around rock shelters on an isolated quartzite hill (Adamgarh Hill) in the middle of the wide alluvial plain

of the Narmada River. Acheulian man occupied the shelters as well as the area on higher ground outside the shelters, away from the river.

The Acheulian sites around *Hunsgi* in Karnataka, (Paddayya 1982) are not found in river gravels either, but in autochthonously weathered granitic gneiss in the vicinity of artesian springs. Paddayya has expounded theories on the seasonal movements of Acheulian man in a climate similar to that of today in *Hunsgi*, saying that the monsoonal type of climate was already present during Acheulian times. He presumes seasonal shifting of the Acheulian groups according to the availability of food and water resources. There are artesian springs near *Hunsgi*, which supply water throughout the year. He speaks of dry-season aggregation (in the vicinity of the artesian springs) and wet-season dispersal of the Acheulian population, when food and water is available everywhere. In Africa, the Bushmen provide good examples of such shifting. Seasonal nucleation and break-up of a regional population serve as a very effective adaptive mechanism for the maintenance of foraging societies (Lee 1972).

Nearby, at *Isampur*, also in the *Hunsgi* valley, a new Acheulian site has recently been excavated. It is an extremely rich workshop (Paddayya et al. 1999; Perraglia et al. 1999) on a limestone bed, slabs and blocks of which were used for tool manufacture. The site has yielded huge cotes and equally huge flakes (20-25 cm in size) the latter having been used for tool manufacture of bifaces, of which, though, there are very few amongst the more than 15,000 artefacts. It is an extremely interesting site, providing a rare insight into a specialised lithic technology. Ten sites were found within 5-6 km around the main site. The age of *Isampur* was estimated to be around 0.5-0.6 m.y. (Paddayya et al. 2000) after radiometric dates from the *Hunsgi* Acheulian sites yielded ages ranging from 174 to more than 350 ka. Attempts at absolute dating of *Isampur* (Paddayya et al. 2002) resulted in preliminary ESR dates obtained from teeth averaging 1.2 m.y. If these dates are accepted it makes *Isampur* the oldest known site in India.

Having seen this extremely interesting material from *Isampur*, comparison with the Early Palaeolithic material from the basal deposits in the *Tui* valley springs to mind. The latter, too, was a workshop where Early Palaeolithic hominids made use of the large quartzite cobbles and boulders of the conglomerate for tool-making. The large number of huge flakes and cores and partly trimmed artefacts support this suggestion.

The *Kuliana* site in Orissa is another site where Acheulian artefacts were not found in fluvial gravels but in a pisolithic weathered laterite, away from the river (Bose & Sen 1948).

But most of the Acheulian remains are associated with fluvial gravels on river terraces in peninsular India, for example at *Gangapur* on the Godavari (Sankalia 1952); at *Anagwadi* on the Krishna River (Pappu 1974); at *Chirki* on the Pravara river (Corvinus 1981,1983); at *Vadamadurai* and *Attirampakkam* in Tamil Nadu on the Kortalar river (de Terra & Paterson 1939); in Andhra Pradesh in the now submerged *Nagarjunakonda* basin of the Krishna River (Bannerjee & Joshi 1975); at *Lalitpur* on the Betwa River, U.P. (Pant 1982). The *Vadamadurai* site north of Madras (Chennai), was the first recognised Palaeolithic site in India, where Bruce Foote found more than one hundred years ago handaxes of classical type (Foote 1916).

Recently Pappu (Pappu et al. 1998; Pappu 2005) has re-examined the archaeological record and has initiated new excavations at the site of *Attirampakkam* between 1999 and 2003. She could distinguish several artefact-bearing horizons with Acheulian up to Upper Palaeolithic assemblages. At 3.5 m depth from the surface a thick layer of laminated clay contains an Acheulian assemblage of mainly handaxes. It is buried by a ferruginous gravel containing Middle Palaeolithic artefacts. Palaeomagnetic sampling suggests an age of the Acheulian within the Brunhes-Matuyama chron of 730 ka. Further excavations are going on and results are eagerly awaited, especially since this site is the oldest ever found Palaeolithic site in India and since it is one of the few well-preserved and stratigraphically controlled sites in India.

The Narmada river graben with its thick alluvial deposits has been a promising area of research for more than one hundred years. The de Terra team (de Terra & Paterson 1939) worked there in the 1930s.

Much later Khatri (1961, 1966) described the Acheulian and its stratigraphy in the lower Narmada gravel, and Sankalia (1974) reported on the Acheulian distribution in the Narmada graben. Khatri (1962) recorded even an Oldovan cobble tool assemblage in basal conglomerates. The Gadari site in Dang valley and the Early Palaeolithic site in the Tui valley belong to this type of site, associated with fluvial sediments on riverbanks.

Amongst these occurrences, primary workshops and camps are rare. Chirki-on-Pravara in Maharashtra is one such primary site, where thousands of implements, both finished and unfinished, bear witness to a factory of Early Acheulian man, on the Pravara River, where he fashioned his tool kit from basalt and from dolerite (Corvinus 1983). A very distinct tool kit came to light here, consisting of three types of implements: 1) cutting tools, 2) piercing tools and 3) chopping tools, indicating a wide variety of functions and activities. But such primary occupation sites are rare even in India. The Early Palaeolithic sites in Nepal cannot be described as camp- or factory sites, except the Tui valley site, which seems to have been a workshop on a wide expanse of boulder gravel that served early man with its readily available supply of large quartzite boulders as raw material. Many large unprepared cores and large Clactonian flakes, along with the one tool, a uniface, heighten the probability that the site was a factory.

Acheulian man in India began in his specialisation of tools with various types of handaxes for cutting, piercing and digging, and more significantly with the very specialised cleavers. Cleavers were made on large flakes according to a prepared technique (Victoria West core preparation) which precede the later levallois technique. From such large flakes he made most of his cutting tools of handaxes, cleavers and knives. Picks and pointed handaxes with thick burrs were made on cobbles. Bifacial and unifacial choppers, polyhedrons and spheroids, too, were made on cobbles, and were always part and parcel of the Indian Acheulian tradition. The Acheulian assemblages from Nepal are too small for us to ascertain on the basis of them whether this was also the case there. Large, prepared discoidal cores and prepared non-levallois flakes belong, too, to the Acheulian, and in the later stages the levallois technique was also employed.

Misra (1987b, 1989, 2005) distinguishes two developmental stages: 1) an earlier Acheulian without the levallois technique comprising handaxes, choppers, polyhedrons and a lower proportion of cleavers and flake tools, made predominantly by stone-hammer technique; here he includes Singi Talav, Chirki, Hunsgi and Anagwadi (I tend to think that Chirki and Hunsgi are not very early, but Middle Acheulian; the cleavers are too well made); 2) and a later stage employing the levallois technique with a high proportion of such flake tools as scrapers, along with small handaxes made by using soft hammers, and with the knowledge of the levallois and discoid core techniques. No prepared core technique could be recorded from the Acheulian sites in Nepal due to the paucity of artefacts, but in the light of the Early or Middle Acheulian appearance of the material it seems unlikely that the levallois technique was used by these populations.

Most Acheulian sites in India cluster around good raw material (dykes in the Deccan Plateau, limestone in Hunsgi, sandstone in Lalitpur and quartzite outcrops in other areas). In Nepal the raw material of the Acheulian was always quartzite, which was abundantly available in the riverbeds of the streams leaving the Himalayan mountains.

Faunal remains have been preserved in India only at a few sites. The Narmada River has yielded the richest fauna in basal gravels, associated with Acheulian tools: *Sus namadicus*, *Bos namadicus*, *Equus namadicus*, *Hexaprotodon namadicus*, *Elephas blythianus* and *Stegodon insignis-ganesa* (Badam 1979, 1984). The site of Chirki and its neighbourhood (Corvinus 1981, 1983) also yielded some bones of *Bos*, *Elephas* and *Equus*. Khatri (1961, 1966) reported on the Acheulian and its stratigraphy in the lower Narmada gravel. But other sites have turned out to be lacking in fauna.

The age of the Acheulian in India is still quite controversial. In Pakistan there is a claim of 2 m.y.-old tools from the Siwaliks, and three handaxes were dated to between 700,000 and 400,000 years on the basis of magnetic polarity stratigraphy (Rendell and Dennell 1985). The fauna connected with the Narmada

Acheulian, which was supposed to be Middle Pleistocene, occurs with Middle Palaeolithic assemblages and therefore is of little help in dating.

The ash of Bori on the Kukdi River, in association with Acheulian artefacts (Kale et al. 1986), was dated to about 650,000 BP by TL and U/Th methods (Mishra et al. 1995). Didwana has U/Th ages of the Acheulian of more than 390,000 years (and above it there also exists a U/Th date of $144,000 \pm 10,000$ for the Middle Palaeolithic (Mishra 1992). Nevasa gave an age of more than 400,000 and Yedurwadi (on the Krishna River) of more than 400,000 years. This means that the Acheulian in India existed at least prior to about 200,000 years.

A cranium of an advanced *Homo erectus* was found at Hathnora near Hoshangabad in the basal gravel of the Narmada. From the same deposit, Acheulian tools were recorded earlier, similar to those of the later Acheulian from the Bhimberka rock shelter (Sonakia 1984; de Lumley & Sonakia 1985). It is the only fossil hominid remain from any Palaeolithic period in the entire Indian subcontinent.

In Nepal, Early Palaeolithic sites are connected in all three cases with fluvial deposits along riverbanks, like the majority of such Indian sites. At the Gadari site, Acheulian man occupied a thin bed of colluvial rubble gravel on the ancient river-cut bedrock which was buried subsequently under fluvial-lacustrine sediments. The Tui valley Early Palaeolithic occurrence is situated on a basal gravel laid down under high energy fluvial activity. The Sarpati Acheulian site, though, stands out as an exceptional site situation, not found in India, being embedded in a tectonically affected sandstone within Upper Siwaliks. The original occupation was, however, also on a sandy beach of a braided river at the foot of the rising Himalaya.

The paucity of tools from the Nepal sites makes a comparison with Indian sites difficult. There is only one cleaver at Gadari, and none at Sarpati. The handaxes are bifacially trimmed with bold flaking and controlled step flaking at Gadari as well as at Satpati. There are no choppers connected with the Early Palaeolithic of the Dang and Tui valleys (in India most Acheulian sites are associated with choppers), but the scarcity of tools allows no conclusions to be drawn about the presence or absence of cobble tools. There is, however, a chopper element in the Satpati assemblage.

No faunal remains have been found at the Dang and Tui sites, but the sandstones at the Satpati site are fossiliferous, containing fragmentary calcified bones, a molar of *Bos namadicus* and a large vertebra of *Bos* or *Bubalus*. It is hoped that more fossils will be found at Satpati which will provide clues to the age of these terminal Siwalik Acheulian occurrences in the folded sandstones. The association with fauna makes this unique site doubly significant. In India Acheulian sites, too, are rarely associated with fauna, the Narmada sites, the Chirki site and the Godavari site being exceptions.

2.2. The Middle Palaeolithic period

The Acheulian culture slowly developed into the Middle Palaeolithic in India and other parts of the world. Significant changes in the tool kit and its technology took place during this period. In India the Late Acheulian included the first use of the prepared levallois core technique in association with handaxes and cleavers, while the Middle Palaeolithic continued, in its initial stages, to use handaxes and cleavers, and also heavy duty-tools in the form of choppers and polyhedrons, but these slowly disappeared. In their place smaller tools, made on flakes and blades, were used. Various kinds of scrapers, points, borers and denticulates are the most common tool types of this period. The now well-developed technique of prepared cores of discoidal and levallois types allowed flake tools to be fashioned according to a sophisticated preconceived notion. The use of raw material also became more varied: quartzite, basalt and dolerite was still used, but finer rock materials of chert, jasper and other siliceous rocks came increasingly into use.

The Middle Palaeolithic culture as a flake industry succeeding the Indian handaxe-cleaver industry has been recognised in India only since 1956 (Sankalia 1956). Todd (1939) had previously found a flake in-

dustry on top of a clay below a Late Acheulian-bearing upper gravel at Khandivli, which he called a blade industry with scrapers, blades and cores. And Cammiade & Burkitt (1930) had come across a flake tool industry in the eastern Ghats which they called a Series II industry of flake tools, saying that „a handaxe industry was followed by one of flakes“ (Cammiade & Burkitt 1930). They grouped into the Series II industry flake tools, flakes and small bifaces. Then Sankalia (1956) designated such flake tools at Nevasa also as Series II (which he later called „Nevasian“ or the Indian Middle Palaeolithic (Sankalia 1962,1974). Later still, he discussed this industry as „the Indian Middle Stone Age“ in accordance with its stratigraphical position in fluvial gravels and described the principal tool types (Sankalia 1964). Thus this flake industry was called in India either Series II, the Nevasian, the flake-blade industry, the Middle Stone Age or the Middle Palaeolithic.

Middle Palaeolithic sites in India are less abundant than the earlier and the later industries. But they are found in the same regions and habitats as those occupied by the preceding Acheulian population. They occur at open air sites along rivers, for example the Narmada River (Allchin 1959; Khatri 1958), the Son River (Sharma & Clark 1983), the Tapi river basin (Sali 1990b) and the Krishna river valley (Pappu 1974). They also occupied stable sand dune surfaces in Rajasthan (Misra & Rajaguru 1986), as well as rock shelters in Central India, for example in Adamgarh (Joshi 1978) and Bhimbetka (Misra 1985b), which also contained Late Acheulian occupations; further they occupied the Deccan Plateau (Sankalia 1956; Paddayya 1974) and the Eastern Ghats (Isaac 1960; Murty 1966; K.T. Reddy 1968).

Nevasa, in Maharashtra, was the first site where tools of the Middle Palaeolithic period were recognised as such in their stratigraphic and cultural context. Sankalia (1956) recorded Series I tools (Acheulian) at Hathi Well in a basal Gravel I. Above a fissured clay he reports tools of Series II in Gravel II. The Series II tools are scrapers, points, borers, a few blades, burins and many flakes and cores. Flakes were also fashioned from levallois and discoidal cores. They are all made from jasper, chert, chalcedony etc. Sankalia called the flake-scraper industry the „Nevasa Series II“ and said that its components are similar to those found by him at Nandur Madhmeshwar on the Godavari. He went on to say that „we have to deal here with two tool-making traditions: an earlier (handaxe-cleaver) tradition and a later (flake and blade) tradition, which flourished side by side for some time, though gradually the latter seems to have ousted the former“ (Sankalia 1956,40); and that: „there is no doubt that the handaxe-cleaver industry was followed by a flake-blade-scraper industry“, indicating thereby for the first time the chronological succession of a Middle Palaeolithic culture (though he did not yet call it such) following the Acheulian one.

Later Joshi (Joshi et al. 1979/80) placed a similar flake-blade-scraper industry from the Central Godavari River in Maharashtra definitely within a period older than 40,000 years BP and called it a Middle Palaeolithic industry. He found an earlier Middle Palaeolithic industry in the older, high-level gravels of the Godavari River near Paithan and a younger Middle Palaeolithic industry in a subsequent alluvial fill of the Godavari, which was dated by ^{14}C to $19,025 \pm 600$ BP (Rajaguru 1970). The tools are consistent with other Middle Palaeolithic assemblages, mainly scrapers, points, borers, some blades and burins, all made from chert, jasper and other siliceous material.

At Adamgarh Hill, in Central India, Joshi (1978) conducted excavations near the rock shelters with Early Palaeolithic artefacts. Above the horizon with an Early Palaeolithic (Acheulian) industry he records a tool-bearing talus with a flake industry, which in turn is overlain by microlith-bearing deposits. The tools are: pointed tools (borers and points) and scrapers, mostly made from quartzite. Occasionally there are also flake-blades and a few discoidal cores. The flake tools have no standardized forms. Joshi writes: „Chronologically the industry belongs to the Early Post-Acheulian stage. On typological considerations the tools can be grouped under the Indian Middle Stone Age“.

At Nagarjunakonda, on the Coromandel coast, Bannerjee (1975) recorded two surface sites situated on higher ground, with a horizon of a calcareous tufa under the top soil. An excavation of a talus deposit, that rests unconformably on a cobble deposit containing Lower Palaeolithic artefacts, yielded a Middle Pa-

laeolithic assemblage made from quartzite. The majority are points, then scrapers, borers, unretouched blades, flake-blades and fluted cores. The points are mostly triangular in shape and are made from truncated or snapped blades.

In the middle Son valley, Madhya Pradesh, two sites were excavated: Patpara (Blumenshine et al. 1983) and Nakjhar Khurd (Misra et al. 1983). In Patpara artefacts were found in a redbrown clay as a channel fill. Altogether 2300 artefacts have been collected and 1736 have been analysed from the excavation and surface collections. The industry displays Middle Palaeolithic affinities together with the retention of a minor, though conspicuous handaxe/cleaver element. This industry was called a „Nevasian“ by Jayaswal (1978); the artefacts, mostly flakes and scrapers on flake, being in the Nevasian fashion. At Nakjhar Khurd, artefacts of an early Middle Palaeolithic industry (with bifaces) occur in a gravel resting on the eroded surface of a clay above bedrock. Some Micoquian-like handaxes with thick butts and some cleavers occur in association with a diminished flake element. The Middle Palaeolithic here still remains inadequately understood.

At Patne, in the central Tapi basin, in Maharashtra, (Sali 1990a) three phases of the Middle Palaeolithic were recognised: early, middle and late. The artefacts derive from gravels and silts overlying unconformably a horizon of Early Palaeolithic artefacts. In the early phase, the tools were made from tachylite, an intertrappean rock, and many surface sites were found in the vicinity of such raw material. Tool types are scrapers, points, borers, blades, and burins made on flakes, and even choppers, made on cores. In the second phase, the use of raw material shifted from tachylite to purely siliceous raw material, chiefly jasper and rarely chert and chalcedony. The tools are the same as those from the early phase. In the advanced or end-phase, jasper continued to be the chief raw material. Tool types are again similar to those of the earlier phases. There is a progressive decrease in the size of tools from the early to the advanced phase. The industry of the second phase is akin to the Nevasian, but that of the early phase seems to be quite distinct from any other known industries in India. According to Sali, the Middle Palaeolithic industries covered the early part of the Late Pleistocene. On the basis of a ^{14}C date of 25,000 BP from ostrich eggshell pieces for the late Upper Palaeolithic at Patne, Sali assigns the advanced Middle Palaeolithic phase to about 40,000 years BP and suggests that the beginning of the Middle Palaeolithic period may be around 100,000 BP.

The only well-developed Middle Palaeolithic site in Nepal is that of Arjun 3 in the Deokhuri valley in stratified context well below the surface of the high terrace. The occupants of Arjun 3 still employed quartzite for their raw material but chose fine-grained, conchoidally breaking varieties, which were available as cobbles in the river. Unlike in India, where chert and other siliceous rocks were available in many areas, it is a rare occurrence in the Dun valleys in Nepal and so the people continued to use quartzite. This difference in raw material masks the similarities to sites in India to some extent. The closest resemblance of the Arjun 3 industry is to the Middle Stone Age site of Nagarjunakonda on the southeast coast of India, which is also based on quartzite (Bannerjee 1975).

Knowledge about environmental conditions during the Middle Palaeolithic in India is rather limited. The best evidence comes from the Thar desert in western Rajasthan, where the climate during the late Middle Pleistocene and early Late Pleistocene fluctuated from arid to semi-arid and back several times (Misra & Rajaguru 1986). During the wetter periods the dunes stabilised. Sites in western Rajasthan, for example Didwana, have revealed that the Middle Palaeolithic groups occupied stabilised dune surfaces, and that these occupations in favourable times „extended right into the harsh core of the desert as revealed by the discovery of assemblages of this culture around and north of Jaisalmer“ (Misra 1987a). The excavation of a fossil dune, 16R, at Didwana reaching through the Upper and Middle Palaeolithic to the Lower Palaeolithic at the base have yielded valuable dates. The Middle Palaeolithic was dated at the lower end to between 163 and 144 ka (Misra & Rajaguru 1986) from strongly pedogenised sands. Above it an Upper Palaeolithic horizon in calcretised sands provided a ^{14}C age of 26,210 BP. (The OSL dates from the Upper

Palaeolithic Gadari site corresponds well with the latter date at Didwana). In the rest of India there is very little data about environmental changes.

The site of Arjun 3 in Nepal is positioned, after a prolonged period of high-velocity fan gravel deposition, at the base of a thick deposit of mottled silty clay which has undergone pedogenetic changes that would indicate a change of environment from a humid climate to drier conditions. This can tentatively be connected with the end of the last interglacial period, maybe some 75,000 to 80,000 BP. Results of OSL dates from this site have more or less confirmed this. In India, the Middle Palaeolithic has been provisionally dated to between 40,000 and 150,000 years BP, based on a series of TL and U/Th decay series dates from dunes with early Middle Palaeolithic associations in western Rajasthan, which range from 150,000 to 100,000 BP. The Middle Palaeolithic in India thus persisted over a long period of time covering the terminal Middle Pleistocene and the greater part of the Upper Pleistocene.

Faunal remains, too, are scarce in India and are absent in Nepal. In the Narmada valley, the Upper Group of the Narmada alluvium comprises a fauna largely similar to that of the Lower Group of the Middle Pleistocene, with *Bos namadicus*, *Equus namadicus*, *Hexaprotodon palaeoindicus*, *Elephas hysudricus*, *Stegodon insignis-ganesa* and *Cervus* sp., which suggests savannah grasslands, probably interspersed with swamps and forests (de Terra & Paterson 1939; Badam 1979, 1984).

No fossil remains of the hominids responsible for the Middle Palaeolithic industry have been found in India.

2.3. The Upper Palaeolithic period

In Nepal there seems to be a long gap of occupation between the Middle Palaeolithic of the Arjun 3 site and the Brakhuti industry of a non-microlithic culture of the Late Stone Age. In contrast to India no typical Upper Palaeolithic culture with blades and blade tools, burins, borers, points and blade cores has so far been discovered.

In India the Upper Palaeolithic is well represented, especially in Southeast India, where, though, it has been recognised as such only since about 1972, when Murty described an industry at Renigunta in those terms (Murty 1970, 1979). Later Raju (1981, 1985) described Upper Palaeolithic artefacts from the Cuddapah District. Sali (1985) described another Upper Palaeolithic industry at Patne, Maharashtra (in his phase II). Based on their work in the Middle Son valley, Kenoyer et al. (1983) describe an Upper Palaeolithic at Baghor I, while in the Belan valley an Upper Palaeolithic culture of blades and burins was recorded by Sharma (1980). At Inamgaon, Maharashtra, Rajaguru discovered an Upper Palaeolithic site on the Ghod River (Rajaguru et al. 1980), which was assigned to the later part of the Upper Pleistocene (between 40,000 to 12,000 BP). Formerly this culture was called various names: „Series III“ by Sankalia, and then „blade-and-burin“, „blade-tool“ or „flake-blade“ industry by others.

Upper Palaeolithic man lived along riverbanks, at the foot of hills and in caves and rock shelters. The raw material tended to be mostly chert, jasper, fine-grained quartzite, quartz, black lydianite and agate, and chalcedony only in the later stages. The industry is almost entirely blade-based. The technology of the Upper Palaeolithic is similar to the microlithic technology of the Mesolithic period. It is a blade-burin industry fashioned from specially prepared fluted cores, and the majority of tools were made on blades. The raw material, too, is the same. The blade tools, however, are altogether larger in size and not microlithic in the true sense, though they do decrease in size in the course of time. Geometric forms, as found later during the Mesolithic, are absent.

Characteristic tool types are first of all blades and burins, then scrapers, knives, points, borers and awls, and sometimes small choppers. Blades were often used as such, unretouched. But many show a variety of retouch, especially the steep blunting retouch on backed blades. Some blades were converted into end-

scrapers. The average length of blades is from 1.8 to 5.5 cm. Burins were made not only on blades but also on flakes and nodules. A special form of core production was used for making blades, e.g. the fluted cores with a single platform (conical or cylindrical) or opposed platforms (cylindrical). The blade technology was used over a long period of time, indicating a continuity of this technology from the pre-food-producing stage of the food-gathering and hunting life-styles of the Upper Palaeolithic to the food-producing life-styles in the Holocene and continuing even into the early historic periods in isolated niches of tribal populations (Jacobsen 1970). It suggests a long period of co-existence between the hunting-gathering way of life and Chalcolithic farming, and the even later urban phases of Indian history.

There is also evidence during this period of working on bone, at the Billa Surgam cave in Kurnool District (Foote 1916) and in Muchchatla Chintamani Gavi cave in Andhra Pradesh (Murty 1974). According to Foote, these bone tools are comparable to those of the Magdalenian of France.

In addition to stone and bone tools, there is the first evidence of ornaments and art. Ornaments made of ostrich egg-shells (OES) and mollusc shells are known in the form of beads and bead fragments (from Parne), and of beads of the marine mollusc of *Oliva* (Parne). Such marine beads suggest long trading journeys to people on the coast. Engraved ostrich egg-shell pieces from Parne represent the first evidence of art (Sali 1985). Wakankar (1976) has described rock paintings from the Bhimberka cave, the earliest of which may well belong to the Upper Palaeolithic. He also describes engravings from there, and compares them to the Magdalenian rock engravings in France.

The environment during the period of the Upper Palaeolithic was subjected to drastic fluctuations in climate and vegetation. The terminal Pleistocene witnessed intense glaciation in the high latitudes and extreme aridity in many parts of peninsular India, resulting in a drastic reduction of the vegetation cover. This contributed a considerable increase in the amount of colluvial sediments washed into the upland rivers. Due to the decreased discharge and the increased sediment load, most of the rivers in the upper Krishna, Godavari and Bhima valleys in Maharashtra underwent a phase of aggradation during the time between 19,000 and 12,000 BP (Rajaguru 1983; Kale & Rajaguru 1987). Palaeoclimatic evidence thus suggests that India experienced, like other parts of the world, intense climatic changes during the peak of the last glaciation, i.e. around 20,000 BP. Such changes must have affected, maybe even more strongly than elsewhere, the Himalayan foothills in both Nepal and India.

The fossil record of the Late Pleistocene comes from river deposits and from caves. The Kurnool caves in Southeast India offers the richest record, with evidence of monkey, hare, civet cat, felis, porcupine, horse, chital, nilgai, *Bos*, *Bubalus*, *Antelope*, *Cervus* and *Gazella*. (Murty 1974, 1975), while Badam (1979) also mentions wild boar, pig, sambar, rhinoceros and even hippopotamus (extinct in India now). Herbivorous animals have also been recorded from gravels at Inamgaon (Rajaguru et al. 1980). The presence of these latter animals suggests that the environment was not as harsh as the semi-arid climatic conditions would imply. Such herbivorous animals would require a grassland environment with pockets of open woodland. It is interesting to note that the ostrich, an animal adapted to desert and semi-desert regions, was apparently also widespread during this period in India.

The evidence of the ostrich eggshell fragments and beads in cultural assemblages of the Upper Palaeolithic indicates that the ostrich was a common animal in West and Central India in the Late Pleistocene, though it became extinct there before historical times. OES pieces have been recorded from more than 40 sites in different areas of Rajasthan and in Central India. At Parne in the Tapi basin they have been found in levels of the Middle Paleolithic and the Upper Palaeolithic (Sali 1990a). The absence of OES in southern and southeastern India shows that the ostrich was common in the more arid parts of West and Central India, but not so in the east, which is thought to have been more humid.

Unfortunately no fossil bones of any fauna have so far been recovered from Nepal from the Late Pleistocene period. It would be interesting to know what fauna inhabited the foothills in Nepal in this coolest period of the last glaciation and what ecological conditions may have existed for the human population.

In India, the restricted food resources must have led to a decrease of population in the arid-to-semi-arid areas of western and Central India, as evidenced by the scarcity of sites. It is only in the relatively humid areas of the Eastern Ghats, that sites of the Upper Palaeolithic are more concentrated (Murty 1970,1979; Murty & Reddy 1976; Paddayya 1970; Reddy 1970; Raju 1985,1987).

A number of ^{14}C dates have been obtained for the Upper Palaeolithic.

Inamgaon:	21,110 \pm 675 BP from shells
	18,750 \pm 350 BP from shells
Belan valley:	19,175 \pm 340 BP from shells
	25,790 \pm 830 BP from shells
Middle Son valley:	11,870 \pm 120 BP from shells
	26,250 \pm 420 BP from shells
Patne, phase IID:	25,000 \pm 200 BP from OES

At Patne the 25,000 age is from the upper level of Sali's Upper Palaeolithic period IID, and that author presumes that the Upper Palaeolithic starts from roughly 35,000 BP.

The earliest dates so far obtained for an Upper Palaeolithic industry is from the site of Palayatha Chandrasal near Kota, with dates of 36,550 \pm 600 BP and 38,900 \pm 750 BP (Namby & Murty 1983). The Upper Palaeolithic culture, thus, ranges roughly between 40,000 and 12,000 BP.

Only a limited number of sites are known in India. Some of the more important Upper Palaeolithic sites will be described below.

The most typical Upper Palaeolithic industries in India come from the Eastern Ghats in Southeast India (Kurnool, Cuddapah, Chittoor districts in Andhra, Orissa); Renigunta (Murty 1970,1979), Chittoor, Andhra; Vemula (Reddy 1970), Cuddapah, Andhra; Vodikal, Beellu (Raju 1985, thesis), Cuddapah, Andhra; Gundlakamma valley (Isaac 1960), Kurnool, Andhra; Kurnool caves (Murty 1974, 1975, 1979; Murty & Reddy 1976); Gambheeram valley (Reddy & Prakash 1985), NE Andhra; Paleru valley (Rao 1979), Andhra; Shorapur Doab, Karnatak (Paddaya 1970), Mysore; Singhbhum (Ghosh 1970), Orissa; but also in other areas: Inamgaon (Sali 1974), Maharashtra; Bhokar (Joshi & Pappu 1979), Godavari basin, Maharashtra; Parne (Sali 1985), Tapti basin, Maharashtra; Belan valley (Sharma 1973), Uttar Pradesh; Son valley (Sharma & Clark 1983), Madhya Pradesh; Bhimbetka and Raisen rock shelters (Misra et al. 1977), Madhya Pradesh.

Cammiade and Burkitt (1930) were the first scholars who distinguished a blade-tool industry in South-east India. They describe a flake and blade-tool industry at two sites in Kurnool District, south of the Krishna River, calling it the „Series III“ industry, which contains backed blades, burins and crescents. Later Isaac (1960) worked there and found 35 sites of the Series III industry in the gravel of the Terrace II, containing tools made on flakes and blades: points, scrapers, blades, burins, axe-like implements, trapezoids, crescent-like artefacts and awls.

Earlier, in 1885, Bruce Foote had excavated one of the caves in the limestone area of Kurnool, the Billa Surgam cave. He recorded animal bones and bone tools, which he compared to those of the Magdalenian in France.

Later Murty (1974) excavated another cave, the Muchchatla Chintamani Gavi cave, in the Kurnool area, which yielded an Upper Palaeolithic industry of mainly bone tools (90.3%) and only 9.7% of stone tools. The bone tools include scrapers, perforators, chisels, scoops, ranged points, barbs and spatulae. This site is important because of the rich fauna associated with the tool assemblage.

Further south, in the Renigunta area, Chittoor District, in Andhra Pradesh, Murty (1970,1979) recognised for the first time an Upper Palaeolithic industry, characterised by a blade-burin industry containing blades, backed blades, points, knives, scrapers and triangles. He assigns this assemblage, based on a

blade-tool technology, to an industry occurring in post-Middle Palaeolithic and pre-Mesolithic contexts in India and filling a gap in the Indian Stone Age sequence. He divides it into three techno-typological groupings: 1) a flake-blade industry, 2) a blade-tool industry, 3) a blade-burin industry.

The flake-blade industries are characterised by relatively broad blades. Scrapers, points and borers, made on flakes and flake-blades, are the common type. These industries are better known from Singhbhum in Bihar (Ghosh 1970).

The blade-tool industries are large-to-small-sized tools, made on flakes, flake-blades and blades, and consisting of blades, backed blade-tools, scrapers, points, burins and awls. This industry, of wide distribution, has a higher standard of the blade-tools.

The blade and burin industry is predominantly characterised by blade, backed blade and burin elements. The riverine sites around Renigunta provide the best-known data. The blade and burin assemblages form a distinct techno-typological entity on the Southeast coast of India, with localised variants. The raw material is always quartzite. Murry assigns an age of ca. 20,000 to 10,000 BP to the Upper Palaeolithic, based on several radiocarbon dates from the Belan valley, Inamgaon and Patne.

The same author opines that the Kurnool cave fauna indicates a forested and grassland habitat and that the occurrence of *Hexaprotodon palaeindicus* points, in addition, to pools and swamps. It is probable that the Southeast coast of India preserved a more humid environment during the peak of the last glaciation than West and Central India.

Another area with Upper Palaeolithic sites in the southeastern area of India is in Cuddapah District, Andhra Pradesh. Raju (1985) explored three sites at Beellu, Rallachenu and Vodikalu (which he excavated), all with an Upper Palaeolithic blade industry. Predominant tools are backed blades and a few burins, made from quartzite and lydianite, with average sizes of 30-60 mm, i.e. bigger than the Mesolithic assemblages.

In Central India, and more so in western India, particularly Rajasthan, sites of the Upper Palaeolithic are scarce, which according to Misra (1989) is due to the severe environmental conditions.

At Bhimberka near Bhopal, Misra et al. (1977) found a not very distinct Upper Palaeolithic industry in a cave (II F-23) above a Middle Palaeolithic horizon which they describe as having developed out of the indigeneous Middle Palaeolithic culture. The assemblage consists of blades, burins, end-scrapers, side-scrapers, points and flakes. The end-scrapers are the most characteristic tools. Earlier Wakankar (1976) had found Upper Palaeolithic artefacts in another cave at Bhimberka, cave III-A-28.

In the Son and Belan valleys, in Central India, Upper Palaeolithic blade-burin industries have been recorded by Sharma (1980), Pant (1982) and Kenoyer et al. (1983). A number of radiocarbon dates have been obtained from them: from the Belan valley two dates ($19,715 \pm 340$ BP and $25,790 \pm 830$ BP), and from the Son valley another two dates ($13,145 \pm 140$ BP and $12,810 \pm 220$ BP), both from the Upper Palaeolithic horizons (Mandal 1983).

From Maharashtra, too, a few sites have been recorded, the most important ones being that of Inamgaon on the Ghod River, in Poona district and Patne in the Tapti basin. At Inamgaon, Rajaguru et al. (1980) discovered an Upper Palaeolithic industry in the lowest gravel of a 15 m-thick alluvium with backed blades, simple blades, points, burins and fluted cores. He says that „it is the earliest microlithic site so far reported in India“, with a date of $11,700 \pm 150$ BP determined from shells. But Sali (1990a) records ^{14}C dates of $21,110 \pm 615$ BP and $18,750 \pm 350$ BP from shells. The basal gravel on the Ghod River yielded bones of *Bos namadicus*, *Elephas maximus*, *Equus maximus*, *Cervus* and *Bubalus* together with Middle/Upper Palaeolithic tools and shells, dated to ca 20,000 BP (Kajale et al. 1976).

At Patne in the district of Jalgaon, Sali (1985) records an Upper Palaeolithic industry with two phases in the Tapti basin: an early phase and a late phase. The Upper Palaeolithic here is based on mass production of blades, produced by indirect percussion or punch technique, from fluted cores, cylindrical or prismatic. The Upper Palaeolithic tool kit of Patne is dominated by blades and tools made on blades. Blades and

burins can be regarded as the characteristic tools, as with the Upper Palaeolithic in Europe. Many blades are without retouch, but backing is common. Points and borers are mostly made on blades, while scrapers (usually end-scrapers) are made on flakes. Lunates (on blades) appear in period IID and triangles and trapezes (on blades) appear in the overlying IIE.

After his Period I, the Middle Palaeolithic, he distinguishes several Upper Palaeolithic periods:

Period IIA: decrease in flake tools; increase in blade tools.

Period IIB: firstfully backed blades, also burins and borers; less jasper, but more chalcedony.

Period IIC: chalcedony becomes the chief material; reduction in tool size; increase in blades and burins.

Period IID: in layer 7, in a fissured clay with *in situ* weathering, representing a soil, a land surface; 12,300 artefacts with OES pieces, some engraved ¹⁴C on OES: 25,000 ± 200 BP; maximum reduction of size.

Period IIE: appearance of geometric forms; transition to the Mesolithic.

The beginning of the Upper Palaeolithic at Patne may well go back to 35,000 BP, and it lasted till about 10,000 BP.

In Kandivli near Bombay, Todd found in 1939 a blade and burin industry in two horizons, with microliths on the surface.

At Nevasa on the Pravara River, Sankalia et al. (1960) found a blade industry, which he called Series III, consisting of blades and burins in a gravel which he dated to the Late Pleistocene.

Palaeolithic industries in Northeast India and Assam are poorly known. Sharma (1985) records what he calls an Upper Palaeolithic assemblage from the Rongram and Ganol valleys in Assam. „Although several sites in the Rongram and Ganol valleys yielded rich artefact assemblages, it is yet not possible to place them clearly into the stratigraphical sequence“ (p.171). He records a stratified site at Michimagiri containing blade tools associated with scrapers, points and a few choppers, cleavers and handaxes (the latter, which I saw in Poona, probably being blanks for Neolithic axes). The tools have no similarity with the Early Holocene Patu industry in eastern Nepal, which had been suggested by some Indian scholars.

General Remarks: The tool assemblages of the mentioned sites all describe a distinct blade-burin industry which is less well developed and less abundant in western and Central India, but quite the opposite, and with distinct tool types, in eastern India. Such industries are completely lacking in Nepal.

The environmental and climatic conditions, suggested by the analysis and interpretation of the various sites in India are of an intense nature: much drier and cooler than the present ones.

The absence in Nepal of a true Upper Palaeolithic in the Indian tradition would imply that human occupation was scarce or absent during that time and that migration started again only after the climatic conditions became more favourable for life in the hills, namely at the end of the Pleistocene and the advent of the microlithic population. Instead of an Upper Palaeolithic blade-burin industry there is the chopper-corescraper-flake assemblage of the Brakhuti industry which lacks blades and microlithic elements. Embedded in the upper part of the older alluvium in the Dun valleys, it is of later Late Pleistocene age. Preliminary OSL datings have provided an age of around 20,000 to 24,000 BP for this industry. Such an age compares well with ages obtained for the Indian Upper Palaeolithic, though its corresponding tool kit is very different, probably made by an entirely different population, unrelated to the Upper Palaeolithic hominids of India.

The fact that it is found in such abundance in Nepal suggests that the climate and the ecological conditions were sufficiently favourable for human subsistence for this population, however cold and dry it might have been. The heavy-duty tools of the Brakhuti tool kit indicate wood-working activities in a forested habitat.

In India, the Upper Palaeolithic succeeds the Middle Palaeolithic and precedes the Mesolithic. The same can be said about the Brakhuti industry which is succeeded by a microlithic industry, brought to Nepal by new populations from India.

The characteristic tools of the Upper Palaeolithic in India are small blades and burins detached from specially prepared fluted cores. Tanged points, used as arrowheads indicate the presence of bows and arrows. Scrapers made on flakes suggest the continuity of the Middle Palaeolithic tradition. When the lithic assemblages from the various sites in India are compared a rather heterogeneous picture seems to emerge, one with marked regional diversity. Misra (1989), summing up, states that „the terminal Pleistocene lithic assemblages in most of the regions in India exhibit a predominant component of amorphous elements“.

In India, tools and ornaments are recorded on bones, antlers, ostrich eggshells and marine shells are recorded. Engravings and paintings of birds, animals and humans are known from several cave sites around Bhimbetka. Nothing similar has come to light so far at the Brakhuti sites. In Europe, cave paintings and engravings date from this period, as well as small objects d'art. No palaeolithic cave sites are known from Nepal.

In Europe, the Upper Palaeolithic is connected with *Homo sapiens sapiens*; in India no skeletal remains have been found. The same is the case for all periods in Nepal. But rich fossil remains of animals in Late Pleistocene river deposits and in caves reveal the variety of animals on which man preyed in India. The ostrich was still living during the later Pleistocene in India, and was being hunted by man: pieces of their eggshells were found in a number of Upper Palaeolithic sites, some of them engraved, and they were also made into beads. The ostrich probably never lived in Nepal and no eggshell fragments have been found.

2.4. The Microlithic culture

The Mesolithic industries in India are a continuation of the later Upper Palaeolithic with the addition of mass production of blades. The full development and wide distribution of the microlithic industry took place only in the Holocene, although the beginning was in the terminal Pleistocene.

The Mesolithic period is known from many sites and many ecological settings in India. The microlith-using people extended human colonisation into areas previously unoccupied, and exploited a great variety of habitats and food resources. They settled on desert dune tops (Gujarat, Rajasthan), in rock shelters (Central India), in caves (in Kutnool), on coastal dunes, on hilltops and on rocky outcrops, on the shores of ox-bow lakes and rivers and in hitherto unoccupied forests. In the Deccan Plateau they occupied almost every hill and rocky eminence.

The great increase in the number of occupation sites in India suggests a significant and rather dramatic growth of population: for example, in the Bhimbetka area earlier Palaeolithic remains are found only in a few shelters, while the microlithic settlements are found in almost all shelters. The use of bow and arrow was known, which improved the hunting methods. Querns and grinding stones indicate the processing of food. The increased rainfall after the end of the Pleistocene suggests an increase in plant growth and animal populations, which in turn assured a greater availability of food.

The characteristic microlithic tools, usually smaller than 1-5 cm in length, were made from micro-blades and include all types of blade tools, retouched and backed blades, lunates, penknives, and perfect geometric forms (triangles, rhombs and trapezes). Small tools made on flakes are also part of the microlithic industry, especially scrapers; the development of end-scrapers, particularly of thumbnail-scrapers, is best seen at Bhimbetka. The raw material of the artefacts is chiefly chalcedony, quartz and other crypto-crystalline silica. The microliths were used as composite tools hafted in bone and wood or antler, as sickles, saws and knives. The manufacture of such composite microlithic tools in much greater variety and greater abundance than in the preceding period suggests very specialised methods of food procurement and leads to the assumption that food was increasingly processed and not only gathered.

The use of bone tools, which developed in the Upper Palaeolithic, continues in the Mesolithic. Bone tools include arrowheads, points, scrapers and saws.

Besides stone tools, a number of sites have brought to light evidence of structures. Stone-lined circular huts are seen at Bagor and Tilwara, and the traces of post holes at Baghor II, Patne and Birbhanpur suggest that huts of a circular or trapezoidal shape were erected.

The subsistence pattern of the microlithic people is well known from the large quantities of animal bones found as food refuse in the excavations of sites at Langhnaj, Bhimberka, Bagor (Rajasthan), Adamgarh and the Kurnool caves. The bones include many kinds of wild animals, most commonly buffalo, humped cattle, sambar, chital gazelle, nilgai and hog deer, and also fox and jackal, and tortoise and fish. The hunting methods were by the use of bow and arrow and spears as seen in the rock paintings at Bhimberka. Evidence of domestication of cattle, sheep and goat comes from excavations at Bagor (Misra 1973) and Adamgarh (Joshi 1978). Bones are often charred, indicating that they were roasted over fire. Paved stone floors were found as butchering areas.

The presence of carbonised grains of wild rice in association with querns at Chopani Mando indicates the harvesting and grinding of wild grains (Sharma et al. 1980). Ill-baked pottery, probably for storage, is known from Langhnaj and Adamgarh.

There is rich evidence for the art of painting among the microlith-using peoples in India. The earliest reliably datable rock paintings belong to this stage (Mista 1985a; Misra et al. 1977). Several thousand painted rock shelters are known mainly from around Bhimberka, Bhopal and Raisen in Central India (Wakankar & Brooks 1976). They provide a glimpse into the life-styles of the Mesolithic people. Since the older paintings depict only a hunting-gathering way of life, they must be associated with the microlithic occupants of the shelters. Pieces of haematite with ground facets are commonly found in the microlithic deposits of the shelters.

There certainly was a great increase in material possessions among the microlithic people: grinding stones for food-processing, sling balls, spears and bows and arrows as weapons, ring stones for digging, stone hammers and other tools of stone and bone, and ornaments of antler, bone and shell. The collecting of food, including honey, is depicted in the Bhimberka paintings. Limited knowledge relating to the making of huts and other constructions is also reflected in the paintings. Weaving must have been known, as seen in the paintings where human figures are wearing some kind of dress around the waist. Dentalium shells were used as decoration at Langhnaj, and other decorative items, such as feathers for head gear, are seen in paintings. Trading and bartering, too, must have been known: cowrie shells from the sea coast found in loessic deposits at the sites of Chaupala in Dhule District and Nevpuri forest, near Aurangabad, far away from the sea, must have been traded. Raw material from distant areas was used. In burials in Mahadaha in the Ganges valley earrings and necklaces made from bone and antler were found as ornaments on the skeletons.

Mesolithic people were the first to perform systematic burials for their dead. In Bhimberka and Mahadaha burials were found in an extended position, at Langhnaj and Bagor in a flexed position.

Thus the Mesolithic period witnessed an increase in human activities, both material and spiritual: new tool forms, the beginning of pottery-making, the storage of food grains, the domestication of animals, the construction of huts with paved floors, trading, long-distance contacts, burial customs, cave art, cloth-making and body decorations are all evidence of a new life-style.

The microlithic-using hunter-gatherers came into contact with more advanced settled agricultural communities of the Chalcolithic and even Harappan culture. The evidence of such direct or indirect contact is seen in the appearance of stone beads, pottery and metal tools in Mesolithic levels of the microlithic hunter-gatherer communities. Mista (1985, p.120) suggests that „the aboriginal communities living today at the foot of the hills containing prehistoric shelters and practising a mixed farming and hunting-gathering economy are almost certainly in the direct line of descent of the stone age hunter-gatherers“. He mentions a copper knife found at Langhnaj, in the middle levels, which could only have come from the Harappan

sites in the neighbourhood. He also mentions copper arrowheads, handmade pottery and stone beads in the Mesolithic level at Bagor, and painted Chalcolithic pottery in the Mesolithic horizon at Bhimbetka.

The chronology is still far from secure. ^{14}C dates gave ages at:

Inamgaon:	c.12,000 BP in association with microliths;
Sarai-Nahar-Rai:	8,395 \pm 110 BC (though from uncharred bone);
Bhimbetka:	7,790 \pm 220 BP oldest date from Bhimbetka;
Adamgath:	7,450 \pm 130 BP;
Bagor:	6,430 \pm 200 BP, earliest date from Bagor.

The beginnings of the microlithic industry have therefore been assigned to c. 10,000 BC. Phase II at Bagor has an age of 4,715 \pm 105 and 4,060 \pm 90 BP for microliths together with copper tools and pottery (chalcolithic). The upper levels at Bhimbetka have readings of between 3,000 and 2,000 BP. The use of microliths completely disappeared only by the beginning of the Christian era.

A few important sites will now be discussed which show, besides the lithic material, other features pertaining to the life-style of the Mesolithic people.

At Langhnaj in Gujarat (Sankalia 1965; Karve-Corvinus & Kennedy 1964) a microlithic horizon is embedded in loessic sands, indicating that the settlement was located on sand dunes. Besides microlithic tools (including geometric forms), there is some ill-baked pottery, dentalium shell beads and haematite pieces, and many associated animal bones (no domesticated species). Eleven burials in a flexed position show mixed mediterranean and vedoid features. Though the ^{14}C date is around 1,900 BC (3,876 BP) they must belong to a time prior to 2,500 BC.

An important Mesolithic settlement was excavated by Joshi (1978) at Adamgarh Hill, near Hoshangabad in Central India. It was embedded in black clay, which was formed on the hill due to wind action in a dry climate. The microliths include backed blades and points, together forming the majority, along with lunates, triangles, trapezes, tranchets, borers, awls, butins and scrapers. Bones of wild animals of horse, sambar, spotted deer and hare are associated with domesticated animals of dog, humped cattle, buffalo, goat sheep, pig. Wheel-made pottery is recorded from this site, probably traded from Chalcolithic people. The site has been assigned to 5,000 BC on the basis of ^{14}C dates.

Another very important site is the rock shelter of Bhimbetka in Central India (Misra et al. 1977). Misra (1985) carried out excavations at the rock shelter III F-23, which yielded, above a succession of Acheulian, Middle Palaeolithic and Upper Palaeolithic horizons, a Mesolithic horizon with a microlithic industry of micro-blades detached from fluted cores of chalcedony and chert. Other cultural material includes querns and grinders, bored stones, haematite pieces with rubbed facets, bone tools within the shelter and rich rock paintings, besides human burials. In the upper part of the Mesolithic horizon were found a few stone beads and fragmentary sherds of plain pottery. The evidence of sherds of painted Chalcolithic pottery in the Malwa tradition and copper objects in the middle levels of the Mesolithic deposits indicates direct or indirect contact with Chalcolithic communities.

In eastern Rajasthan, excavations were carried out by Misra (1971,1973) at Bagor on and in a large sand dune, overlooking the river Kothari. A habitation deposit of a Late Mesolithic culture was underlying a Chalcolithic level. The Mesolithic settlement was in existence during the formation of the dunes, as tools were found throughout the dune. Associated with the microlithic tools are bones, some of them charred, of domesticated and wild animals. One human burial was found in an extended posture. ^{14}C dates point to a late Mesolithic age within the period of around 5,000 BC to 2,800 BC.

In the Damodar valley in West Bengal, Lal (1958) carried out an excavation at Birbhanpur into a Mesolithic occupation horizon on a consolidated lateritic gravel formed under a mild, dry climate, and overlain by wind-blown sands of a still drier climate. The industry lacks geometric forms but has large crescents made on flakes, and is certainly more archaic than the industries from the western and central parts of India, though unfortunately no radiocarbon dates are available.

The Teri sites (Zeuner & Allchin 1956), south of Madras in South India, seems again to represent an older stage of the microlithic. The sites are found on stabilised sand dunes covered by a red soil. The tools include not only microlithic backed blades, lunates, triangles, arrowheads and typical bifacial points, but also small chopping tools. The sites were dated to 4,000 BC on the basis of sea-level changes.

A well-stratified site is Chopani Mando on the Belan River and Mahadaha in the Ganges valley, where Mesolithic groups occupied abandoned ox-bow lakes of the river repeatedly during a time period of 14,000 to 8,000 BC. (Sharma et al. 1980; Sharma 1973). At the excavations at Chopani Mando three cultural phases were recognised: I) the Epipalaeolithic, II) the Early Mesolithic and III) the Late Mesolithic. The earlier part of the Early Mesolithic is without geometric forms, while in the later part a geometric microlithic industry occurs in association with five circular huts, some of them with stone-paved flooring. Phase III represents an advanced stage and is Neolithic rather than Mesolithic. It is marked by the appearance of handmade pottery. Thirteen circular and oval huts were excavated. The floors were littered with microliths, anvils, hammerstones, querns, ring stones and wild animal bones.

Mesolithic communities in India exploited a much greater variety of habitats than their predecessors (Mista 1989). They colonised not only the arid, semi-arid and open woodland regions of western and central India, but extended their occupations into hitherto virgin, forest-covered areas like the alluvial plains of the Ganges valley, the tropical regions of Kerala and the southern Tamil Nadu coast.

The foregoing description of Mesolithic sites in the Indian subcontinent indicates the existence of a great wealth and diversity of sites, some of which have provided us with evidence of the evolutionary stages of the Mesolithic period and the later transition to a fully settled Neolithic life.

In Nepal, the evidence of microlithic populations is still scanty, but it does give us preliminary knowledge of their existence and provides us with the certainty of a continuous prehistoric heritage from the Palaeolithic to the Neolithic. The microlithic population occupied the same areas as their predecessors in the Dun valleys. Only continued explorations will show whether in Nepal, too, the microlithic colonisation is of a denser nature and of a wider extension, like in India.

The closest neighbours of microlithic populations to similar populations in western Nepal are the sites of the forested alluvial plains of the Ganges valley north and south of Allahabad. Nearly 200 sites of this period have been located there, including Chopani Mando and Sarai Nahar south of the Ganges and Mahadaha north of the Ganges on abandoned ox-bow lakes. These sites range from the Epipalaeolithic through the Mesolithic to the Neolithic. Sharma et al. (1980) postulate that the Ganges valley was colonised due to demographic stress and the onset of aridity in the Vindhyan hills, which combined, caused the migration into the hitherto unpopulated Ganges valley, with its assured supply of water and game. The microlithic sites of Dang in Nepal are not more than 300 km to the north of the Ganges sites, and migrations may have been undertaken from there. Whether the Dang sites were occupied only seasonally, like the Ganges sites, is not known. The Mahadaha occupations have yielded a great abundance of animal bones, the majority of them charred, suggesting that the economy of these people was closely linked with hunting. The animal species represented include sheep, goat, followed by cattle, antelope, pig and hippo all belonging to wild species, domestication having not yet begun at Mahadaha (Sharma et al. 1980).

The three major microlithic sites, Lamahi and Bhatarkund in the Deokhuri valley and Ammapur in the Tui valley have provided a first insight into the lithic traditions of the microlithic people in Nepal. These are characterised by a micro-flake and blade-tool technology. The tool types consist of blade-flakes, backed flakes and blades, scrapers (mainly thumbnail-scrapers), lunates and a few geometric tools, which latter, however, are not a distinct element and are not of the classical type found in the Indian Mesolithic.

Apart from the lithic material, no other cultural evidence so far has come to light—no bone tools, no ornaments, no hut-like structures, though this negative evidence may be reversed by excavations. Unfortunately no bones have been found at the Dang microlithic sites, and therefore no conclusions can be drawn as to their economy or life-style.

A significant feature is that all the three sites have a heavy-duty component of unifacial choppers and corescrapers directly or indirectly associated with the microliths. The continued use of choppers in Nepal from the Middle Palaeolithic periods into the microlithic period would indicate a need for heavy-duty tools alongside the small composite microlithic tools. Such tools would be required for work in a more densely forested type of environment rather than in open grassland or within a savannah type of vegetation. Choppers, though only of a small size, are associated in India only with the southern sites of Teri, Sangankallu and Palghar (Kerala), which must have seen, as today, a rather densely forested environment.

Regarding the comparison of the tool types, the most characteristic difference is that the microlithic technology in Nepal is not blade-based as in the Indian Mesolithic, and typical fluted blade cores are absent, apart from a few cylindrical cores. Only an occasional blade element is apparent in Lamahi and Ammapur ill-defined blades struck from single-platform cores. Classical geometric forms of triangles and trapezes are completely absent, only a few microliths resembling geometric forms which are not made from blades and which are not intentionally prepared geometrics, are found.

Most microlithic tools at the three sites in West Nepal, which all belong to the same technological tradition and therefore must all be contemporaneous with each other, are micro-flake tools made on flakes and occasionally on blade-flakes. It is a flake-based microlithic technology. The most characteristic tool type is the thumbnail-scraper, made on flakes struck from small discoidal cores. Next in importance are crescent-shaped backed tools, lunates and backed blade-flakes. The majority of microlithic tools are ill-defined side- or endretouched flakes of microlithic size.

The most important cores are small discoidal ones, along with a variety of small polyhedral, single- or double-platform cores and backed alternate-bifacial cores. Significant is the presence of small-sized levallois cores, and prepared flakes. A few grinding stones are present only at Ammapur, in association with the microlithic artefacts.

The special features of the microlithic sites of the Dang-Deokhuri valleys are: a) the absence of true geometric microliths, b) the presence of levallois elements, c) the presence of heavy-duty tools in the form of choppers and corescrapers, d) the absence of a characteristic blade-based microlithic technology; instead the technology is based on microlithic flakes. In the light of this evidence it seems likely that the microlithic sites of Dang-Deokhuri in Nepal are from an early phase of the Mesolithic or even from a late Upper Palaeolithic phase. The continued presence of a levallois element, the absence of geometric forms and the scarcity of genuine blades suggests a transition from the Palaeolithic to the true microlithic tradition.

The use of microliths in India lasted for a long time, from the Upper Palaeolithic through the Mesolithic and Neolithic periods and continued up into early historic times in isolated niches of tribal populations. The great abundance of microlithic sites in India has given us a good insight into the changes and evolutionary phases of the various stages of the microlithic period. In Nepal we are still far from such an understanding. All we can say at the moment is that microlithic populations migrated into the foothills of the Nepal Himalayas, but at what stage or time this was and in what relation they stood to their Indian neighbours is still too early to conclude, apart from the fact that it has only limited similarities to the well-developed blade-based Mesolithic microlithic tradition of India.

Apart from the presence of a microlithic technology in western Nepal, which certainly had its contacts with India, there existed a completely different Mesolithic tradition in the eastern part of the Nepal foothills: that of the Hoabinhian-like tradition of large adzes and unifacial tools of the Paru industry (Corvinus 1987, 1989). This industry, while certainly belonging to the early Holocene, has no counterpart in the Indian Mesolithic so far. There exist, on the other hand, certain similarities to the Southeast Asian Hoabinhian assemblages, and this points to relations to the east rather than to the south. This will be the subject of discussion in chapter VII.3.2.

3. Comparisons with East Asia and Southeast Asia

3.1. East Asia (China and Korea) and Island Southeast Asia in the earlier Palaeolithic

Though the closest affinities of Nepal's prehistoric cultures from the Early to the Late Palaeolithic are with its southern neighbour India, some reflections on the tool traditions of its eastern neighbours are warranted. One reason is the evidence of a Mesolithic macrolithic cultural assemblage, the Patu industry, in eastern Nepal, which seems to have no affinities or connections with India, but rather with the Hoabinhian tool complex and technological tradition of southeast Asia. This chapter will not deal, however, only with the Hoabinhian of the Late Palaeolithic and Mesolithic, but will go back to the period of the beginning of the Stone Age cultural traditions in the East, as compared to the earliest Stone Age evidence in Nepal, the Acheulian handaxe tradition.

The several sites containing bifacial tools in the Acheulian tradition in Nepal connect this country definitely with the Indian subcontinent and ultimately with Africa. This has been described in the comparative chapter with India. It is, however, interesting at this point to have a look at what lies beyond the so-called Movius Line (Movius 1944, 1948), east and southeast of Nepal, during the earliest Palaeolithic.

The Early Palaeolithic in East and Southeast Asia is recorded in an increasing number of sites, particularly in China, where new research after the long gap of the Cultural Revolution has increased our knowledge considerably. Unfortunately most of the recorded literature is in Chinese and Western scholars have to rely mainly on secondary literature by other Western scholars and the few English publications by Chinese scholars. New findings and new research in China increase with every year, and the potential is enormous, whereas in southeast Asia new records of the earlier Palaeolithic periods are rather sparse.

Homo erectus and his stone tools in East and Southeast Asia (with special comments on handaxe-like tools)

Homo erectus (or *Homo ergaster*) evolved from an earlier stock of *Homo* in the open woodlands of Africa and from there migrated into other parts of the world. He was supposed to have ventured out of Africa some 1.5 m.y. ago and to have colonised Asia and later Europe. But new hominid findings challenge these older theories and new ideas have emerged. The Dmanisi hominids in Georgia have certainly questioned the out of Africa theory of *H. erectus* (Gabunia et al. 1999).

Klein (1999) has recently reviewed the evidence for hominid evolution in Africa and Asia. He prefers to call the descendants of *Homo habilis* in the Africa of 1.8 to 1.7 m.y. ago no longer *Homo erectus* but *Homo ergaster*, and goes on to say that „*H. ergaster* was the first human species to colonise Eurasia, and by 1 m.y. ago it had given rise to *H. erectus* in the Far East“ (p.256). Klein's interpretation (p.274) is „that *H. erectus* developed exclusively in eastern Asia, beginning 1 m.y. ago or before, and that *H. ergaster* persisted in Africa until the emergence of *H. sapiens* or *H. heidelbergensis* 600-500 ky ago“. Since this interpretation, however, new hominid fossils have been discovered in Dmanisi in Georgia of six individuals, dated to 1.8-1.7 m.y., in association with thousands of simple stone artefacts, but no bifaces. The newest and best preserved skull is far more primitive than *H. erectus* and seems to be more akin to *H. habilis* and may be placed between *H. habilis* and *H. erectus* or *H. ergaster* (National Geographic, August 2002). These recent discoveries throw interesting new light on the question of who migrated where and when, and with what tool kit.

The Early Palaeolithic in Africa and the Old World is securely associated with *H. ergaster* and *H. erectus* and his tool kit of well-conceived bifacially worked implements of handaxes and cleavers of the Acheulian

techno-complex. In India, the abundant handaxe-cleaver assemblages have always been regarded as the work of *Homo erectus*, on the basis of comparisons with Africa and the Old World. The first cranium of an advanced *H. erectus* was discovered in 1982.

The data on lithic traditions in East and Southeast Asia is not comparable to that of Europe and Africa, not only because comparatively fewer sites are known and fewer detailed studies are available but also because the chronology of the cultural succession, especially in China, is not yet clearly understood, and, further, because those records are typologically so different and incomparable with those in the West. This induced Movius to propose in 1948 his classificatory concept of the eastern chopper/chopping tool complex as opposed to the handaxe tradition in the West.

Bifacial handaxe-like tools in Southeast and East Asia are a rarity, though they are not totally absent. The scarcity of such tools was one reason why Movius (1948) conceived his concept of two different stone tool traditions. According to him the handaxe tradition is a Euro-African culture (the same applies to India), while beyond it lay the realm of the chopper/chopping tool tradition of East and Southeast Asia.

Movius distinguished four major sub-traditions: the Soan in northwest India, the Anyathian in Burma, the Choukoutian in China and the Patjitanian in Indonesia. But though they all do have chopper/chopping tools as a major element, they differ greatly from each other, given the size of this area. The assemblages of the Choukoutian, Anyathian and the Patjitanian are situated beyond this imaginary boundary; those of the Sonian in northwest India, however, are not, true handaxes being found in the same area as choppers.

The Anyathian in Burma is a badly understood and neglected assemblage of mainly implements made from silicious wood. According to U Aung Thaw (1971) unifacial choppers continue into the Neolithic at the Padah-lin cave.

Movius's simplistic concept has been followed for decades, the idea of a monotonous, unchanging Asian Palaeolithic having been accepted by most researchers. But this concept does not hold true in the light of the new discoveries of the last few decades. „Despite the apparent dichotomy of Palaeolithic assemblages in the two areas the lack of an explanation for this difference has always been the biggest obstacle to the acceptance of Movius' hypothesis, a view forwarded already by Bordes in 1968" (Yi & Clark 1983, p.187).

The progress made in the research of the last 40 years in China, though still scanty in comparison to that in Europe and Africa, however, implies a rather wide range of regionally varying stone tool technologies and tool complexes in East and Southeast Asia, many of which cannot be described any longer in terms of the chopper/chopping tool complex.

Movius's notion of the virtual absence of handaxes has to be viewed with caution, too, given the occurrences of pointed bifacially trimmed tools in the form of handaxe-like implements in East and Southeast Asia (China, Korea, Indonesia), though small in number and only at few places. These occurrences, however, are too far from each other in time and space to have any connections with the Acheulian tradition of the West.

A short résumé of only those sites which have yielded the earliest Palaeolithic remains, and those from which bifacial handaxe-like tools have been reported will be given here.

3.1.1.1. *Homo erectus* in East Asia and the Early Palaeolithic record

In the East Asian region several sites with pointed, handaxe-like, bifacially trimmed tools have turned up in China and Korea. In China, many new Palaeolithic sites have come to light during intensified research in the last 20-30 years, some of which report an association of fossil remains of *H. erectus* with stone artefacts. A number of Palaeolithic sites also record the occurrence of bifacial tools, though the records are unfortunately mostly in Chinese. In Korea, it is the site of Chongokni in South Korea which has yielded

handaxe-like bifacial tools (Kim & Chung 1979, Natt 1981, Bae 1987, 1989). Reynolds (1984) notes „Recent discoveries of handaxes in Korea (Bowen 1979; Hwang 1979) once again raise the question as to whether there was an „Acheulian,, presence in East Asia“.

The site of Chongokni is probably the most important site in Asia where handaxe-shaped tools have been recorded in terrace deposits, during excavations in the late 1970s and the early 1980s. No fauna or human fossil remains are associated with the lithic assemblages. Amongst the 1,082 excavated artefacts of quartzite, of which a considerable number are unifacial and bifacial choppers and scrapers, only 5 (which I have seen) are bifacial tools in the shape of a handaxe (Bae 1987). They were made in the hard stone-hammer technique on large cobbles. The two so-called cleavers (two of them are depicted in Natt 1981) only marginally resemble cleavers, as they were not made in the distinct technique from specially prepared cores, the way true cleavers of the Acheulian tradition were. The few „handaxes“, though, could be described as handaxes in the Western sense, but they are so few in number that one should be careful to relate them with the handaxe tradition of the West. The stratigraphic position of the assemblage is in a red clay and sandy clay above a basalt flow along the Hantan River. While the basalt was dated to between 0.6 and 0.4 million years, the overlying fluvial deposits were dated provisionally to about 0.2 m.y. during a warm, humid climate (Bae 1989).

The oldest hominid site in China is the Longgupo limestone cave site in Wushan, Sichuan province, which was excavated between 1985 and 1988 by Chinese scholars. It yielded some of the earliest Pleistocene primate fossils in China, including a mandible fragment and an incisor of a subspecies of an early *Homo erectus* (though the claim that it belonged to an earlier *Homo*, comparable to *Homo habilis* or *Homo ergaster* of Kenya, has been made) and a fragment of the hominoid species *Gigantopithecus blacki*, as well as two stone artefacts in association with an *Ailuropoda* and *Stegodon* fauna of Lower Pleistocene age. The two artefacts, a thick cortical flake and a hammerstone, evidently derive from the same stratigraphic unit as the hominids and the fauna. Recent age determinations place this unit in the Early Pleistocene, with an ESR date of 2.01 to 2.04 m.y. (Huang, Ciochon et al. 1995). Though researchers remain sceptical about the date and the artefacts (Culotta 1995; Klein 1999) one can not rule out its importance (references of Culotta from Huang & Hou 1997).

The site of Xihoudou, near Kehe, Shanxi, (Huang & Hou 1997, 4) yielded a Lower Pleistocene fauna (Aigner 1978,) in probable association with artefacts. Jia Lanpo (1985) records 30 artefacts from the same deposit as the rich fauna from gravels below Middle Pleistocene clays. The artefacts seem to include choppers, cores, flakes and a heavy pointed tool. Unpublished palaeomagnetic dates indicate an age of 1.8 m.y. for the site. If these dates prove to be correct and if the association of the fauna with the artefacts can be ascertained, the Xihoudou artefacts constitute some of the earliest cultural remains in China, predating the *Homo erectus*-associated assemblages from Zhoukoudian and Lantian. No hominid remains, though, have been recorded. The association, as well as the human manufacture of the stones, is, however, questioned by some authors (Yi & Clark, 1983; Aigner 1978; Huang & Hou, 1997).

Another interesting site complex is in the Yuanmou Basin, Yunnan province in South China, where in the upper layers of a 700 m-thick sequence of fluvio-lacustrine sediments (in Member 4) two hominid incisors, which are referred to as belonging to *H. erectus*, were discovered. Three retouched stone artefacts described as scraper were recorded *in situ* within the same deposit, though not from the same stratum as the incisors. In addition to these, a total of 22 artefacts of unmodified flakes, cores and choppers were found in the vicinity, and thought to be of the same period, but unassociated with the layer of the hominid teeth. Though the rich fauna below the hominid layers reflects a Lower Pleistocene age, the absolute age of 1.63 m.y. (by palaeomagnetic analysis) of the hominid layer has been questioned. Wu Rukang et al. (1985) quotes that the accumulated data of bio- and litho- and magnetostratigraphy suggest an age no older than the Brunhes/Matuyama boundary, some 0.7 m.y. But Jia Lanpo (1985) argues that the very archaic fauna and the primitive morphology of the hominid teeth warrants the earlier age. The controversy

has not been solved, and whether the Yuanmou incisors and artefacts are or are not some of the earliest fossil and cultural remains of *H. erectus* in China, it remains a very promising area of inquiry.

A key position for Early to Late Palaeolithic research holds also the Nihewan Basin in Hebei province, which has been known since the 1920s for its rich mammalian fauna. The stratified open air sites of Xiaochangliang and Donggutuo have yielded the earliest traces of human occupation in the basin, in association with Lower Pleistocene mammalian fossils within thick fluvio-lacustrine sediments (You et al. 1978; Jia Lanpo and Wei 1987; Pope et al. 1990; Keares 1994). Excavations at the Xiaochangliang site brought to light fossils together with artefacts, which are described as bipolar flakes, scrapers, choppers and waste, some 60 m below the thick loess cover in fluvio-lacustrine deposits. Calculations of the age „indicate an age of roughly one million years for the assemblage“, constituting „some of North China's earliest Palaeolithic remains“ (Jia Lanpo 1985, 143). Excavations at the Donggutuo site uncovered over 2000 stone artefacts, many of which resemble specific tool types from Choukoutian Locality 1 (Jia Lanpo 1985). The tools of the assemblage include mainly small unretouched flakes, some minimally modified utilised flakes (Schick et al. 1991) and artefacts described as tools with simple, crude retouch: borers, scrapers, notches, small choppers (Huang and Hou 1997). Yi & Clark (1983, 184) mentions that „western archaeologists discovered a handaxe and a few flakes from this area (Breuil 1935, Fig.3)“, which were later discounted as natural objects (T. de Chardin 1935; Pei 1939; Keates 1994). Palaeomagnetic dating indicated that the artefact-cum-fossil-bearing horizon of both the sites lies below the Jaramillo subchron (ca. 0.93 to 0.97 m.y.) (Li and Wang 1982; Schick and Dong 1993), whereas recent magnetostratigraphic dating at Xiaochangliang suggests an even older age, going back to 1.67 m.y. (Tang et al. 1995). Recently Zhu et al. (2001) report an age of 1.36 m.y. (between the Oldovan and Jaramillo subchron) for the artefact-bearing lacustrine sediments at Xiaochangliang, which they claim constitute „the oldest known assemblage comprising recognisable types of Palaeolithic tools in East Asia“.

The Lantian area in southern Shensi provided some of the oldest *H. erectus* fossils from red Middle Pleistocene clays in the loess-palaeosol sequence within the loess plateau of northern China, namely a cranium at Gongwangling and a mandible at Chenjiaowo. The 1964 cranium from the Gongwangling locality is more primitive than the remains from Choukoutian Locality 1. It is, according to Aigner (1978), the earliest known *Homo* from eastern Asia and is as primitive as the JETIS-Sangiran fossils from Java. It derives from level 6 of five buried soils, and the few stone artefacts which were found just above it in levels 7-8 are the oldest verified stone tools from East Asia.

The faunal and geological context point to a Mosbachian age (up to 700,000 years), while the pollen suggest an interglacial period. Wu Rukang & Dong (1985) note that the Lantian (Gongwangling) cranium is more primitive than *H. erectus* from both Choukoutian 1 and the Kabuh Formation (Trinil fauna) of Sangiran in Java, as the cranial capacity is smaller, while Bellwood (1997) notes that the Lantian cranium is probably as much as 1.2 million years old (Howell 1994) and compares well with the Javanese material and that of Choukoutian 1, which has been dated to between 500,000 and 230,000 years. Huang and Hou (1997) record recent datings of an age of 1.15 m.y., based on palaeomagnetic polarity determinations and the lithostratigraphic position in the loess, and Klein (1999) mentions that the Lantian skull is perhaps 800-750 ka old.

Seen in this light, the Javanese *H. erectus* fossils cannot be as old as 1.7 m.y. or even as old as 1.3 m.y., but are more likely between 700,000 and 1.2 m.y. The few artefacts from the Lantian sites are, according to Aigner, only one small flake, one large flake and four „nuclei“, though Zhang Shensui (in Rukang & Olsen, 1985, 149) reports 20 artefacts in the form of cores, flakes and (4) scrapers, in association with the hominid cranium of *H. erectus* and a scraper and 3 flakes from the other, slightly younger Lantian site at Chenjiaowo where the mandible of *H. erectus* was found in red clays.

One interesting specimen at the Lantian site complex is a biface found *in situ* in a palaeosol at Pingliang in a palaeosol, 2 km east of Gongwangliang. According to Huang & Hou (1997, 4, with a drawing of the

tool), who call this tool a handaxe with Acheulian affinities, this implement may be older than the cranium and „may be the oldest handaxe reported from East Asia“. Zhang (1985,152) is more cautious in describing these tools from the loess area as pointed choppers, that resemble bifaces (his figure 9.3, p.152 of the Lantian „protobiface“) and in saying that choppers are the most numerous tool types. I agree with him in his use of the term pointed chopper.

The Kehe site complex, situated in the elbow of the Huangho River in the loess country, consists of 11 localities, one of which, Locality 6054, is the richest. The cultural and faunal material is thought to come from an early Middle Pleistocene context and to be equivalent to the lowest layers of Choukoutian 1 locality, according to Chinese scholars who worked there in the early 1960s. Aigner (1969, 1978), however, relates the fauna, and possibly the artefacts as well, to the middle layers of Choukoutian 1 and suggests an age equivalent to a later Holstein interglacial period, though the geological and cultural contexts are not firm. The artefacts (138 according to Aigner) consist of choppers, large pointed tools, scrapers, large flakes with conspicuous bulbs, some with retouch, and nuclei—all rather crudely made (the drawings, refigured in Aigner, are only outlines). The artefacts have been compared to those from Dingcun (Yi & Clark 1983) but are, more probably, ancestral to Dingcun (Aigner). Choppers constitute the most common tool type. The large pointed tools represent the more interesting element of the assemblage, but they, too, are crude. One point has been figured in Zhang (1985, 154) from Locality 6056.

Of the famous Zhoukoudian cave sites, in Hopei province, under excavation since the 1920s, the cave of Zhoukoudian Locality 1 is the oldest. To judge by the fauna of the cave, it is of Middle Pleistocene (Holsrein interglacial) age, and has been dated to between 500,000 and 230,000 years ago. The remains of more than 45 individuals of *Homo erectus* were found in layers 4, and 8 to 10. Artefacts, too, were found in these layers, though not in direct association with the human fossils (Aigner 1979). Bones seem to have been used, as tools too. The utilization of fire by *H. erectus* between 500,000 and 400,000 years ago has been established at the cave. The stone assemblage from Locality 1 yielded more than 10,000 artefacts. Most artefacts are small, consisting of irregular flakes between 20 and 60 mm in size and waste material, many of them altered by crude retouch into scrapers, borers and points. Choppers, on cobbles and on flakes, are present, but rare (Huang & Hou 1997). The assemblage looks crude, mainly due to the poor quality of the raw material of quartz. The most common technique (Zhang 1985) was the anvil-supported direct percussion (or bipolar) technique, but the simple direct percussion and block-on-block percussion method was also employed. One-third of the flakes produced by simple direct percussion have cortex platforms. Those made by the bipolar technique have one or two crushed ends. Zhang distinguishes six tool categories: scrapers, points, graters, awls, choppers and spheroids, of which scrapers form the majority (75 %).

The Cave of Guanyin (Guanyindong) in the karst landscape of Qianxi county in Guizhou province, has yielded in a sequence of 8 m archaeological remains and vertebrate fossils within 8 layers. The roughly 3,000 artefacts have been summarised by Zhang Senshui (1985) as belonging to an early (Group B) and a late (Group A) stage. The early stage is characterised by a small flake industry struck off from both polyhedral and single-platform cores by simple direct percussion. The assemblage consists of small utilised flakes and flake tools of mainly scrapers, points, graters and choppers, and is comparable with that of Zhoukoudian Locality 1.

The vertebrate fossils from the early stage from layers 3-7 belong to a typical Middle to Upper Pleistocene *Stegodon-Ailuropoda* fauna. No human fossils are recorded.

The Group B assemblage has been dated provisionally to an early Middle Pleistocene to early Upper Pleistocene, and the artefact assemblage is regarded as Early Palaeolithic on typological grounds only (Olsen & Miller-Antonio 1992). Huang & Hou (1997) quote a rather late uranium series date of 76,000–119,000 years for Group B. They also include „handaxes“ in the assemblage, which no other author, though, has done.

Another area in southern China, the Bose Basin, in Guangxi province, yielded almost one hundred Palaeolithic sites on river terraces, most of them as surface finds on eroded laterite. More than 6,000 artefacts were collected from the surface in the 1970s, while about 600 artefacts could be recovered from excavations in 1988 and 1993 in the lateritic bed. Apart from unifacial picks, choppers and scrapers, most of them unifacially trimmed (Huang & Hou 1997), and flakes, a number of large bifacial implements are of interest, which have been described as „handaxes“ by Huang (in Chinese, 1987, see Olsen & Miller-Antonio 1992), some of them very large, up to 38 cm. „They certainly constitute a typological category distinct from their nearest relatives, the bifacial „chopping-tools“ that are such a common element in Chinese Palaeolithic industries“ (Olsen & Miller-Antonio 1992). Huang & Hou (1997) record „more than 100 handaxes“, „being the largest number from any single Paleolithic locality in China“. Two are illustrated in their paper, though one is a rather large pointed tool with a thick cortex butt, while the other is a small bifacial point. Having not seen them, but judging from the few illustrated specimens, I am inclined to call them pointed bifacial tools or picks rather than handaxes. Although Hou et al. (2000) argue that the technology at Bose exhibits all the characteristics of what they call mode II of the Acheulian at Olduvai and Olotgesaillie (where there are hundreds of Acheulian bifaces), the sample from the various sites at the Bose Basin taken together is too small (only a few amongst the thousands of cobble tools and flakes) to call them Acheulian; though they carefully call them Acheulian-like. Unifacial flaking dominates and only a quarter of the bifacially flaked tools were made on large flakes (7 specimens only).

In the absence of any hominid and mammalian fauna, the sites have been dated preliminarily as Middle Pleistocene while the artefacts have been described as having probable Late Palaeolithic affinities (Olsen & Miller-Antonio 1992). In 1993 tectites found *in situ* in association with stone artefacts have given ages of 0.732 m.y. (Huang & Hou 1997), and of 803 ± 3 ky (Hou et al. 2000).

The Zhoukoudian Locality 15 is a fossiliferous fissure in the limestone area of Zhoukoudian which, according to Aigner (1978) belongs to a cool Pleistocene period younger than Locality 1, probably of a late Middle Pleistocene (equivalent to the Riss) period. No hominids are recorded, but a poorly preserved fauna, including *Cervus*, *Elephas* and *Moschus* which may indicate nearby forests. More than 10,000 artefacts come from this site, constituting mainly a small tool assemblage, as at Zhoukoudian Locality 1, and made by simple, direct percussion. Tool types, however, show an improved regularity of shape and comprise scrapers, points and choppers, made on small flakes or chunks and can be assigned to the late Middle Palaeolithic (Qiu 1985). The dominance of small flake tools is the most significant feature of Zhoukoudian, both in Localities 1 and 15.

Important for our study are the Dingcun (formerly called Tingsun) sites in Shanxi, as here a few handaxe-like tools are recorded. A total of 26 localities (Huang & Hou 1997), 13 according to Aigner (1978) and 10 according to Qiu (1985) were discovered within a stretch of about 11 km along the Fen River, in the inner knee of the Huangho River. The sites belong to an interglacial/intertstadial phase, probably of an Eem- or early Würm-equivalent age, according to the fauna, indicating an early Upper Pleistocene age (Aigner 1978). Hominid remains of three teeth of one individual indicate a taxonomic position between *H. erectus* and *H. sapiens*, but probably closer to the latter. The study of many shell remains from the same stratigraphic units as the other fauna and the artefacts suggests an early Upper Pleistocene age, and indicates also, together with the recorded fish remains, wetter conditions than now. Recent radiometric dating has yielded conflicting results of 70 ka, 120 ka and 160-210 ka (Huang & Hou 1997).

More than 2,000 artefacts (made mainly from hornfels) include *in situ* and surface finds. The surface finds are dominated by small flake tools, but include also most of the well-made (and most often illustrated) handaxe-like tools known from the Dingcun area. These tools are described as chopping tools, large pointed tools or heavy points and scrapers. „These heavy points, which may be typologically classified into trihedral and pick-like forms, are considered index fossils of the Dingcun Middle Palaeolithic“ (Qiu 1985, 191 and Fig.10.3). Cobble tools include handaxe-like implements and bifacial choppers, altogether

less than 20 specimens (Qiu 1985). One fine handaxe-like tool (Fig.10.7 in Qiu) is a surface find and is the only one of its kind. Pointed chopping tools resemble proto-bifaces. It seems to me that these occasional handaxe-like tools developed via pointed choppers.

Qiu describes the Dingcun assemblage as Middle Palaeolithic, as it exhibits more progressive elements than the Early Palaeolithic assemblages in China, such as finer, more even trimming and a greater number of well-made shapes. Breuil (see Aigner, 1978) had interpreted many of the Dingcun chopping tools as bifaces similar to the Late Acheulian, but Pei (1965) regards them as independent from the European typology. Hopefully new research data will provide us more insight into these interesting sites.

Discussion

We have seen that a number of East Asian sites have recorded hominid remains of *H. erectus*, some of them in direct or indirect association with stone artefacts, particularly Zhoukoudian and Dingcun. A number of sites have a bifacial tool element: Lantian, Bose, Dingcun, and of these sites Lantian and Dingcun are associated with hominid remains of *H. erectus* (at Lantian) and *H. erectus* / *H. sapiens* (at Dingcun). Handaxes in the Acheulian sense are not an integral part of the Early Palaeolithic in China.

We have also seen that sites of an Early Pleistocene age, according to the recovered fauna, have yielded cultural remains which are regarded as the earliest signs of human existence in China (Longgupo, Xihou-dou, Nihewan, Yuanmou), though there is still a considerable lack of certainty concerning their age and their genuine association with stone tools, excepting the Nihewan Basin in the latter respect. Sites considered to be of Middle Pleistocene age have provided better and more diagnostic cultural material, such as Zhoukoudian Locality 1 and Locality 15, Kehe, Lantian, Guanyindong. Of these, the sites of Zhoukoudian and Lantian also record the remains of *Homo erectus* in association with stone tools.

Jia et al. (1972) in their report about the Shiyu excavation (Jia & Huang, 1985; Yi & Clark 1983) made first attempts to describe assemblage variation in North China and concluded that there are at least two major Palaeolithic traditions in China: one is the Zhoukoudian Locality 1-Shiyu series of small, irregular flake tools associated with scrapers and burins, and the other is the Kehe-Dingcun series, characterised by chopper/chopping tools made on large flakes and heavy triangular pointed tools (some of which may have handaxe-like shapes). But Jia & Huang (1985, 264) also recognise „the enormous complexity of the pre-historic archaeological record in China“, with many regional and subregional variations among the different industries, all of which has yet to be understood in terms of geological context and chronology, and of technological development.

Although the Zhoukoudian Locality 1-Shiyu series of small flake tools is quite well understood, the Kehe-Dingcun series leaves many questions open. Statistics and comparative analysis are lacking; and apart from the large pointed tools, as index tools, there are many small flake tools in the Kehe-Dingcun series as well, but what comparative or special features they exhibit vis-a-vis the Zhoukoudian series is not clear.

Besides this, the Zhoukoudian series shows a continuity and improvement in the technique of the flake manufacture from the Middle Pleistocene into the Upper Pleistocene (at the Upper Cave at Zhoukoudian). Further south, the Kehe-Dingcun complex exhibits much less continuity, but more local lithic differences.

Handaxes are not a cultural tradition in China and southeast Asia. The handaxe-like tools which occasionally occur at such sites as at Lantian, Dingcun, Bose, Chongokni (Korea) are few and widely dispersed from each other, and do not form a distinct handaxe tradition. These occasional bifacially trimmed tools in the form of handaxes document a Chinese element of its own, rather than a cultural continuity of the handaxe tradition from the west into East and Southeast Asia. They may have the overall shape of handaxes, but they lack the refined, secondary retouch and edge shaping of the Acheulian handaxes. Aigner (1978, 223) comments: „There is no Pleistocene collection from China which reflects the absorption of European or Eurasian technological developments during any period of the Pleistocene“. Narr (1981) also

comments on this issue and asks whether independent evolution of large bifacial tools may have taken place there (p.27) or not.

One other significant fact, in my opinion, is that nowhere in China and Southeast Asia, even in sites where handaxe-like tools have appeared, are there any true cleavers, which are a most essential part of the Acheulian tradition in the Afro-European and Indian regions. True cleavers are a very distinctive tool type, which are made in a clearly preconceived manufacturing technique on large flakes. The cleaver edge is a preconceived sharp distal edge, being the intersection of the ventral face and a flat, distal part of the dorsal face of the flake. No such tools are found and no such distinct preconceived manufacturing processes are apparent anywhere in the Palaeolithic of East and Southeast Asia. The large bifacial pointed tools and so-called handaxes in eastern Asia are, therefore, in my opinion, a by-product, sometimes maybe more or less accidental, of pointed bifacial choppers. Or they may have developed from pointed bifacial choppers as a regional adaptation to specialized functions and stimuli.

No later cultural assemblages in China will be discussed here, as this would go beyond the scope of this book. The described Early to Middle Palaeolithic assemblages were included to highlight the problem posed by bifacial tools in East and Southeast Asia.

We will turn southwards now and view this question as it relates to Mainland and Island Southeast Asia.

3.1.2. *Homo erectus* in Southeast Asia and the Early Palaeolithic record

The question of *Homo erectus* in association with stone tools is even less clear in Southeast Asia than in East Asia. Though fossil remains of *H. erectus* are abundant in Java from a number of sites, no remains have so far been found in the rest of Island Southeast Asia, or in mainland Southeast Asia. Ages of the *H. erectus* fossils are still very controversial and range from 1.66 to 0.4 million years. Over the last hundred years since 1891, when Dubois found the first skull cap of *Homo erectus* in Trinil, Central Java, many more fossils of *H. erectus* have been found at the main hominid site of Sangiran, as well as at some other localities in Central and Eastern Java.

The hominids from Sangiran come from the upper Pucangan Formation, the „Grenzbank“ and the lower part of the overlying Kabuh Formation.

The black, lacustrine beds of the Pucangan Formation was dated to between 1.67 and 0.73 m.y. (Sémah 1982), while a fission track dating on tuff in the upper part of the Pucangan clays yielded an age of 1.16 ± 0.24 m.y. (Suzuki et al. 1985), as discussed by Theunissen et al. (1990), a valuable paper for understanding the complicated history of Sangiran. Siesser & Orchiston (1978) suggest that the foraminifera found in sediment attached to one of the most ancient hominid mandibles (*Pithecanthropus* mandible C from the Pucangan Beds) are at least 1.6 m.y. old. Later Swisher et al. (1994) reported a $40Ar/39Ar$ age of 1.66 ± 0.04 m.y., obtained from pumice in the Pucangan Formation, reportedly contemporaneous with two hominid fossils. The Pucangan Beds have yielded a rich vertebrate fauna, called the Jeris fauna by von Koenigswald (1935), and from its upper part remains of *Homo erectus* were recorded, classified as archaic *H. erectus* of a more robust population (i.e. the Sangiran No.4 and 31 and the *Meganthropus* mandibles), though the precise provenance of the fossils is uncertain (Sémah et al. 1990). Van den Bergh et al. (1996a) comment that the presence of giant tortoise, *Geochelone*, at around 1.2 m.y. is an indirect indication that *Homo erectus* was not in Java at that time.

The Pucangan Beds are separated from the overlying Kabuh Formation by the „Grenzbank“, dated to somewhere between 0.7 to 0.9 m.y. (Sémah et al. 1981; Sémah 1982, 1986; Watanabe & Kadar 1985). Hyodo et al. (1992) reported a Jaramillo normal event just below the „Grenzbank“, while the fossil fauna from this layer points to an age slightly younger than 1 m.y. as well (van den Bergh et al. 1996a).

Overlying the „Grenzbank“ are fluvial deposits of the Kabuh Formation, which contain fossils of the Trinil fauna and the bulk of the *Homo erectus* fossils from Sangiran, classified as classical *Homo erectus*. Most scholars seem to agree that the Java *H. erectus* fossils from the Kabuh Formation at Sangiran (e.g. Sangiran 2,3,12,17,38) and Dubois's fossils from Trinil are of Middle Pleistocene age (Sémah et al. 1990) or at least not older than 1.2 m.y. (Pope 1984; Matsuura 1982; Suzuki et al. 1985) or around 0.9 m.y. (van den Bergh et al. 1996a) or below the Brunhes/Matuyama boundary (Bartstra 1994). The most recent data were recorded by Larick et al. (2001) from the Kabuh Formation (which they call the Bapang Formation) ranging from 1.51 ± 0.08 m.y. near the „Grenzbank“ to 1.02 ± 0.06 m.y. above the hominid-bearing strata. These dates do not tally at all with any of the other dates or the geological biostratigraphical field data from Sangiran.

All the absolute dates available for the Java hominids are still very controversial and differ from each other (Hutterer 1982/83; Keates 1998). They display more discrepancies than conformity, and have up to now not proved helpful in defining the antiquity of *H. erectus* in Java (Klein 1999), and he continues „it may be meaningful that most specimens are less than 800ka old“ (p.272). I agree with Keates (1998) that only the combined results of a multidisciplinary approach towards the Javanese hominid sites, including in-depth knowledge of the field situation in geological, litho- and biostratigraphical, palaeontological and geomorphological terms, linked with the radiometric data, can ultimately resolve the questions of age and origin of the Javanese hominids.

Disregarding the controversial radiometric data of Swisher et al. (1994) and Larick et al. (2001) but taking into consideration the interpretation on the basis of the fauna, environment, sea-level changes etc., it seems to me that the most convincing date of the arrival of hominids on the Sunda shelf is by about 1 m.y. ago. Klein (1999) comes to the same conclusion when he says: „when all factors are considered it is reasonable to conclude that the known Java *H. erectus* fossils are probably all younger than 1 m.y.“ (p.273).

The youngest hominid fossils of the *H. erectus* range in Java come from the Solo River terraces at Ngandong (some 60 km east of Sangiran), which were excavated in the early 30s. Associated with a rich fauna are 11 skulls and 2 tibia (Oppenoorth 1932) which were called *H. erectus soloensis*. On the basis of the fauna, which has been classed loosely as Upper Pleistocene (von Koenigswald 1934; Sartono 1976) the hominid remains have been assigned the same ages. They are now considered to belong to transitions between *H. erectus* and *H. sapiens*, or, more probably, late members of *H. erectus* (Santa Luca 1980). Allen (1991) prefers to call the hominid fossils from Ngandong the Ngandong fossils, reflecting the still prevailing uncertainty as to whether these fossils belong to *H. erectus* or to *H. sapiens*. Although the fauna from Ngandong appears to be Late Pleistocene, the majority of species are shared with the Trinil fauna, including the only extinct key genus *Stegodon*, but they also display some modern forms. The fauna does not help much in the dating, as it is not yet known when *Stegodon* became extinct in Java. The intriguing question whether modern *H. sapiens* developed from *H. erectus* (and not only in Southeast Asia), or whether *H. erectus* is an extinct species without living descendants, is still much debated (Bellwood 1997; Klein 1999). A number of provisional Uranium/Thorium dates on fossil bone range from 31,000 to 101,000 BP (Bartstra et al. 1988).

In spite of the abundance of fossils of *H. erectus*, no cultural remains in the form of stone or bone artefacts can be securely associated with the human fossils. Stone tools have been found at several localities in Java, and repeated attempts have been made to connect them with the hominid findings, ever since von Koenigswald found the first artefacts in Sangiran in 1934. He made a collection of small flake tools on the top of Ngebung Hill in association with fossil bones in gravels above the hominid-bearing layers. Identifying the fossil fragments as belonging to the Middle Pleistocene Trinil fauna he thus dated the flakes, too, to be of Middle Pleistocene age (von Koenigswald 1936, 1978). The fossil bones, however, turned out to be reworked from older deposits, and later scholars (Bartstra 1985, 1988; Bartstra & Basoeki

1989) described these gravels as „Old River Gravels“, overlying the sterile volcanic Notopuro Beds, and dated them to the Upper Pleistocene and so not connected at all with *H. erectus*. One single fission track analysis from a pumice ball from the underlying Notopuro Beds has yielded an age of 250 ± 70 ka (Suzuki et al. 1985). Bartstra (1988) doubts this age on the basis of the pumice having probably been reworked from an older horizon. He regards the „Old River Gravel“, containing the Sangiran industry, as belonging to the early Upper Pleistocene and as being equivalent in age to the Solo River high terrace system (Bartstra and Basoeki 1989; Bartstra 1992).

New data from results of recent excavations of the Kabuh Beds at the Ngebung Hill at Sangiran (Sémah et al. 1992; Simanjuntak & Sémah 1996) may throw new light on the question whether *Homo erectus* made stone tools. The authors have found 20 (rather doubtful looking) stone artefacts of chalcedony *in situ*, in sandy-gravelly layers of some 5 m in thickness above a sterile layer of the lower Kabuh Beds. The authors claim that the artefacts are related to the Sangiran industry and are the work of *H. erectus*. The few artefacts are, however, distributed within 5 m of sediment and certainly do not come from an occupation floor. Keates (1998) is convinced that the artefact layer belongs not to the Kabuh sequence but to a later, infilled deposit. The present author, having seen Sangiran, questions the authenticity of the artefacts. The original Sangiran artefacts come from gravels on top of the Kabuh Beds and are much younger. They are also made from chalcedony, and many pseudo-artefacts can be found amongst them (personal observation). The association of *Homo erectus* with artefacts in Java still remains unproved. Widiyanto et al. (2001) claim to have found similar artefacts within the „Grenzbank“ at Sangiran during an excavation, but no documentation or description of the artefacts is given.

No stone artefacts were found during the 1930s excavation at the fossiliferous site of Ngandong that yielded the remains of *H. erectus soloensis*. But an assemblage of small crude flakes of chalcedony, later collected by von Koenigswald, was called by van Heekeren (1972) the Ngandong industry. They seem to derive from the fossiliferous High Terrace Gravel, the fossils of which yielded the uranium series dates of c. 40-100 ka (Bartstra et al. 1988; Bartstra 1989). Many scholars are unwilling to agree that the stone artefacts were found in direct association with fossils. But Bartstra correlates the Ngandong High Terrace Gravel with the „Old River Gravel“ of Sangiran on geomorphological grounds, and the flakes contained in both on typological grounds. Bartstra and Basoeki (1989) claim that the artefacts at Ngandong as well as those from the „Old River Gravel“ at Sangiran are the work of *H. erectus soloensis* and that the above age is also the age of the flake industries, and thus Late Pleistocene. Bartstra et al. (1988, 333) argue that „as long as it can not be established that the Ngandong hominids have been reworked, the artefacts must be associated with *Homo erectus soloensis*“.

Another intriguing hominid site in Central Java is Sambungmacan on the Solo River. There, remains of a late *H. erectus* were recovered (Sartono 1979) and more recently a new calvarium was discovered (Baba et al. 2003), which the authors placed as an intermediary form between the earlier Trinil/Sangiran and the later Ngandong fossils. At this site Jacob et al. (1978) claimed to have found two artefacts, a chopper and a flake, in a gravel deposit at Sambungmacan approximately contemporaneous with the layer that yielded the hominid fossils. Though some authors agree that these artefacts are man-made and are the work of *H. erectus* (Sémah et al. 1990) others disagree. Bartstra 1982 (p.319) comments that the fossil deposits are Upper Pleistocene terrace deposits, and that the two tools are not older than Upper Pleistocene. He concludes „that on Java there is still not a single site where artefacts can be associated with *H. erectus*“.

Apart from the small flake industry of Sangiran and Ngandong, there is another Palaeolithic industry on Java, that of the Pacitanian. The Pacitanian (formerly Patjitanian) and the Sangiran flake assemblages were both assigned a Middle Pleistocene age by earlier scholars (Movius 1948; de Terra 1943; van Heekeren 1972) and have been associated with *H. erectus*. But all recent studies by other scholars disagree.

The Pacitanian artefacts were collected after von Koenigswald and Tweedie found the first stone implements in 1935 at various localities along the Baksoka River on the south coast of Central Java. Von Koenigswald and Tweedie collected only from the dry riverbed, but later researchers (Movius, Van Heekeren) also found artefacts on the surfaces and slopes higher up along the banks, which were thought to be terrace remnants of a Middle Pleistocene age. No vertebrate fauna or human fossils were found associated with the artefacts. Movius (1944, 1949) described the tools as „Early Palaeolithic“. They included many core tools (part of his well-known „chopper-chopping tool complex“ of the „Far East“) and even „hand-axes“ (see also Mulvaney 1970). Subsequent research along the Baksoka River indicated that some artefacts were indeed *in situ*, in terrace-like deposits, but that the bulk of the material was found on the surface, either deriving from these fluvial sediments or reworked (or even younger).

This inconclusive stratigraphic evidence suggested to Bartstra (1976, 1984, 1992; Bartstra & Basoeki 1989 and Keates & Bartstra 2001) that the artefacts come from various cultural traditions, but should all be regarded as Upper Pleistocene and Early Holocene, and are the work of early modern humans (*H. sapiens*) in Java. Hutterer (1977) comments that the artefact assemblage has no secure position in space or time, and that the Pacitanian as a single lithic tradition has to be questioned. Having seen the site, the present author thinks likewise.

The artefacts from the Baksoka River terraces include unifacial and bifacial choppers (chopper/chopping tools in Movius's terms), hand-adzes (in fact rectangular choppers) and occasional bifacial handaxe-like tools. Besides heavy-duty tools, there are numerous small flake tools, such as high-backed, steep-edged scrapers and other small flake tools together with much waste (Bartstra 1978a; Hutterer 1985). The few so-called handaxes from Pacitan are often figured in the literature, but they make up a very low percentage of the total artefact assemblage. I am not of the opinion that we can speak here of Acheulian-type handaxes, even if one of the Pacitanian handaxes, JP 217, often depicted in the literature, „can not be described other than as an Acheulian biface“ (Keates & Bartstra 2001). There is no Acheulian in the Far East and it is far more appropriate to call these few bifacially worked tools „pointed bifaces“, of which there are only six specimens (Keates & Bartstra 2001). There is a profound techno-ideological difference between western and eastern handaxes.

Sites with presumed Pleistocene artefact assemblages outside Java include the Cabenge site in south Sulawesi and Mengeruda on Flores, and perhaps a few cobble tools from Ban Mae Tha in northern Thailand with a provisional palaeomagnetically dated age of about 0.7 m.y. (Pope et al. 1986).

At Cabenge van Heekeren found in the 1940s a Clacton-like flake industry with clearly defined bulbs of percussion on the terraces of the Walanae River, which he compared with the Sangiran (Van Heekeren 1972). The association of these artefacts from the surface of the higher terraces with vertebrate fossils of an *Elephas-Celebochoerus* fauna (Hooijer 1975) moved van Heekeren (1972) to suggest a Lower to Middle Pleistocene age for the artefacts. However, subsequent research revealed that the fauna, which is probably of Pliocene to Lower Pleistocene age (Sarrono 1979), is not associated with the artefacts, the latter being Upper Pleistocene (Bartstra et al. 1994; Hooijer & Bartstra 1995). The artefacts come from river gravels, of indeterminate Pleistocene age, that cover the Pliocene fossiliferous deposits. The Cabenge artefacts can be attributed to early modern humans and a comparison with the Pacitanian has been made (Keates & Bartstra 2000). Soejono (1982) also mentions „handaxes“ along with large cobble tools and horse-hoof cores (van Heekeren only mentions a small flake industry, devoid of larger tools). Such tools were later described by Keates & Bartstra (1994, 2001) as „pointed partial bifaces“ which „evince similarities to Acheulian bifaces“ (Keates & Bartstra 2001, 20). In the present author's opinion one should not call them bifaces, but rather partial bifacially worked cobble tools, which puts them into the category of Movius's old scheme of chopper/chopping tools or cobble tools. There is no reason to connect these tools with Middle Pleistocene bifaces found in Africa, Europe and India. They are of Late Pleistocene age and are the work of modern humans.

Caution necessary in judging the age of the presumed Palaeolithic assemblages in Island Southeast Asia should certainly be exercised in Mengeruda on Flores, from where Maringer & Verhoeven (1970 a,b) describe scrapers, borers, points, retouched flakes, a few cobble tools and one small bifacial handaxe. They suggested that hominids of the late *Homo erectus* type may have been able to venture from Java beyond the Huxley's Line to the Lesser Sunda Islands. The artefacts seem to be in association with *Stegodon* fossils (see also Glover 1973). It is not known when *Stegodon* became extinct, as it is present in island Southeast Asia in the Upper Pleistocene and maybe even in the Early Holocene (see also Allen 1991).

Recently new data have come from Flores (van den Bergh et al. 1996), where excavations into the Ola Bula Formation at Mata Menge in the Soa Basin, in the same area of Maringer and Verhoeven's earlier studies, revealed some 25 crude flakes of chert and basalt in layers shared with fossil bones of *Stegodon trigonocephalus florensis*, which were dispersed through about 3 m of sandstone above a palaeosol which contains the palaeomagnetic Brunhes/Matuyama boundary, suggesting an age of at least Middle Pleistocene for the artefacts. The boundary being recorded from a palaeosol poses the question whether there is not a large hiatus between the palaeosol and the artefact layer. Morwood et al. (1997, 27) comment: „The 1994 Mata Menge excavation yielded a large fossil assemblage and a number of stone pieces (45), which the excavators believed to be artefacts“. The latter occurred dispersed throughout a 1.64 m layer of tuffaceous sandstone. Fission track datings at Mata Menge (Morwood et al. 1998) have yielded ages between 0.88 ± 0.07 and 0.80 ± 0.07 m.y. for the strata which contain the rather frustrating looking artefacts. Further excavations in the Soa Basin revealed a number of other fossiliferous sites in fluvio-lacustrine deposits of the Ola Bula Formation (Morwood et al. 1999). The researchers claim to have found 6 stone artefacts together with a *Stegodon* fauna at Boa Lesa site (Maringer & Verhoeven 1970) while at Doza Dhalu artefacts of a completely unconvincing nature, were only found on the surface, not in the excavation. O'Sullivan et al. (2001) report further fission track dates from the fossiliferous Ola Balu Formation: > -0.85 m.y. from below the artefact layer and < -0.84 m.y. from above the artefact layer.

On the basis of these results the excavators suggest a possible presence of *Homo erectus* on Flores, which would have implied the ability to cross the deep sea channels separating Sundaland from the eastern islands (see also Bednarik 1999). But how would *H. erectus* have crossed the deep seas? That the sophistication to make boats existed about 1/2 m.y. ago sounds altogether too impossible. Keates (1998) argues that the earliest evidence of crossing to Sulawesi is about 30,000 years ago, based on radiometric dates (Glover 1981) or possibly 40,000 to 50,000 years ago (Bowdler 1992 and 1996; Keates & Bartstra 1994). Bowdler comments „in southern Asia as in Australia, there is no clearly dated evidence older than 50,000 years BP“ (Bowdler 1992, 559). The oldest site in Australia is Malakunanga II at the northern tip of the continent, dated by thermoluminescence to about 50 to 60 ka (Roberts et al. 1990; Bowdler 1990) which seems to be the period of first human arrival in Australia. It will be interesting to await further results from Flores.

Recent-most discoveries in Flores at Liang Bua include a new dwarfed human species, dated to 18,000 years ago, called *Homo floresiensis* (Morwood et al. 2004, 2005), recovered from Late Pleistocene deposits, in association with small tools, evidence of fire and bones of dwarfed *Stegodon*. This miniature hominin has generated much controversy. Some claim that microcephaly could explain the miniature brain of a deformed pigmy *Homo sapiens*. Others suggest that *H. floresiensis* was a dwarfed descendant of *H. erectus* which is thought to have arrived on Flores by 800,000 years ago (Morwood et al. 1998, 2004). This last suggestion remains speculative in the absence of convincing archaeological evidence from as early as 800,000 years ago. The finds from Liang Bua are, however, exciting, because of the questions they raise, but the evolutionary origins remain obscure (Lieberman 2005).

On Timor, Glover (1970, 1973) reports unifacially trimmed flake tools and a few choppers in the Atambua area as surface finds (see also Maringer & Verschuuren 1981), eroded from gullies above *Stegodon* fossil-bearing gravels. The *Stegodon* fauna is almost certainly of Middle to early Upper Pleistocene age.

These artefacts occur „in possible but unproven primary association with the fossils“ (Bellwood 1987, 186), although Glover (1973) quotes a few *in situ* tools in bone-bearing layers. They consist of mainly unifacially retouched scrapers and a few choppers. A later flint-based industry dated to between 13,000 to 3,000 BP is found in caves, which is well-made and contains mainly steep-edged scrapers. One interesting feature of it is the record of silica gloss at the edges of unretouched flakes (Bellwood 1985, 191).

Inconclusive data comes also from the Philippines. The Cabalwani industry in the Cagayan valley of Luzon is recorded as having cobble tools, retouched flakes and horse-hoof cores, but mainly small flake tools, supposed to be associated with a genuinely Early to Middle Pleistocene *Stegodon* fauna. Excavations by the National Museum (Fox 1978) led to claims that the fauna is associated with the artefacts, but Wasson & Cochrane (1979) assert that the artefacts postdate the fossils and are probably not older than the terminal Pleistocene.

An interesting industry, from the Lake Tingkayu sites in Sabah, northern Borneo has been described by Bellwood (1984, 1988). This industry flourished along a lake between about 28,000 and 17,000 years ago. It contains a bifacial tool component found nowhere else at this time in Southeast Asia. It is described in more detail in chapter VIII.3.2.2 .

Discussion

The above-mentioned sites on Sulawesi, Flores and Timor lie beyond Huxley's Line to the east to Wallacea, where the dispersal of hominids and fauna during the Pleistocene could only have come about by crossing several sea channels from the Sunda Shelf. There is no direct association of stone artefacts with a Middle Pleistocene *Stegodon* fauna either at Cabenge or in the Cagayan valley. „The fossils predate the artefacts“ (Allen 1991, 257), and Bellwood (1987, 186) comments: „the extreme conclusion which one might draw.....is that all stone industries in Island Southeast Asia are associated with *H. sapiens* populations, who were also the first population to cross Huxley's Line perhaps 50,000 years ago“, to populate the Lesser Sunda Islands, New Guinea and Australia. The new data from Mata Menge on Flores (van den Bergh et al. 1996; Morwood et al. 1999) suggest a possible presence of *Homo erectus* beyond Huxley's Line, yet it is far from certain that this is the case. We shall have to await further data on this interesting question.

The Sunda Shelf, west of Huxley's Line, was populated at least in the Middle Pleistocene or even late Early Pleistocene by *H. erectus* populations. His tools, though, remain a puzzle. While in East Asia the association of Middle Pleistocene hominids with stone artefacts is a known fact, the lithic cultures of *H. erectus* in the Southeast Asian island belt remain elusive. Pleistocene assemblages in Southeast Asia still raise doubts about their stratigraphic contexts, so that our knowledge of Early Palaeolithic cultures there continues to be inadequate.

There seems to be, however, no problem in connecting at least the later *Homo erectus*, from Ngandong on Java, with a small flake industry and with a *Stegodon* fauna, though the dating is still problematic. Previously Jacob (1978) estimated ages between 300,000 to 900,000 BP for the Ngandong hominids. But Sartono (1987) and Bartstra et al. (1988) suggest an Upper Pleistocene age between 30,000 to 100,000 BP for the Solo River high terraces.

Bartstra et al. (1988) also distinguish between a small flake industry of the Sangiran-Ngandong type during the earlier part of the Upper Pleistocene and a heavy-duty complex of the Pacitanian type for the later part of the Upper Pleistocene. For the classical *Homo erectus* hominids from Java, however, there is not yet any convincing evidence of stone artefacts in Southeast Asia, and it is quite probable that tools made from wood and bamboo must have played a major role in tropical Southeast Asia in the Palaeolithic periods. Bellwood (1987) implies a totally organic tool kit for *H. erectus* in Java; and Bowdler (1990) hypothesises that the Java *H. erectus* population was entirely bereft of lithic culture. Nart (1980), too, speculates on the use of wood and bamboo as a major material for tool-making in Southeast Asia.

All the cobble tool assemblages (of unifacial and bifacial choppers, large flake tools and occasional hand-axe-like tools) of the Pacitanian type, which nonetheless contain a large number of small flakes and the small flake industries (without cobble tools) of the Sangiran/Ngandong/Cabenge type have through recent research become younger, and seem to represent only the tool kits of Upper Pleistocene hominids, and none are directly associated with archaic *H. erectus*, except possibly the two stone tools from Sambungmacan in Java.

As to the question of handaxes in Southeast Asia, the answers are similar to those from China. True handaxes in the Acheulian tradition are absent, though bifacial oval and pointed tools exist in the Pacitanian (see Fig. 2.9 in Bellwood 1997; van Heekeren 1972, which are only bifacial choppers) and at Cabenge. At the latter site, though, van Heekeren only mentions a small flake industry and only Soejono (1982) talks of „hand axes“. The question of a bifacial tool element in Southeast Asia, thus, is of little consequence, and in any case, is not connected with *Homo erectus*.

In comparison to western and African Palaeolithic cultures, the Southeast Asian industries „appear to be simple, amorphous and undifferentiated“ (Bellwood 1985, 68) and in Movius's view unprogressive. But though the lack of new technologies, like the production of handaxes and core-prepared levallois tools in the West, indicates an apparent unprogressiveness, we are still far from understanding why this should have been so. It is argued that *Homo erectus* in Southeast Asia may not have used stone tools (Bowdler 1990), and that stone tools may have been used for manufacturing wooden or other non-lithic tools. It can also be argued that the raw material available to early man in Southeast Asia may have influenced their skills and needs, and that their diet in a less drastically changing environment than in Europe and Africa may be reflected in the continuity and „unprogressiveness“ of their material cultural traditions. Allen (1991, 258) comments that „environmental, taphonomic and ecological factors are still insufficient to explain the absence of stone implements from the Middle Pleistocene layers at Sangiran“, whereas throughout Eastern Asia cultural material is known, though not very common, in association with the Middle Pleistocene hominid findings in China.

3.2. Mainland Southeast Asia and the Hoabinhian

While the link to India in the cultural traditions of prehistoric Nepal, especially in western Nepal, is evident, comparisons to the Southeast Asian regions are necessary, too, particularly in the light of the Hoabinhian-like industry of Patu in eastern Nepal. This early Holocene site lies about 400 km to the east of the Dang-Deokhuri area, within the belt of dense, monsoonal forests at the foot of the Siwaliks. The main tool types from this site, described in chapter V.2.3., belong to a cobble-based tool complex of adzes of the sort which is absent in western Nepal.

The Patu industry, an early Holocene Mesolithic-macrolithic culture in eastern Nepal, is characterised by bifacially and unifacially trimmed adzes and adze-like tools made on flat river cobbles of quartzite. No other site with a similar industry is known of. Only two isolated adzes were found in the western Dun valleys of Nepal. No ground-edged tools or polished axes, and no pottery, is associated with the Patu industry.

Surprising similarities in tool types and technology of the Patu industry can be recognized with the Hoabinhian assemblages from a number of caves of the Hoa Binh region in North Vietnam. The author has carried out comparative studies of the tool assemblages of the original Hoabinhian, as Colani has described it, at the Institute of Archaeology at Hanoi, in order to investigate any possible relationship of the Patu Industry with the Hoabinhian. But before any conclusions can be reached it is necessary to describe the Hoabinhian tool complex in its chronological and spatial framework.

3.2.1. The Hoabinhian in Vietnam

The Hoabinhian tool complex is widespread throughout mainland Southeast Asia, having left its imprint over much of Vietnam, Thailand and Malaysia (Gorman 1970; Moser 1997). Hoabinhian sites do not occur within the island belt of the Indo-Malaysian „Sundaland“, except in Northeast Sumatra. The culture was first defined in 1932 at the First Congress of Prehistorians of the Far East at Hanoi, and was based on the work by Colani in the Hoa Binh area in North Vietnam.

The Hoabinhian in Vietnam will be described here in more detail, because there is a lack of English literature describing sites of this important cultural complex in Vietnam.

Hoabinhian sites are mostly found in rock shelters, but there are a number, too, in coastal middens (Sumatra). It is an indigenous Southeast Asian culture of the terminal Pleistocene and Early Holocene, which first appeared during the Late Pleistocene and continued as a recognisable industry until ca. 5,000 BC (Gorman 1970). The main dates in Vietnam fall between 14,000 and 4,000 BC. But dates, as early as 28,000 BP have been recorded from Vietnam for the Tham Kuong cave (Nguyen Van Binh 1993) and the Xom Trai cave (Pham Ly Huong 1994), while Colani's Lang Vanh cave, re-excavated by the Hanoi team, yielded an age of 16,470 BP (Ha Van Tan 1997).

Still earlier dates are recorded from the so-called Sonvian industry, a cobble tool assemblage of mainly unifacial choppers but no sumatraliths or axes (Ha Van Tan 1976), thought to be ancestral to the Hoabinhian or an early phase of it, with dates ranging from 23,000 to 13,000 BP.

The characteristic tool types of the Hoabinhian are cobble tools on large river cobbles, trimmed uniaxially over all of one surface (the majority) or over both surfaces, in varying shapes oval, rectangular, discoidal or triangular and found in association with flat-based, often high-backed uniaxial sumatraliths, short axes and simple utilised flakes. It is described as a tool tradition of generally uniaxially flaked core tools with cutting edges all around their periphery.

Edge-ground tools and even cord-marked ceramics occur in the later Hoabinhian phase, before the appearance of polished axes. In Vietnam, edge-grinding is known from about 9,000 BC onwards, while simple pottery is recorded from at least 6,500 BP onwards (Bellwood 1997). Edge-grinding seems to have been an early development in Asia: it is documented in Japan 30,000 years ago, in Vietnam from the end of the Pleistocene and in northern Australia from 20,000 years ago (Bellwood 1997).

Ha Van Tan (1997) considers the presence of sumatraliths and the technique of uniaxial stone-knapping as the fundamental characteristics of the Hoabinhian, and says that there is a continuous development from the earlier Sonvian to the Hoabinhian, that means that the Hoabinhian has its roots in the chopper tool tradition of Southeast Asia (Ha Van Tan 1976). Solheim (1970), too, is of the opinion that the Hoabinhian developed directly out of the chopper/chopping-tool tradition and even goes so far as to suggest an early dating of the beginning of the Hoabinhian back to about 50,000 years during a milder climatic period between 42,000 and 22,000 BP.

The Hoabinhian is preceded in Vietnam by the Son Vi industry (or Sonvian) and develops in Vietnam into the Bacsonian with its polished axes and an increase in short axes and bifacially worked tools.

The Sonvian is a chopper industry without sumatraliths (though Reynolds 1990 reports the occasional occurrences of sumatraliths and short axes). Belonging to the Late Pleistocene but scarcely found in the Holocene, it occurs mostly as surface open air sites, but a few caves have also yielded Sonvian remains in their lower levels—for example, at the Con Moong cave, with dates of 12,920 to 8,500 BP, at the Nguom rock shelter, which contains a Sonvian level dated to between 23,000 and 18,600 BP (Ha Van Tan 1985) and at the Dieu rock shelter, with a date of 24,000 BP for its lowest Sonvian level.

The culture is characterised by rather crude and indistinct cobble tools, including uniaxial side- and end-choppers dated to between 23,000 and 13,000 BP (Ha Van Tan 1976, 1985, 1997). It is considered by Ha Van Tan (1997) to be the origin of the Hoabinhian, there being a continuous development from

the Son Vi to the latter („which appears to grade into the Hoabinhian with no clear demarcation“: Reynolds 1990). Indeed, the distinctions in tool types and assemblage variability between the Sonvian and the early Hoabinhian are not clear enough to decide whether they are culturally significant (Bellwood 1997)

Ha Van Tan (1985) describes a small flake tool assemblage at the Nguom rock shelter, the so-called Nguom flake tool industry, which derives from lower levels below the 23,000 date, and which yielded pollen indicative of a vegetation belonging to a severely colder climate, of a type nowadays found only in high mountain altitudes in Vietnam. This colder period is thought, on the basis of a comparison with Niah cave, to be of an age around 32,000 BP.

Supposed by some to be earlier than the Sonvian cobble tool assemblage is the Nui Do assemblage in Vietnam, of a surface site near Mount Do, which has been described by P.H. Kinh and L.T. Tieu (1973, in Vietnamese). Boriskovski (1969/70) characterises the industry as an assemblage of large Clacton-like flakes, large discoidal cores with alternate zigzag edges, large choppers and „handaxes“ and „cleavers“, and assigns it to the Early Palaeolithic. This, however, has been objected to by other scholars, such as Olsen & Ciochon (1990), who claim that the „bifaces“ are Neolithic blanks for axes, though he contends that part of the collection may well belong to the late Middle or early Late Pleistocene. Hutterer (1977) speaks of a rather amorphous character of the Mount Do industry. The present author has seen much of the material, housed in Hanoi. The artefacts are crudely worked and bear large primary scars but no secondary trimming. 90 % of them are flakes in a Clacton-like technique. They are very rounded and made from basalt, and often retain much cortex, and have wide platform angles with distinct bulbs of percussion. The smaller flakes are 5-10 cm in size, the larger ones 10-20 cm or even larger. They have no secondary trimming, but often have usable edges, and are very weathered, so that one is unable to distinguish usemarks. The cores are huge and discoidal (with seemingly prepared lower faces) or with alternate bifacial (zigzag) removal of flakes. The flakes correspond well with such cores. There are a few handaxe-like tools, especially No. 3711/1 (p.127 in the Kinh & Tieu book), which is made on a large, pointed cortex flake, partly bifacially trimmed and retaining cortex on the upper face. The other so-called bifaces are rough, large tools on blocks, with little work except some large primary flaking forming zigzag edges. The „cleavers“ in the book are but roughly trimmed flakes and cores. There is one „cleaver“, however, No.3756/49, which is not shown in the book. It is made on a large, partly cortical flake, where the distal edge is the intersection between the flake face and the cortex on the dorsal face. It is uniaxially trimmed on both lateral sides of the dorsal face, while the ventral face is left untrimmed. It is the only „cleaver“ I have ever seen in East and Southeast Asia.

On the other hand, there are large artefacts which resemble blanks for Neolithic axes, but many of them are so large (more than 25 cm) that one wonders, why such huge blanks were needed to produce small axes? And even if they were so used, why does one not find a single finished axe?

The Nui Do assemblage is an intriguing material. It is probable that we deal here not with one cultural unit, but with multiple cultural events spanning a long period of time. It is a surface site in an area of very suitable raw material. No other similar sites have been found in Vietnam. Continued research in the Mount Do area should be an interesting and worthwhile undertaking.

The type region of the original Hoabinhian in North Vietnam is the area of Hoa Binh, where Colani (1927, 1929) has first surveyed and described the Hoabinhian.

After this author had studied the material in Vietnam for a comparison with the Patu industry of Nepal some of the major cave sites are described below.

Most of the information about the Vietnamese data was supplied to the author gained with the kind help and assistance of the director of the Institute of Archaeology in Hanoi, Dr. Ha Van Tan, and his colleague from the same institute, Dr. Nguyen Van Binh. One invaluable source of information was the book „Van Hoa Hoa Binh O Viet Nam“ (under Nguyen van Binh 1989), to which many members of the Insti-

tute, writing in Vietnamese, contributed. It lists all Hoabinhian sites and the ^{14}C dates obtained for several caves in laboratories in Berlin and Beijing.

The pioneering work was carried out by M. Colani in 1924 to 1926 (Colani 1927 a,b, 1929), when she surveyed and excavated 54 caves in the Hoa Hoa Binh area. In the 1st Conference on prehistory of the Far East in 1932, the Hoabinhian was formally recognised as a cultural unit in Vietnam. More than 70 Hoabinhian caves are known in Vietnam.

Since 1968, a number of excavations have been carried out by Vietnamese scholars, and new ideas about the age and development of the Hoabinhian continued to be put forward.

The theory of the Sonviian being ancestral to the Hoabinhian seems to be challenged by the excavators: The lowest, 7th layer in the Dieu rock shelter has been dated to 24,000 BP (Nguyen van Binh, pers. comm.), and contains a certain percentage of Son Vi material together with artefacts of the Hoabinhian type, while the younger 6th to 1st levels date from about 18,000 to 8,000 BP, and contain only Hoabinhian assemblages. A rockfall layer (probably pointing to a cooler climate) is recorded between the 3rd and 4th layers. According to Nguyen Van Binh, this cave indicates an early beginning of the Hoabinhian, so that by 24,000 BP there were two cultures side by side, the Son Vi cobble tool industry in open air sites and the early Hoabinhian in cave sites. There may have been contacts between the two industries in the Late Pleistocene influencing each other.

The oldest dates from the Hoabinhian are from the Tham Khuong rock shelter, excavated in 1974 by Chu Van Tan. It yielded typical Hoabinhian tools along with some edge-ground axes even in the lowest levels (Nguyen Van Binh, pers. comm.). The Tham Kuong cave site is an important one, as it has yielded the earliest radiocarbon dates for the Hoabinhian, on shells analysed by a Berlin lab: $28,130 \pm 2000$ BP (Bln-1408), at a depth of 1.50 m, and $33,150 \pm 2300$ BP (Bln-1412), no depth given, (quoted in Nguyen van Binh et al., 1989; Reynolds 1990, 1993) and more recently also a younger date of $15,800 \pm 150$ BP (HCMV-13/93) (Ha Van Tan 1997). Unfortunately no data are available on the stratigraphic level of the dates and their association with the industry. Chu Van Tan divided the cave deposits into three cultural layers and two technological groups: an (earlier?) traditional chopper/chopping tool group (Son Vi) and a typical Hoabinhian group. But according to Nguyen Van Binh (pers. comm) there is no definite change in the tool kit; he recognises only one cultural unit, that of the Hoabinhian techno-complex, and the dates, therefore, refer to the Hoabinhian industry. Ha Van Tan (1997) is doubtful about the early dates and opines that the younger date of 15,800 BP is more appropriate for the Hoabinhian, while Reynolds (1993), too, says that the earlier industry can only provisionally be termed Sonviian. In my opinion, after having seen the material, it is indeed a typical Hoabinhian tool assemblage, though somewhat cruder than the material from other Vietnamese caves.

The Nguom rock shelter, Vietnam, (Ha Van Tan 1985) is particularly interesting, because it has a stratigraphical succession through a typical Hoabinhian (layer 2) overlying a Sonviian assemblage in layer 3, dated to 18,600 to 23,000 BP. Below the latter, in layers 4 and 5, a flake industry of amorphous small flakes with a few blade-like flakes is found (Ha Van Tan 1985) in association with a varied mammalian fauna (Reynolds 1993). But there also occur a few cobble tools of chopper-like appearance in the lowest layer (Ha Van Tan 1997). Dates for the flake layer are lacking, but it must be earlier than 23,000 BP, based on two dates from the base of layer 3. What the percentage of flake tools versus core tools is in layer 5 is not clear, as there is no analysis. In my notes there is a short mention of a so-called Middle Palaeolithic flake industry from the Nguom rock shelter and from the nearby Mieng Ho cave. From the latter Boriskovski (1972) describes a Middle Palaeolithic „Nevasian“ flake industry, but again in association with choppers.

Dates from other Hoabinhian caves and rock shelters are younger, usually between 8,000 to 11,000 BP. The Con Moong cave has furnished many dates, from 8,500 to 12,920 BP. It was excavated in collaboration with a Bulgarian team and disclosed three layers: The 1st layer, belonging to the older Son Vi cul-

ture (with dates between 11,000 to 12,000 BP), the 2nd layer, belonging to an early Hoabinhian (dated to 9,000 to 10,000 BP) and a 3rd layer, with a typical Hoabinhian (dated to about 8,500 BP).

The Xom Trai cave is one of the most important and undisturbed caves of the Hoabinhian. It was excavated by members of the Institute of Archaeology in Hanoi in 1981 and discloses only one cultural unit of 1-2 metres (with a typical Hoabinhian) which has been dated on the basis of many samples of shells and charcoal to between 14,000 to 18,000 years BP (Nguyen van Binh et al. 1989). But the drawings and profiles were unfortunately lost in Berlin (Nguyen Van Binh, pers. comm.). The material from Xom Trai, which I studied in some detail, consists of well-formed almond-shaped tools: discs, sumatraliths and short axes, almost all of them unifacially trimmed, with the lower face consisting of cortex.

Not all caves in North Vietnam show such a dominant presence of unifacial sumatraliths as the Xom Trai cave. Though the majority of Hoabinhian tools in the caves and rock shelters are unifacially trimmed (sumatraliths, unifaces, unifacial axes), there is a substantial percentage of bifacially trimmed axes present as well in many caves. Each Hoabinhian site shows distinct features of its own, but all are related to each other by the production of a great variety of axes.

The axes from the Hang Muoi cave (excavated by the History Museum and University of Hanoi in 1963 and 1965; no dates) for example, were very well made on flat cobbles or split cobbles of small ovate and round form, mainly unifacially but often also bifacially trimmed around the circumference. The so-called „haches courtes“ are quite numerous in this cave, too. Edge-ground axes are present as well, as in many other Hoabinhian caves.

In the Lang Doi cave (Colani 1927; no dates) the axes are ovate or elongate-ovate, and many are bifacially trimmed, but only at the distal or lateral edges, leaving much cortex on both faces and often at the butt. The distal ends are mostly round and convex and are often associated with lateral edges as well. The artefacts are quite beautiful and well made. There are also „haches courtes“ and discs made on flat cobbles or even on cortex flakes.

The first impression one gets from the axes of the Hang Oc cave (excavated by Colani; no dates) is that they were made on very flat cobbles and have a distinct bifacial edge trimming, with much cortex having been left in the centre of both faces.

At the Sao Dong I and II caves (Colani 1927; no dates) the axes are large elongate tools made on flat cobbles. They are well-made and often bifacially trimmed. Haches courtes are abundant. Some of the axes are quite rectangular in shape owing to the fact that they possess straight distal edges, which are rather rare in other Hoabinhian assemblages, but a feature that links them to Patu.

At the Phu Ve cave (no dates) the tool kit is characterised by tortoise-shaped unifacial tools (or round sumatraliths) with a flat cortical lower face and a steep edge all round, a common tool type found in other caves too, but not so abundantly as at Phu Ve. Bifacial tools are very rare at Phu Ve.

The My Te cave material (no dates) is divided into two groups, one comprising polished axes, the other Hoabinhian tools, amongst which there are long, rectangular bifacially trimmed forms with straight distal edges, rather like some of the rectangular adzes at Patu, but with a symmetrical cross section.

Vietnam has provided the largest record of the Hoabinhian period as well as what existed before and what came after – comprising of four different industrial types, which occurred between 30,000 and 8,000 BP, namely the Nguom small flake industry, the Sonvian, the Hoabinhian and the Bacsonian (Reynolds 1993).

3.2.2. Hoabinhian sites in other Mainland Southeast Asian countries

Hoabinhian assemblages are well established at various cave sites in other mainland Southeast Asian countries. To name but a few important ones:

Spirit Cave in North Thailand, where Gorman (1970, 1971) defined a cobble tool assemblage as a subcultural assemblage of the Hoabinhian techno-complex, containing large sumatraliths, grinding stones stained with ochre and utilised flakes within Hoabinhian levels 1 (dated to between 11,700 and 9,500 BP) and level 2 (dated to between 8,800 and 7,600 BP). A most important feature at this site is the possible introduction of domesticated plants by 11,700 BP and the appearance of polished axes and cord-marked pottery at 8,800 BP in association with Hoabinhian tools (Solheim 1970; Gorman 1971).

Nearby in Burma is the Padaung-lin Cave, where U Aung Thaw (1970) recorded a Hoabinhian assemblage, which I saw in the museum in Rangoon. This assemblage comprises typical sumatraliths, choppers and oval-to-elongate unifacial and partly bifacial tools from the lower levels and also edge-ground artefacts. The oldest date seems to be 11,400 and the youngest 6,200 BP.

The Laang Spean Cave in Cambodia, excavated by Mourer (1970, 1977), records Hoabinhian type core tools, described as short axes, sumatraliths and other unifacial implements and scrapers, as well as flakes with cortical striking platforms (and with step flakes, it seems) from cultural level II. This level has been assigned a date of 6,240 BP, which also marks the first appearance of cord-marked pottery.

Lang Rongrien, a karst rock shelter in southern Thailand, discovered and excavated by Anderson (1987, 1990, Reynolds 1993) is a well-dated site, which has yielded in its lower units, 8-10, a small Late Pleistocene assemblage which Anderson calls primarily a flake tool industry, although a few core tools are present, too (21 % core tools, 48 % flake tools). Charcoal dating points to ages between 38,000 and 28,000 BP. The collection, however, is too small, altogether 48 artefacts, to allow a clear understanding of this Late Pleistocene assemblage. Anderson, however, points out that the basal flake assemblage is not ancestral to the Hoabinhian tools of the later units (Anderson 1987, 1990; Bellwood 1997). Above it is an Early Holocene Hoabinhian from units 5 and 6, dated to between 7,500 and 9,600 BP with a few unifacial choppers, but also some bifacial core tools, sumatraliths and one short axe, as well as edge-ground tools. They differ from the classical Hoabinhian of Vietnam in being ~~manufactured not~~ on river cobbles but on thin, tabular chert. It is not a rich assemblage (208 artefacts), but it is Hoabinhian and well dated. The upper units contain burials with cord-marked pottery similar to the Neolithic site of Ban Kao in western central Thailand.

The cave of Moh Khiew in the karst area of Krabi province in southern Thailand was excavated by Pookajorn (1991) and yielded, below a Neolithic layer (2) a Hoabinhian assemblage in layers 3 and 4, with dates of between 6,000 and 11,000 BP, and below it, in layer 5, a unifacial cobble tool assemblage (Sonvian ?) dated to 25,800 BP. But it seems that the dates are not yet clearly established (Moset 1998; Moser shows many fine bifacial adzes from Moh Khiew).

The rockshelter of Sai Yok in Thailand (van Heekeren and Count Knuth 1967) yielded a typical Hoabinhian assemblage of sumatraliths, predominantly unifacial but also partly bifacial ovate tools and choppers, which van Heekeren called a „pebble tool industry“ of choppers and „Hoabinhian proper“. There is also fauna, but no radiocarbon dates for them, nor is there any stratigraphy. The site has been assigned preliminarily to the terminal Pleistocene and Early Holocene. Recently Kamminga (unpublished paper at the conference „The Hoabinhian 60 years after Colani“, Hanoi, January 1994) has undertaken a renewed examination of more than one thousand artefacts from Sai Yok. He describes the site as a cobble adze workshop and continues to say that this type of adze was probably hafted onto a wooden handle.

Going further south into the Malayan peninsular there are the caves of Gua Cha and Gua Kechil and the open air site of Kota Tampan.

Gua Cha, in western Malaysia, first excavated by Sieveking (1954), was re-excavated by Adi (1985). It is a Hoabinhian rock shelter in the dense rainforest inland area. The deposits show that a 1.70 m-thick alluvial Hoabinhian level above bedrock separated by a gap from an overlying Neolithic level. The Hoabinhian industry seems to be a very homogeneous assemblage with an emphasis on bifacially trimmed tools, in oval and elongate shapes, made on river cobbles. According to Moset (1998), the Hoabinhian

tools resemble those from Moh Khiew. Radiocarbon dates put the beginning of the Hoabinhian just after 10,000 BP and the end as late as 1000 BP (Bellwood 1997). A rich spectrum of fauna is associated with the Hoabinhian level with a predominance of pigs, particularly juvenile pigs.

At the Gua Kechil cave (Dunn 1964; Bellwood 1997) in Pahang province Malaysia, a layer of late Hoabinhian tools in association with cord-marked and plain pottery was found in the lowest level, overlain by a Neolithic similar to that of Gua Cha, but dated earlier, to the 4th millennium BC.

The earlier open air site of Kota Tampan in Perak, in western Malaysia, was first thought to be a Middle Pleistocene chopper/chopping industry (Sieveking 1960; Walker & Sieveking 1962; Reynolds 1993), but recent excavations by Majid (1990) could revise this opinion by dating a Toba ash above the cultural horizon to $31,000 \pm 3000$ BP. The site is described as a workshop. The artefacts are extremely crude in my opinion, and have no affinities with the Hoabinhian. They are made up of worked and battered quartzite cobbles, a few choppers and much waste. I have seen only three well-trimmed unifacial cobble tools from the gravel horizon. The so-called flakes are, rather, flake-like pieces with no discernible platform or bulb of percussion, and the retouch on the „flake tools“ looks more like natural „retouch“. Hoabinhian tools, however, were found on the surface in the vicinity of the excavation.

The southernmost extension of the Hoabinhian is in northeast Sumatra, in coastal shell middens, none of which have been systematically excavated. Most of them have been destroyed during the manufacture of lime. Van Heekeren (1972) reports oval and elongate unifacially worked cobble tools, sumatraliths (the major tool type), and short axes, while bifacial tools, edge-ground tools and utilised flakes seem to be rare. A radiocarbon date within the 6th millennium is available from the midden at Sukajadi (Bellwood 1997), and Bellwood suggests ages for the Sumatran Hoabinhian between 10,000 and 3,000 BP.

The dates of the Hoabinhian beginnings are earlier in Vietnam and become younger towards peninsular Southeast Asia, in South Thailand and Malaysia. For a summing up of a chronological succession of dates and cultures refer to Reynolds (1993).

3.3. Non-Hoabinhian sites in Island Southeast Asia

The Hoabinhian is not found in Island Southeast Asia, except in middens in Northeast Sumatra. While the Hoabinhian represents an industry with a predominance of cobble tools, as opposed to flake tools, the stone tool assemblages of Island Southeast Asia are „characterized by varying proportions of simple pebble (cobble) tools, cores and flakes with non-standardized shapes“ (Bellwood 1985), ranging back in time to around 40,000 BP. Bellwood comments that this fact may reflect not only important cultural differences but also geological ones, namely the different kinds of raw material available. Chert and other silicious material are used more widely in the islands. The basic technology of cobble tools and simple flake production did not undergo much change over this time before the appearance of well-ground axes and pottery after 3000 BC.

One of the best known sites of this complex is Niah Cave in Sarawak, Borneo, (Harrisson 1957, 1970; Majid 1982) which was inhabited from about 40,000 to 2,000 BP. The artefacts are crude and rather terrible and undiagnostic. Bellwood quotes that the stone tools of the older periods are made on sandstone and therefore smashed rather than flaked, and comprise untouched chunks, chips and few conchoidal flakes, with no specialized flaking technology, and few pebble tools. According to Majid edge-ground axes start to appear already between 20,000 and 10,000 BP. The importance of Niah is its long stratigraphic record and its faunal remains and human burials. The faunal evidence suggests that the area of northern Sarawak had a drier and more seasonal climate during the last glacial maximum (Bellwood 1997; T. Harrisson et al. 1961). Amongst the faunal remains, most prominent are bones of pigs (*Sus barbatus*) as

popular prey. The single human „deep skull“, has been dated to about 40,000 BP, though no stratigraphic details have been published, and there are still many unresolved questions (Reynolds 1993).

Tabon Cave on Pawala Island in the Philippines has yielded a dated sequence which extends from 45,000 to 9,000 BP (Fox 1970) including a flake tool industry of large, undifferentiated flakes with little retouch in addition to a very few cobble tools (Hutterer 1977; Fox 1978). Noteworthy are hump-backed scrapers with steep edges and flat bases.

An interesting and rather well-made industry from the Madai-Baturong region in Sabah, northern Borneo has been described by Bellwood (1984, 1988). The Lake Tingkayu sites in Sabah contain an interesting bifacial tool component found nowhere else at this time in Southeast Asia. The occupation was situated along the ancient shores of the lake, which existed between 28,000 and 17,000 years ago. The sites yielded, besides the basic cobble and flake tools and single-platform (horse-hoof) cores, many bifacially worked tools and lanceolate knives, worked on locally quarried tabular slabs of chert. This industry shows a unique level of skill. However, no faunal remains have survived in the acid soils on the lake bank. After the lake drained, the sites were abandoned, and only rock shelters nearby in the Baturong limestone hills, such as Hagop Bilo, were occupied and yielded shell middens with no bifacial tools, but with much fauna, dated to around 15,000 to 10,000 BP. After 10,000 BP these caves were abandoned, too, and other caves closer to the sea, in the Madai limestone massif (Agop Atas and Sarapad), were intensively inhabited between 9,000 and 7,000 BP, and also yielded a very rich stone industry. The cave industries are characterised, like all Southeast Asian island assemblages, by the typical Indo-Malaysian pebble (cobble) tools and utilised flakes, and by small, flat-based, steep-edged scrapers.

Some of the best pre-Neolithic industries of the Southeast Asian archipelago are those found in the southwest arm of Sulawesi, in caves and shelters in the limestone karst area of Maros, particularly the shelter of Leang Burung 2 (Glover 1977, 1981; Presland 1980), which have been dated to the Late Pleistocene, to between 29,000 and 17,000 BC, by radiocarbon analysis on freshwater shells. The industry shows, in addition to a few thousand unretouched utilized flakes of chert, often with an edge gloss, and multi-platform cores, a few (4) elongate blade-like flakes with faceted platforms, quite similar to the levallois technique of western Eurasia, though there are no prepared-platform cores. Such incidences of conscious core preparation prior to the removal of the flake is not found at any other site in the Southeast Asian prehistoric industries.

Glover (1976, 1977) reports a later shelter in Sulawesi, Ulu Leang, with an Early Holocene industry of small flat-based, steep-edged, domed tools and horse-hoof cores, similar to the Agop Sarapad industry from Sabah of about the same time. These tools, together with horse-hoof cores and unretouched utilized flakes, are often associated with unifacial and bifacial choppers, and seem to be a characteristic element in the terminal Pleistocene/Early Holocene preceramic sequences in the Southeast Asian archipelago.

One interesting element in these industries may be mentioned here. A distinct chert edge gloss is found on flakes at many sites in the Southeast Asian archipelago, for example in the sites at Sabah (Hagop Bilo; Agop Sarapad) and Sulawesi (Leang Burung 2 and Ulu Leang, (Bellwood 1987) and Timor. Kaminga (1979) suggests that the gloss derives from cutting opaline, silica-rich plant material, such as grasses and palms. Glover (1981), however, believes that it stems from the use of the flakes for matting or basketry, possibly involving palm leaves.

Many of the adzes of the Patu industry also show an extensive gloss at the adze edge, on both sides, and I am inclined to think that they were used for cutting and stripping bamboo, rather than working on palms. Bamboo is abundant in the Siwalik and Terai forests in a variety of species, while palms are rare.

Sinha & Glover (1984) have made detailed description of gloss on flakes from Leang Burung 2 and Ulu Leang, and have conducted their own experiments with cherts on various plant material. They distinguished four types of gloss produced by working on coconut palms, ratran palms, grasses and pandanus leaves. The gloss in all cases never extends more than 3-6 mm away from the edge. The authors des-

cribe work by cutting, slicing, whittling and scraping. None of the described gloss seems to be comparable to the gloss on the Patu adze edges, which is much more extensive, up to 30 mm away from the edge and mostly on both faces. They say, however, that on three flakes from Ulu Leang 1 the gloss has a wider area of polish on both surfaces, for which no reasonable explanation is offered, as no similar results were achieved by their experiments. My own experiments with home-made quartzite adzes, including slicing and whittling work on bamboo more than an hour, achieved no gloss whatsoever on the quartzite edge. I presume that the gloss on the Patu edges is the result of many hours of repeated work on bamboo by slicing, whittling and probably scraping.

Apart from some characteristic tool types, such as pebble tools (choppers), high-backed, steep-edged scrapers and retouched flakes, the cultural material of the Late Pleistocene and Holocene island industries contain in the main simple unretouched flakes—some utilized—associated with multi-platform and horse-hoof cores. According to Bellwood (1985), the level of technological skill is similar to that of some Middle and Late Palaeolithic industries of India and northern Asia.

3.4. The microlithic assemblages in Island Southeast Asia

There is no sign of any systematic attempt at blade production in Southeast Asia until after 6,000 BC. Until then, at most sites, the basic core and flake tradition in association with cobble tools persists. The only more diagnostic industries of the terminal Pleistocene and Early Holocene in Island Southeast Asia are the Lake Tingkayu and the Leang Burung 2 industries just described.

But by the Mid-Holocene the still continuing unprepared flake production in the Southeast Asian archipelago acquired a new element with the production of small blades and blade-like pieces and microliths. This new element only formed a minor component of the assemblages, and is not very widespread. It occurs only in the Philippines, on the Talaud Islands, and on Sulawesi and Java, but not in the rest of the archipelago. The artefacts are blade-like flakes and elongate flakes rather than true blades with parallel ridges, as found in the Old World and India. Cylindrical and conical cores are very rare.

In the Philippines and the Talaud Islands, this component consists of unretouched blades and blade-like flakes, with some of the flakes glossed. Fox (1970, 1978) describes a flake-blade industry from the Duyong cave, Palawan (near the Tabon Cave), but says that no prepared cores are found nor any retouched blades, and that this industry is not the classic „microlithic“ of South Asia (Fox 1978). Though retouch is absent there is some edge gloss.

The most important and interesting site for the blade-flake complex in Southeast Asia is the Toalian industry in southwest Sulawesi, which started by 6,000 BC. Van Stein Callenfels (1938) and van Heekeren (1949, 1972) recognised this element at about 20 sites and van Heekeren (1972) established a three-phase sequence of plain blades, backed blades and geometric microliths.

The more recent excavations of two rock shelters, Leang Burung 1 and especially Ulu Leang in the Maros area in Sulawesi, have thrown more light on the Toalian industry. Ulu Leang (Glover 1976, 1977, 1978) has preserved a good sequence. The lower levels contain the above-mentioned flake- and steep-edged tool industry, dated to 8,000–6,000 BC. By 6,000 BC the new element of microliths appears, associated with the continuing basic flake industry, including glossed flakes. This element consists of pieces similar to backed blades, crescents and geometric microliths (Glover & Presland 1985; Bellwood 1997). Later, after 4,200 BC, the so-called „Maros“ points appear, which are concave-based and often serrated.

At Leang Burung 1, which has only the later stage characterised by Maros points, 24 % of the used tools have edge gloss (Chapmann 1981). Chapmann notes the absence of steep-edged scrapers and edge-ground tools. Edge-ground tools seem to be absent in all Toalian sites. (Bellwood 1985). At Leang Bu-

rung 1 it is interesting to note that only 35 % of all retouched tools are microliths (the retouched tools make up 6 % of all artefacts). At Ulu Leang this percentage is 20 %. But no cylindrical cores are recorded.

The question of the existence of a blade technology is still unsolved and disputed. In the absence of prepared blade cores one can hardly speak of a blade technology. Glover & Presland (1985) deny too, that there was one. But the evidence of a significant microlithic element is beyond doubt.

At most excavated sites the Toalian industry continues on into a phase with pottery by about 2,500 BC. It seems that in Sulawesi the tradition of retouched flakes and glossed flakes lives on even as late as 1000 BC (Chapman 1981), although the microliths and Maros points have disappeared and only plain, round-based points occur. A hunting and gathering life-style seems to have survived there well into the period of cultivators elsewhere.

In eastern Java the so-called Sampung industry (van Heekeren 1972) consisting of bone tools and fine stone arrowheads similar to the unserrated Toalian points was excavated at the Gua Lawa Cave (van Stein Callenfels 1932). It seems to be preceramic, and also includes small retouched flakes and „blades“ as well as retouched shell-scrapers (van Heekeren 1972). Backed microliths and geometrics are absent. It appears that this industry is found at many sites in eastern Java, but no recent research seems to have been carried out on this interesting aspect of the pre-ceramic period in Southeast Asia, although Forestier highlights in his recent paper (1999) the question of Holocene „blade“ industries in Indonesia. On the Bandung Plateau, in western Java, a number of sites have yielded an obsidian assemblage (van Heekeren 1972) of backed flakes, crescents and retouched points, and even some geometrics displaying similarities with the Toalian. But detailed descriptions are lacking (Bellwood 1997).

Australia will not be included here, but only the fact is mentioned that microlithic tools in the form of backed blades, geometrics and points appear as a typical element in Australia from 4,000 BC onwards.

As far as one can see, there is no full replacement of the earlier unprepared flake industry by a microlithic technology, only an added component of microliths to the continuous flake production, and at a much later stage than in India. There is no link with the Indian microlithic.

To sum up: There is no systematic blade production in Southeast Asia. But Maros points and other, unserrated points occur with microliths exhibiting backing retouch and with geometric forms in Sulawesi and Java in Mid-Holocene times, much later than in the classical microlithic cultures of the Old World and India. The Nepal microlithic industries fall well within the spatial and cultural sphere of the Indian microlithic. Retouched stone arrowheads do not co-occur with the Nepal microlithic. But later, in the Neolithic period, small polished stone points appear together with cord-marked pottery and with polished axes.

3.5. Concluding discussion on the Hoabinhian in comparison with the Patu industry

Comparisons of the Hoabinhian tool kit of Vietnam and the Patu assemblage disclose a variety of analogies which may be understood given the fact that both populations are forest dwellers. Patu is, like the Hoabinhian, primarily a cobble tool industry, but one with a high percentage of corescrapers (which are not present at Hoa Binh) and choppers, and with an added element of adzes, adze-like tools, scrapers and knives. The most obvious distinction is that the characteristic tool type of Patu is the adze with a predominantly straight-edged distal edge and asymmetrical in cross section, while the Hoabinhian assemblages are characterised by axes, which display predominantly round distal edges, are symmetrical in cross section, and are associated in the later stages with a certain percentage of ground-edged and polished axes, which are absent in Patu.

Though at Patu the majority of tools are also unifacial tools (such as sumatraliths and unifaces) which bear a certain resemblance to the tool kit at the Hoa Binh caves, the adzes from Patu are different from the axes of Hoa Binh. They are manufactured in a different fashion, with large, shallow primary flake scars over both faces, leaving often much of the original split surface or flake face in the centres, and with extensive step-flaking and fine retouch along the edges. The Hoa Binh axes are predominantly unifacial, and their trimming mainly along the circumference, leaving much cortex in the centre of the upper face. The axes are made on flat cobbles, while the Patu adzes are mainly made on either split cobbles, slices or flakes. The shapes differ, too: while at Hoabinh the axes are oval, elongate or round and mostly have a round or convex distal end with a more or less symmetrical biconvex section, at Patu the shapes are more angular and geometric and there is always a very distinct, usually straight distal edge with asymmetrical section—an adze edge for fine, not heavy work. There is also more variety in the cross section at Patu, and one finds fewer biconvex cross sections than in the Hoa Binh axes but rather planoconvex, trapezoid and rectangular ones. The adzes are altogether more angular at Patu, and they are trimmed, in most cases, bifacially or partly bifacially.

The gloss at the distal edge, too, is a very distinct feature of the Patu adzes—which is, to the author's knowledge, not present in the Hoabinhian sites at Hoa Binh.

An interesting observation, though, was that the flakes I studied from some of the Hoa Binh cave collections (Hang Muoi and Sao Dong), have a number of characteristic features in common with the Patu flakes. Flakes seem to possess, in the majority, cortical platforms and stepretouch at the dorsal platform edge, similar to many Patu flakes. So-called „orange“ flakes and flakes with cortex opposite the platform are common, too, and point to a technology similar to that at Patu: such flakes seem to be tool-manufacturing flakes and rejuvenation flakes (see also White & Gorman 1979).

M. Nishimura (1994) came to the same conclusion after he made an analysis of the flakes from the Xom Trai and the Bung caves. He declares that there are almost no special flake production methods present and that the flake debitage can be divided into two categories: manufacturing (of heavy-duty tools) and reduction (resharpening and rejuvenation) flakes. Most of the flakes he studied had cortex platforms and, it seems, also a stepretouch at the platform edge on the dorsal face, which in Nepal is such a typical feature of the Patu flakes, and the Brakhuti flakes as well.

Another interesting observation is that the method of splitting cobbles for the manufacture of tools seems to have been practised in some Hoabinhian assemblages, too, for example at Hang Muoi and, rarely, at Lang Doi. But in the main flat cobbles are used, and the lower face of the sumatraliths at Phu Ve and the unifacial axes at Xom Trai (Fig. IV in Nguyen Van Binh et al. 1989) consists always of cortex.

After quite an intensive study of the Hoabinhian tools in Vietnam, I have come to the conclusion, somewhat contrary to the comments by Narr (1980), that the Hoabinhian industry is, at least in Vietnam, a well-defined tool complex with a wide variety of types, but with a distinct manufacturing technique, though I agree with him that a satisfactory definition is lacking. That is the reason why an attempt is made here to describe the distinct elements of the Vietnamese Hoabinhian.

Summing up the comparisons: The Hoabinhian axes

- 1) are almost entirely made on flat cobbles, rarely on flakes or on split cobbles, as at Patu;
- 2) are trimmed either completely unifacially, but
- 3) sometimes bifacially, in which case the trimming is mainly along the edges, leaving cortex on both central faces and sometimes at the butt, while the Patu adzes have much less cortex and show much more overall bifacial trimming;
- 4) have very fine edge retouch, as at Patu;
- 5) have usually oval, round or almond-shaped forms, and thus also rounded distal edges, rarely straight distal edges (though in My Te and Sao Dong rectangular distal edges are seen), while Patu has more angular, geometric shapes, with predominantly straight distal edges;

- 6) have predominantly symmetrical and biconvex cross sections, while Patu has mainly asymmetrical and plano-convex sections.
- 7) Unifacial round „discs“ and oval sumatraliths are also typical. The Phu Ve collection is entirely characterised by such discs and sumatraliths. In Patu such tools are present, too, but rare and not so distinct.
- 8) The „hache courte“ is a typical tool in many Hoabinhian caves. In Patu they are present but very rare.
- 9) Choppers are present in Hoabinhian caves, but they are of crude craftsmanship, specially at the lower levels; they continue through into the Bacsonian levels.
- 10) Cotescrapers, as known from Patu, are not observed or recorded in the Hoabinhian assemblages.
- 11) The distinct phytolithic gloss which is observed on many adzes at Patu at the distal working edge is not found on any of the tools of the Hoabinhian industry.

Comparisons of the Patu industry with the Southeast Asian Hoabinhian assemblages indicate certain similarities and point to adaptations to similar environments, if not to interconnections between the two regions. It is suggested that they both share similar subsistence patterns and a tool kit adapted to it. The bifacial and unifacial tools show a certain resemblance to unifacial and bifacial axes from Hoabinhian caves in North Vietnam, particularly from Colani's caves Mi Te and Sao Dong and the recently excavated caves of Xom Trai and Hang Muoi. The differences have been discussed. Patu is a separate industry of early Holocene age, with a Mesolithic, macrolithic stone tool assemblage of its own.

There do not seem to be any connections of Patu with India. The presence of adzes is a very characteristic feature of Patu and is very different from the contemporaneous microlithic Mesolithic industries of its southern neighbour India. Patu cannot be recognised as being part of the Indian Mesolithic culture, but represents a special cultural complex, more akin to the southeast Asian context, reflecting adaptations to a densely forested habitat.

The post-Pleistocene period was a time of amelioration of the climate after the last glacial maximum, when the rainforests re-established themselves in mainland Southeast Asia after the drier climatic episodes of more open woodlands in the Late Pleistocene. The Hoabinhians were hunters and foragers in a densely forested habitat and adapted themselves to the more restricted resources in thick forests. Their tools must have been wood-working tools. Those from Patu were in all probability used for wood and bamboo work.

Bellwood (1985) comments that such restricted resources „promote non-specialised economics and low population densities amongst hunter-gatherer populations“ which „strongly suggests that rainforest occupation is very much a Holocene adaptation“.

Although the Himalayan foreland in eastern Nepal in the Holocene did not belong to the rainforest belt, as it did in Southeast Asia, it nevertheless was covered densely by monsoonal subtropical forests in the Early Holocene during the occupation at Patu. Now these virgin forests have all disappeared due to the ruthless cutting down by the recent population within only the last century.

Although the Hoabinhian-like cobble tools in Nepal lie far beyond the actual Hoabinhian belt of mainland Southeast Asia, the fact remains that the highly specialised tool kit of Patu reflects a very specialised economic exploitation of resources in a dense forest environment distinct from the rest of the recorded prehistoric occurrences in Nepal. Further, the spatial gap between Nepal and Northeast India on the one hand and Vietnam on the other is a rather unexplored blank area, apart from the few Palaeolithic sites in the Irawaddi valley in Burma.

These forest-dwelling people of Patu did not seem to have moved further west. In spite of the intensive survey in the western Dang-Deokhuri area, no sites reminiscent of the Patu tool inventory were encountered there, and it will be the task of future investigations to survey the foothill areas between Dang and Patu in order to find out whether links exist or whether Patu is the furthest western extension of this Hoabinhian-like industry. The same goes for the explorations east of Patu, to search for connections with

the Burmese highlands. The nearest sites are the Padalinh cave in Burma (U Aung Tha 1971) and the Spirit Cave in northwestern Thailand (Gotman 1970).

In India macrolithic Mesolithic industries are absent, and the Mesolithic is characterised by microliths, commented on already by Boriskovsky (1975). It is, however, interesting to mention that some evidence of Mesolithic macrolithic industries seem to have come recently from northeastern India.

Reports by Mohanty (1993) record heavy-duty Mesolithic tools together with microliths in the Keonjhar district in Orissa in northeastern India. Amongst the heavy-duty tools he mentions core scrapers, including bifacial tools with some resemblance to the adzes of Patu (but without the distinct distal edges of the Patu adzes; in fact they may be blanks for axes) and steep-edged, flat-based unifacial tools resembling sumatraliths. He discusses more than 50 surface localities, in 39 of which microliths occur together with heavy-duty tools, while in 5 sites only heavy-duty tools occur, and in 14 localities only microliths. Unfortunately it is not clear whether his so-called core scrapers are always found in association with microliths, or also separately. In Patu, not a single microlith occurs, the same is the case in the Hoabinhian.

Mohanty's core scrapers, on the other hand, are not similar to the corescrapers of Patu, but are rather a heterogeneous category of steep-edged, high-backed tools of varying shape and size. They include oval bifacial and unifacial tools, and also medium-to-small scrapers (Mohanty 1993, Fig.7) with a flat base of either cortex or a flake face, and steeply retouched uniaxially around the circumference. Such high-backed scrapers do not occur at Patu, but they do exist in the island belt of Southeast Asia, in sites like Hagop Bilo and Agop Sarapod in Sabah and Ulu Leang in Sulawesi and in Australia.

Unfortunately, too, there is no stratigraphical evidence that would allow the question to be answered whether microliths and heavy-duty tools reflect two different sets of occupations or whether they belong together, the latter being Mohanty's opinion (pers. comm.) Be that as it may, the important fact is that several heavy-duty tool types of apparently Mesolithic age with some resemblance to Patu have recently been recorded from India, some 500 km south of Patu. While the Patu site lies somewhat north of the actual tropical forest belt, the Orissa sites lie well within the tropical belt, which includes Burma and Vietnam.

The interesting observation, gleaned from the various Vietnamese industries, is the long persistence of the use of heavy-duty cobble tools (in contrast to the more prevailing smaller flake industries in Island Southeast Asia). This may reflect a special adaptation to the kind of life and subsistence in a tropical forest environment, one which needed a heavy-tool kit. Boriskovski (1969/70) also was of this opinion when he said that life in tropical forests was conditional on the persistence of the macrolithic technique.

The question whether there is an uninterrupted continuum of cobble tools in mainland southeastern Asia from the traditional „pebble tool“ complex via the Sonvian and the Hoabinhian into the Neolithic, however, has not been solved, as there are intermittent flake industries reported in separate layers in a few caves (the Nguom cave and Mieng Ho cave in Vietnam, and maybe Lang Rongrien) in pre-Hoabinhian levels. But one must not forget that the emphasis of the study of the Hoabinhian has always been on the large tools and that the Hoabinhian assemblages, at least all those I have seen, are always associated with utilised flakes, besides the bulk of the manufacturing waste flakes. Larger collections are needed than the one at Lang Rongrien in Thailand, in conjunction with a careful study of the Hoabinhian flakes.

IX. Significance of the Nepal data within the framework of Asian Palaeolithic Prehistory

Nepal has been a blank on the prehistoric map of the world up till the beginning of this survey. Cultural material of the stone age was absent, apart from a number of Neolithic axes. The same lack of data was apparent for the Quaternary geology record.

In view of the fact that in its neighbouring country India, the prehistoric record from the Early to the Neolithic is abundant it would have been surprising if prehistoric man would not have occupied the foothills of the Himalayas in Nepal as well.

The presented data, the outcome of more than 11 years of fieldwork, is ample evidence of this assumption. It was the first, and pioneering, attempt of untangling the Palaeolithic past in Nepal and is a significant addition to our knowledge about Early Man in South Asia.

The survey was confined to three areas, shown in Fig.1, situated in the southern part of the predominantly mountainous country, which was thought to be promising for a prehistoric survey.

Since nothing was known before, it must be emphasised here, that the presented data should be regarded as a first fundament of the Palaeolithic history in Nepal, though recorded and described with great attention. It should be considered as a milestone on the road to our knowledge of Nepal's earliest past, and should serve as a basis for future research.

The cultural palette of the findings in Nepal is colourful and full of variety and gives evidence of the presence of numerous different groups of Early Man during the Palaeolithic periods. The findings in the surveyed areas in Nepal indicate a low population density in the Early and Middle Palaeolithic periods, i.e. in time before the last glacial. Maybe barriers, induced by climate and very dense vegetation etc., have prevented movements. However the significant fact remains that during these earlier periods connections did exist to the southern neighbour India. Towards the end of the last glacial the density of occupations in the Siwalik foothills increased considerably, with the appearance of the Brakhuti industry with its technique special to Nepal. These cultures are found in the Siwaliks in the western part of Nepal. The Patu industry of eastern Nepal stands as yet outside the cultural range of western Nepal and points to connections with Southeast Asia rather than with India. We will come to this issue presently.

The prehistoric evidence in Nepal has established Nepal as being a border stone between the Palaeolithic cultures of the west and the east. It lies at the boundary between two „worlds“ of lithic expression, i.e. between the western technocomplexes, including the Acheulian and the Levallois traditions and the numerous Late Palaeolithic cultures with blades and well-retouched, distinct flake tools, culminating in the microlithic technique, and the eastern technocomplexes of cobble-tools and the much less distinct and less retouched complex of small flake tools. It lies, in fact, on the boundary of what scholars have always referred to as the "Movius Line.", which has been the focus of much discussion, and on which I myself have commented in a recent article (Corvinus 2004) as being a borderstone between two distinct cultural entities.

Nepal, therefore, is a border country and its Palaeolithic cultures exemplify this. The high mountain range of the Himalayas forms a formidable barrier to the east and the north. This is reflected by the cul-

tural remains that Nepal's earliest inhabitants left behind. The Palaeolithic record of the earlier periods of the Pleistocene, i.e. the Early and Middle Palaeolithic, has definite connections with India, and through India with the west. Migrations must have been restricted to movements from the south and back.

In this respect the occurrence of *in situ* Acheulian tools in Nepal is of great significance. In India the majority of Acheulian sites are not in stratified context. But recent research has focussed on *in situ* findings in stratigraphically controlled position, as in the case of the yet unpublished data from the ongoing excavations at Morgaon (S. Mishra and S. Deo, pers. comm.) and Attirampakkam near Madras (Shanti Pappu, pers. comm.). But in spite of published data, including those from Chirki (Corvinus 1983), Bhimbetka (Misra 1978, 1985b) and Didwana (Misra & Rajaguru 1983), discussions on age and relationship between the sites are continuing without yet presenting a satisfying picture.

The evidence from Nepal will help to elucidate the problematic questions of when and where Acheulian man lived in South Asia. The significance of the Nepal Acheulian lies in the fact that both, the Gadari assemblage and the Satpati Acheulian are in strictly *in situ* geological strata, which can be correlated with the geological events of the Himalayan uprising: the Gadari bifaces being in stratified context right after the Siwalik uprising before the major alluvial in-fill of the tectonic Dun valleys and the Satpati Acheulian being in stratified position within folded Upper Siwalik sediments. Particularly the Satpati occurrence in the Upper Siwalik context is of crucial significance for the antiquity of the South Asian Acheulian. This is discussed in greater detail in chapter V.2.3.1 in the concluding remarks and will not be repeated here. It is enough to say that at Satpati we can relate the earliest evidence of the prehistoric occupation with the last Himalayan uprising.

These are unique and doubtless evidences of the antiquity of the Acheulian in South Asia, pointing back to the Early Pleistocene or at least to the early Middle Pleistocene, as discussed also in VII.3.

The Middle Palaeolithic Arjun site, a rare and rather isolated industry in Nepal, opens interesting speculations regarding its link to India. What in India was called initially the Middle Stone Age or Series II or Nevasian is a flake-scraper industry with few blades, which in central and western India is not a well-conceived industry and is different from the Levallois-based Arjun industry of Nepal. Arjun is probably of a later, better developed phase of the Middle Palaeolithic which connects best with the sites at Nagarjunakonda on the Coromandal coast in South India (Bannerjee 1975). The raw material in Arjun is still quartzite (so is Nagarjunakonda), while most sites in India started to use siliceous material of chert, jasper and chalcedony, which is not available in Nepal, a fact which masks similarities to Indian sites considerably. In India the Middle Palaeolithic seems to span a long period of time, through the last Interglacial, but has been dated in Rajasthan by TL and U/Th series method to between 100,000 to 150,000 years BP.

The picture changes somewhat in the later periods, where the lithic remains show remarkable independence from western influence, for example in the case of the Brakhuti industry, for which the provenance is still unclear, and even seem to be influenced by eastern traditions, as in the case of the Hoabinhian-like Patu industry, while the microlithic tool assemblages again suggest origins from the south.

This is significant, as it shows interaction and intermovement not only from the south but also from and to the east which could be interpreted as an increase in mobility. And this, in turn, may be an expression of a search for new ecological niches.

Also of importance is the fact that a distinct cobble-tool element is evident in Nepal, not in the earlier Palaeolithic periods, but from the Middle Palaeolithic, continuing into the Early Holocene. This stands in contrast to the data coming from the northwest Indian foothills where the so-called Soanian cobble-tool complex is supposed to be of Early Palaeolithic origin, though it is not established by stratigraphic context. This is described in more detail in chapter VIII.1 and in Corvinus (1998). The evidence from the Indian foothills and those from the stratigraphically controlled Nepal foothills do not conform with each other, and it is likely that the Soanian cobble-tools are much younger, too, than hitherto thought to be.

One has to reconsider the Soanian question if stratigraphical data are forthcoming from the Indian foothills.

Another significant record is the occurrence of a Mesolithic-macrolithic industry of adzes in association with cobble-tools and sumatraliths in eastern Nepal which seems so far to have no connections with India but rather with the Hoabinhian concept of production of axes and adzes, a tool kit suggested to be associated with occupations in forested habitats in mainland Southeast Asia.

The sumatralith is a tool type, initially from Sumatra, describing a unifacial, flat-based and steep-edged tool from the Hoabinhian cultural complex in Southeast Asia. These tools are quite typical for the Hoabinhian in Vietnam and neighbouring countries. I have used this term for similar tools in Nepal, mainly in the Patu industry, where this type is present (Pl.33), though not common and with considerable variations (Pl.32). But sumatralith-like tools are also present in the Brakhuti industry, some of which can be described as true sumatraliths (Pl.70/4-5 and Pl.79), though most others only resemble them to some extent and are called sumatralith-like tools, some being high-crested (Pl.139/1) or horse-shoe shaped (Pl.127/1). These tools seem to have developed via corescrapers. The fact remains that a tool type resembling Southeast Asian sumatraliths are present in Nepal in the Dang-Deokhuri area as well as in the Patu industry in association with corescrapers and unifacial choppers and with a very special stone knapping technique.

This perhaps superficial resemblance must, however, not consequentially indicate direct connections with SE Asia, nor that the Brakhuti industry and Patu are contemporaneous. This question on the relationship between the two industries timewise has been also commented on by Freund (1991). On the other hand it is an interesting and thought-inspiring phenomenon that such tools are present in the end Pleistocene and the early Holocene in Nepal and Southeastern Asia but not in India.

The great advantage in Nepal is that Quaternary sediments are present almost everywhere in the studied areas, albeit often only in remnants, and that the prehistoric findings are in primary context, exposed by the strong erosion. This is of great importance, as the lack of stratigraphically controlled sites in India, and altogether in Asia is a great negative factor, causing problems and misconceptions. Especially in eastern and southeastern Asia the lack of stratigraphical description, the lack of adequate documentation, i.e. of drawings, profiles, photos and detailed descriptions of the artefacts and final, detailed reports of the field-survey and excavations is to be regretted (see also Freund 1991).

In this respect the Nepal data is of particular interest and significance, because almost all recorded sites are in some way or other connected with the geological strata of the Quaternary.

Important for future search would be to survey the eastern part of Nepal, beyond the surveyed Patu area, in order to verify this author's idea or theory of cultural influences from the east in the Early Holocene or Late Pleistocene, as well as to further the assumption that the earlier Palaeolithic periods, i.e. the Early and Middle Palaeolithic and the Microlithic have their origin from India.

It may also answer questions about the Brakhuti industry and clarify the original provenance of this remarkable industry and relate it to South- or Southeast Asia (see also Freund 1991).

In addition to new surveys much more work has to be done on dating. Absolute dating often does not correspond with the observed geological/stratigraphical and typological data. I myself am of the opinion that detailed geological and stratigraphical recording is of the most fundamental importance and shall always have priority to provide the most reliable basis for later absolute datings. On the other hand, typological data and the functional use of the tool kit in an assumed environment play an important role in establishing a basis for absolute dating processes.

The Brakhuti industry is a good example in this respect: though stratigraphy and absolute dating relate with each other the typology could point to a younger age. The flake production technique and the technology of the heavy duty tools have similarity with that of the Patu industry, though the most significant tool types of Patu, the adzes, are unique to Patu and are missing in the Brakhuti industry. Could the

Brakhuti industry be a predecessor of the Patu industry? Could the heavy duty tool element at Patu with its unifacial choppers and corescrapers be inherited from the Brakhuti industry for heavy work and could the adzes at Patu either be a new invention for finer work or an import from the east? Could the choosing of lifestyles in different habitats and ecological settings (niches) have played a role for the differences?

Whatever may be the answer, we do not know it yet. But one fact remains: the heavy duty tools have played a major role in almost all the assemblages in Nepal, right from the Middle Palaeolithic Arjun industry to the Mesolithic Patu industry. These tools seem to have been the staple element in a life in the more or less forested areas in Nepal.

The evidence from Nepal have firmly established the presence of prehistoric man in the Nepal Himalayas forming links between western and eastern life styles and subsistence patterns during the Stone Age.

I want to add at this place some remarks by Freund (1991, 152). She says that, in spite of the fact that in a country which up till now did not play any role in prehistoric research, a great number of findings of different cultural periods could be found in relatively short time, indicating 1. how dense the occupation pattern could be even in a limited area, 2. how great the typological variability between sites of even similar periods can be, and 3. in what different sedimentological context sites can be placed (if based on detailed geological studies), which eventually help to provide the chronological sequence of the findings.

The presented data are fundamentally new results collected over the many years of investigations in an entirely virgin research area. It is a first beginning in this field of research in Nepal. It must, however, be pointed out at this place that the presented data is the result of a single person project. It would have needed a team of scholars to take up the many different aspects of the vast research which presented themselves during the course of the search, and it is therefore unavoidable that some of the aspects could not be dealt with in more detail and shortcomings can be expected.

Much work has been done and many discoveries made during this research, but more work in the future is required to fill the gaps. The potential for further research is vast. If the surveyed areas have presented such a wealth of cultural material, future researchers should now concentrate on surveying other promising areas, such as the Surkhet valley in the west, and the large Chitwan Dun valley in central south Nepal, or the Gaighat area in the far east. I am convinced, through short visits and some findings there, that sites could be found there as well in order to link the data recorded in this monograph, with new data. The same should be done with the study of the geological settings and the stratigraphy in those other areas. Other aspects, such as sedimentological and pedological studies along with more sampling for dating should be included. Since no full-scale excavations could be undertaken during the project by the author, it would be important to carry out excavations at sites like Ammapur, Brakhuti-W, Gadari, etc. before all primary evidence is lost to erosion. This is also the reason why the photo documentation is so extensive, because in twenty years time the sediments documented in the photos, will be eroded and lost for ever, and the photos will be all that is left.

The abundant discoveries of this project represent the first evidence of Nepal's most ancient heritage, and the interpretation of its data is the first attempt at elucidating Nepal's prehistoric past.

Summary

When this research was started in Nepal there was no data available or known about the earliest prehistoric periods of the country, nor was there any knowledge about the Pleistocene geology, stratigraphy and palaeoenvironment. In the early 80's it was a virgin country, regarding prehistory and Quaternary geology, and one could not foresee what the results would be and what the implications would be. The beginning was a bagful of ideas and hopes, combined with a tenacious determination to obtain results, aided by the experience of a lifetime of prehistoric explorations in Africa and India.

The outcome of the research, which took altogether 20 years, is now presented herewith, though with a rather long delay due to the abundance of the data.

Fieldwork was undertaken every year for several months between 1983 and 1994. The areas of research were chosen after a number of traverses through the Siwaliks.

For the purpose of necessary comparisons of the discovered data from Nepal, Nepal being a border country near the so-called „Movius Line“, i.e. between western and eastern cultural expressions, journeys were undertaken to a number of Southeast Asian countries.

The work was financed by the Deutsche Forschungsgemeinschaft = DFG (German Research Council) for eleven and a half years. After the end of the supported project the main write-up and documentation was carried out since 1994 by my own means.

After the first discovery was made in April 1984, of a microlithic site at Lamahi in the Deokhuri valley, a comprehensive survey was undertaken in the Dang and Deokhuri Dun valleys, and it soon became apparent that the country had been occupied by various cultural groups during the Stone Age. In the course of the survey 75 site complexes with over one hundred localities were discovered in the Dang, Tui and Deokhuri valleys, the Arjun and Mashot valleys (western Nepal), in the Sarpati area (central Nepal) and in the Rato River area (eastern Nepal).

Of great significance was that most of the discovered sites were in stratigraphic context within the Quaternary strata of the Dun valleys. The discoveries were possible due to the strong recent erosion of the deposits which exposed the buried sites.

Since nothing was known about the Quaternary geology of the Dun valleys it was of the utmost importance to study the sediments and establish the geological history and stratigraphical sequence of the strata in which the cultural material was embedded. These studies had priority over the description of the sites and the cultural material and covers the first part of the monograph, apart from an introduction (chapter I) and the description of the geographical situation (chapter II).

Chapter III describes the Dang and Deokhuri valleys as so-called Dun valleys, formed tectonically as intermontane valleys during the orogenic movements of the Siwalik uplift in the early part of the Pleistocene. They were subsequently filled with Quaternary sediments of not only alluvial but also colluvial nature. The aggradation took place between the times of occupation of Early Palaeolithic to Neolithic groups which frequented the valleys. During the detailed stratigraphic and geological survey I was able to establish a sequence of fluvial and lacustrine deposits filling the valleys, and of colluvial deposits covering the hill slopes and foot of the hills as hillwash deposits. Both contain cultural material.

The alluvial deposits were then divided into a number of new formations, introduced by me, which have been called: the Babai Formation with a Lower and Upper Member for the older alluvial deposits, the Sitalpur Formation for the younger alluvial sediments, the latter being without any lithic content, and the Gidhiniya Formation, formed by colluvial hillwash deposits. Both, the Babai and the Gidhiniya Formations, have yielded abundant lithic material from the Early, Middle, Late Palaeolithic, the Microlithic and the Neolithic periods.

A detailed description of the new formations was carried out so that the sites embedded in their strata could be understood and interpreted through their provenance within the stratigraphic framework. The lowest part of the alluvial deposits of the Babai Formation, consisting of basal gravel and rubble beds, contain the earliest cultural material in the form of Early Palaeolithic artefacts. These basal beds are, after an unconformity, succeeded by lacustrine clays and clayey silts of the Lower Member of the Babai Formation which contain no lithic material. They are at many places, due to an erosional phase after a time of stabilisation, replaced by the Upper Member of the Babai Formation. This latter, consisting of stratified fluvial deposits of silts and sands, and intercalated with coarse lateral influxes of Siwalik rubble, forms the very dissected surfaces of the Older Terrace of the Dun valleys. The majority of the later Palaeolithic sites have their provenance in the Upper Member of the Babai Formation.

The Gidhiniya Formation was posing interpretational problems. Geologically it was of a different facies, but culturally it contained remains of typologically similar character as those from the Upper Babai Formation. The Gidhiniya Formation, consisting of unstratified silts of colluvial origin, cover hill saddles and the lower slopes of the Siwalik hills as hillwash fans. These sediments are found wherever the hills consist of Lower Siwalik siltstones, which are the parent material for the colluvial silt fans. Repeated field studies finally revealed the relationship between the Babai and Gidhiniya Formations. The latter interfinger at the base of the hills with the Upper Member of the Babai Formation, thus making them more or less contemporaneous with each other, confirming the prehistoric data.

Further studies revealed a significant erosional unconformity between the Babai and the younger Sitalpur Formation. Deep incision must have occurred after the end of the alluvial sedimentation of the Babai Formation, even below the recent river level, after which rapid aggradation of fluvial deposits, intercalated with lignites and diatomites, formed the low, wide terrace flats in the centre of the valleys.

After the stratigraphical succession of the sediments was established (summarised in Fig.11 and 12) it was possible to evaluate the cultural events in their chronological sequence.

The main part of the monograph (chapter IV and V) deals with the description of the sites and their cultural material, and this was done areawise, that means by their occurrence in the investigated valleys. More than hundred localities could be recorded during the many months of fieldwork. The discovery of this wealth of sites was aided by the recent erosion during the last ca. 50 years, caused by the increase in population and the drastic deforestation in the Dang-Deokhuri valleys. The heavy erosion resulted in deep gullying and badland formation, exposing the embedded sites. I must say at this place that luck was on my side: I came at the right moment for the exploration, the sites began to be destroyed by the rapid erosion so that the occupation horizons were revealed to the searching eye. If I had come 30 to 50 years later the destruction would have been quite complete, and the artefacts would have been seen only in reworked secondary placement with no data on their original stratigraphic position.

The deep erosion exposed the sediments down to bedrock and thus the remains of the earliest occupants of the Siwalik Dun valleys came to light, those of the populations of the Early Palaeolithic with an Acheulian assemblage at Gadari in the Dang valley and a large flake-core industry in the Tui valley at Brakhuti-W, both being contained in the earliest Dun fillings in the basal deposits above bedrock. The beginning of the Dun filling occurred just after the last event of the Himalayan uplift, somewhere in the Early Pleistocene.

The explorations revealed even earlier findings. The occurrence of Acheulian bifaces in folded alluvial deposits within a sequence of uppermost Siwalik sediments at Sarpati Hill was an unexpected chance discovery. The handaxes were lifted up by the folding of the latest tectonic events along the Himalayan front some time during the Early Pleistocene and thus belong to some of the earliest Acheulian evidence in South Asia.

The same deep erosion as in Dang exposed in the neighbouring Deokhuri valley a complex of sites of Middle Palaeolithic populations in stratigraphical context, the richest being Arjun-3. The Arjun-3 industry consists of an assemblage of prepared flakes and cores in a Levallois technique with a well-made blade- and flake-tool assemblage. This industry belongs in all probability into the last Interglacial period, which is more or less confirmed by OSL dating. Both, Early and Middle Palaeolithic occupations are, however, rare in Nepal.

Subsequently, during the later part of the alluvial fill, occupations in the Siwalik valleys in Nepal increased considerably. An abundance of sites and localities of various groups of populations of the Late Palaeolithic are scattered throughout the Dang and Deokhuri valleys and in other river valleys. They are almost everywhere associated with the Upper Member of the Babai Formation and with the Gidhiniya Formation, which, on the basis of geological observations seem to belong into the later part of the Late Pleistocene. The majority of these localities belong to a flake- and cobble-tool assemblages called the Brakhuti industry. Their characteristic tool types are unifacial cobble-tools of choppers and corescrapers in association with small flake tools. The type site of the numerous flake- and cobble-tool assemblages of the Brakhuti industry, is the rich Brakhuti-W site in the Tui valley, while the Gidhiniya assemblage seems to be an earlier facies of this industry, found in stratigraphically older context. Because of the special stone knapping technique of this industry, the artefact assemblage at the Brakhuti W site was submitted to a particularly detailed description, especially in view of the fact that this technique was special to Nepal and had no connections with India. OSL dating at one of the sites has placed the Brakhuti industry into the coldest part of the last Glacial period. This industry is also connected with the highest terrace levels along narrow river courses within the Siwaliks.

Of particular interest was also a chopper assemblage, called the Sanpmarg industry of East-Deokhuri, which was of special significance because of its *in situ* position deep within the alluvial deposits on a palaeosol and because it is one of the OSL dated sites, older than the Brakhuti industry. The cobble-tool assemblages on the high river terraces in West-Deokhuri at Oj, Saunri and Lauki may belong to a similar period.

The few Microlithic sites found in the Dun valleys were described separately but compared with each other. Typologically they seem to form a uniform assemblage with slight differences and have their origin assumedly from India. Their stratigraphic provenance is not quite clear, though at the Ammapur site the artefacts derive from the top part of the colluvial silts.

Special attention was given to one of the richest and most interesting site complexes, that of the camp-cum-factory site of Patu at the foot of the Siwaliks in eastern Nepal. The site has been dealt with earlier (Corvinus 1987, 1989), but must not be omitted in this final report. The Patu industry is a Mesolithic assemblage of macrolithic character with a cobble-tool and flake industry, associated with very well-made adzes. These latter tool types have been dealt with in greater detail as they are special to Nepal and have no counterpart in India, but rather have affinities with the Hoabinhian tool complex of Vietnam and mainland Southeast Asia, which has been discussed.

One observation gleaned from the collected and analysed data and from own experiments is interesting in this respect. The cobble-tools of choppers, corescrapers and of adzes, which form such a significant element in the later part of the Palaeolithic record in Nepal, seem to have been used for heavy wood- and bamboo work and so indicates forest habitats of the people who produced them, similar to what has been deduced for the Late Palaeolithic and Hoabinhian in mainland Southeast Asia.

The few Neolithic remains have been recorded but have not been dealt with in any detail, as they were too disrupted by erosion.

After the in-depth description of sites and cultural material areawise chapter VI deals with the suggested chronological sequences in their stratigraphic context. They have been summarized in Tables 19-21.

The chapter VII discusses the geological and archaeological data and some of its problems, and interprets the cultural material in its chronological order and in its environmental framework. The environmental interpretations point to fluctuations of climatic conditions during the time of the various Palaeolithic occupations, as determined by the studies of the deposits.

Chapter VIII deals with comparisons of the recorded data with cultural traditions in Asia outside Nepal. This comparative chapter is based on own extensive studies on much of the Palaeolithic material which I was able to see during my visits in most of the Southeast Asian countries, so that I could form my own opinion on many of the sites and the connected problems. This chapter has been given special attention in order to give the cultural remains in Nepal a place within the Asian archaeological record.

The concluding chapter IX discusses the significance of the Nepal data in the light of the Palaeolithic record of other Asian countries and to place the Nepal data into the framework of the all-Asia palaeolithic context, pointing out possible connections and affinities to cultures in South Asia and further east. Nepal lies right at the border of the great mountain barrier, the Himalayas, and this geographic situation has certainly influenced, if not restricted, movements of the hominid populations, at least in the earlier part of the Palaeolithic.

Since these studies are the first of its kind in Nepal I want to say at this place that the results are based entirely on own observations and studies and that the interpretations are my own and may undergo changes with new studies and findings in the future. It is hoped that the research results presented here will be a base or guideline for future survey.

Thanks to the generosity of the German Research Council it was possible to provide the monograph with a large documentary part of figures and photos. Maps, diagrams, profiles etc. are included in the text. In a second volume an extensive catalogue of drawings and photographs of the prehistoric material and of photos of the archaeological sites and their environment has been presented. With this documentation of the work of 20 years in Nepal the author hopes to have made a significant contribution to the Asian Palaeolithic research.

Zusammenfassung

Bei Beginn der hier präsentierten Forschungsarbeiten in Nepal waren weder Daten über die urgeschichtlichen Perioden des Landes vorhanden, noch gab es Informationen zur pleistozänen Geologie, Stratigraphie und Paläo-Umwelt. Es war Anfang der 80er Jahre im Bereich von Urgeschichte und Quartär ein unberührtes, unerschlossenes Land, und man konnte nicht vorhersehen, in wie weit die Forschungsarbeiten überhaupt Ergebnisse erzielen würden. Am Beginn stand somit eine große Anzahl von Fragen, verbunden mit Ideen und Hoffnungen und der Entschlossenheit, zu Ergebnissen zu gelangen dank der Erfahrung von jahrzehntelangen urgeschichtlichen Geländearbeiten in Indien und Afrika.

Die Resultate der insgesamt 20 Jahre umfassenden Forschungen in Nepal werden in dieser Monographie vorgelegt, leider mit einiger Verzögerung, vor allem wegen der Vielgestaltigkeit und des Reichtums der Fakten und Daten.

In den Jahren von 1983 bis 1994 sind jedes Jahr für mehrere Monate Geländearbeiten unternommen worden. Die Arbeitsgebiete wurden nach zuvor erfolgten, nicht weniger als sieben Durchquerungen durch die Siwalik Kette, des Vorgebirges des Himalaya, ausgewählt.

Um notwendige Vergleiche der entdeckten Fundplätze in Nepal mit Befunden in den benachbarten Ländern Asiens zu erstellen, und um Nepal als Grenzland an der sogenannten „Movius-Linie“ zwischen den Kulturen der westlichen und der östlichen Welt zu werten, sind Reisen zu den meisten süd- und südostasiatischen Ländern unternommen worden.

Das Projekt wurde von der Deutschen Forschungsgemeinschaft (DFG) elfeinhalb Jahre lang kontinuierlich finanziert. Nach Ende der Förderung im Jahre 1994 wurden die Arbeiten, vor allem der größte Teil der Auswertung der Daten, mit eigenen Mitteln bestritten.

Nach der Entdeckung des ersten Fundplatzes im Frühjahr 1984, einer mikrolithischen Fundstelle in Lamahi im Deokhuri Tal, wurden ausgedehnte Geländebegehungen im Gebiet der Dang- und Deokhuri Dun Täler unternommen. Es stellte sich bald heraus, dass das südliche Nepal durch viele urgeschichtliche Kulturperioden hindurch besiedelt gewesen war. Im Laufe der Untersuchungen sind 75 Fundkomplexe mit über 100 Lokalitäten in den Dang-, Tui- und Deokhuri-Tälern, sowie in den Arjun- und Mashot-Tälern (südliches West-Nepal), im Sarpati-Gebiet (südliches Zentral-Nepal) und im Rato Khola-Gebiet (südliches Ost-Nepal) entdeckt worden.

Von ausschlaggebender Bedeutung war, dass der größte Teil der Fundplätze in stratigraphisch gesichertem Kontext innerhalb der die Dun Täler füllenden Sedimente des Quartärs aufgefunden wurden. Dank der starken rezenten Erosion der Talsedimente, in denen die Kulturhorizonte vorkommen, waren die Fundplätze aufgeschlossen worden und sind daher auffindbar gewesen.

Da über die quartärgeologischen Zusammenhänge der Stratigraphie der Talsedimente nichts bekannt war, wurde es zunächst notwendig, die Geologie der Täler zu erforschen, um die stratigraphische Abfolge der Schichten und damit die darin eingelagerten paläolithischen Horizonte zu erfassen. Die geologisch-stratigraphische Erforschung hatte somit Vorrang vor der urgeschichtlichen Erkundung und nimmt zusammen mit einer Einleitung (Kapitel I) und Erläuterungen über die geographische Situation (Kapitel II) den ersten Teil der Monographie ein.

Kapitel III beschreibt die Täler des Dang-Deokhuri Gebietes als sogenannte Dun Täler, die tektonisch als intermontane Becken während der orogenetischen Hebungen und Aufschiebungen der Siwaliks im frühen Pleistozän gebildet wurden. In der darauf folgenden Zeit wurden diese Täler mit quartären, alluvialen und kolluvialen Sedimenten aufgefüllt, die ebenfalls tektonischen Störungen unterworfen wurden. Die Sedimentauffüllung geschah in der Zeit zwischen der Begehung im Altpaläolithikum bis ans Ende des Pleistozäns. Während der detaillierten stratigraphisch-geologischen Erforschungen war es mir möglich, eine Folge fluviatiler und lakustriner Ablagerungen in den Tälern nachzuweisen, so wie auch die Existenz kolluvialer Sedimente, die die Hänge und Fußzonen der benachbarten Hügel als „fan deposits“ bedecken. Beide Ablagerungsfazien enthalten Fundhorizonte.

Die alluvialen Sedimente sind in mehrere von mir neu benannte Formationen gegliedert worden, und zwar die Babai-Formation mit einer „Lower Member“ und „Upper Member“ für die älteren Schichten, die Sitalpur-Formation für die jüngeren alluvialen Schichten und die Gidhiniya-Formation, die als kolluviale „hill-wash“-Sedimente beschrieben sind. Beide, die Babai-Formation und die Gidhiniya-Formation, enthalten außerordentlich viel paläolithisches Fundmaterial, das vom frühen Paläolithikum über das mittlere bis ins spätere Paläolithikum reicht.

Eine ausführliche Untersuchung dieser neuen Formationen wurde durchgeführt, um die in ihnen gefundenen Kulturhorizonte chronologisch einstuft und zeitlich interpretieren zu können. Der unterste Teil der alluvialen Schichten der Babai-Formation, der aus basalen Schottern besteht, birgt die ältesten Funde, nämlich die einer Faustkeilkultur und einer altpaläolithischen Abschlagkultur. Nach einer Diskordanz wurden sie von lakustrinen Tonen der „Lower Member“ der Babai-Formation überlagert, die keine lithischen Funde enthalten. An vielen Stellen sind diese Tone während einer Erosionsphase, die einer Zeit der Stabilisierung folgte, abgetragen und durch die Schichten der „Upper Member“ der Babai-Formation ersetzt worden. Letztere bestehen aus geschichteten fluviatilen, schluffigen und sandigen Sedimenten mit Interkalationen (Einschalungen) groben Schotters, der durch laterale Einschübe aus Erosionsmaterial von den Siwalikhängen eingelagert wurde. Diese Schichten der „Upper Member“ der Babai-Formation bilden die sehr aufgerissene, durch rezente Erosion tief eingeschnittene Oberfläche der Älteren Terrasse der Dun Täler. Der größte Teil der späteren jungpaläolithischen Fundplätze stammt aus den oberen Schichten der „Upper Member“.

Die Beschreibung der Gidhiniya-Formation führte zu Interpretationsproblemen. Geologisch bestehen die Ablagerungen dieser Formation aus einer Fazies, die sich von allen anderen Schichten unterscheidet, aber sie enthält Funde, die typologisch mit denjenigen aus der „Upper Member“ der Babai-Formation zu vergleichen sind. Die Schichten der Gidhiniya-Formation bestehen aus homogenen, ungeschichteten Schluffen kolluvialen Charakters, die Hänge, Sättel und Fußzonen der Siwalik Hügel bedecken. Sie sind aber nur an den Hängen zu finden, die aus Gestein der Unteren Siwalik Stufe bestehen, d.h. aus „siltstones“ (Schluffgestein). Diese letzteren bilden das verwitterte Ausgangsgestein für die kolluvialen Schluff-Fächer. Ausgiebige Geländestudien haben schließlich die Relation zwischen der Babai- und der Gidhiniya-Formation erkennen lassen: letztere verzahnte sich an der Fußzone der Hänge mit den Schichten der „Upper Member“ der Babai-Formation, sodass beide mehr oder weniger zeitgleich sind und somit die chronologische Einstufung der urgeschichtlichen Funde in beiden Fazien bestätigen.

Weitere Studien enthüllten das Vorhandensein einer bedeutenden Erosionsdiskordanz zwischen der Babai- und der Sitalpur-Formation. Am Ende der Sedimentation der Babai-Formation folgte eine Phase tiefen Einschneidens, hervorgerufen durch tektonische Einflüsse, die die Sedimente bis tiefer als das heutige Flussniveau einschneiden. Danach erfolgten erneute rapide Ablagerungen fluviatiler Schichten, mit Einschaltungen von Ligniten und Diatomeen-Lagen, die die weite, jüngere Terrassenfläche im Zentrum der Duntäler füllten. Urgeschichtliche Funde sind in diesen Schichten bisher nicht gemacht worden.

Nachdem die stratigraphische Schichtenfolge in den Tälern gesichert war (siehe Fig.11 und 12), war es möglich, die Kulturreste in ihre chronologische Abfolge einzugliedern.

Der Hauptteil, Kapitel IV und V, behandelt die Fundplätze (Siedlungsplätze) und das aus ihnen stammende Fundmaterial. Die mehr als 100 Lokalitäten, die im Laufe der Untersuchungen entdeckt wurden, sind nach ihrer geographischen Lage, entsprechend der untersuchten Täler geordnet, beschrieben. Die Entdeckung eines solchen Reichtums an Fundplätzen ist durch die starke Erosion der letzten ca. 50 Jahre, verursacht durch das stetige Anwachsen der Bevölkerung und die intensive Abholzung der Wälder, erheblich erleichtert worden. Tiefes, vertikales Einschneiden in die Sedimente bildete eine typische „badland“-Topographie, wodurch gleichzeitig zum Teil die Siedlungsplätze freigelegt wurden.

An dieser Stelle sei hervorgehoben, dass das Glück auf meiner Seite war: ich kam zur rechten Zeit an die rechten Orte, gerade nachdem die Siedlungshorizonte durch die Erosion aufgedeckt und dem suchenden Auge auffindbar waren, jedoch bevor sie ganz weggewaschen, zerstört und umgelagert wurden. Dreißig bis fünfzig Jahre später wäre die Zerstörung vollkommen gewesen und die Artefakte hätten nur in sekundärer Lagerung gefunden werden können. Zumindest gilt dies in den Dun Tälern; es hätte keine Hinweise mehr auf ihre ursprüngliche stratigraphische Position im Sediment gegeben.

Die tiefe Erosion zerschneidet die alluvialen Sedimente bis zu ihrer Basis auf die Siwalikfelsen, sodass auch die Kulturreste der ältesten Bewohner der Dun Täler freigelegt wurden. Dies sind Artefakte einer Faustkeilkultur bei Gadari im Dang Tal und einer altpaläolithischen Abschlagkultur im Tui Tal. Beide stammen aus den untersten Schichten, die kurz nach dem letzten tektonischen Ereignis der Himalaya-Aufhebung im unteren Pleistozän in den Dun-Becken abgelagert wurden.

Die Forschungsarbeiten ergaben indes noch ältere Fundplätze. Das Auffinden von Faustkeilen in verfallenen Sedimenten innerhalb einer Sequenz von Ober-Siwalik-Schichten im Sarpati Hügel (südliches Zentral-Nepal) war eine unerwartete Entdeckung. Die Faustkeile sind in die Faltung der Siwalik-Aufhebung des Himalaya einbezogen worden, die im frühen Pleistozän stattfand, und gehören somit zu den frühesten Zeugnissen des Acheulian in Südasien.

Die ebenso tiefe Erosion wie im Dang Tal hat im benachbarten Tal von Deokhuri den Fundkomplex einer mittelpaläolithischen Population in stratigraphisch gesicherter Position freigelegt, dessen wichtigster Fundplatz Arjun-3 ist. Die Arjun-3-Industrie besteht aus präparierten Kernen und Abschlägen in Levallois Technik mit Klängen, Spitzen und Schabern. Sie gehört aller Wahrscheinlichkeit nach ins letzte Interlazial, was mehr oder weniger durch OSL Daten bestätigt ist. Alt- und mittelpaläolithische Fundstellen sind jedoch im Untersuchungsgebiet in Nepal bisher selten.

Während der späten Phase der alluvialen Auffüllung nahm die Besiedlung durch den urgeschichtlichen Menschen erheblich zu. Eine Fülle von Besiedlungsplätzen verschiedenster Populationen des späten Paläolithikums ist in den Dang- Deokhuri Tälern und in benachbarten Gebieten aufgefunden worden. Die Funde sind fast überall mit der „Upper Member“ der Babai-Formation und mit der Gidhiniya-Formation assoziiert, die beide auf Grund der geologischen Beobachtungen dem späteren Teil des oberen Pleistozäns zuzuweisen sind. Der größte Teil dieser Lokalitäten gehört zu einer Abschlag- und „cobble tool“-Industrie, die hier als Brakhuti-Industrie bezeichnet ist. Die charakteristischen Werkzeugtypen sind unifaziale „cobble tools“ mit „choppers“ und „corescrapers“ (Kernschaber) sowie kleinere Abschlagwerkzeuge. Der Leitfundplatz (type site) dieser Industrie ist die reiche Brakhuti W-Fundstelle im Tui Tal, während das Inventar des Gidhiniya Fundplatzes einer früheren Fazies der Brakhuti-Industrie angehört und sich auch in stratigraphisch älterem Kontext befindet. Wegen der speziellen Art der Steinbearbeitung dieser Industrie wurde das Inventar einer detaillierten Bearbeitung und Beschreibung unterworfen, besonders da diese Technik eine für Nepal spezifische Steinbearbeitung zeigt, die keine Verbindung mit Indien hat. OSL-Datierungen an einem der Fundplätze haben diese Industrie dem kältesten Teil des letzten Glazials zugewiesen. Die Brakhuti-Industrie ist auch auf den höchsten Terrassen der tief eingeschnittenen Flusstäler innerhalb der Siwalikkerten zu finden.

Von besonderem Interesse ist eine „chopper“-Industrie, die Sanmatg-Industrie von Ost-Deokhuri, die durch ihre *in situ* Lage in einem Palaeoboden, eingebettet in fluviatilen Sedimenten, von spezieller Bedeu-

tung ist. Auch diese Industrie ist durch OSL-Proben datiert und ist älter als die Brakhuti-Industrie. Die „cobble-tool“-Inventare der Hochterrassen im West-Deokhuri bei Oj, Saunri und Lauki mögen ein ähnliches Alter haben.

Die wenigen mikrolithischen Fundplätze in den Dun Tälern sind separat beschrieben und miteinander verglichen worden. Sie gehören mit wenigen Unterschieden einem einheitlichen Inventarkomplex an. Sie haben ihren Ursprung wahrscheinlich in Indien. Ihre stratigraphische Zugehörigkeit ist nicht ganz klar, obwohl der Ammapur Fundplatz aus dem obersten Teil der kolluvialen Schluffe stammt.

Besondere Aufmerksamkeit wurde dem Fundkomplex von Patu am Fuße der Siwaliks im östlichen Süd-Nepal gewidmet, der früher schon ausführlicher behandelt wurde (Corvinus 1987, 1989), in der hier vorliegenden, abschließenden Monographie aber nicht fehlen darf. Er ist einer der reichsten und interessantesten „camp-cum-factory“ Fundstellen in Nepal. Die Patu Industrie gehört zu einer mesolithischen Besiedlung, jedoch mit makrolithischem Charakter, ohne Mikrolithen. Sie besteht aus „cobble-tools“ und unretuschierten Abschlägen, in Verbindung mit sehr fein gearbeiteten „adzes“ (Beile). Dieser letztgenannte Werkzeugtyp ist im Detail beschrieben worden, ist er doch ein ganz spezieller Typus für die Patu Industrie in Nepal und hat kein Gegenstück in Indien. Das Inventar von Patu besitzt dagegen Ähnlichkeit mit dem Hoabinhian-Technokomplex von Südost-Asien, speziell von Vietnam.

Eine interessante Beobachtung konnte an Hand der analysierten Steinwerkzeuge und durch eigene Experimente gemacht werden. Die Geräte der Gruppe der „cobble-tools“ der „choppers“ und der „adzes“, die ein so bedeutendes Element im späteren Paläolithikum in Nepal bilden, sind aller Wahrscheinlichkeit nach zu schweren Holz- und Bambusarbeiten verwandt worden und würden daher auf ein Leben in dicht bewaldeten Gebieten hinweisen, ähnlich wie dies auch für das späte Paläolithikum und Hoabinhian in Südostasien angenommen wird.

Die wenigen neolithischen Reste sind in ihrer Fundsituation beschrieben, aber nur kurz behandelt worden, da sie durch Flächenerosion sehr zerstört worden sind.

Kapitel VI behandelt die chronologische Abfolge der Kulturen in ihrer stratigraphischen Zugehörigkeit. Die Tabellen 19-21 fassen die entsprechenden Ergebnisse zusammen.

In Kapitel VII werden die geologischen und urgeschichtlichen Fakten und Daten diskutiert und das gesamte Material in seiner chronologischen Gliederung und in seinem Umweltraum gedeutet. Die Interpretation der Paläo-Umwelt weist an Hand der Sedimentstudien auf Fluktuationen der klimatischen Verhältnisse während der verschiedenen Besiedlungsphasen hin.

In Kapitel VIII werden Vergleiche mit Kulturtraditionen in Asien außerhalb Nepals gezogen. Dieses Kapitel basiert auf umfassenden Studien an paläolithischen Inventaren, die die Autorin selbst während vieler Besuche in den benachbarten südost-asiatischen Ländern durchführen konnte, um eine eigene Vorstellung von einem großen Teil der Fundplätze und der mit ihnen verbundenen Probleme zu erhalten. Diesem Kapitel wurde besonderes Gewicht beigelegt, um die paläolithischen Funde in Nepal in den gesamt-asiatischen Rahmen stellen zu können.

Im abschließenden Kapitel IX wird die Bedeutung der für Nepal gewonnenen Resultate im Gesamtbild der paläolithischen Forschung in Asien herausgestellt und mögliche Verbindungen und Affinitäten mit den Kulturen Süd- und Südostasiens beleuchtet. Nepal liegt am Rande der großen Gebirgsbarriere des Himalaya, und diese Begrenzung hat vermutlich Bewegungen der Bevölkerungsgruppen beeinflusst oder gar verhindert, was zumindest für die frühen Epochen der paläolithischen Kulturgeschichte gelten dürfte.

Da diese Studien die ersten ihrer Art in Nepal sind, möchte ich betonen, dass die Resultate ausschließlich auf eigenen Beobachtungen und Untersuchungen beruhen und dass die Interpretationen meine eigenen sind, die durch zukünftige Studien und Funde Änderungen unterworfen sein können. Die hier vorgelegten Ergebnisse mögen jedoch Grundlage und Richtung für zukünftige Forschungen sein.

Dank der Großzügigkeit der DFG war es möglich, die Monographie mit einem großen Dokumentationsanteil zu versehen. Karten, Diagramme, Profile etc. befinden sich im Textband. Band II gibt mit Zeich-

nungen und Photos einen hinreichenden Eindruck vom Reichtum und Charakter des archäologischen Materials wieder. Dasselbe gilt für die photographische Dokumentation der Fundplatz- und Geländesituation. Mit dieser Dokumentation einer Arbeit von 20 Jahren in Nepal hofft die Autorin einen grundlegenden Beitrag zur asiatischen Urgeschichtsforschung geliefert zu haben.

Résumé

Lorsque cette recherche a débuté au Népal, aucune donnée n'était disponible ou connue à propos des premières occupations préhistoriques de ce pays ni à propos de la géologie, de la stratigraphie ou du paléo-environnement pléistocènes. C'était un pays vierge concernant la préhistoire et la géologie quaternaire et personne ne pouvait présumer des résultats, ni prévoir ce que pourraient en être les implications. Le début de cette recherche fut nourri d'un „plein sac“ d'idées et d'espoirs, accompagnés d'une détermination tenace à obtenir des résultats, et supportés par une longue expérience des explorations préhistoriques en Afrique et en Inde.

Le résultat de cette recherche est donc présenté dans cet ouvrage, dont l'achèvement a pris du temps à cause de l'abondance des données.

Les campagnes sur le terrain ont duré chaque année plusieurs mois, entre 1983 et 1994. Les zones d'étude étaient choisies à la suite de nombreuses traversées de la chaîne des Siwaliks. Dans le but de comparer, comme il se doit, les découvertes faites au Népal - le Népal étant un pays frontalier de la „ligne de Movius“, c'est à dire la ligne séparant les expressions culturelles de l'Est et de l'Ouest - des voyages ont été entrepris dans plusieurs pays de l'Asie du Sud-Est.

Ce travail fut financé par la „Deutsche Forschungsgemeinschaft“ = DFG (Conseil allemand de la Recherche) pendant 11 ans et demi. A la fin du projet subventionné, la principale partie de la rédaction et la documentation ont été réalisées grâce à mes propres moyens.

A la suite de la première découverte, en 1984, qui concernait un site microlithique à Lamahi dans la vallée de Deokhuri, l'exploration totale des vallées de Dang et de Deokhuri a été entreprise et il est vite apparu que le pays avait été occupé par différents groupes culturels au cours du Paléolithique. Cette exploration a permis de découvrir 75 groupes de sites avec plus de 100 localités dans les vallées de Dang, Tui et Deokhuri, ainsi que celles d'Arjun et Mashot (Népal occidental), dans la zone de Satpati (Népal central) et dans le secteur de la rivière Rato (Népal oriental).

Il est important de souligner que la majorité des sites découverts se trouvent en contexte stratigraphique, dans les strates quaternaires des vallées du Dun (Doun'). Les découvertes ont été possibles en raison de l'intense érosion récente, qui a mis au jour les sites autrefois enfouis. Comme on ne savait rien de la géologie quaternaire des vallées du Dun, il était indispensable d'étudier les sédiments et d'établir l'histoire géologique ainsi que la séquence stratigraphique des dépôts dans lesquels se trouve le matériel culturel. Ces études furent prioritaires par rapport à la description des sites et des vestiges culturels et elles constituent la première partie de la monographie, après l'introduction (chapitre I) et un chapitre (II) sur la géographie.

Cette première partie, chapitre III, décrit les vallées de Dang et Deokhuri en tant que vallées du Dun, d'origine tectonique, qui s'est formée à l'intérieur de la chaîne de montagne, lors de la phase orogénique qui a provoqué le soulèvement des Siwaliks, dans la première partie du Pléistocène. Ces vallées ont ensuite été remplies par des sédiments quaternaires de nature non seulement alluviale mais aussi colluviale. Cette sédimentation s'est produite entre la période d'occupation des populations du Paléolithique ancien et celle des populations néolithiques qui fréquentaient ces vallées. Grâce aux études de terrain détaillées concer-

nant la stratigraphie et la géologie, j'ai pu établir une séquence du remplissage fluvial et lacustre des vallées, ainsi que des dépôts colluviaux qui couvrent les versants et pieds de collines en conséquence du lessivage et de l'érosion des pentes. Ces deux types de dépôts contiennent des vestiges culturels.

Les dépôts alluviaux ont alors été classés en différentes formations nouvelles, définies par moi-même et dénommées comme suit : la Formation de Babai, avec deux ensembles, inférieur et supérieur, pour les plus vieilles alluvions, la Formation de Sitalpur pour les alluvions récentes - celle-ci étant dépourvue de tout vestige lithique - et la Formation de Gidhiniya, colluvion qui résulte du lessivage des versants. Les deux Formations de Babai et de Gidhiniya ont livré un abondant matériel lithique du Paléolithique inférieur, moyen et supérieur, du Microlithique et du Néolithique.

Les nouvelles formations ont été décrites en détail, de manière à comprendre les sites interstratifiés et à les interpréter en relation avec leur provenance au sein du cadre stratigraphique. La partie inférieure des dépôts alluviaux de la Formation de Babai, qui consiste en des graviers de base et des lits de cailloutis, contient les premiers vestiges culturels sous la forme d'artefacts du Paléolithique ancien. Ces niveaux de base sont recouverts, après une discontinuité, par les argiles lacustres et les limons argileux de l'ensemble inférieur de la Formation de Babai, qui ne contiennent pas de matériel lithique. En de nombreux endroits - en raison d'une phase d'érosion consécutive à une période stable - ils sont remplacés par l'ensemble supérieur de la Formation de Babai. Celui-ci est composé d'alluvions de sable et de limons stratifiées où s'intercalent des apports latéraux de cailloutis grossiers des Siwaliks ; il constitue les surfaces très ravonnées de la plus vieille terrasse des vallées du Dun. La majorité des sites du Paléolithique plus récent proviennent de l'ensemble supérieur de la Formation de Babai.

La Formation de Gidhiniya a posé des problèmes d'interprétation. Du point de vue géologique, elle se présente sous différents faciès mais du point de vue culturel elle contient des vestiges dont les caractères typologiques sont semblables à ceux de la partie supérieure de la Formation de Babai. La Formation de Gidhiniya, constituée de limons non stratifiés d'origine colluviale, couvre les croupes et les bas de pente des collines des Siwaliks sous la forme de cônes de colluvions. Ces sédiments se retrouvent partout où les collines sont formées des marnes des Siwaliks inférieurs, qui constituent les matériaux sources de ces cônes colluviaux. Les nombreuses études de terrain ont fini par éclaircir la relation existant entre les Formations de Babai et de Gidhiniya. Cette dernière s'interstratifie, au niveau basal des collines, avec l'ensemble supérieur de la Formation de Babai, ce qui rend ces deux formations plus ou moins contemporaines l'une de l'autre et explique les données préhistoriques.

Des études plus poussées ont révélé une discontinuité érosionnelle significative entre la Formation de Babai et la Formation plus récente de Sitalpur. Une profonde incision a dû se produire après la fin de la sédimentation alluviale de la Formation de Babai, allant même au-dessous du niveau récent de la rivière. Ensuite une rapide accumulation des dépôts fluviaux, avec intercalation de lignites et de diatomites, a conduit à la formation de la basse terrasse qui s'étend largement au centre des vallées.

La séquence stratigraphique étant définie (synthétisée sur les figures 11 et 12), il devient possible d'appréhender les événements culturels dans la séquence chronologique.

La partie principale de l'ouvrage (chapitre IV et V) porte sur la description des sites et de leurs vestiges culturels ; elle s'organise géographiquement, en fonction de la position des sites dans les vallées explorées. Plus de cent localités ont été répertoriées durant les nombreux mois passés sur le terrain. La découverte de si nombreux sites a été favorisée par l'érosion récente de 50 dernières années, consécutive à l'augmentation de la population et à la déforestation drastique des vallées de Dang et de Deokhuti. La forte érosion a provoqué de profonds ravissements et la formation de „*bad lands*“ où les sites sont peu à peu dégagés. Je dois reconnaître ici que la chance était de mon côté : je suis arrivée au bon moment pour explorer la région car les sites commençaient à être détruits par l'érosion rapide ; ainsi les niveaux d'occupation s'offraient directement à la vue. Si j'étais arrivée 30 à 50 ans plus tard, la destruction aurait été pratiquement totale et

les artefacts se seraient trouvés seulement en position remaniée sans aucune indication sur leur position stratigraphique originelle.

L'érosion profonde a affecté les sédiments jusqu'au substratum de sorte que les vestiges des plus anciens occupants des vallées du Dun ont été mis au jour. Il s'agit de Paléolithique ancien qui, à Gadari, dans la vallée de Dang, consiste en un assemblage acheuléen, et à Brakhuti-ouest dans la vallée de Tui, consiste en une industrie à grands éclats et nucléus. Ces deux assemblages sont inclus dans le plus ancien remplissage du Dun, c'est-à-dire le dépôt basal qui repose sur le substratum, ce remplissage ayant débuté juste après le dernier événement de soulèvement de l'Himalaya, au Pléistocène inférieur.

Les explorations ont révélé des éléments encore plus anciens. La découverte de bifaces acheuléens dans la colline de Satpati, au sein des gisements plissés de l'extrême sommet de la séquence des Siwaliks, était tout à fait inattendue. Les bifaces ont été soulevés lors du plissement correspondant à la dernière phase tectonique le long du front himalayen, au cours du Pléistocène ancien. Par conséquent ces outils font partie des plus anciens témoins de l'Acheuléen en Asie du Sud.

La même érosion profonde qu'à Dang a mis au jour, dans la vallée voisine de Deokhuri, un ensemble de sites du Paléolithique moyen, le plus riche étant Arjun-3, avec une industrie en contexte stratigraphique. Celle-ci comprend des éclats préparés et des nucléus débités selon la méthode Levallois, ainsi qu'un ensemble d'outils sur éclats et sur lames de belle facture. Cette industrie appartient très probablement au dernier interglaciaire, ce qui est plus ou moins confirmé par la datation OSL. Cependant les occupations du Paléolithique inférieur et du Paléolithique moyen sont, les unes comme les autres, rares au Népal.

Plus tard, alors que le remplissage alluvial se poursuit, la fréquence des occupations augmente considérablement dans les vallées des Siwaliks du Népal. De nombreux sites et localités, correspondant à des groupes de populations variées de la fin du Paléolithique, sont dispersés dans toutes les vallées de Dang et de Deokhuri, ainsi que dans d'autres vallées. Ils sont presque partout associés avec l'ensemble supérieur de la Formation de Babai et avec la Formation de Gidhiniya, qui, sur la base des observations géologiques, semble appartenir à la fin du Pléistocène supérieur. La plupart de ces localités livrent des assemblages d'éclats et outils sur galets, qui constituent l'industrie dite de Brakhuti. Leurs outils caractéristiques sont de type chopper et racloirs nucléiformes sur galets, en association avec de petits outils sur éclats. Le site le plus représentatif de ces nombreux assemblages est le riche site de Brakhuti-ouest, dans la vallée de Tui, tandis que l'assemblage de Gidhiniya semble être un faciès antérieur à cette industrie, et se trouve dans un contexte stratigraphique plus ancien. En raison de la technique de taille particulière de cette industrie, les artefacts du site de Brakhuti-Ouest ont été soumis à une description très détaillée, surtout en regard du fait que cette technique est spécifique du Népal et n'a pas de connexion avec l'Inde. La datation OSL a placé cette industrie dans la période la plus froide de la dernière glaciation. Cette industrie est aussi connectée avec les niveaux de la plus haute terrasse le long des rivières étroites, dans les Siwaliks.

Un autre assemblage de choppers mérite une attention particulière, à l'est de Deokhuri : l'industrie de Sanpmarg, dont l'intérêt réside d'une part en sa position d'origine dans des dépôts alluviaux profonds, sur un paléosol, et d'autre part dans son âge obtenu par datation OSL, qui s'est avéré plus ancien que celui de l'industrie de Brakhuti. Les assemblages d'outils sur galets des hautes terrasses alluviales, dans le secteur ouest de Deokhuri, à Oj, Saunti et Lauki, appartiennent peut-être à une période semblable.

Les quelques sites microlithiques trouvés dans les vallées du Dun ont été décrits séparément mais comparés entre eux. Typologiquement, ils semblent constituer un ensemble uniforme avec de légères différences et ils ont probablement une origine indienne. Leur provenance stratigraphique n'est pas vraiment claire, bien qu'au site d'Ammapur les artefacts soient dérivés de la partie sommitale des limons colluviaux.

Parmi les ensembles de sites les plus riches et les plus intéressants, celui de Patu, à la fois campement et atelier, a été décrit minutieusement. Il se situe au pied des Siwaliks, à l'est du Népal ; c'est un site mésolithique à caractère macrolithique, avec une industrie à galets taillés et éclats, associés à des haches (*adzes*)

de très belle facture. Celles-ci ont été étudiées avec précision car elles sont particulières au Népal et n'ont pas d'équivalent en Inde; elles ont plutôt des affinités avec le complexe hoabinhien du Vietnam et de l'Asie du Sud-Est continentale, comme cela est envisagé dans la discussion.

Une observation qui ressort des données recueillies et analysées, ainsi que de l'expérimentation personnelle, est intéressante à cet égard. Les outils sur galets que sont les choppers, les racloirs nucléiformes et les haches (*adzes*), éléments si importants dans la dernière phase paléolithique du Népal, semblent avoir été utilisés comme outils lourds dans le travail du bois et du bambou. Ils sont par conséquent les indicateurs d'un habitat forestier pour les populations qui les ont produits, à l'instar de ce qui a été proposé pour le Paléolithique tardif et le Hoabinhien de l'Asie du Sud-Est continentale.

Les quelques vestiges néolithiques ont été inventoriés mais n'ont pas été analysés en détail, vu qu'ils sont trop désorganisés par l'érosion.

Après la description approfondie des sites et de leurs vestiges culturels, par ordre géographique, le chapitre VI traite des séquences chronologiques dans leur cadre stratigraphique. Cela est résumé dans les tableaux 19 à 21.

Le chapitre VII discute les données issues des études stratigraphiques et quelques uns des problèmes qui se posent ; puis il envisage le matériel culturel dans l'ordre chronologique et dans son contexte environnemental. Les interprétations environnementales basées sur l'étude des sédiments font ressortir les fluctuations des conditions climatiques à l'époque des diverses occupations paléolithiques.

L'important chapitre VIII traite des comparaisons entre les données acquises et les traditions culturelles asiatiques, en dehors du Népal. Ce chapitre comparatif est basé sur des études personnelles concernant de nombreux assemblages paléolithiques, que j'ai eu la possibilité de voir lors de mes visites dans la plupart des pays du sud-est asiatique. Cela m'a permis d'établir ma propre opinion sur beaucoup de ces sites et sur les problèmes qui s'y rapportent. Ce chapitre a donc été particulièrement soigné, afin de replacer les vestiges paléolithiques recueillis au Népal dans le cadre archéologique de l'Asie. J'espère que les résultats présentés ici constitueront la base ou la ligne directrice de futures explorations, mais intéresseront aussi les lecteurs asiatiques.

Finalement, le chapitre IX discute la signification des découvertes faites au Népal, à la lumière de ce que l'on sait du Paléolithique dans les autres pays de l'Asie, puis situe le Népal dans le contexte du Paléolithique asiatique en général, en mettant en évidence les possibles relations ou affinités avec des cultures de l'Asie du Sud et au-delà, vers l'Est. Le Népal se trouve juste au bord de la grande barrière montagneuse que constitue l'Himalaya et cette situation géographique a certainement influencé, sinon limité, les mouvements de populations, au moins au début du Paléolithique.

Comme ces travaux sont les premiers du genre au Népal, je tiens à dire que les résultats sont entièrement fondés sur mes propres observations et études, et que mes interprétations personnelles pourront subir des changements avec d'autres travaux et découvertes à venir.

Grâce à la générosité du Conseil allemand de la Recherche (*DFG*), il est possible de produire une monographie avec une abondante illustration comprenant des cartes, des diagrammes, des profils, etc., répartis dans le texte et surtout avec un catalogue complet, sous la forme d'un second volume, regroupant les dessins et les photographies du matériel préhistorique, ainsi que les photos des sites archéologiques et de leur environnement. Avec cette abondante documentation concernant un travail des vingt années au Népal, l'auteur espère avoir contribué de manière significative à la recherche sur le Paléolithique en Asie.

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Abbreviations

MQRSEA: Modern Quaternary Research in Southeast Asia

BIPPA: Bulletin Indo-Pacific Prehistoric Association

Bull.Decc.Coll.Res.Inst.: Bulletin of the Deccan College Research Institute, Poona.

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Appendix I

Analysis of the „tuff“ raw material

by H.G.Dill, Hannover and K.Heide, Jena with comments by G.Corvinus, Kathmandu/Erlangen.

This unusual sedimentary rock of extremely fine lamellation was used by prehistoric people in the Dang and Deokhuri area since Middle Palaeolithic times. It is found as rather angular cobbles in fluvial gravels in the river valleys in the Dang-Deokhuri Duns within the Siwalik range in Nepal. The provenance of the cobbles seem to come from the Siwalik deposits, but from which part and from which formation is still unclear. The special and unusual characteristic of these cobbles is that it is, now, a very light and brittle material, easily scratchable with a knife, even with a fingernail. It seems to have been leached, and the original rock was a hard compact material.

The particularly interesting point is that this rock has been used by prehistoric populations as raw material for their stone tool manufacture during the later Pleistocene. The material must have been, at the time of manufacture, a hard splintering rock which was not only suitable but particularly favoured for stone tool manufacture at that time, i.e. it had the conchoidal fracture required for tool manufacture. The stone tools, mostly of small size, then, were used as scrapers and knives and sharp flakes with very sharp edges. Even large corescrapers were made from this raw material.

But now, after the tools had been embedded for a few thousand years in fluvial and lacustrine, fine-grained sediments, which buried the sites, the artefacts are extremely fragile, leached and brittle and could not be, by no means, used for any cutting or scraping work, which once was the main purpose of the tools. Nowadays one could not make any usable tool out of this material. Interesting, too, is that in spite of the leaching and the soft, fragile nature of the rock, all facets of the former manufacture are perfectly preserved, when freshly exposed from the sediment, but break easily at exposure.

The question is what happened to the rock? What sort of rock was it originally during the time of tool manufacture? Why did it „leach“ out and what did leach out? By what process could a once hard, conchoidally fracturing rock become so light and fragile?

The rock material has been analysed by two parties:

It is a sedimentary rock with well sorted grain spectrum. Mineralogically it is mainly quartz, according to the x-ray diffraction pattern in a finely dispersed matrix, which contain muscovite, haematite and Fe-oxyhydrates. The quartz grain size is ca. 0.02 mm. Numerous pores, which apparently are the cause of the light specific weight of the rock have the same size as the quartz grains. The evolved-gas-analysis („Entgasungsspektrum“) gives evidence of a small content of finely dispersed Fe-oxyhydrate (m/e 18 with a maximum at ca. 180°C). Carbonates, sulfates or oxides are not seen. The rock seems to be a somewhat unusual sedimentary rock, from which possibly the cementing material (carbonate?) has been dis-

solved. It may be a diagenetically cemented and changed loess or a lacustrine sediment (K. Heide, Institut für Geowissenschaften).

H. G. Dill (Federal Institut for Geosciences and Natural Recources) writes: The fine lamellation does not contra-indicate an „air fall tuff“, but if the sedimentary environment does not include pyroclastics this explanation is not applicable. The very fine lamellation points against a normal loess. However, such lamellation could be formed through reworking and compaction. The complete de-carbonisation of the material, however, indicates no such explanation. The grain size does not contra-indicate aeolian origin, but muscovite and haematite are not minerals found usually in eolianites.

It probably is a marginal lacustrine sediment where the fluvial component is only traceable in fine-grained form, and where aeolian reworking is also possible in the „mud flats“. As neutral description one could call it an Fe-containing quartz-siltstone, according to the grain size and the major mineral component. And the original environment would best be described as „marginal lacustrine environment of deposition“. The compaction could be explained best as „duricrust-formation“ through oscillating watertables.

These analyses answer the question of what type of rock it is geologically and mineralogically. But the questions of the prehistorian are not satisfactorily solved. What happened to the material after it was embedded? Why was it suitable a few thousand years ago and why is it leached and unsuitable now? Even the cobbles found now in the exposed gravel layers on the river bank are leached. It must have been a rock originating from the Siwaliks, probably from the Lower Siwaliks. That means that the time of deposition of this rock material, as cobbles eroded from the Siwaliks, is very much older than the time when prehistoric man made use of it in the form of cobbles which he took from the gravel. That also means that the cobbles at the time when prehistoric man collected them from the river gravels and used them for tool manufacture, must have been still very hard, and it is only in the last few thousand years that they leached out to such an extent. Why? Why only in the last few thousand years and why not earlier, when they were reworked from the original Siwalik deposits into the river gravels? The river gravels are all not older than Middle Pleistocene or even Late Pleistocene, whereas the original rock from which the „tuff“ came must have been at least a few million years old.

These intriguing questions are still unanswered and a plausible explanation is lacking. No other place is known anywhere where a similar raw material is found and used.

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Appendix II

OSL/IRSL fine-grain dating. A preliminary chronology of Quaternary
slopewash and alluvial deposits from the Dun valleys of Dang and Deokhuri in
western Nepal

by Annette Kadereit, Günther A. Wagner, Heidelberg and Gudrun Corvinus, Kathmandu/Erlangen

After the geological and stratigraphical studies of the Quaternary deposits and the prehistoric sites embedded in them have given first ideas about the geological sequence of events and of the chronology of the sites, it was thought that luminescence dating of the sediments of some of the more important sites would be useful to provide numeric ages.

It was therefore decided that a number of samples should be taken from three sites, i.e. from the Middle Palaeolithic site of Arjun 3, the end-chopper site of Sanpmatg and the Late Palaeolithic site of Gadari of the Brakhuti industry. All three sites are stratigraphically controlled by being embedded in the Babai Formation. One of the samples (HDS 298) was taken from the top part of the Gidhiniya Formation.

Introduction to the dating-method

Optical stimulated luminescence (OSL) dating is a means to estimate the time that elapsed since sediment grains were last exposed to daylight during a former cycle of erosion, transportation and deposition, before they were effectively shielded from any further light impact by covering sediment grains (for recent overviews see Wagner 1998; Aitken 1998; Prescott & Robertson 1997). The dating method is based on the phenomenon that light-protected mineral grains accumulate measurable crystal damages, which grow with the length of the covering period and the strength of the ionising background radiation causing the damage (Fig. 1). Thus, common and frequent minerals like quartz and feldspar may be used as natural dosimeters to directly date the event of deposition and burial of a sediment. The amount of the stored dose (i.e. palaeodose) may be measured via the strength of a luminescence signal, which is emitted, when the grown damage in the crystal fades fully due to the input of photon energy (Fig. 2). If also the dose rate is determined, i.e. the accumulated energy per unit time of the background radiation, the depositional age of the sediment may be calculated according to: $\text{age [ka]} = \text{palaeodose [Gy]} / \text{dose rate [Gy/ka]}$.

OSL dating determines the last exposure to daylight, even for sediments that have gone through several cycles of erosion, transport and deposition (Fig. 3a). A few seconds of bright sunlight are sufficient to reset an accumulated luminescence signal completely (Godfrey-Smith et al. 1988). However, if sediments like fluvial or slopewash deposits have been transported in turbulent suspension, bleaching prior to deposition may be incomplete (Fig. 3b) (e.g. Forman 1988; Forman & Ennis 1992; Ditlefsen 1992; Richardson

2001). As in such case there is still an unknown residual of the palaeodose of a former sedimentary cycle stored within the grain, luminescence dating will overestimate the paleodose corresponding to the last erosional cycle. OSL-ages will then represent maximum ages. On the other hand, also minimum ages can occur. They are caused by anomalous fading of the luminescence signal

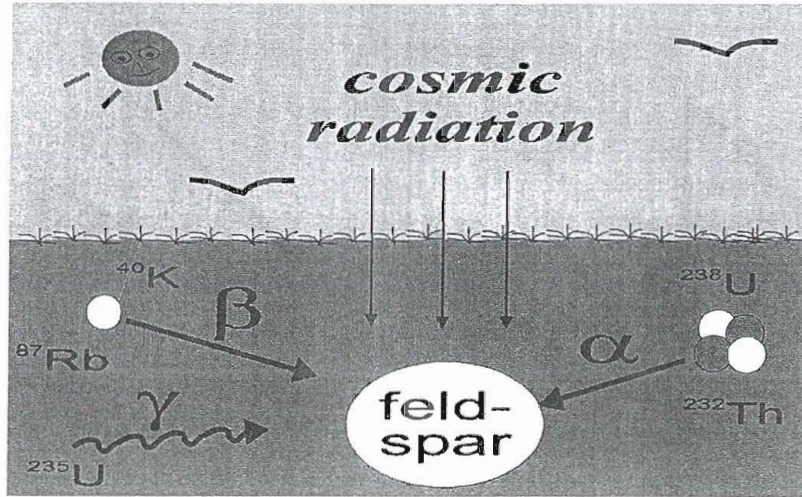


Fig. 1. Feldspar - a natural dosimeter. Energy, resulting from α -, β - and γ -rays of the natural radionuclides ^{40}K , ^{87}Rb , and those of the ^{235}U , ^{238}U and ^{232}Th decay-chains as well as from cosmic radiation, is deposited and stored in common minerals as e.g. feldspar, if the grains are covered in a light-shielded surrounding like a sedimentary body.

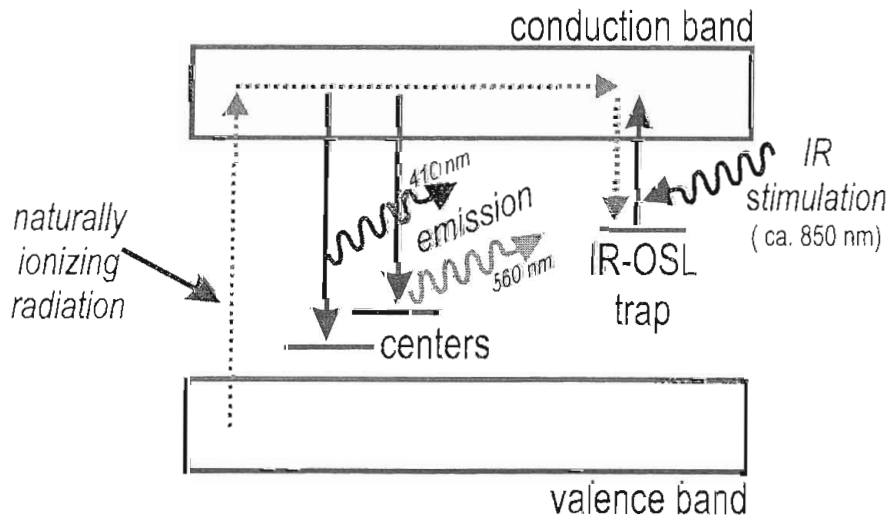


Fig. 2. Feldspar crystal as illustrated by the energy-band-model. Some of the electrons ionised through the natural background radiation are trapped and stored at crystal defects (here: IR-OSL-trap). The number of stored electrons reflects the amount of the accumulated palaeodose. (Day-)Light stimulation will release the captured electrons and reset the luminescence clock. The recombining electrons emit a luminescence signal (here: blue 410 nm, yellow 560 nm), which in the luminescence laboratory is detected to determine the palaeodose. Feldspats are easily stimulated in the near infrared ~ 850 nm (IR-OSL, briefly IRSL).

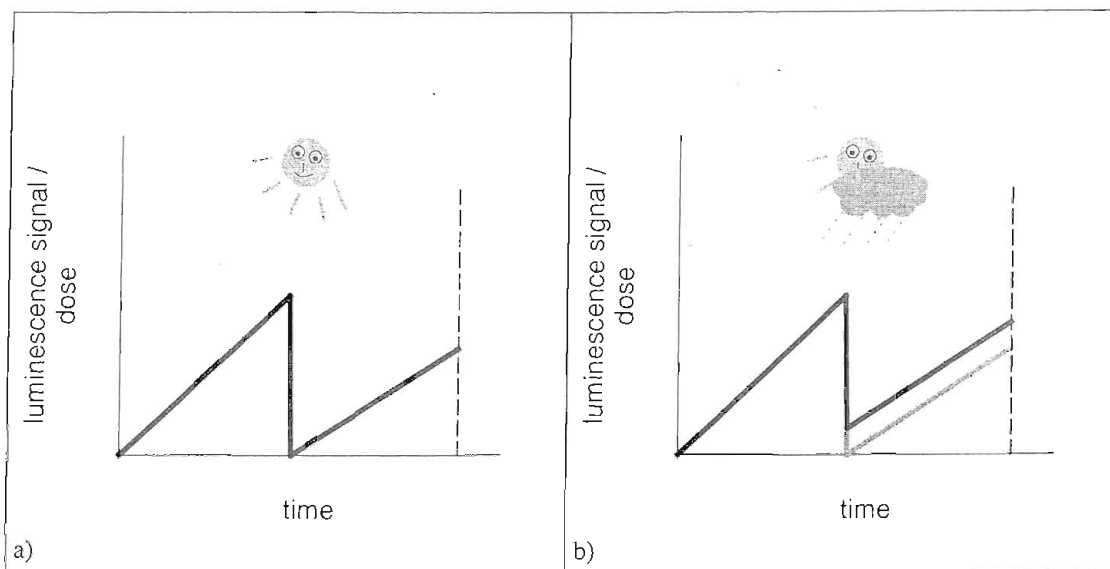


Fig. 3. Growth and zeroing of the latent luminescence signal in a mineral grain. Ionising radiation causes the latent luminescence signal of a light-shielded mineral grain to grow with time (left). Daylight exposure during reworking will reset the luminescence signal (left). If bleaching is insufficient the latent luminescence signal is not completely reset to zero and the palaeodose is overestimated (right).

Sampling localities

During a field campaign in 1995 altogether 9 samples were collected for OSL-dating from alluvial T1-terrace sediments of the upper member of the Babai-Formation and from stratigraphically contemporaneous interlinked hillwash sediments of the Gidhniya Formation in the two intramontane basins (Duns) of Dang and Deokhuri (see Fig. 2 of main text). OSL-samples were taken from the exposed river-terrace walls in blocks that were carved out of the slightly consolidated sediments. In the luminescence dark laboratory the outer rims (about 1 cm) of the samples were eliminated and retained for dose-rate determinations. Sample collection was carried out at three important prehistoric sites embedded in the Quaternary Dun sediments (see Figs. 124, 137 and 83 of main text):

The end-chopper site *Sanp marg* which is situated in the Deokhuri Dun on the southern bank of the Rapti river, where the river flows from the narrowly incised valley of the Siwalik range into the wide basin (see Fig. 124 in the main text):

Sample HDS-291 (A) was taken at a depth of 5.90 m below the surface of the 21 m terrace (T1) from reddish silt, which consists of a consolidated palaeosol containing the artefact horizon.

Sample HDS-292 (B) was collected at a depth of 3.70 m below the terrace top from the overlying yellow alluvial silt.

Sample HDS-293 (C) originates from the top red soil, where it was taken at a depth of 0.7 m below the terrace top.

The Middle Palaeolithic *Arjun 3* site on the eastern bank of the Arjun river in the Deokhuri Dun (see Figs. 136 – 142, particularly Fig. 142 in the main text):

Sample HDS-294 (A) was collected at a depth of 8.5 m below the surface of the 30 m terrace (T1) of block II from a reddish alluvial silt, 10 cm above the cultural horizon containing the artefacts.

Sample HDS-295 (B) was taken 6.0 m below the 30 m terrace top from the yellowish alluvial silt above sample A.

Sample HDS-296 (C) was collected from the capping red soil at a depth of 2.5 m below the terrace top. During an earlier field campaign in 1989 samples for thermoluminescence (TL) dating had been collected from the same terrace block II by Corvinus and Bronger. OSL-sample HDS-296 corresponds to TL-sample No. 5 taken from the same red top soil at a depth of 2.1-2.8 m below the surface (Zöller 2000).

The Gadarı Flake site on the Babai river in the Dang Dun valley (see Fig. 83 in the main text):

Sample HDS-297 (A) was taken at a depth of 0.5 m below the top of Babai Formation from the reddish-yellow silt just below the artefact horizon.

Sample HDS-298 (B) was collected at a nearby locality, about 300 m south of HDS-297, where it was taken from the reddish silt of hillwash deposits of the Gidhiniya Formation at a depth of 0.6 m below the surface.

Sample HDS-299 (C) was taken at a depth of 1.7 m below the top of the surface of the Babai Formation from yellow alluvial silt overlying unconformably a rubble horizon which nearby contains a handaxe site.

Experimental details

In a first dating-approach polymineral fine-grain separates (4-11 μm) were extracted for infrared-stimulated luminescence (IRSL) analyses of the feldspar component. The procedures used are described in detail by Lang et al. (1996). Measurements were carried out on a Risø-TL/OSL-Reader DA12, which is equipped with a ring of TEMT484 infrared-diodes (emission at 880 Δ 80 nm; strength $\sim 40 \text{ mW/cm}^2$) for IR-stimulation and a photomultiplier EMI9235Q for detection of the luminescence signal (Bøtter-Jensen 1988, 1997). In order to restrict OSL-detection to the blue feldspar emission ($\sim 410 \text{ nm}$) (see Fig. 2), a Schott-glass filter combination of BG39, BG3, BG39 and OG400 (3 mm each) was used (Krbetschek et al. 1996). IR-stimulated shine-downs were carried out for 60 s and a preheat for 300 s at 220°C was applied prior to IR-stimulation. For equivalent dose-calculation¹ the early integral of 0-24 to 0-40 s was used, while the integral of 50-60 s was chosen for late-light subtraction (Aitken and Xie 1992).

IR-short shines (0.4 s) from aliquots carrying the natural luminescence signal were used for inter-aliquot normalisation. Growth-curves were defined measuring 10 aliquots with the natural luminescence signal (N) and 6 to 10 additive dose points (N+ β) (5 aliquots each), which were distributed above the zero dose point to deliver luminescence intensities up to four times of the natural luminescence signal (Fig. 4). Laboratory irradiation was carried out using a ⁹⁰Sr/⁹⁰Y-beta-source ($\sim 9.2 \text{ Gy/min}$) for beta-equivalent dose determination (D_{EP}) and an ²⁴¹Am-alpha-source ($\sim 4.2 \text{ Gy/min}$) for a-value-determination.² For the latter purpose 3 additive dose points were used (3 aliquots each), the doses of which were selected to produce luminescence signals of ~ 1 -, 2- and 3-times the size of the natural signal. After laboratory irradiation the samples were stored for 1 month at room-temperature prior to IRSL-measurement. For tests of luminescence-signal-stability (fading test), 2 additional sets of aliquots (5 aliquots each), one with the natural signal (N) and one with the highest additional laboratory dose (N+ β_{max}), were preheated together with the other aliquots, yet then stored for another 2 months prior to IRSL-measurement.

¹ The latent luminescence signal of a natural sample is built up by a wide energy spectrum of ionizing radiation energies released by α -, β - and γ -rays from the naturally occurring radionuclides (see Fig. 1). In the luminescence laboratory the natural samples have to be irradiated artificially in order to define the dependency of the intensity of the luminescence signal on the amount of the accumulated dose. Artificial irradiation in the luminescence laboratory, however, is usually performed with a mono-energetic beta-irradiation. The calculated laboratory-dose, which would give an equal luminescence signal to that of the stored palaeodose, is called *equivalent dose* (D_{E}).

² Whereas β -, and γ -irradiation are supposed to possess equal luminescence efficiencies, the intensity of luminescence signals due to α -irradiation are usually only $\sim 10 \%$ of those created by the same dose of β - or γ -irradiation. This ratio is called a-value.

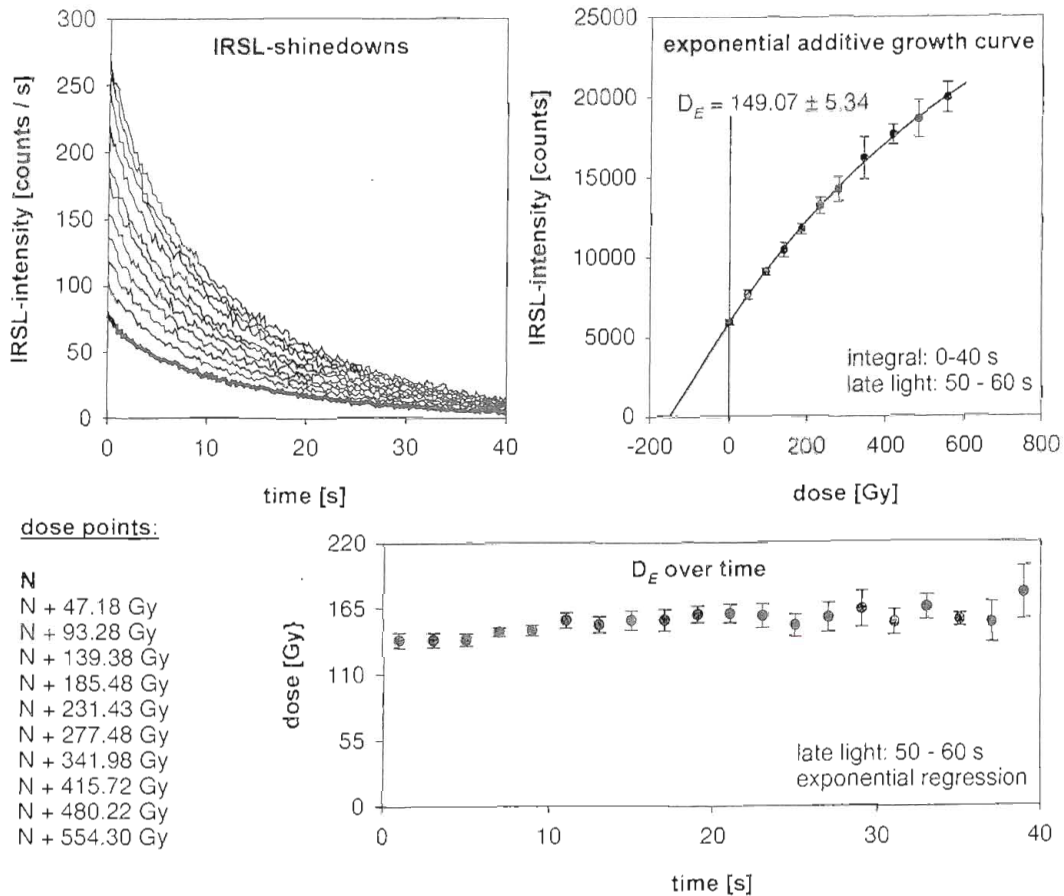


Fig. 4. Equivalent-dose (D_E) determination for sample HDS-296. Presented are the integrals 0-40 s of the IRSL-shinedowns (exponential decay-curves of group averages (10 natural aliquots, 5 aliquots per additive dose point)) (top left), the exponential growth curve as built up from 10 additive dose points above the natural signal (i.e. zero-dose point) (top right) and D_E -values over stimulation/readout time (bottom). The late background-light of the integral 50-60 s (not shown here) was subtracted for D_E -calculation from earlier integrals (≤ 40 s).

Dose-rate determination was carried out by a combination of α -counting, β -counting and low-level γ -spectrometry, which allows to detect for possible radioactive disequilibrium in the ^{238}U -chain. The contribution of cosmic radiation was calculated according to Prescott and Hutton (1988). For effective dose-rate calculation a ratio of 1.17 ± 0.06 of wet to dry sample weight was assumed (cf. Zöller 2000). Error calculation follows Gaussian error-propagation law and IRSL-ages are quoted on the 1- σ confidence-level.

Results and Discussion

Analytical data are presented in tab. 1 and tab. 2. None of the analysed samples exhibits radioactive disequilibrium as is apparent from the equal uranium equivalent-contents within the ^{238}U -chain (2- σ confidence level).

Tab. 1: Analytical data – dose-rate determination

lab.-no.	locality/sample-no.	altitude a.s.l. [m]	depth b.g.l. [m]	uranium [$\mu\text{g/g}$]	thorium [$\mu\text{g/g}$]	potassium [weight.-%]	effective dose rate [Gy/ka]
HDS-291	Sanpmarg A	340	5.9	3.90 ± 0.08	18.80 ± 0.24	1.99 ± 0.04	5.13 ± 0.38
HDS-292	Sanpmarg B	340	3.3	2.80 ± 0.05	16.97 ± 0.19	2.23 ± 0.04	4.71 ± 0.31
HDS-293	Sanpmarg C	340	0.7	3.92 ± 0.12	19.36 ± 0.51	2.15 ± 0.11	5.74 ± 0.44
HDS-294	Arjun A	320	8.5	3.15 ± 0.12	17.87 ± 0.50	1.98 ± 0.10	5.07 ± 0.37
HDS-295	Arjun B	320	6.0	2.94 ± 0.07	18.04 ± 0.23	1.72 ± 0.04	4.61 ± 0.30
HDS-296	Arjun C	320	2.5	3.03 ± 0.09	18.85 ± 0.47	2.01 ± 0.09	4.96 ± 0.34
HDS-297	Gadari A	590	0.5	2.89 ± 0.06	14.25 ± 0.17	1.19 ± 0.03	4.22 ± 0.70
HDS-298	Gadari B	630	0.6	3.10 ± 0.07	18.71 ± 0.24	1.58 ± 0.04	4.67 ± 0.35
HDS-299	Gadari C	595	1.7	3.48 ± 0.08	18.14 ± 0.23	1.44 ± 0.04	4.50 ± 0.29

Tab. 2: Analytical data – paleodose-determination and IRSL-ages

lab.-no.	locality/sample-no.	D_E		a-value	signal-fading	age [ka]
		late light: 50-60 s integral: 0-24/40 s [Gy]	late light: 5-6 s integral: 0-1 s [Gy]			
HDS-291	Sanpmarg A	168.96 ± 17.66	140.65 ± 26.49	0.08 ± 0.01	0.90 ± 0.08	32.91 ± 4.21
HDS-292	Sanpmarg B	196.67 ± 22.22	136.10 ± 19.45	0.07 ± 0.01	1.10 ± 0.10	41.77 ± 5.45
HDS-293	Sanpmarg C	89.52 ± 11.53	59.52 ± 5.35	0.10 ± 0.01	1.05 ± 0.15	15.61 ± 2.34
HDS-294	Arjun A	297.02 ± 32.45	321.07 ± 31.56	0.10 ± 0.01	0.91 ± 0.08	58.56 ± 7.70
HDS-295	Arjun B	309.74 ± 23.28	231.20 ± 44.20	0.09 ± 0.01	0.98 ± 0.11	67.15 ± 6.69
HDS-296	Arjun C	149.07 ± 5.34	141.29 ± 15.25	0.09 ± 0.01	0.93 ± 0.08	30.04 ± 2.30
HDS-297	Gadari A	98.35 ± 6.08	78.32 ± 11.55	0.12 ± 0.05	1.01 ± 0.11	23.28 ± 4.13
HDS-298	Gadari B	73.49 ± 8.30	65.25 ± 12.90	0.09 ± 0.01	0.98 ± 0.15	15.72 ± 2.14
HDS-299	Gadari C	190.52 ± 13.64	155.49 ± 10.69	0.08 ± 0.01	0.95 ± 0.11	42.37 ± 4.11

Two samples (HDS-291 from Sanpmarg and HDS-294 from Arjun 3) are suspicious of anomalous fading (tab. 2, row 6, 1- σ confidence-level), which means that age underestimation is likely. Luminescence-signal instability is additionally indicated by the fact, that the two samples give younger IRSL-ages than the corresponding samples (HDS-292 and HDS-295) taken from the overlying strata (tab. 2, row 7).

Yet, apparent age-inversion may also (or additionally) be due to age-overestimation of the overlying sediments caused by insufficient bleaching of the luminescence signal. Possibly improper zeroing of the OSL-signal prior to deposition is indicated by the fact that for several samples (HDS-292, HDS-293, HDS-295, HDS-299) palaeodoses seem to be significantly smaller if D_E -calculation is based on the most light-sensitive initial integral 0-1 s (while using the integral 5-6 s for late-light subtraction) (tab. 2, row 3) instead of longer integrals with later late-light integrals used for background subtraction (tab. 2, row 4). Such apparent D_E -reductions are diagnostic of partially bleached sediment samples, whereas possible differential bleaching may not be detected with the applied MAA fine-grain dating-protocol (Lang et al. 1999)³. At present, it therefore seems advisable to keep in mind that the gained IR-OSL-ages may represent maximum ages (*terminus post quem*)⁴. This explains, why the IRSL dates partially corroborate the results of the stratigraphical and geological data.

³ Among insufficiently bleached sediments Duller (1994) distinguishes heterogeneous mixtures of well and badly/not bleached grains (differential bleaching) from those in which the latent luminescence signal of every grain has been reduced to the same degree (partial bleaching).

⁴ Future work on the OSL-samples will include blue-optically stimulated luminescence (B-OSL) dating of small aliquots of coarse-grained quartz separates (100-200 μm), which allows to check for possible differential bleaching.

The dates of the Gadari site complex satisfy the geological and stratigraphical interpretation of the locality. The eroded top part of the Upper Babai Formation with the embedded Brakhuti flake site in the sediment of sample HDS-297 (Gadati A) yielded a maximum age ~ 23 ka, which confirms the age indication obtained by the typological interpretation of the Brakhuti industry. Due to IRSL-dating the bottom part of this facies may be about 20 ka older (sample C, HDS-299), suggesting a minimum-age of ~ 40 ka for the handaxe site contained in the unconformably underlying Lower Babai Formation (Fig. 83 of main text). However, sample HDS-299 gives indication of partial bleaching and thus age-overestimation.

The date of sample HDS-298 (Gadati B) from the upper part of the Gidhiniya Formation is concordant with the geological interpretation. The solpe-wash deposits of the Gidhiniya Formation are partly contemporaneous and partly slightly younger than the Upper Babai Formation.

As explained above, at the Sanpmarg site (Fig. 124 of main text) the IRSL-age yielded for sample HDS-291 (Sanpmarg A) taken from the artefact horizon, may be underestimated due to anomalous fading of the IRSL-signal. On the 1-s error-level the date of 32.9 ± 4.2 ka is not discriminable from the date of 41.8 ± 5.5 ka produced for sample HDS-292 (Sanpmarg B) gained from the overlying yellow silt. The upper sample HDS-293 (Sanpmarg C) yielded 15.6 ± 2.3 ka. These ages of $\sim 33 - 42$ ka for the lower part including the archaeological site and ~ 16 ka for the upper part are in agreement with the typological and the geological data. However, since the deepest sample (A) comes from a palaeosol, which must have experienced a considerably long time of land stabilisation before the deposition of the sediments of samples B and C, one would assume a long time gap between the lowest sample and the middle sample rather than between the middle sample and the upper sample. Significant age overestimation, as already indicated by a failed D_E -plateau-test, is therefore likely for the alluvial sample HDS-292 (Sanpmarg B).

The Arjun 3 site is of particular importance as it is the only Middle Palaeolithic site in Nepal and is comparable to similar sites in India. Sample HDS-296 (Arjun 3 C), collected from the top reddish soil at Arjun 3, does not exhibit any sign of partial bleaching. Within error margins it delivers the same age as the stratigraphically corresponding TL-sample No. 5 dated by Zöller (2000) (IRSL 30.04 ± 2.30 ka; TL 29.5 ± 4.1 ka). The lower two samples HDS-295 (Arjun 3 B) and HDS-294 (Arjun 3 A) give IRSL-ages of 58.6 ± 7.7 ka and 67.2 ± 6.7 ka, respectively, which are identical within error-margins. These dates are minimum-ages for the underlying Middle Palaeolithic artefact horizon. The Arjun 3 silt is not assumed to have been transported in turbulent condition but rather in a slow, quiet water regime, and, thus, one would not expect an unknown residual of a palaeodose of a former sedimentary cycle. Yet, an age of ~ 60 ka for the underlying artefact horizon (see Fig. 142 of main text) seems to be rather young for this industry. By geological - and also typological - observations one would estimate an age corresponding to the later part of the last interglacial (Eem) period. At least the lower sample HDS-294 (A) is suspicious of anomalous fading, which may result in age-underestimation. For the moment a minimum age of about 60 ka is to be accepted for the Arjun-3 Middle Palaeolithic site in Nepal. In India, the Middle Palaeolithic has provisionally been dated to between 40 to 150 ka. The most reliable dates come from Rajasthan where the beginning of the Middle Palaeolithic was dated to between 163 and 144 ka (Misra \pm Rajaguru 1986).

Conclusions

Three of the more important prehistoric sites in Nepal described in this monograph were dated applying IR-stimulated luminescence techniques to the polymineral fine-grain component of alluvial and slope-wash deposits gained from the artefact horizons themselves and overlying sediments. IRSL-dating yields preliminary ages of ≤ 23 ka for the Gadari flake industry, of $\sim 33-40$ ka for the Sanpmarg chopper industry and ≥ 60 ka for the Arjun-3 Middle Palaeolithic industry, all of which are in general agreement with the archaeological and geological situations. All dates are of Late Pleistocene age and present a first attempt of a chronometry of Middle to Late Palaeolithic industries in Nepal.

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List of photos, corresponding with the photos on the plates, with added photos which are only scanned (-Sc)

- Ph.1 (Pl.202/1): The Siwalik hills in the western area in Nepal.
- Ph.2-c (Pl.243/1): Alluvial Dun valley filling at Mohannagar in the eastern Dang valley, heavily dissected into badlands.
- Ph.3-c (Pl.243/2): The Dongpur block (a Siwalik sandstone block) in the dissected alluvium of the southern Dang valley.
- Ph.4 (Pl.202/2): A Tharu village in the Tui valley.
- Ph.5 (Pl.202/3): Hand-made pottery in a Tharu village.
- Ph.6 (Pl.203/1): Tharu women carrying their pottery ware from the Deokhuri valley, to sell in other areas.
- Ph.7 (Pl.203/2): View into eastern Dang Dun valley with its infilled alluvium.
- Ph.8-c (Pl.244/1): Remnants of colluvial silt deposits on the slopes in the Tui valley near Ammapur.
- Ph.9-c (Pl.244/2): View over a small tributary valley of the Tui valley with „hanging“ colluvial fan deposits, near Ammapur. The hills consist of steeply dipping and fractured Lower Siwalik rocks of fine-grained sandstones and mudstones. The alluvial deposits of the Tui valley are just seen in the extreme left, and of the Dang valley in the extreme right.
- Ph.10 (Pl.204/1): Cliff at Nimbukhuti, exposing the alluvial deposits of the Babai Formation in the Deokhuri valley.
- Ph.11-c (Pl.245/1): Colluvial deposits at Lalmatiya, Deokhuri valley with a red soil developed over it. The Lalmatiya site is embedded in the red soil in the foreground.
- Ph.12 (Pl.204/2): The Middle Palaeolithic site of Arjun 3 at the base of the 30m terrace remnant seen in this photo. The artefact horizon is at the level, where the author stands.
- Ph.13 (Pl.205/3): The mesolithic site of Patu on the 60m terrace of the Rato Khola in eastern Nepal.
- Ph.14 (Pl.205/2): High-level colluvial silt above Ammapur, containing a microlithic industry.
- Ph.15 (Pl.205/3): View over the Ammapur 1, 2 and 3 sites in a colluvial fan deposit. The Tui river is beyond between the two hill ranges.
- Ph.16-Sc: The microlithic site of Ammapur 4, eroding out from the upper level (at top part of hammer) of a colluvial, yellow silt.
- Ph.17-Sc: The small microlithic locality Ammapur 5 in a colluvial slope wash deposit, north of Ammapur.
- Ph.18 (Pl.206/1): The small microlithic locality of Ammapur NW and see also Pl.205/2.
- Ph.19-c (Pl.246): Dissected colluvial slope wash deposits in a small tributary valley of the Tui river.
- Ph.20 (Pl.206/2): The site of Gidhiniya on top of a hillock above the Tui river, behind our porters.
- Ph.21 (Pl.207/1): Exposed surface of the Gidhiniya site.
- Ph.22-c (Pl.245/2): The Gidhiniya site covered by colluvial yellow silt, seen in 1989.
- Ph.23 (Pl.207/2): The Gidhiniya Pass site at the saddle above Gidhiniya. Of the artefact-bearing yellow, colluvial silt, overlying bedrock, which once covered the entire saddle-basin, only remnants are present. Artefacts are washed out from the silt down to where the man stands.
- Ph.24 (Pl.207/3): Gidhiniya Pass site. The colluvial silt overlies bedrock.
- Ph.25 (Pl.208/1): Colluvial silts, west of Gidhiniya, with a levallois core eroding out from the silt.
- Ph.26 (Pl.208/2): Gidhiniya site, test-cutting.
- Ph.27-Sc: Gidhiniya site, test cuttings III, I and II, from left to right.
- Ph.28 (Pl.208/3): Raniapur S2 site, looking north, red artefact-bearing silt over bedrock of Siwalik Boulder Conglomerate.
- Ph.29-Sc: Raniapur S site, looking west. The Siwalik conglomerate exposure, at left, is overlain by colluvial silt, seen in the background at left. The gravel at right below the silt is derived from the Siwalik conglomerate.
- Ph.30 (Pl.209/1): Raniapur S3 site, looking NE to site S2 in the background. The man shows the silt with the *in situ* flakes.
- Ph.31 (Pl.209/2): View from the Raniapur fossil site over the Raniapur S3 site (at extreme right) towards Majhghatwa in the back. The colluvial silts of the Gidhiniya Formation in the front are very dissected and overly fossiliferous Lower Siwalik bedrock.
- Ph.32-Sc: Near Raniapur S, looking into the red, colluvial silt badlands. The silt has been eroded away for almost 2m only in recent years by deforestation, as seen by the former silt surface at the height of the author's head.

- Ph.33-c (Pl.247): The painted clay figurine.
- Ph.34 (Pl.210/1): Brakhuti W boulder gravel NE, looking south-west over the artefact-bearing cobble gravel and the covering alluvial silt in the background. Man Bahadur sits on the exposed, imbricated gravel, at artefact outcrop.
- Ph.35 (Pl.210/2): Brakhuti W boulder gravel S site; the boulder gravel overlying bedrock and overlain by the alluvial silt.
- Ph.36 (Pl.211/1): Close-up of *in situ* artefacts in the gravel seen in Pl.210/2.
- Ph.37 (Pl.211/2): Close-up of *in situ* artefacts in the gravel seen in Pl.210/2.
- Ph.38-Sc: Boulder gravel S exposure below the covering silt (this photo is taken from the top at Ph.35).
- Ph.39 (Pl.211/3): Brakhuti W boulder gravel NW; the boulder gravel below the silt and *in situ* artefacts in the gravel.
- Ph.40 (Pl.212/1): Imbricated gravel sheer west of Saskhuti in the Tui river bed.
- Ph.41-Sc: Large Early Palaeolithic core from the imbricated gravel west of Saskhuti.
- Ph.42-c (Pl.248/1): View over the whole Brakhuti W site to E. The site is where the arrow points. The Neolithic locality is near the big tree on the yellow surface at central left. Brakhuti village is on the green terrace at upper left.
- Ph.43 (Pl.212/2): The site of Brakhuti W, looking north; the site is in the silt behind the person who sits on bedrock.
- Ph.44 (Pl.213/1): The site of Brakhuti W, looking east valley-upwards.
- Ph.45 (Pl.213/2): Brakhuti W site, artefacts eroding out from a horizon 0.35m below the surface, (which is below the squatting man in photo above).
- Ph.46 (Pl.213/3): Locality Brakhuti NN, artefacts eroding out from a level 0.50m below the alluvial silt surface.
- Ph.47-Sc: View over colluvial silts above Siwalik mudstones, looking westwards to the Brakhuti NN locality in the background.
- Ph.48-c (Pl.248/2): West of Saskhuti S, silts of the Gidhimiya Formation in the foreground and stratified Upper Babai Beds in the middle ground.
- Ph.49 (Pl.214/1): Brakhuti SE site, looking north, the fireplace and the axe place at the 27m level, at the man's feet.
- Ph.50 (Pl.214/2): Saskhuti N2, an iron arrowhead.
- Ph.51 (Pl.214/3): Saskhuti S site, the colluvial artefact-bearing silt fan overlying bedrock (exposed on the left).
- Ph.52 (Pl.215/1): Saskhuti S site, artefacts eroding from the horizon; close-up of the artefacts seen in Pl.214/2 at bottom.
- Ph.53 (Pl.215/2): Rajje site, boulder gravel with large artefacts, buried by alluvial silts of the 30m terrace surface.
- Ph.54 (Pl.215/3): Rajje site, large cores and flakes in the boulder gravel, overlain by silts.
- Ph.55-Sc: Rajje site, the imbricated nature of the artefact-bearing cobble-boulder gravel.
- Ph.56-Sc: Rajje site, the boulder gravel, overlain by a cover of silts.
- Ph.57-c (Pl.249/1): View from the Gairakhuti site towards east over the badlands of the Babai Formation.
- Ph.58 (Pl.216/1): Gairakhuti site, in 1989, scatter of artefacts eroded out from the occupation horizon.
- Ph.59-Sc: The Gairakhuti site, in 1994, 5 years later, with many artefacts lying eroded out on the bedrock.
- Ph.60-Sc: The Gairakhuti site in 1999, 10 years after discovery, the last remnants of the artefact-bearing yellow silt (looking north), above the darker-coloured murrum of weathered bedrock.
- Ph.61-c (Pl.249/2): The Gairakhuti site in 1999, with artefacts *in situ* eroding out from the artefact horizon (at the handle of the shovel), 10cm above bedrock in the yellow silt.
- Ph.62 (Pl.216/2): Stratified alluvial deposits of Babai Beds at Ranighora. Basal cobble gravel (in foreground), overlain by red silts of the Lower Babai Beds and above in the well-stratified Upper Babai Beds (in background).
- Ph.63 (Pl.216/3): Early Palaeolithic site of Ranighora.
- Ph.64 (Pl.217/1): View from the Ranighora fossil site north over the dissected alluvium of the Babai Formation. The Ranighora S artefact site is on the bare surface in the middle centre. The Gairakhuti site is at the extreme right behind the tree branches.
- Ph.65-c (Pl.249/3): The Ranighora fossil site at the foot of the hill in Lower Siwalik rocks. Behind it one sees well the inter-fingering of the alluvial Babai Beds and the fan deposits of the colluvial silts of the Gidhimiya Formation.
- Ph.66-c (Pl.250/1): Panoramic view from the handaxe site SW-wards to the Gadari Flake Site (on the second flat terrace block from right).
- Ph.67 (Pl.217/2) and 68-Sc: Gadari handaxe site, a core *in situ* in the basal rubble.
- Ph.69-Sc: Gadari handaxe site, handaxe No.2 and environment.
- Ph.70 (Pl.217/3): Gadari handaxe site, looking SE. The *in situ* core of the photo above is at the notebook at bottom of photo. The first handaxe (found on 1.3.90) was where the man stands.
- Ph.71 (Pl.218/1): Gadari handaxe site, the cleaver spot, where the man stands.
- Ph.72 (Pl.218/2): Gadari Flake Site, the mottled, compact top silt of the Upper Babai Formation with the flake site embedded in it. The horizon is 15 to 20cm below the surface (where the person sits).
- Ph.73-Sc: Gadari Flake Site, scattered artefacts washed down from the site onto the slope.
- Ph.74-Sc: Gadari Arrowhead Site, view from near the handaxe site westwards to the Arrowhead Site on the flat terrace block, looking north.

- Ph.75-Sc: View from the Gadari E flake site towards NE, over the deposits of the Babai Formation: the red silts of the Lower Babai Beds and above it the stratified deposits of the Upper Beds.
- Ph.76 (Pl.218/3): Artefacts from the surface of the Arrowhead Site.
- Ph.77a,b (Pl.219/1): The stone arrowhead from the Arrowhead Site, 5cm long.
- Ph.78 (Pl.219/2): Perforated discs and celt fragments from the Arrowhead Site.
- Ph.79 (Pl.220/1): Deposits of the Upper Babai Formation with inset Sitalpur Beds.
- Ph.80 (Pl.220/2): Storage jars of clay by the Tharu people.
- Ph.81 (Pl.221/1): The Basantapur SW site on rocky surface (in foreground) with remnants of the once existent colluvial silt covering the rocky surface. At right (background), the colluvial silt of the Gidhiniya Formation, and the terrace surface of the Babai Formation (in the middle background).
- Ph.82-c (Pl.250/2): The Basantapur W locality in 1984. The celt place is at right, below the tree (from slide 22/33)
- Ph.83 (Pl.221/2): The Basantapur W locality 5 years later in 1989.
- Ph.84 (Pl.222/1): Daingaon site, in 1984, on an eroded silt surface near the foot of the hills.
- Ph.85 (Pl.222/2): The Daingaon adze locality, 1990. The eroded site in the foreground. At left the colluvial silts and in the middle background the stratified Babai Beds.
- Ph.86a,b (Pl.223): The „table“ (deposits of the Babai Formation), left by the erosion like a table. At the left in this panorama photo (b being a continuation of a) are colluvial fan deposits of the Gidhiniya Formation. It is a textbook example of badland erosion and the interfingering of alluvial with colluvial deposits.
- Ph.87 (Pl.224/1 and also Pl.243/2): The sensational Dongpur block, looking SW towards the hill.
- Ph.88 (Pl.224/2): Looking over Lamahi 1 site in 1984. Lamahi 2 is seen in the left background at the foot of the hill.
- Ph.88-Sc: View over Lamahi site 1, where the man stands, towards north.
- Ph.89-Sc: Lamahi 1 W site in 1990 with remnants of the yellow silt.
- Ph.90-c (Pl.251/1): The Sanpmarg site with the exposed artefact horizon in the foreground.
- Ph.91-Sc: The Sanpmarg site with the exposed artefact-bearing palaeosol in the foreground.
- Ph.92-c (Pl.251/2): The Sanpmarg site, with all deposits exposed: above the artefact-bearing palaeosol (in middle ground) the overlying yellow silt, topped by a red soil, and below the artefact-bearing palaeosol the underlying gravel (in foreground).
- Ph.93 (Pl.225/1): Artefacts eroding out from the artefact-bearing horizon at Sanpmarg.
- Ph.94 (Pl.225/2): Masutiya 4 site on the red colluvial silt.
- Ph.95 (Pl.226/1): Alluvial silts (foreground) and colluvial silts (background), NE of Parhwa.
- Ph.96-Sc: Morighat NWW locality, colluvial slopewash silts filling irregular bedrock depressions.
- Ph.97 (Pl.226/2): Locality Parhwa NNE, with the red colluvial silt on the slope (back, at right) and the yellow alluvial silts (foreground, left).
- Ph.98-c/a,b (Pl.252): a. The Arjun 3 Middle Palaeolithic site; the horizon is at the base of the silt of the 30m terrace, just above the gravel (in front). Tr.IV, V and VI are at right at the base of the small silt block, which in b. is covered by the silt remnants of Tr.III in the right front. b. the same site; Tr.II is at left at the small silt block; Tr.III is at the base of the small remnants of silt at right.
- Ph.99 (Pl.226/3): A blade eroding out from the silt at Arjun 3.
- Ph.100a (Pl.227/1a): A flake on a 6cm silt stilt at Arjun 3.
- Ph.100b (Pl.227/1b): A flake on a 10cm silt stilt, Saunri site.
- Ph.101-c (Pl.253/1): Arjun 3 site, the 30m silt terrace at right, with the underlying gravel (in front) and the young cultivated 10m terrace in the back.
- Ph.102 (Pl.227/2): Arjun 3, cutting III. The artefact horizon is 25cm above the base of the silt.
- Ph.103 (Pl.228/1): Arjun 3, cutting III. The artefact horizon is 25cm above the exposed base of the silt (arrow)
- Ph.104 (Pl.228/2): Arjun 3, cutting IV, looking northwest.
- Ph.105 (Pl.229/1): Arjun 3, cutting IV (at right) and VI (at left).
- Ph.106-c (Pl.253/2): The Arjun site seen from the river. Here, the sudden vertical dip of the bedrock is well exposed along the river just below the left part of the 30m terrace block.
- Ph.107 (Pl.229/2): Arjun 1 site, cutting.
- Ph.108-c (Pl.254/1): Arjun 3 SE site in the badlands, looking towards northeast. The artefact horizon is at the level where the man stands.
- Ph.109-Sc: View from Arjun 3 site towards Arjun 3 SE site, in the foreground are Tr.IV-VI.
- Ph.110 (Pl.230/1): Tharu woman with hand-made pottery.
- Ph.111 (Pl.230/2): The Bhararkund microlithic site. The man stands on the western edge of the silt surface on bedrock. The horizon is behind him at the level of his waist.

- Ph.112-c (Pl.254/2): Jalkundi site. The biface containing gravel is seen in front, overlain by a red buried soil.
- Ph.113 (Pl.231/1): Oj site; the terrace deposits at Oj W with a red buried soil, seen in the centre right, above the lower gravel.
- Ph.114 (Pl.231/2): Saunri site, view over the site; artefacts eroding out from the upper silt.
- Ph.115 (Pl.231/3): Saunri site, artefacts eroded out from the silt.
- Ph.116 (Pl.232/1): 40m cliff of terrace deposits at Gotari Khola.
- Ph.117-Sc: Mashot, 92m terrace site; the dissected terrace silts 92m above the river.
- Ph.118 (Pl.232/2): Mashot 2, Tr.I, A/2, subsurface/20-28, fitting pieces of a flake.
- Ph.119 (Pl.233/1): A round, bifacial chopper from a conglomerate in the Dhan Khola Formation (Upper Siwaliks) at the Surai Khola.
- Ph.120 (Pl.233/2): Handaxe No.21, on Satpati Hill.
- Ph.121 (Pl.233/3): Molar of *bos namadicus* from the Satpati Hill.
- Ph.122-c (Pl.255/1): The handaxe site on Satpati Hill (at X).
- Ph.123-Sc: The site, seen from the opposite slope.
- Ph.124 (Pl.234/1): The Satpati site at the saddle on the hill, where the man stands, and the white handaxe in the gully at the bottom, washed down from above.
- Ph.125 (Pl.234/2): The white handaxe in the gully at Satpati.
- Ph.126 (Pl.235/1): The site of handaxe No.21 at the sandstone outcrop on the hill, after cleaning the site of leaves.
- Ph.127 (Pl.235/2): Chabeni site, place 2, terrace surface with artefact scatter, with the Siwalik hills in the background. The Satpati handaxe site is in the hills, slightly to the right.
- Ph.128 (Pl.236/1): The Patu 2a site, the thick artefact scatter, on the 60m terrace, looking NW. Note the large manuport boulders.
- Ph.129 (Pl.236/2): Artefact concentration in square C-5 at Patu 2a.
- Ph.130 (Pl.237/1): Large split cobble and cluster of small round cobbles (top right) in square D-5c at Patu 2a.
- Ph.131 (Pl.237/2): Testpit II (in front) and III (where the man stands); below the surface scatter is sterile alluvial silt (after Corvinus 1987).
- Ph.132 (Pl.237/3): A termite mound, more than 2m in height near the site of Pa2a in the forest (after Corvinus 1987).
- Ph.133a,b (Pl.238/1): Anvils with cuts and rills caused by stone knapping.
- Ph.134 (Pl.238/2): Own experiments: block-on-block smashing of cobbles to be split.
- Ph.135 (Pl.239/1): Experiments on stone knapping: block-on-block method (the middle person) and free stone-hammer method (left person) (after Corvinus 1987).
- Ph.136 (Pl.239/2): Own experiments: hard stone hammer method (middle person); and cutting wood with a sharp flake (the person on the right) (after Corvinus 1987).
- Ph.137 (Pl.240/1): Own experiments: a self-made chopper and the large split cobble (from Pl.238/2).
- Ph.138 (Pl.240/2): Own experiments: cutting a tree with a self-made chopper.
- Ph.139 (Pl.241/1): Own experiments: making a sharp point on a wooden stick.
- Ph.140 (Pl.241/2): Locality E-Bawshi 9, the 30m terrace, capped by the artefact-bearing red soil (after Corvinus 1989).
- Ph.141-c (Pl.256): The Patu 7 site on the 60m terrace, capped by a red soil (at left) of the Rato River (at right).
- Ph.142 (Pl.242/1): Locality Bawshi 1 south, covered with artefacts and manuports (after Corvinus 1989).
- Ph.143 (Pl.242/2): Locality E-Bawshi 8, dissected badlands of the 30m red terrace with artefacts washed down from its original horizon in the red soil (after Corvinus 1989).
- Ph.144-c (Pl.255/2): Bawshi Khola west cliff, displaying a buried red palaeosol.

