SCIENTIFIC RESULTS

OF

THE SECOND YARKAND MISSION;

MEMOIR

OF THE

LIFE AND WORK

OF

FERDINAND STOLICZKA, PH.D.,

PALÆONTOLOGIST TO THE GEOLOGICAL SURVEY OF INDIA
FROM 1862 to 1874.

BY

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FERDINAND STOLICZKA, PH.D.

FERDINAND STOLICZKA, the subject of this Memoir, was born at Hochwald, in Moravia, in the month of May 1838. His father was a Forest Officer in Kremsier, and though but little is on record of Stoliczka's early life, it may, perhaps, be assumed that at this period there were opportunities afforded to him, which we cannot but suppose he eagerly availed of, for cultivating that ardent love of nature which characterised in a remarkable manner the man in after life.

His school education was obtained at the "Gymnasium" in Prague, from whence he proceeded to the University of Vienna, where he largely devoted his time to Natural Science, and especially to those branches of it which are most intimately connected with Geology. On graduating from the University he took the degree of Doctor in Philosophy.

To Professor Süess, who still presides over the Geological Department in the University of Vienna, he was indebted for his first regular training in Geology, and with the "friendly and "almost fatherly aid of Dr. Hörnes, of the Imperial Cabinet, he made his first essay in "Palæontology."

Dr. Stoliczka's first paper of which we have any record was a description of certain species of fresh-water Mollusca which characterise a stratum associated with the marine beds of the cretaceous formation in the North-eastern Alps.

This paper (1),* which was presented to the Vienna Academy by Professor Süess, and was subsequently published, contained descriptions of nine new species and a new genus (*Deianira*); it was illustrated by a plate, which includes, besides figures of these species, one of the tooth of a saurian which was found associated in the same bed. Thus, it may be said, was Stoliczka's career as a palæontologist commenced by a valuable and carefully worked out descriptive paper when he was only about 21 years old.

One year later (1860) his second paper was read before and published by the same Academy (2). Its subject was the *Gasteropoda* and *Acephala* of the Hierlatz Beds, and it contains descriptions and figures of about 40 new species. The plates are especially noteworthy for their excellence; they belong to a standard of quality to which Stoliczka often strove to attain in India, but with only partial success, owing to the difficulties attending such work in that country. These two papers were followed in quick succession by others on the Tertiary Fossils of the Southern Alps (3), and the Crystalline Schists of Southern Hungary (4), &c.

In the year 1861 Stoliczka became attached to the staff of the Austrian Geological Survey, of which Dr. Haidinger was then the chief. In the following year two papers appeared on a subject which he had in a very special manner made his own, namely, the Bryozoa; the first of these was entitled the "Oligocene Bryozoa of Latdorf, in Bernburg," and was published in the Proceedings of the Vienna Academy, with full illustrations (6); the second was on the "Heteromorphous cell-formation of Bryozoa (*Cœlophyma*, Reuss)," and appeared in the Transactions of the Zoological and Botanical Society of Vienna (7). The same volume contains a "Contribution to the knowledge of the Molluscan fauna of the Cerithien and

* These numbers refer to the Catalogue of Dr. Stoliczka's papers given on pp. 32 to 36.

" Inzersdorfer Beds of the Hungarian Tertiary basins " (8); from the former two, and from the latter eight species are described and figured as new. Two papers (9 and 10) " on the " Geology of South-western Hungary " were the next to appear; these being followed in the year 1864 by " A critical notice of Herr F. v. Römer's description of the North German " tertiary Polyparians " (11).

Referring to this period in a letter to the writer, Herr Ritter v. Hauer says: " Fully " apparent in these first works of Stoliczka are the conscientious accuracy and extensive " knowledge of which he gave such ample proof in later life. He acquired for himself " during his residence amongst us, in equal manner as he did later in India, the sincerest " friendship and regard of all his colleagues."

In the interval which elapsed between the publication of the last paper and those which preceded it, Stoliczka, already a palæontologist with a made reputation, had entered upon the new field of his labours.

In the year 1862, Dr. Oldham, the Superintendent of the Geological Survey of India, visited Europe, for the purpose of obtaining four additional assistants for the staff of the Survey. Large numbers of fossils had been accumulated by the labours of the Geological Survey in Southern India and elsewhere, and awaited the arrival in India of a qualified describer. It was important on this account that at least one of the four assistants to be selected should be a competent palæontologist. Application was therefore made in Vienna to Dr. Haidinger and Professor Süess, with the result that Stoliczka was named as a palæontologist with an already established reputation, and as he proved, when introduced to Dr. Oldham, to be not only willing, but most anxious to obtain service in India, he was at once recommended to the Secretary of State for India as a suitable candidate to fill one of the vacant posts. Soon afterwards he was duly appointed. In order to make the acquaintance of some of his future colleagues, and see the country whose service he had entered, he forthwith paid his first visit to England, and was present at the meeting of the British Association which was held in the autumn of the year 1862 at Cambridge, together with Mr. W. T. Blanford, who was at that time home from India on leave, and also with Mr. A. B. Wynne, another of the newly appointed surveyors, by whom Stoliczka is described as being at that time a slight young fellow, wearing spectacles, and having a black beard and long hair brushed back. All who met him then, in spite of his difficulty in expressing himself in English, were impressed with his unaffected geniality. The three colleagues were to have sailed for India together, but as Blanford and Wynne received instructions to take up work at Bombay, and Stoliczka was bound for the head office at Calcutta, this project was not carried out, and he started alone.

On arrival in Calcutta the Cretaceous Fossils of Southern India were placed in his hands, and he soon set to work on his *magnum opus*, which, when completed, in 1873, contained 1,454 pages and 176 plates.

In the year 1864 Stoliczka made his first acquaintance with the Himalayas, and as a result of the journey which he took in company with Mr. F. R. Mallet, of the Geological Survey, who had previously visited a part of the same region, he published a memoir on the sections across the mountains from Wangtu Bridge, on the River Sutlej, to Sangdo on the Indus, to which was added an account of the geological formations in Spiti, with a revision of all the known fossils from that district (15).

In his introductory remarks he says, " there are few parts of India which offer so many " difficulties to the scientific traveller as that elevated tract of mountains which borders the

" north-west of British India—the North-western Himalayas. Several portions of this " country, being partly independent or protected States, have rarely, if ever, been visited by " any European traveller, and such visits as have been made have usually been in " great haste, for the resources of the country do not generally admit of any long stay in " one place. As a result of these great difficulties we do not as yet know much of the " natural wealth of this portion of the Himalayan ranges, although probably more of this " than of the more eastern parts of this great system of mountains."

He then proceeds to give a brief abstract and criticism of the observations on this region by Strachey, Moorcroft, Trebeck, Herbert, Gerrard, Jacquemont, Thomson, Cunningham, Hutton, Hay, Theobald, and Medlicott. With reference to the sections between the plains and the Sutlej which were examined and described* by the last-named, he writes : " These three sections give an insight into the relations of the rocks between the plains on " the south and the Hatu mountain, near Narkanda, to the north-east of Simla. When " Mr. Medlicott's report was published, the contrast between the geological structure of the " southern portion of the Himalaya and that of the northern portion, so far as then known, " must have been noticed by every reader. It was, therefore, of the highest interest to " ascertain, if possible, the connexion between these, chiefly metamorphic, rocks of the " southern slopes and the fossiliferous rocks of Spiti, which, since the time of Gerrard's " first discoveries, have been several times examined. The stratigraphical relations of these " fossiliferous rocks in Spiti had not, however, been successfully traced out, and even " Mr. Theobald's and Mr. Mallet's collections of 1861 gave no sufficient explanation, showing " clearly a mixture of fossils from different formations. Such being the case, it was almost " unavoidable to repeat the attempt to trace out the stratagraphical positions of the Spiti " rocks."

In the beginning of June 1864 the party started from Simla, north-eastwards, through Bissahir to Spiti, crossing the Bhabeh pass. So far as time permitted, the Spiti problems were submitted to examination. Thence a move forward over the Parang pass was made to Rupshu, and so onwards through the Para, Tsomoriri, and Puga valleys to the Indus. After two days' march along that river, another cross traverse was made through Ronggo, Hanle, and the Tagling pass to Spiti. The western and north-western parts of Spiti were then examined in some detail, and the return to Simla was made by a route traversing Lahoul and Kulu.

A small outline map attached to the memoir enables the reader to follow the geographical indications of position and some special geological details, but the materials for a geological map in the full sense of the term were not obtained till many years afterwards, when Mr. R. Lydekker prepared the map of the extensive region which includes the tracts visited by Stoliczka.

To many geologists, and especially to Stoliczka, the preparation of detailed maps and the tracing out of boundaries have proved tasks to be avoided, while following sections across wide tracts of country have presented a far stronger attraction. These remarks are only made *en passant*, as the subject was one often referred to by Stoliczka in conversation, for on the present occasion there was neither time nor intention to attempt to prepare a geological map in the ordinary sense of the term.

Besides the regular official report of this journey which has just been noticed, a letter from Simla was published in the Proceedings of the Vienna Academy.

* Mem. Geological Survey of India, Vol. III, Part 2.

"*My last letter was, I think, dated Kotgurh the 11th June. I was then already on my "journey, and only returned a few days ago to Simla. My colleague, Mr. F. R. Mallet, "remained with me the whole time of our expedition, and begins in a few days his survey "in Central India towards Bombay. We left Simla on the 8th June, and our journey went "beyond Spiti towards Rupshu and up to Hanle on the Indus. I regret that it was im- "possible for us to return to Spiti from Hanle by the Chinese Province of Tshu-Tshu. We "ourselves encountered no difficulty, but the inhabitants declared war upon the followers "who accompanied us, and we received orders from the Government to avoid all contact. "We returned back again through the northern portion of Spiti, and from thence by the "English provinces of Lahul and Kulu to Simla. All the time we enjoyed splendid health, "and as we were 18,000 feet above the sea, on the Lanak pass, near the Indus valley, it was "not exactly agreeable in our tent; the temperature being 18 degrees of Fahrenheit. But "the prospect towards Eastern Tibet and the northern hills was magnificent. We crossed, "however, a still higher pass, the Parang-la, about 19,000 feet high, but were nearly over- "whelmed by a fall of snow.

"As for what concerns the geological portion of our expedition, I can call it a success. "It is not in the least degree below my expectation. In Spiti, where heretofore only two "formations were known, there are nine clearly established, all, with the exception of the "uppermost, petrographically distinguishable layers, with very characteristic fossils. A "brief sketch is this. Before one reaches the Bhabeh pass (in the Central Himalayan chain) "one finds oneself on Silurian ground, and this formation continues to the Kunzum pass, in "the north-western direction towards Lahul. Upon the Silurian strata lies the Carboniferous "formation, with characteristic fossils, and three separate petrographical subdivisions: "conglomerate and siliceous sandstone, earthy calcareous shales, and quartzites. On this "rests a very extensive series of limestones, the lower strata Trias, with *Halobia lommeli*, "globose Ammonites, *Orthoceras*, *Auloceras*, and many Brachiopods. Upon the Trias lies a "bituminous limestone, with extraordinarily large and massive bivalves, somewhat resembling "the *Megalodon triqueter*. I obtained, after much pains, a whole example, nearly a foot "broad. Undoubtedly, remains of Gasteropoda are extremely rare, as one sometimes finds in "the Kössener strata. I scarcely think that this limestone with the bivalves can represent "anything else than the Rhætic formation with the *Haupt-dolomit*.

"Again, a limestone with Belemnites, Ammonites (very rare) and many Brachiopods. It "was not possible to identify more certainly, by a mere superficial examination, whether "this limestone is Lias, but I scarcely doubt it, as a Gasteropod at the Parang pass, and also "the Brachiopods, closely resemble and are possibly identical with sundry Alpine fossils in "the Hierlatz Beds.

"Over these three limestone formations (possibly more will be ascertained by a future and "further survey) lie the argillaceous and shaley beds, with concretions which contain the "known Spiti Cephalopod fauna; these are our 'black shales.' These strata have a small "thickness, and, like the following formations, a limited extension in Spiti. But the black "shales are followed by yellowish, generally silicious or calcareous sandstones with *Avicula "conf. echinata* and an *Opis*. I consider these strata to be equivalent to the upper Jura of "Nattheim, &c. Upon this a lighter limestone with *Nodosaria*, *Dentalina*, *Cristellaria*, "and fragments of shale, which, I think, can only with the utmost difficulty be regarded as

* Letter to Dr. Haidinger, dated Simla, 3 Oct. 1864. Sitz. der K. K. Akad. Wien, Band L, Abth. I, pp. 379–382.

" belonging to the same formation, while it is highly probable that it belongs to the " cretaceous formation, although no trace of it is known in the Himalayas, as in Persia.

" Over all there lies, in Spiti, a light calcareous marl, that appears to be of the same age " as the underlying chalk, but of fossilisation there is not a trace to be found.

" Oldham considers this result as one not to have been expected, although it is all as clear " as it can be. Indeed, surveying is here of some difficulty. Hunger, thirst, and cold are " daily companions, but not a single tree, or even a blade of grass, hinders or conceals the " view of the picture which spreads itself before the eyes of the geologist. The majority of " the hills reach, in the snow region, to upwards of 20,000 feet, and the lower ranges are " commonly 8,000 to 10,000 feet, and often more. For nearly three months I did not see a " single tree, and but little vegetation; such as it is, however, it is exceedingly interesting. " I collected every plant that came under my eyes (of course, with the help of my followers), " and neither Stur and his *Drabas* nor Schott with his *Primulas* were forgotten. I have " looked particularly sharply after *Draba*, and to-day I hope to send a small package to our " friends. I have made numerous notes upon the flora and fauna, especially upon the " highest animal and plant life and their limits. Insects are apparently abundant, some " birds, reptiles, fish, and mammals, unfortunately very few snails; no wonder, where there " is no rain, or the same as none, there the vegetation is very poor, and how then can snails " be there? In the whole of Spiti I only found three *Helices*, one *Pupa*, and one *Lymnæa*, " all nearly microscopical; this even F. v. Hauer must accept (I think I am not mistaken), " as the complete fauna of a whole trans-Gangetic province.

" Beyond Spiti I did not find a trace of land shells. Of *Equus kyang*, the wild ass (not " horse as it is often called), I obtained more skins and skeletons; also of *Capra ibex*, and " others. Immediately on reaching Calcutta I will send all to Vienna.

" I brought a quantity of curiosities with me, manuscripts, weapons, and pictures, if one " can so call the Tibetan work.

" The mineralogical productions are, as yet, but little described, and we collected about " 30 mineral species, many very rare and good examples. On the Indus, near Rongo, and " in the extension from the mouth of the Puga to the Hanle stream, are widespread syenitic, " epidotiferous, serpentiniferous, and diallagiferous rocks. In the serpentine chromic iron " occurs not uncommonly, and in veins of the same there is found a green mineral, which " includes chrome, and is probably oxide of chrome, which Dana barely mentions in his " 'Manual' and altogether ignores in his 'System.' As soon as I get back to Calcutta, " I hope, after an examination of the whole, to prepare a short list, as, in spite of " Herbert's 'Report,' so little is known of the much esteemed mineralogical wealth of the " Himalayas.*

" I remain only a few days here, and spend the rest of this month between Simla and the " plains, in order to accomplish my geological section of the whole of the hills. I must " be in Calcutta by the beginning of November, where much work awaits me.

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Among Stoliczka's first papers published in the English language was a zoological one (12) descriptive of a small mammal of which he obtained several examples in Ladak, near the extreme limit of vegetation, at an elevation of about 19,000 feet.

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* A list and description of these minerals by Mr. F. R. Mallet was published in the same memoir as Stoliczka's report above quoted.

His work on the Cretaceous Cephalopoda of Southern India was steadily progressing in the early part of this year, 1865, and some of the general results which he had arrived at were communicated to the geological public in Europe, through the agency of the Geological Society of London, the Philosophical Magazine, and the Verhandlungen of the Vienna Geological Reichsanstalt.

Having completed the MSS. of his memoir upon the Himalayas, from which the above extract has been quoted, and an elaborate paper, entitled "A Revision of the Gasteropoda " in the Eastern Alps," which was dated Calcutta, April 20th, 1865, and published in the "Sitzungsberichte" of the Vienna Academy for the same year, he again started for the North-west, leaving Calcutta early in 1865. As companions on this journey he took with him an artist friend and a dog, a dog so remarkable that he is deserving of some notice in this Memoir. It was not until the following year that the writer made the personal acquaintance of the master, an acquaintance which soon ripened into warm friendship and regard as circumstances brought us into close association both in office and in the field. The acquaintanceship with the dog was of a very limited character indeed, in fact we were never even on speaking terms, for a more unapproachable irreconcilable canine savage it was never my lot to meet. He had served Stoliczka as a guard in his tent on the wild Himalayan slopes so efficiently that stories were told of how the artist friend, when he returned to camp, was often kept for hours sitting disconsolate outside the tent, till Stoliczka's arrival after his day's work afforded the necessary escort for a practicable entrée. Stoliczka and the native who fed the dog were alone recognised as masters, and the method by which he was first subjugated by his master was of the most stringent and severe character. At the hotel in Calcutta where we stayed the dog's critical inspection, as though with a view to future operations, of the calves of everyone he met on the stairs, and still more his fancy for constituting himself the guardian and sole occupant every morning of a whole range of bath rooms, led to such complaints on the part of the residents that before long his master had to part with him and he disappeared from the scene.

In March 1866 Stoliczka had completed the account of this second trip, and it was soon afterwards published, appearing together with the previous one in the same volume of the Memoirs of the Geological Survey of India.

He described the route followed on this journey in the following words:—*

"Starting from Simla on the 1st of May 1865, I proceeded through Suket, Mandi, the " Kulu valley, and then, crossing the Rotang pass, to Kyelang in Lahul. Here I was " detained for nearly a week, waiting until I could hear whether the Baralatse pass " was passable or not. After having received favorable reports, I managed to cross the " pass on the 22nd June, and after two short marches reached the Chumig-giarsa, a spring " remarkable for its large supply of cold water, a little north of the junction of the Lingti " and Yunam rivers, and at the place where the Tsarap river unites with both. Up to this " the course of my journey was more or less, but mainly, due north from Simla.

"From Chumig-giarsa I turned towards the east, proceeding south along the Tsarap valley, " up its course; crossed the Pangpo-la into the Phirse valley, then the Lanyer-la† into the " Gya valley, and after a few minor passes (of about 18,000 feet in elevation) reached " Korzog on the 2nd July.

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* Mem. G. S. I., Vol. V, pp. 338–340.

† *La* in Tibetan means a *pass*.

" Here, being at the principal camping ground of the Rupshu tribe, I arranged for my " further journey and started on the 5th July for Puga,* and from here towards the Thso†- " Kar and the foot of the Taglang pass, the second camping ground of the Rupshu tribe. " After again one day's interruption of my journey, rendered necessary by making further " arrangements, I crossed the Taglang pass and reached Leh on the 16th July. This place I " left on the 21st July, proceeding towards the village Rumbag, and then in crossing a few " minor passes to Trantse-Sumdo, the summer camping ground of the Karnag tribe; crossed " the Shapodog and Saiji La and reached Padam on the 6th of August after a horrible ex- " perience of hill travelling. I may remark here that it is not the bad road nor the high " passes which make travelling in these wild countries difficult at this time; in this case it " was chiefly due to the large quantity of glacier water, which had swollen every stream to a " depth of 3 or 4 feet; and to cross these torrents, often 20 times, while on a day's march, is " ruin to those who cannot enjoy every comfort during and after the day's work. Having " seen the necessity of parting here with the remainder of my men from Kulu, who had " offered me their services for the whole trip, on my arrival in Simla on the 10th of May, a " few days elapsed before other arrangements for the journey were settled. On 10th of " August I was able to start, and proceeded from here to Suroo and then to Kargil, from " which a separate trip towards the Indus in a north-eastern direction (across the Hambuting " pass) was thought necessary. I again left Kargil on the 1st of September, visited Dras, " and reached Srinagar on the 10th September, there I had to overcome some of the " difficulties of the season and of certain restrictive orders as to travelling in Kashmir; but I " at last managed to start, on the 26th of September, on my route through Islamabad, " Kishtwar, Budrawar, Chambi, and Kangra, and reached Simla again on the 31st October " 1865, thus terminating my trip for this season."

A very interesting sketch of the characteristics of the fauna and flora of Chini formed the subject of a communication to the Zoological and Botanical Society of Vienna in 1866 (19). The successive portions of this paper deal with—I, Valley of the Sutlej river; II, Geographical position of Chini; III, Climatic conditions; IV, Soil; V, Flora; VI, Fauna, to which are added some remarks on the inhabitants. While it may be said that for its thoroughness, accuracy, and withal readable and attractive style, it is a pattern of what such a description of a district should be, it must be added that comparatively few men are competent to write such accounts, owing to the diversity of acquirements, coupled with powers of observation, which are required for the purpose.

Space does not admit of more than a quotation from the concluding remarks in this paper.

" This is the condition of a small luxuriant tract in the valley of the historically renowned " Sutlej. My intention was, as I stated above, to direct the attention of readers to the " vegetation and fauna of a tract which serves as an equivalent to our middle temperate " zone. The observer of nature alone feels the truth of the long stated proposition that " similar climatic conditions produce and cause to live and flourish similar (I will not say " the same) plants and animals. I have been led to this picture by the wonderful " contrast produced by the sharp boundary of these snow peaks. On that side the moist,

* *Puga* signifies a *hole*, referring here to the sulphur mines.

† *Thso* means a *lake*; *Chu* a *river*, or, in general, water.

" warm Indian climate of the sub-tropical foreign kind, and on this side the northern " temperate climate of home.

" Where the lofty chain is partly or wholly interrupted by a valley, there the same " necessary moisture is present to produce the climatic conditions as in the majority " of the provinces of our Empire. This mild temperate zone in the Himalayas is " strikingly small, and extends from Northern Bhootan, Northern Nepal (the so-called " Kachar), Northern Kumaon, Gangotri, and Jumnotri, or the provinces of the sources " of the Ganges and Jumna, the western portion of the province of Kunawar, on the " Sutlej, the valley of the River Wangur, the northern Kulu valley, the Beas river, the " Chundra-bhagar, and the Chenab to Kishtwar and Northern Kashmir. At the widest " portion this zone is 15 miles wide, often only two or three, owing to the approximation of " the lofty chains. If one subjected the fauna and flora of this zone to a special and critical " examination, he would find himself scarcely able to separate 50 per cent. good species " from Central European products, and of the remaining 50 per cent., probably the half, if " not more, would prove to be equivalent species.

" There is a peculiar charm when one in his travels far from (real) home sees himself " surrounded by homely familiar forms in a highland country which is still unexplored for " hundreds of square miles, and of which we know nothing, save that it is inhabited by " numerous wandering tribes rich in cows and sheep. We do not yet know the sources of " the Sutlej and Indus. This enormous territory remains still for the inquirer to explore, " who, with the great observer of the coral life of the Pacific Ocean, may observe : 'There " is a noble pleasure in deciphering even one sentence in this book of nature.' "

In this same year, 1866, Stoliczka published (23) a general sketch of the results obtained by his preliminary examination of the Cretaceous Gasteropoda of Southern India. It was not till about two years later, October 1868, that the last fasciculus descriptive of this portion of his work was issued.

In his general remarks we find abundant evidence of the wide and masterly view which he took of the subject he had in hand. He states (24), for instance, that he has been " desirous " to prove of what very great importance the study of the fossil Gasteropoda is, with a view " to classification, having repeatedly had occasion to state that without the knowledge of the " fossil forms no natural grouping of shells can ever be obtained. Sufficient zoological " information was somewhat slowly procured, but this was chiefly due to the little attention " that many palæontologists have paid and still do pay to fossils as *zoological* objects, con- " sidering that the inquiries about them ought to terminate with the discussion of their " *geological* value. These obstacles, however, have now happily abated, and will undoubtedly " soon disappear. Geological research requires the determination of fossils, and palæon- " tology asks for an explanation of the time and conditions under which these fossils lived " in connexion with the state of things prior to that geological formation. All other infor- " mation with regard to fossils can only be obtained from zoological sources."

Again, having discussed the question of the age of the strata containing the Gasteropoda, which, in spite of the occurrence of certain Tertiary forms, he decides to be Upper Cretaceous, and corresponding to the Cenomanian and upwards of the European classification, he says :—

" I entirely reject, however, the argument of some palæontologists that certain genera are " restricted to certain formations. It is clear that a certain type of Gasteropod, which we " call a genus, must have had its first appearance somewhere ; but this is a point which

" experience must settle, or regarding which no statement could have any value excepting " so far as it were justified by our experience limited to a certain date. But to determine " *a priori* that a genus does not occur below the Tertiary formation, and to start with the " idea that rocks must be *Kainozoic* because they contain a few fossil types not as yet met " below these strata, is simply to impede the progress of science. Field Geology has yet a " great task to solve."

Such a statement as to the inter-dependence of Zoology, Palæontology, and Field Geology, and the necessity of their co-operation, though admitted now, was perhaps never before enunciated so clearly by any authority so competent as Stoliczka. The spectacle of geologists on the one hand and palæontologists on the other striving for the undue pre-eminence of the authority of their own subjects respectively has been too often witnessed.

In the year 1867 Dr. Oldham visited Europe for a few months, taking with him Dr. Stoliczka, for the purpose of affording him an opportunity of visiting various collections of fossils similar to those on which he was at work in India, and also for the purpose of obtaining his assistance in reference to the purchase of specimens which he had been authorised by the Government of India to procure for the Calcutta Museum. They returned to Calcutta in December after this, the only visit paid by Stoliczka to Europe during the 12 years of his Indian service.

A letter by Stoliczka to Hofrath Ritter v. Haidinger (28), descriptive of the return journey, consists of an account of his doings *en route*, and concludes with some remarks on meteorology and the proposal to establish a meteorological department in Calcutta, which were evoked by the observations which he made on the disastrous effects of the cyclone of 1867.

The next year was a busy one for Stoliczka. In May he was appointed, together with the present writer, joint Curator of the Indian Museum during the absence of Dr. John Anderson. As we both had duties at the Geological Survey Office to perform, we attended at the Museum on alternate days, and each took special portions of the collection of what had been the Asiatic Society's Museum, in order to prepare an inventory of the specimens which had been taken over by Government. Our joint work consisted mainly in the preparation of monthly reports for the trustees of the Museum. During the five months in which this work lasted the whole of the very extensive collections were overhauled and checked with the aid of Blyth's Catalogues, and such others as had previously been prepared.

In July 1868 Dr. Stoliczka was appointed Natural History Secretary of the Asiatic Society of Bengal, an honorary post involving much labour and personal sacrifice, owing to the severe editorial duties which belonged to it. In spite of all these duties, over and above the major claim on his time, preferred by his palæontological work for the Survey, he proved himself not only equal to them, but found time to write long letters to correspondents at home, and to prepare for publication various papers on widely different subjects, as will be seen from the following titles: "On the Jurassic deposits in the North-west Himalayas" (25); "On the Andaman Islands" (27); "On *Pangshura tecta* and other species of *Chelonia* from the newer Tertiary deposits of the Nerbudda Valley" (30); "On *Nanina pollux* and *Helix propinqua*" (31); "On *Sagartia schilleriana* and *Membranipora bengalensis*" (32). At this time he commenced, also, a valuable series of papers on the anatomical characters of Indian Mollusca, a subject which had previously been much neglected, although Conchology had received so much attention from numerous writers. The first of this series of papers was entitled "Malacology of Lower Bengal, No. 1, On the genus *Onchidium*" (35).

The following letter* to H. v. Haidinger from Stoliczka contains some account of his life and principal occupations in Calcutta at this period :—

"Our geological results are now being slowly digested; all the Assistants are returned " home from the field and are at work upon their last investigations. The mercantile offices " are often closed on account of the great heat; notwithstanding this, an active life rules in " the Geological Survey Office, hammering and chiselling, mechanical and chemical analysis, " neting and examining, writing and drawing. So it goes on from morning to evening; our " worthy chief, seated in our midst, presides over all.

"We have had now for many days terribly hot weather, daily in the shade 100° F. (30° R.), " often much higher; sometimes there comes a 'north-wester,' like manna fallen from " heaven, and makes the air tolerably cool. This north-west wind during the hot portion of " the year is remarkable. A thick cloud appears in the north-west, and a strong wind begins " to blow from the south-east, turns towards the east, towards the north, and brings rain " from the north-west, and often from the west. The last days of the hot season are usually " especially sultry; however, this year we had frequent storms towards the end. The last " storm was on the 5th, and many clouds collected together on the northern horizon. On " the 6th it remained unchangeable. On the 7th, at 3 o'clock in the morning, it began " to rain like a torrent, though, curiously, altogether without thunder. During this one day " rather more than 5 inches of rain fell, and since it we have seen neither sun nor stars. It " rains incessantly, often very lightly, but one can nevertheless perceive the fine dust; both " yesterday and to-day, for about two hours after 12 o'clock, I saw many pavement stones " dry. It is to be hoped that the weather will on many days be broken, but at intervals " it rains every day. In the ordinary course of things the rainy season comes in about " the middle of June, this is therefore somewhat in advance, but it was acceptable as " the heat was unbearable. It is now prematurely cool, the temperature being only about " 80° F. (21⅓° R.).

"In the past month of May Oldham was elected President of the Asiatic Society by a large " majority; Blanford resigned the general secretaryship; in short, a place on the council " became vacant, and they did me the honour to elect me to the same. Already they had " appointed me Natural History Secretary, and in part I found myself also in the office of " general secretary. A mass of work is connected therewith, but in my proper official time " I officiate in part as Curator of the Indian Museum for Dr. Anderson, who has gone with " the Yunan expedition, the other half is devoted to my work as palæontologist to the Survey. " It is certain that it is as much as a man can do in this hot climate, but one has the conso- " lation that the Government provides for the sustenance of its servants.

"Lately the Government in England appointed a special mining geologist. He has already " arrived, and will, during next winter, examine many of the most important coal fields.

"My summer journey must be given up under the pressure of other work; however, " it is possible that I may go to the Andaman Islands for one or two months, as soon as " Dr. Anderson returns.

"My Gasteropoda are quite ready; but, alas, the ship has not arrived which brings the " paper, and the index cannot, on that account, be printed. This causes a delay of about " two months. I shall now occupy myself with the arrangement of a deep-sea collection,

* "Arbeiten an dem Geological Survey in Calcutta" (from a letter to Hofrath Ritter v. Haidinger), dated Calcutta, 11th June, 1868.—Ver. der K.K. Geol. Reichs., Wein, 1868, p. 244.

" and soon afterwards attack the bivalves. If the Government approves of our 'Quarterly " Records,' I hope often to make use of the opportunity to report upon many palæontological " subjects under my observation."

An important paper on the Ornithology of the Sutlej Valley (34) was Stoliczka's first contribution to a branch of natural history which he had, it is believed, taken up practically for the first time during his Himalayan journeys. His observations were primarily made on birds seen and obtained during the summer months, from May to October, but having employed natives to shoot for him during the winter, he was enabled to add further notes founded on the information so afforded.*

The introduction to this paper contains a valuable description of the physical features and the distribution of animal and vegetable life throughout the region itself and those bounding it. A German translation of it appeared in Petermanns Mittheilungen in the year 1870. Although too long for insertion here, some extracts will perhaps be sufficient to direct those who are specially interested in the subject to the paper itself.

" The fauna has an essentially Tibetan character. The Kyang, *Equus hemionus*, is very " plentifully met with in a wild state; the Yak, *Poephagus grunniens*, has become domesti- " cated, and is at present very rarely found wild to the south of the Indus; *Ovis ammon*, " *Ovis nahura* (Burrel), *Moschus moschiferus*, and other ruminants are, however, still tolerably " common. *Ursus tibetanus*, *Lynchus europeus*, *Vulpes montanus* and *V. ferrilatus*, *Mustela* " *erminea*, and others are also not rare. Of birds a large number of FRINGILLIDÆ, " RUTICILLINÆ, ALAUDIDÆ, CORVIDÆ, and others, mostly of European type, are to be met " with. As to reptiles and fishes, I have not been able to procure any information, but I " should think they are not specifically very different from those of Western Tibet."

* * * * * * * *

" The highest peaks in the North-west Himalayan chain rise on an average somewhat " above 22,000 feet, and the limit of snow lies in general at about 17,000 feet, increasing to " about 18,500 feet on the Tibetan slopes.

In the narrow valley Indian tropical plants were found at the base of hills upon which, higher up, the finest cedar and pine forests flourished, while beyond their limit glacial or Alpine plants occurred in the interval up to the edges of the eternal ice and snow.

" The province of Kunawar, in which many of the ornithological observations here recorded " were made, extends from Shipki to Wangtu Bridge (N. lat. 31° 27′ E., long. 78° 3′). A " large portion of this province is situated on the north-eastern declivity of the Central " Himalayan range, and has much Tibetan admixture in its fauna and flora. Travelling " from the Chinese frontier to the west, we soon see the Tibetan *Caragæna* and the *Juniperus* " *squamosa* replaced by the larger *Juniperus excelsa*, *Pinus excelsa*, and a few others; " fine specimens of apricot and poplar trees become abundant, and the first vineyards are to " be observed in the neighbourhood of small cottages." * * * *

" The limit of vegetation almost corresponds with the snow line, lying between 17,000 and " 18,000 feet; the limit of growth of trees being nearly 12,000 feet. We often find at this " limit *Betula bajpaltra*, and in other places *Pinus excelsa*, which ranges almost higher " and extends further into the interior than either *Pinus gerardiana* or *Cedrus deodora*.

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* Dr. Stoliczka's collection of Himalayan birds was subsequently described by Herr A. von Pelzeln in the "Journal für Ornithologie" for 1868, and a translation of the same by Lord Walden was published in the Ibis for 1868, p. 302.

" The eatable pine is, I think, peculiar to the Sutlej Valley, and the seeds are a favourite food " of the rare *Sitta leucopsis*.

" *Fringillidæ*, like *Metoponia pusilla*, *Loxia himalayana*, *Propasser rodochrous*, or *Fregilus himalayanus*, are usually found at the limit of trees, where they generally also " breed. * * *

" The fauna of the more western portions of the Sutlej Valley can be viewed under two " somewhat different sections, namely, that of the greater elevations, between 12,000 and " about 6,000 feet, and that of the lesser elevation, 4,000 or 5,000 down to about 1,000 feet.

" The former section includes some of the largest forests of the Himalayan cedar, especially " in the neighbourhood of Nachar, stretching on one side into the Wangur and Baspa " valleys, and on the other along the tops of the hills almost to the immediate vicinity of " Simla. About Guna and Serahan, between 7,000 and 9,000 feet, some of the finest " specimens of the *Ulmus himalayensis*, *Pavia indica*, *Juglans regia*, mulberry, and other " trees occur, besides a thick vegetation of low forests and brushwood. There exists on " these moderate elevations a particularly mild climate; the supply of water is abundant " during the whole year, and some of the places best adapted for cultivation of grain, &c. are " to be found here." * * * *

" The Indian character of the flora and fauna becomes more prevalent the more we " proceed southwards and the more we descend to lower elevations."

The country to which the paper refers extends for 180 miles along the course of the Sutlej from Shipki on the Tibetan frontier to Belaspur.

The number of species of birds recorded amounted to 280, of which several were described as being probably new.

In the year 1869 Stoliczka visited, during a period of three months' leave, portions of Burmah, the Malayan Peninsula, and the Andaman and Nicobar Islands, and in the following year a crop of papers on the malacology, ornithology, reptiles, &c. of these regions appeared in due course; but before mentioning these in further detail, it should be recorded that in 1869 a new subject of investigation presented itself to him, which time did not admit of his pursuing further, as it was his intention to do when sufficient materials should have been accumulated. His first paper on this subject was entitled " A Contribution " towards the knowledge of Indian Arachnoidea " (38), and in 1873 he published another " on the Indian species of Thelyphonus " (66).

Such papers, it may be here noticed, not unfrequently evoked criticism from those specialists who looked upon them as incursions into their special domains; but Stoliczka was generally well enough armed to be able to do battle with his critics, though in the multitude of the subjects which he undertook it was well nigh impossible but that here and there an oversight should occur, which his critics did not fail to detect. These remarks apply, for instance, to several of his ornithological papers, which sometimes contained statements or identifications with which other ornithologists could not agree. In some directions, however, he had probably no peers, and in them no hostile critics were ever heard of.

Other papers which also appeared in 1869 were " Osteological notes on *Oxyglossus pusillus* (*Rana pusillus*, Owen) from the tertiary frog beds in the Island of Bombay " (36), and " Observations regarding the changes of organs in certain mollusca " (37).

Among the above-mentioned results of Stoliczka's visit to the islands of the Bay of Bengal there is to be first noted what might almost be spoken of as one of his regular descriptive letters sent to Vienna and published on this occasion in the Verhandlungen der Geol. Reichsantalt (39). It was addressed, like many others, to Dr. v. Haidinger. From it we

learn that he left Calcutta on the last day of July (1869), and made a short stay at Akyab, then spent a week in Rangoon and 16 days each at Moulmein and Penang. He then had a day at Malacca, eight days in Singapore, and thence proceeded to the Nicobars and on to the Andamans, reaching Calcutta by the 14th of October.

His collections were most abundant as regards fish, mollusca (both marine and land), arachnids, crustacea, &c., and he also obtained some birds' skins by purchase. Although he did little directly in reference to geology, he says, "I am firmly convinced that a geologist "learns more geology on such a journey than if he had worked the same time in the field, I "mean with hammer and chisel." At Akyab he obtained living species of *Lingula*, and his observations on living Tellinas led him to pronounce unfavourably on Deshayes' classification of that genus, and similarly with regard to H. and A. Adams' classification of *Glauconomya* of which he found examples in brackish swamps at Rangoon.

At Moulmein he found a number of land shells living on isolated rocks, each of which showed more or less peculiarities in the species or varieties found within its own particular limits. He says, "I have never seen so splendid an opportunity for determining what a "variety is, and how it becomes a species."

In Burmah he co-operated with Dr. Day, who was engaged in preparing a report on the fish of that country.

Of Penang he says, "To give a description is beyond my powers, I cannot paint a picture "sufficiently beautiful." His letter enumerated his principal acquisitions as he progressed, and he speaks in enthusiastic terms of his success at each of the localities. At Singapore he obtained his first view of coral reefs in all their splendour, but with regard to them and their contents he observed and noted rather than collected. After a few remarks on the new English colony and its surroundings at Camorta in the Nicobars, where he spent but a short time, he relates how he subsequently sent back a collector from Calcutta, who obtained for him a rich harvest of valuable specimens; then, referring to the coral reefs in the Andamans, he writes, "I stood for hours on a sandstone prominence surrounded by coral reefs, observing how the "soft shales (standing almost perpendicularly) between the hard sandstone layers were entirely "washed away, how the living coral had built up in the eroded spaces, and how two wholly "different formations presented themselves to the observer in apparently concordant layers "at a depth of 50 to 60 feet below the level." The shore life, with the distribution of the mollusca, he found most instructive, and mentions some particulars.

He concludes thus, "You will now ask, what will you do with all this material? "What I can I will myself slowly work out, and as soon as I am ready I will deposit a "portion of the collection in our museum here, and a portion in our museum in Vienna. "My ornithological collection must lie by for one or two years. * * * * Firstly, I will in "my private morning time work out the reptiles as far as possible. I have many new "species. Then I shall take up the Moulmein land shells, then a monograph of the "Arachnids of Penang. Next year I will write a monograph on the Penang land shells, "and then on those of the Nicobar and Andaman Islands, and, if possible, work out the "birds. My Arachnids are particularly numerous; I have at least 150 new species, and "many very interesting new genera."

"Of butterflies I have collected none, it was impossible to attend to everything, and of "other insects I have very few; but of Myriapods I have apparently a large number."

He then speaks of the Crustacea which he had given to Mr. Wood-Mason to describe, and of the fish which Dr. Day had examined, and of which he was starting off a large series to Vienna.

The letter concludes finally, like several others, with a brief sketch of the work in the field upon which his colleagues were engaged, and of his own palæontological publications connected with the Survey.

During the year 1870 he published the following papers: "Note on the Kjokkenmoddings "of the Andaman Islands" (41), which was founded on an examination of an old kitchen midden, the results obtained pointing to the existence of a race with some different habits from those of the existing Andamanese; "Note on a few species of Andamanese land shells" (42); "A contribution to Malay Ornithology" (43), of which a critical review by the Marquis of Tweeddale appeared in the Ibis for 1871, p. 158; "Note on three species of "*Batrachia* from Moulmein" (44); and "Malayan *Amphibia* and *Reptilia*" (45).

In spite of these varied occupations, which, it will be observed, did not follow the order predicted in his letter to Dr. v. Haidinger, his palæontological work always occupied the principal part of his time, and, referring to it, Dr. Oldham in his annual report says, "Dr. "Ferdinand Stoliczka, Palæontologist to the Survey, has throughout maintained the same "thorough and indefatigable devotion to the work he has undertaken as has hitherto "distinguished his labours."

In 1871 the following papers and notes were published: "Observations on Indian and "Malayan *Telphusidæ*" (47); On the Anatomy of *Cremnoconchus* (48); "Notes on terres-"trial Mollusca from the neighbourhood of Moulmein, Tenasserim Provinces, with description "of new species" (49); "Notes on some Indian and Burmese Ophidians" (50); "Note on "*Testudo Phayrei*" (51); Tertiary Crabs from Sind and Kach (Cutch) (53).

The following letter to Ritter v. Hauer gives an account of his palæontological work:*

"You will see the next account of our progress in Oldham's Annual Report, which will "be published at the end of this month. Geological surveying continues in all parts of "India, my Himalayan work alone remains still interrupted, and it is not probable that I "shall find time this year to go to Tibet; willingly I made a revision of Spiti, for that "is a key to wider work. Perhaps, when it becomes possible, I will go for three months "to Niti, in Kumaon, where Strachey has done so much work. I hear the Jurassic Beds "are importantly developed there, and the Silurian Beds contain more fossils than in Spiti. "The visit would therefore be specially interesting.

"My *Pelecypoda* are now finally ready. The second portion of the volume I will send "next, and the third part will soon be printed. The whole volume will contain upwards of "600 pages and 50 plates. I have described 243 species from the South Indian Cretaceous "formation, and made, as far as possible, a complete revision of all the living and fossil genera "of Pelecypodes. The geological result is interesting. There are about 12 per cent. identical "with European species, possibly more, but the identifications are less certain. It is note-"worthy how the geological oyster layers correspond with the European. For example, "*Exogyra ostracina*, *Gryphæa vesicularis*, and *Ostrea ungulata* are in Europe only found "in the chalk, with us also exclusively in the Arrialoor group, while *Exogyra haliotoidea*, "*Gryphæa suborbicularis* (*columba*), *G. vesiculosa*, *Ostrea carinata* lie deeper in Europe, "and similarly in India only occur in the Ootatoor group. Of other characteristic species I

* "Geologische Arbeiten in Indien" (from a letter to Herr Director v. Hauer, dated Calcutta, 8th March 1871). *Vide* 52.

" can mention to you, *Pholadomya caudata*, Röm, *Cytherea plena*, Sow. *Cardium produc-*
" *tum*, *Protocardium hillanum*, Sow, *Eriphyla lenticularis*, Goldf. *Trigonia scabra*, Lam.
" *Inoceramus cripsianus*, and *labiatus*, *Pecten curvatus*, Gein, &c. Not one single species
" corresponds with those of the Gault. What we have are Cenomanian, reaching thence to
" the highest Senonian.

" I hope the revision of the genera of the *Pelecypoda* will contain something useful. I
" have already received many encouraging letters about the *Gasteropoda*, although the
" enumeration must remain very incomplete, but it was the chief reason why I took up the
" *Pelecypoda* with greater zeal.

" During my private time I have written a rather long paper on the tertiary crabs of Sind
" and Cutch. The work is already at press, and the plates have been lithographed; it will
" appear in a special part of the Palæontologia Indica. I describe two species of *Palæocar-*
" *pilius*, 1 *Galenopsis*, 2 *Neptunus*, a new genus of the rare family of the *Leucosidæ*, and
" two are incompletely characterized.

" My zoological work goes slowly forward. I have some remarkable anatomical results
" in the Mollusca, and my paper for this year on this group will nearly take a whole number
" of the Asiatic Society's Journal. I will next describe a new *Comatula*, and to it will add
" some remarks upon the importance of deep sea dredging in the Indian Ocean. We have hope
" that the Government will do something, and that the matter will therefore be undertaken."

This record would be incomplete did it not contain some account of Dr. Stoliczka's social life in Calcutta; for several years he lived in a house in Wood Street, where he was able to give a room to friends visiting him from the country, and had more or less ample accommodation for his collections. This latter qualified statement is made in consequence of the fact that shelves laden with bottles, packing cases, the boxes containing a menagerie of living land shells and occasionally live snakes, besides books and other working materials, crowded his rooms.

Here, in the midst of these surroundings, he entertained his friends, of whom there may be said to have been two classes, one consisting mostly of men who were in a greater or less degree connected with scientific work, and the other of his own compatriots, with whom he identified himself as a leading member of the German club. But this distinction was not sharply defined, as the Germans and other foreign residents included some men of distinction in science, like Drs. Brandis, Schlich, and Kurz, and Stoliczka's frequent invitations to his English friends to entertainments given by the German club served in an important degree to remove any barrier which might exist between the two communities.

Among those of the first-named class who partook of his hospitality and spent hours with him working at his collections, the names of Jerdon, Day, Godwin-Austen, Nevill, Wood-Mason, Waterhouse, Medlicott, Blanford, Theobald, and Waagen, with several others of his colleagues belonging to the Geological Survey, are the most prominent; but besides these there were others too, mostly travellers or occasional visitors to Calcutta, like Brooks and Mandelli. With Allan Hume, too, he was on terms of close intimacy and friendship, and of the high opinion and regard which Mr. Hume entertained for him ample testimony will be found in the pages of "Stray Feathers." Officially, from his position as a Secretary to the Government, he was able to promote Stoliczka's interests in many ways, and he never lost any opportunity which occurred to him of doing so.

The name of another warm friend of Stoliczka should also be mentioned here, namely,

that of Colonel Hyde, Master of the Calcutta Mint, who, as President of the Asiatic Society during a part of Stoliczka's term as Secretary, was very closely connected with him.

In October 1871 Stoliczka visited Cutch, in order to unravel on the spot, by actual examination, some of the doubtful questions as to the distribution of the fossils and the detailed subdivision of the beds belonging to the several formations which occur there. Some of the results which he arrived at are stated in letters addressed to Mr. A. B. Wynne, to whom with thoughtful and characteristic consideration, he wrote, "my admiration for your work "is no less on that account, because you did not discover everything."

He himself never published any account of these results, but some of them are given in the Manual of the Geology of India, and in Dr. Waagen's description of the Cutch fossils which is published in the *Palæontologia Indica*.

In the year 1872, after his return from Cutch, in March, the productive powers of Stoliczka's head and hand, gauged merely by the number of papers which he published, may be said to have reached their maximum, for we find in this year no fewer than 11 distinct communications, of which six were on the *Reptilia* and *Batrachia* of various parts of India, Burmah, and Malayana (54, 55, 56, 57, 58, 59), four consisted of anatomical and other notes upon the land mollusca of the Himalayas, Penang, and Burmah (60, 62, 63, 64), and one paper was devoted to a description of the mammals and birds inhabiting Cutch (61). In the introductory remarks to the last there is, as is usually the case in Stoliczka's papers, a careful description of the physical, climatological, and vegetable conditions characterising the region in which the animals were found. Such remarks are not easy to epitomise, and the following should be regarded rather as a sample than as a *précis*. He commences by saying that "the study of local faunas must, for some time at least, continue one of the most "important means of leading to a full understanding of Indian zoology. India combines "such an enormous variety of physical conditions, namely, differences of level, climate, and "vegetation, all of which have to be studied in connexion with the animal life, that one is "almost lost in the chaos of information required, and is very apt to overlook conditions "which may be essential for the explanation, not only of peculiarities as regards distinction "of species, but also of those relating to geographical distribution."

"The province of Cutch extends for about 150 miles along the tropic of Cancer, having a "breadth of about 40 miles on either side of it, and the meridian of 70° E. longtitude passes "through it a little eastward of the centre. The mainland stretches along the sea coast "from the most eastern branch of the Indus to Kattiwar, from which it is separated by the "Gulf of Cutch; to the north and east it is entirely isolated from Sind and the eastern "Rajputana States by the so-called Run, which was no doubt formerly an arm of the sea, "but is now being much silted up. It has a varied breadth of from 40 to nearly 100 "miles." * * *

"During the rainy season by far the greatest portion of the Run is inundated, and a good "number of the larger water birds are said to be seen on it. The slightly elevated ground "which locally forms strips in the Run proper supports a very scanty vegetation of rough "grasses (*Cyperaceæ*) and of a few scattered bushes of tamarisk, &c.; this part is called the "Buni, and if the monsoons are not heavy, it affords rich pasture for cattle during that "time, but in the dry season even the nomadic Sindees are often obliged to leave it for "want of water."

Then follows a description of the more elevated portions of the area. Of the climate he gives some particulars. The south-west and west winds bring but little moisture to

this parched country. "The ground is so dreadfully heated under the powerful glare " of a rarely covered sky that it seems entirely to prevent the approach of moisture, " unless the atmosphere be near the point of saturation, and this seems indeed to be of very " rare occurrence." In December and January the temperature after mid-day rose to 80° to 90° in the shade, and in February to 100°; the water supply, as might be expected, was bad. " The simple recollection of the foul and dirty fluid that one is occasionally obliged to accept " in order to quench his thirst is enough to make one shudder."

" All these elements of physical condition to which I have briefly referred tend towards " making the country a *terra hospitibus ferox*, an expression often repeated for want of a " more suitable one, or, as an early traveller expressed himself, a country fit only for a " geologist to travel in."

Under all the circumstances described, both the fauna and flora are poor; the latter, in point of numbers, consists chiefly of plants which grow in sandy or saline soils, and as there are no forests, the larger Carnivora, Pachyderms, and Ruminants, and the ordinary feathered denizens of forests, are absent.

Among Mammals the Rodents are most abundant (*Gerbillus*, *Sciurus*, *Lepus*), and next to them the Indian antelope and gazelle, all vegetable feeders.

Of birds, 160 species were obtained, of which about 100 only were regular residents. Of *Reptilia* and *Amphibia* 30 species, and of fresh-water fish 18 species, which it was believed must be nearly the total number existing in this almost riverless region.

In October of this year (1872), Dr. Stoliczka, in company with Dr. Waagen and myself, paid a visit to Darjiling, where he much enjoyed the relaxation from work. During this short trip he made a considerable collection of *Cicadidæ*, intending to write a monograph of the family, but for this he never found time.

Early in the year 1873 an exploring tour to the Andaman and Nicobar Islands was organised by Mr. Allan Hume, who arranged with the British India Steam Navigation Company that one of their steamers, which were in the habit of making the monthly trip from Calcutta to the settlements on these islands, should, in addition to completing its ordinary course, be placed at his disposal for the purpose of visiting the southern islands of the Nicobar group and various outlying islands of the Andaman group, concerning the natural productions of which but little was known. Dr. Stoliczka, Mr. Wood-Mason, assistant curator of the Indian Museum, and the writer were invited to be of the party, and a very enjoyable month was spent in exploring and collecting in these islands. Both Stoliczka and I had previously visited the islands on separate occasions, but as our explorations had not extended far beyond the limits of Port Blair in the Andaman Islands, and Camorta in the Nicobars, we gladly availed ourselves of the unusual facilities thus afforded for making more extended investigations.

We left Calcutta in the steamer "Scotia" on the 1st of March, with a cargo of supplies and convicts for Port Blair. Were there space available, there are ample materials* for giving an extended account of the tour and its results. To these published records I would refer the reader, confidently believing that if he should have an opportunity of reading the first of them, he will derive an amount of interesting information and amusement which will make him feel grateful for the reference.

Somewhat to my surprise, Stoliczka on this occasion gave most of his time to assisting in the main object of the expedition, the investigation of the ornithology, and he was among the

* *Vide* "Stray Feathers, Vol. II, 1874, pp. 29–139, and Jungle Life in India." De la Rue, London, 1880, pp. 356–412.

most energetic of those who shot birds; he paid but little attention to other branches, relying principally upon the collections of invertebrates which were made by his servant. He was in truth "on pleasure bent," and while he thoroughly enjoyed himself, his good fellowship was the cause of not a little of the pleasure from the trip which was derived by others. One incident, of which he was the hero, deserves particular mention, though the facts cannot for want of space be detailed in full here. Having landed, towards evening, with some others of the party on the Island of Meru, one of the Nicobars, he became separated from them and was lost in the jungle. After several attempts by his companions to find him had failed, and news of his loss had been brought to the steamer, a regular search party was organised, and at length, by his replying to our shots, he was discovered about midnight, fairly hemmed in, in the midst of a thorny jungle into which he had wandered.

The joyful news that he was found, and was unhurt, was conveyed to those who were on board by a preconcerted signal discharge of fire-arms, and by three such cheers as it may safely be said were never before heard in that island.

The scene presented in that jungle, when seen by the lurid blue lights which we carried, and as the motley group of English, Indian Lascars, and Nicobarese stood on the white coral strand, is one which is not likely to be forgotten by any of those who were present. As a memento of the occasion we brought away a fine specimen of the gigantic crab known as the cocoa-nut thief, *Birgus latro*, which we interrupted in his nocturnal rambles, and when we had subsequent experience of the tremendous powers of his claws, it was a matter of congratulation that neither Stoliczka nor any one of the relief party had unwittingly placed his foot within their reach. Ominous rustlings in the jungle had caused Stoliczka, after he had given up all hope of finding his way out, to climb up a tree, and it was only when he heard our shots that he descended in order to reply. The crab is now in the Calcutta Museum. Copious doses of quinine which were taken by all the party served, perhaps, to ward off what otherwise might have been the unpleasant consequences of this memorable night's adventure.

After visiting, on the return route, some of the smaller islands lying off the Andamans, the Cocos, Preparis, and the volcanoes of Barren Island and Narcondam, we returned to Calcutta by the end of March.

It had been arranged that Stoliczka, together with some other members of the Geological Survey of India, was to go as a deputation to the Vienna Exhibition in charge of a large collection of minerals and fossils intended to represent the Geology of India.

For Stoliczka it would afford an opportunity of re-visiting his home and seeing and conferring with his scientific friends; it is needless to say, therefore, that he looked forward to it with the utmost pleasure and ardour, but it was not to be, a still greater attraction presented itself. The Government having recently received an Envoy from the newly appointed Atalik, or King of Yarkand and Kashgar, resolved to send a mission with return letters and presents. Mr. Forsyth, now Sir Douglas Forsyth, was chosen as the Ambassador and chief of the mission, and five other officers were selected to complete the number, six, which had been agreed upon with the Envoy as the limit of the party. These five officers were Dr. Bellew, Lieut.-Col. Gordon, and Captains Biddulph, Trotter, and Chapman. Stoliczka's application to the Government to be appointed a member of the mission was not answered for some weeks, and rumour was rife as to whether the authorities would or would not recognise the importance of sending a geologist and naturalist. The difficulty as to the limit to the number of members constituting the mission was, however, got over, and at length, after

some other difficulties had been disposed of, instructions were conveyed to Stoliczka appointing him to the post of naturalist to the Yarkand Mission.

He at once commenced to make the necessary preparations, and clear off arrears of work, by completing the publication of sundry papers which were passing through the press. These included the final fasciculi of his great work on the Cretaceous Fossils of Southern India, which, as already stated, contains nearly 1,500 large quarto pages of letter-press and 176 plates, and several papers on reptiles, arachnids, mollusca, and insects, which were published in Volume XLII of the Journal of the Asiatic Society of Bengal. See Nos. 65, 66, 67, 68, 69. In a paper on the *Passalidæ* which he read before the Society he took occasion to describe the principles of philosophic classification advocated by Dr. Kaup, and the system of rational nomenclature proposed by Prof. Hartwig of Utrecht. The former, with its limit of five species to each genus, encountered some hostile criticism, to which those who were present will remember Stoliczka replied with considerable energy and warmth. While not exactly supporting the system himself, he claimed for it, on account of the respect due to its inventor, careful consideration and examination by the application of test cases. It may be added that an obituary notice of Dr. Kaup appears side by side with that of Dr. Stoliczka in the Ibis for 1874, and the notice there of this artificial system of classification is not favourable.

Regarding the above-mentioned work on the Cretaceous fossils, Dr. Oldham, in his presidential address to the Asiatic Society,* said "These volumes form an invaluable record, " descriptive of one of the finest and most extensive collections from a single formation " which has ever been brought together, and have been prepared with a fulness of illustra- " tion and a widely embracing accuracy of description which render them essential to the " palæontologist and almost equally essential to the recent conchologist.

" We desire to acknowledge the liberality with which the Government of the country has " provided the funds necessary to enable us to double the quantity issued in the year of this " series descriptive of Indian fossils, and we rejoice the more in this because we read it as a " convincing testimony that the loving labours of my colleague Stoliczka are really appre- " ciated. I, who can speak from experience of his unfailing energy, of his untiring research " and marked accuracy, and of his wide range of knowledge of all the bearings of his " subject, know full well the immense labour which these works represent, the high " scientific value of that labour, and the great interest which they have excited among the " palæontologists of Europe. But more than all this, I know, too, and appreciate fully the " unswerving loyalty to his task which the author has invariably shown, and the " undeviating conscientiousness and devotion which he has brought to bear on its " accomplishment."

Early in May information reached Stoliczka that the Government had appointed him naturalist to the mission as above stated, and on the 17th of that month he left Calcutta; but before following him on that journey, from which he never returned, it will be convenient to say a few words as to the materials which exist for giving an account of this portion of his career.

Shortly after the return of the mission and the arrival of the baggage at Simla, in October, the writer was deputed to receive over and take charge of the collections which had been made by Stoliczka. Many packing cases had to be sorted over and their contents roughly classified† in order that the several divisions of the collection might be made over to those who should be appointed to work them out. The results of their respective labours are given

* P.A.S.B., 1873, p. 57.

† Everything of the nature of private property, including purchases made in Yarkand, was set apart and subsequently sent to Vienna to Dr. Stoliczka's brother, his nearest surviving relative.

in this volume, and to any reader of them it will be sufficiently obvious that their value is largely dependent on the full notes and observations which were made by Stoliczka. These notes were contained in diary form in a number of pocket books, and one of the first things to be done was to put everything left in writing into shape for the printer. Some portions, complete in themselves, were printed in the records of the Geological Survey of India, Nos. 75, 76, 77, and 78, and the remainder, forming the diary, were printed for private circulation among those who undertook the scientific description of the collections.

This diary affords most remarkable testimony to the persistent energy with which Stoliczka carried on his observations and made his collections in spite of difficulties under which any one less resolute might have failed.

As 60 large quarto pages of this diary have been thought to be too large an addition to make to this volume, I have been constrained to make a certain number of extracts from it, which will serve to convey some idea of its general character; but I may, perhaps, be permitted to say that I have approached this part of my task with greater reluctance than any other. It is not by any means easy to condense such a diary as this, in which there is no padding and no fine writing, but which bristles throughout with observations on the geology, so far as it could be studied, and the animals and plants which were observed.

His departure from Calcutta is dismissed by Stoliczka in four words: "17th May left Calcutta"; but for those of his friends who were present at the Howrah Station on the night of that day to wish him good bye there was a certain impressiveness in the scene, not so much perhaps because there were any forebodings of evil, but rather because each one realised that during the two years which were expected to elapse before the return of the traveller many events might happen which might make or mar his success; but these events, whether political or otherwise, were all beyond Stoliczka's personal control; in him all confidence was felt, as being a man pre-eminently fitted in every respect for the arduous task he had undertaken.

The diary proceeds to mention a brief visit paid to Simla and his progress thence to Murree, where he remained from the 10th June to the 15th July, with the exception of a few days' run to Changlagali and Dungagali. During this period of a month he was engaged in making final preparations for the journey, while he geologised, shot birds, and busily searched for such land shells and reptiles as the unfavourable season afforded.

Writing to Mr. A. B. Wynne from Murree he refers to the surprise expressed in a letter received from Dr. Oldham at his having elected to go to Yarkand rather than to Vienna; but for his own part he felt regardless of what it might cost him if he could only accomplish all he desired should be done with reference to Central Asian geology and zoology.

On the 15th of July a start was at last effected for Kashmir, and Srinagar was reached on the 27th. *En route* collecting birds and mollusca and observation of the geology progressed steadily, though at Oori he suffered for a day from a sort of sunstroke, from which, however, he rapidly recovered.* While at Srinagar several excursions on the lake enabled observations to be made on the breeding of the water birds which abound there. On the 6th of August, Colonel Gordon having joined the advance party of the mission, marching was resumed. A day's halt at Sonamurg was spent by Stoliczka in the following way; he writes: "I went out "in the morning on the northern slopes of the left bank of the river. They are rather thinly "wooded with deodar, a good deal is low jungle. There are not many birds to be seen "about in the highest forests. *Hemichelidon* is very common; I found the nest with young

* On the road to Srinagar, he met Mr. and Mrs. A. B. Wynne, and expressed to them a doubt as to his ever returning alive.

" birds at the end of a branch of a tree about 40 feet above the ground. *Yunx torquilla* is " decidedly rare. *Sitta* and *Certhia* are not common. An *Alauda* is common here, inter- " mediate in size between *guttata* and *dulcivox*. *Dumeticola affinis* is rare, and another " large bird like *Dumeticola* is also rare. *Phylloscopi* and *Abrornis* were numerous; all had " young. *Motacilla personata*, moderately common, also *Budytes*, *Orocœtes cinclorhynchus*, " *Turdus hodgsoni*, two species of *Machlolophus*, &c.

" I got also several shells. A *Bulimus*, mostly found on the currant bushes, which are " rather abundant here in forests; an *Ampullopsis* (*Helicarion*); a small *Rotula*, very like " that found about Murree; a slug like the one I got at Changligali, having the foot " sharply crested; and a species of *Macrochlamys*, or, perhaps, *Zonites*, which is rare; it " resembles *M. petasus*, but grows larger. Afzul Khan brought me a *Phaiomys leucurus* " from about 11,000 feet." From the 14th to 17th, before and after reaching Dras, there were some stiff marches, the elevations crossed rising to 11,800 feet, while the temperature ranged from 38° to 130°. On the 27th the party reached Leh, where a halt was made till the 11th of September. On the 19th the Pangong lake was reached, when observations on the lake were made by the surveyors of the party and the geology was examined by Stoliczka. At Kiam and Pangtung the hot springs were found to have temperatures ranging from 100° to 135°, and a saline efflorescence connected with them consisted of soda and borax.

Besides many birds, a wild yak and several Tibetan antelopes, *Kemas hodgsoni*, were seen between the above places. After the last-named date falls of snow caused much discomfort, but Stoliczka's diary does not dwell upon this, nor even upon a severe attack of spinal meningitis which prostrated him for several days (1st to 6th October) at Kiziljilga. He merely records of it that he had been knocked up by the cold and had to remain nearly the whole time in tent, being therefore unable to observe. He was subsequently distressed at finding this sickness referred to as having been of a serious character in the newspapers, and until Dr. Bellew impressed it upon him, did not realise the danger he had passed through, and the risk which would be involved in a second attack. The temperature here fell to from 10° to 15° below zero, and a few days later the minimum thermometer registered – 33° at midnight, in spite of which, however, he records that a little tortoiseshell butterfly, *Vanessa urticæ*, was caught on the snow.

On the 13th of October the advance party was joined by the main force of the mission under Mr. Forsyth. Stoliczka rode with the others to meet the Ambassador, and remarks, " Strange, " they all thought me very ill or dying " (from the account they had received of his attack). As a matter of fact, however, in the week which had elapsed since his attack he had accomplished much hard work, and had resumed his usual observations.

From Shahidula, which was reached on the 18th, a visit was paid to the famous Jade mines at Karakash, which have supplied the Chinese with this much esteemed mineral since the earliest times. The jade occurs in veins in mica schist, which is associated with syenite. A full account of the mines forms the subject of a special paper (No. 75) which was printed in the Records of the Geological Survey. It is said, on the authority of Mr. Johnson, that the best jade was obtained further east, on the same range, on the road to Khotan.

By means of yaks, which were supplied by Rosi-beg, the headman of the Sanju Kirghiz, the Gidjik or Jujgi pass was crossed on the 23rd. " The Sanju pass is undoubtedly the most " difficult we have had as yet; our last day's camp was about 13,500 feet high, while the " pass is 16,500. The ascent is steep, and though the road is tolerable, the slope was in

" several places on the frozen path very steep, and consequently dangerous. The ridge is " very narrow, only about 10 feet broad at the top; a rugged uneven rock. On the northern " side the pass is very steep for a couple of thousand feet or more, and then the road leads " into an open grassy valley. At the camp wood and grass were procurable." At Sanju there was a halt from the 27th October to 2nd November, during which time Stoliczka obtained a number of birds and made observations on the geology; he mentions, too, the rather curious fact that *Charas*, the well-known intoxicating preparation made from hemp, is sent from thence to India *viâ* Ladak. The people were of a more Aryan type than the Khirgiz, had fair complexions, rosy cheeks, and proved to be of friendly disposition.

On the 8th of November the party reached Yarkand, where they met with a suitable reception from the Dadkhwa, a local functionary (governor) representing the Atalik, who was himself at Kashgar.

Not very much freedom was enjoyed by the party, who appear to have been under a sort of honourable espionage. Stoliczka, however, managed to do some collecting in the neighbourhood of the city, his attention being especially directed to a swamp, where he obtained a number of birds. Of his experiences during the 20 days which the party spent in Yarkand he records some interesting particulars. The following letter to a friend in Vienna gives, however, a more general sketch of his proceedings during that period :—

" * We had a dreadfully cold and difficult journey across the Himalayan Mountains. My " toes were frozen for a whole month, and were not really thawed till we reached Yarkand.

" On the 17th September we left the last village, Tanksi in Ladak, and on the 26th " of October we came to the first village in Turkistan, which was Kiwaz, south of Sanju. " From Sanju to Yarkand there are seven marches, the first five over waste lands with " solitary oases, or rather woods, which are inhabited. The last two marches are in inhabited " country, but nothing grows except by watering. Here, in Yarkand, the climate is almost " European. We receive each day the finest grapes, apples, and pears that you can imagine. " The custom is that the governor sends us each day a '*dastar-khwan*' with fruits, both " fresh and dried, *pilaus*, &c. All these are spread openly upon a carpet, and the guests sit " round about, the knees bent as in a Catholic church. One must not allow the toes to be " seen when sitting, a position which is very uncomfortable—like the Turkish. But one must " in time accustom oneself to all things; one must rejoice that his throat has not been cut. " Such freedom as we have is, of all things, in our situation not to be envied. It is not the " custom to go about the country until one has seen the king. To live within four walls " for 20 days is certainly not agreeable.

" Only this morning the day was fixed for our journey to Kashgar, where the king is. " When we bring the treaty to a conclusion, and as soon as the articles are signed, we have " been promised that we shall go about in the country. We shall remain about two months " in Kashgar, then we hope to receive permission to travel for three months in Turkistan, " and then to return by the Pamir plateau, Badakshan, and Kabul back to India.

" The latter journey will probably be the most interesting. By November or December of " next year I shall be back in Calcutta. I have already a good zoological collection, some " new birds and mammals, and many fish. Geology is very meagre. Here there is nothing " but *löess*. Hills only to be seen in the distance. The air is never clear, being always full " of dust."

* Reise nach Yarkand (from a letter to Dr. A. Schrauf, dated Yarkand, 28th November, 1873).—Ver. der K.K. Geol. Reichs. 1874, p. 119.

After a farewell feast given by the Dadkhwa on the 27th, marching was resumed on the following day, and on the 4th of December Yangihissar, or Kashghar, was reached, and the party were forthwith summoned to the presence of His Majesty the Atalik, by whom all were well received; but the formal presentation of the letters of the Queen and the Governor General of India, with the accompanying presents, was postponed for about a month, till the 10th of January. During the interval the members of the mission were enabled to go about freely, and Stoliczka availed himself of the liberty to collect and observe in the neighbourhood. He also obtained specimens of some of the large mammals, such as the great sheep, *Ovis karelini*, which were brought in by the inhabitants for sale.

A few days later he started with Colonel Gordon and Captain Trotter on a trip to the Chadirkul, and he then had an opportunity of seeing a number of these noble animals, 130 in one day, of which 85 were in one flock. In this trip the party came under the observation of some Russian-Kirghiz spies, who, however, disappeared at their approach, and nothing more was heard of them.

At Chakmak, the *Toksawa*, or commander of the fort, insisted on their taking with them nine *Kulja* (*Ovis karelini*) and *Tekke*, or ibex (*Capra sibirica*) from his store of winter provisions.

The general results of Stoliczka's geological observations were recorded in papers which he wrote from time to time, some of them, having been forwarded by post, were published as soon as they reached India.

On the 2nd of February the treaty with the Atalik was duly signed, and on the 14th some of the party started on an excursion to Artish and Kalti Ailak, encountering much snow and the inconveniences resulting from delayed baggage during the trip, in which, however, numerous observations on the geology were made. On the 3rd of March Colonel Trotter and Dr. Stoliczka returned to Kashgar, and a few days later it was decided to arrange for the return journey to India, certain visits to coal and other mines which were to have been shown to Stoliczka having been abandoned, apparently on political grounds. The party to which Dr. Stoliczka was attached was instructed to march to India by the Pamir and Kabul.

On the 16th of March they shook hands with the Atalik, and took their leave of Kashgar on the following morning; marching was continued daily till Panjah was reached, on the 14th of April, when, in consequence of the disturbed condition of Kabul, the original intention of returning through that country, *vid* Badakshan, was relinquished by Colonel Gordon, who was in charge of the detachment from the main camp with which Stoliczka travelled. The route of the Pamir Kulan was adopted, and Panjah was left on the 25th.

As the temperature ameliorated with the advance of the season, gentians and other flowers began to appear, and Stoliczka's notes on the vegetation at various elevations, though of necessity not extensive, are often very interesting.

At Sarikol, which was reached on the 8th of May, Stoliczka records that "he heard to his horror" that they were to return by the same road as that by which they had gone to Yangihissar. It was no doubt a keenly felt disappointment to him to see an opportunity for traversing a new line of country thus put out of reach.

At Pasrobat he found the vegetation more advanced than elsewhere, which he attributed to the effects of numerous hot springs.

On the 21st of June the party re-entered Yarkand, where they remained to the 27th. At this period a new subject is added to those with which Stoliczka's diary previously abounded, this is the nidification of birds, and under this heading there are many valuable observations recorded. At Beshterek he noticed a curious dimorphism on the leaves of a species of

poplar. He says, "I noticed that all the *Populus balsamifera*, which have all their branches "cut off and are much mutilated, have in the lower part of the stems very thin leaves, much "like those of the willow, while the ordinary form of leaves is only seen near the top. I "have taken some branches with two entirely different kinds of leaves. Palæontologists "would make two different genera out of these leaves. Why should these lower leaves be so "narrow? It is evidently a want of development; some of the poplar bushes have only "these narrow leaves. It is the same thing as with the mulberry when on the lower "undeveloped branches all the leaves are much slit and emarginated."

In a letter to Mr. A. B. Wynne, dated 30th May, he says: "The worst news I can give "you is that I am on my way back, already two marches out of Yarkand, and all this "without having seen Aksu or Farfan; but I went across the Pamir to Wakhan and back "with a party under Colonel Gordon. The geology is all very meagre, nothing but gneiss "and old rocks without fossils; with the exception of a few Triassic and very few Car- "boniferous brachiopods, I got nothing. My volume on the geology of the Yarkand "Embassy will not be a brilliant one, but I intend supplementing it by work to the south "of the Indus, in Rupshu and Spiti, through which I shall return to Simla."

Here and there there are indications in this diary, of which, indeed, other evidence is not wanting, that Stolickza's enthusiasm as a naturalist had become infectious, and that some of his companions had become, to some extent, his competitors in the search for rareties. And though he says occasionally that he should have liked certain specimens which one or other of them had obtained, he did so in the interest of the Indian Museum, where he thought such would be most fittingly preserved.

Kufelang was reached on the 12th of June, and here, so far as is known, he wrote the last letters which were received by any of his correspondents. The following, addressed to the writer of this memoir, arrived in Calcutta but a few days before the news of Stoliczka's death brought sorrow to the hearts of so many of his friends. In it there is no trace of anything but confident resolution as regards the future, but the last paragraph but one gives a slight insight into what he had gone through, and what his sufferings before the final and fatal attack must have been:—

"My Dear Ball, "Kufelang, 12th June 1884.

"Since I answered your letter I got two more of yours. How good of you to write "so regularly; but do not blame me if I am a little tardy; the fact is we often get our "letters in a lump, some a month in advance of others.

"I shall be at Leh about 1st July, write there my preliminary report, leave about the 13th, "and go through Rupshu, Spiti, and Kulu, so as to be at Calcutta about the 1st of November, "when I hope to see you all.

"We had a very tough journey from Yarkand by the Koggar route, first heat, then any "amount of water and cold. Here at the camp you would not find a single flowering plant, "except *Myricaria gallica*, sticking 6 inches above ground; the higher bushes do not "flower at all. Our baggage animals are dreadfully reduced by want of provisions, but we "hope to reach more stores to-morrow at Aktagh. If we do not our animals will be reduced "by half over the Karakoram passes, and our journey a very tough one. With the exception "of a few hot days at Yarkand, I had not a pleasant warm day for the last 10 months, so I "will be glad of a few days' recess at Leh. I hear Shaw is coming up to take his appointment "at Kashgar, the former Envoy to India is coming over to Calcutta, but it is said he will also "proceed to Constantinople.

" I have made a fair zoological collection, and will have at the end of my journey, certainly " materials for two volumes. The geological and palæontological part will be somewhat " meagre, but this cannot be helped when full half the ground was under snow at the time " of my journey.

* * * * * * * *

" I will not be able to do anything for the Asiatic Society of Bengal; I shall have enough " of my own work to prepare for my leave next year. I am afraid I will not be able to go " home before the end of May next.

" I am delighted to hear of such a lot of good work being turned out by the Survey. The " chief (Dr. T. Oldham) will, I hope, have returned by next winter, and also Waagen.

" You ask about Bulram (Stoliczka's bearer). Of course he is with me, and grey, and " looking as old as myself. I can hardly recognise myself; but few know what I suffered in " order only to do some work.

* * * * * * * *

" Please tell Waterhouse to order for the Asiatic Severtzov's " *Turkestanskie Jevotnie* " " immediately, if it is not at the Indian Museum. If they do not like ordering it, order it " for myself through Trübner without delay. Do not forget, please. Stege's death great " loss to me.*

" Ever sincerely yours,
" FERD. STOLICZKA."

In a letter to Mr. A. B. Wynne, written on the same day, he refers to the impracticability of any trade in Salt Range salt to Turkistan being established, as salt is already cheap there, the price being one pice for a pound of small cubic crystals, and seven annas for a donkey load of common efflorescent salt fit for animals.

On the 16th the Karakorum was ascended, and the elevation caused Stoliczka to feel pains in the back of his head, but this is not referred to in the diary.

On the 17th of June the party reached Bursi, and Stoliczka's record of the day's work was as follows :—

" A long march of about 24 miles. First we crossed for several miles the Dipsang plain, " which is utter barren waste, with solitary, low, clumsy hills, probably still belonging to the " Taglang series. Then we ascended towards the watershed of the high plain, crossing " several streams flowing eastward, but which, further on, no doubt, turn round and join " the Shaiok, which flows from the Kundan Glaciers.

" In ascending to the watershed the low, worn-down hills to the west were thickly strewn " with round pieces of whitish or reddish compact limestone, intermingled with boulders, " large and small, of fine grained syenitic gneiss. This must be somewhere *in situ*, near the " head of the watershed. Further on there were many greenstone boulders coming down " from the west, and this rock must also be somewhere up there *in situ*. At last we " descended into a narrow gorge, the sides of which for fully a mile consisted of limestone " conglomerate, the boulders, of white, grey, or black limestone, being well rounded and worn, " and cemented together with a bright red stiff clay; upon this followed rather indifferently

* This gentleman was the captain of a ship, with whom Stoliczka had shared in a mercantile speculation. In a letter to Mr. A. B. Wynne, dated 30th May, he mentioned his financial loss; but as he had no one to provide for, he expressed a mere passing regret that his money was gone, and implied that he would have been satisfied if he only received the zoological collections which Captain Stege was to have made for him.

" bedded, mostly massive white dolomitic limestone, and this was overlain by bluish shales " and well bedded limestone, extending from about six miles south of Bursi to the camp. *I* " *must have a ramble in these limestones to-morrow;* they seem to be triassic, compact with " layers full of small Gasteropods, among which I recognised a *Nerinea*. The so-called " Karakorum stones, *i.e.*, corals, occur in dark shales below the limestones, which are topped " by a yellowish brown well-bedded limestone of ? age; the whole series dips to south-east " at a moderate angle."

Here the diary terminates, for although on the following day a march forward was accomplished, by the evening of that day the power to record the observations was at an end, and we must look to others to furnish the details of what took place during the few hours which remained of Dr. Stoliczka's life and labours on earth.

Towards the end of June a short note from Mr. Allan Hume conveyed to us in Calcutta the sad news, which had been sent by telegraph to the Foreign Office at Simla, that Dr. Stoliczka was dead. In due course the post brought an official announcement from Colonel Gordon, addressed to Mr. H. B. Medlicott, who was at that time Acting Superintendent of the Geological Survey of India.

Colonel Gordon describes in this letter, in sympathetic language, the circumstances attending the death, but the facts are given somewhat more in detail by Captain Trotter, who wrote to Captain Chapman on the same date (19th June), for the information of the advance party under Mr. Forsyth.

This letter bears testimony to the kindness with which those who were present attended Stoliczka in his last moments. For the writer, Captain Trotter, Stoliczka had expressed the greatest regard in some of the letters which he had written to his friends in India, and that the esteem was heartily reciprocated is fully apparent in the lines which follow:

" My Dear Chapman, Camp Murghi, June 19, 1874.

" Col. Gordon is writing to Mr. Forsyth the melancholy intelligence about poor " Stoliczka, but you may all of you like to hear more details about his last illness than the " Colonel will have time to write.

" On the 16th, the day we crossed the Karakorum, he complained of head-ache, the pain " being at the back of his head, but as he had suffered from head-ache more or less on every " occasion of going up to a great height, I did not think anything of the circumstance nor " of its continuation.

" On the 17th we crossed the Dipsang plains, and were still, as you know, on very high " ground.

" On the 18th (yesterday) he started on horseback early in the morning to examine some " rocks up the stream which joins the main river at Burchae, and joined us at breakfast " halfway between Burchae and this. He was then looking fagged and complained of his " head on arrival here. About noon he lay down, and very shortly commenced to breath " very heavily and coughed a good deal and spat; his head and hands were very hot, and his " pulse beat very rapidly and strongly. He complained much of pain in his neck and the " back of his head, and on my advice he put on two mustard plasters, one on his neck and " the other on his chest. They did not, however, appear to give much relief. In the even- " ing the cough was very bad, and the native doctor made up some mixture to relieve the " irritation which caused the cough, which, however, continued all night.

" In the morning the cough was much subdued, but he appeared much exhausted and " scarcely conscious. From the previous evening he had spoken nothing but an occasional

" monosyllable in answer to questions put to him. He would generally, however, take no " notice of anything said to him. I twice asked him this morning if he still had pain in his " neck, to which he replied, no.

" The native doctor appeared to think that he was suffering from acute bronchitis and " inflammation of the lungs, but from what Biddulph and myself had seen of his previous " illness, it was clear that the disease was the same as the former one, viz., what is known " as spinal meningitis. On the doctor's advice, however, a blister was placed this morning on " his right side. He continued up till noon in a semi-unconscious state, occasionally taking " a little chicken broth and a little brandy mixed up in the cough mixture. He did not " appear to be better or worse, generally making about 50 respirations in the minute, " irregular, however, and very often alternately deep and heavy and short and light; the " respiration throughout the day was always accompanied by a rattling noise, somewhat " resembling that of a ripple on the sea shore or the noise of a troop file-firing in the distance. " Later it appeared to me that the rattle was more continuous, although less loud, and the " breathing somewhat easier.

" About 2 p.m. he made a gesture that he wanted to sit up; he was accordingly moved to a " chair and I gave him some port wine, but his appearance was so ghastly and he was in such " a state of exhaustion that I called in Biddulph from the next tent. B., thinking him worse, " fetched Col. Gordon. Meanwhile, he was moved back to his bed; he tried to sit up, and I " got behind him to support him. Meanwhile the Colonel came in. The rattling noise " ceased, but he still breathed deeply; his respiration grew slower and slower, as also did his " pulse, and he finally breathed his last, dying so quietly that it was impossible to say at " what precise instant he passed away. There was no struggle, and he died apparently " without pain, a quiet and peaceful expression remaining on his countenance after death.

" From the time he came in yesterday until he passed away he hardly spoke a word, and " conversation was, of course, impossible. Occasionally, when looking at me, I would " observe a very anxious expression of countenance, from which I inferred that he was " aware of his critical position. In fact, in previous conversations, weeks before, he told me " that a second attack of meningitis would be his certain death, it being rare that a first " attack is recovered from. He took great precautions in clothing, &c. to prevent his " getting a chill, but the passage of the Karakorum brought on that which he was so anxious " to avoid. I cannot help thinking that the height had much to do with it, at all events " aggravated the symptoms; he had been exposed to far greater cold on the Pamir trip, but " without the same elevation, and he had not suffered.

" Apart from the bitter regret that we must all feel at the loss of one who has been our " constant companion for so many months, the loss to the scientific world will be very great. " He made copious notes during our trip to the Pamir, but no one will have the knowledge " to utilise them as he would have done himself, and it is possible that they may not be in a " shape to enable an outsider to make competent use of them, and his intended geological " observations between Leh and Simla would, with his previous investigations of Himalayan " geology, a subject with which he was, perhaps, better acquainted than any man living, have " enabled him to write a most complete and valuable report. I can hardly yet realise his " loss, it has been so sudden and unexpected. It is a most melancholy termination to our " trip, which would otherwise have been so successful.

" There was, as I told you, no opportunity for him to communicate his wishes or to send " messages to his family. From yesterday evening he has been in a state of semi-uncon-

" sciousness, and evidently unable to collect his thoughts, even if he had been able to speak. " Had I known the names or addresses of any of his relatives, I would have written. Should " you or Bellew know, you might forward them this letter in order that they may have some " account of his last moments. He could not have passed away more quietly, and the calm " and peaceful expression of his countenance after death showed, I think conclusively, that " the latter had no terrors for him.

" Believe me,
" Yours sincerely,
" HENRY TROTTER."

Colonel Gordon, in his letter to Mr. Medlicott above referred to, states that he had at once sent off the body in charge of a company of Tartar horsemen, who were instructed to travel night and day, to Leh, which was still 11 marches off. They reached Leh on the evening of the 23rd, the departure of Mr. Forsyth's party having been delayed in order that the members of the mission might be present at the funeral, the circumstances connected with which are related in the following letter from Captain Chapman to Mr. H. B. Medlicott.

" Camp Lama Yaru,

*" DEAR SIR, June 27, 1874.

" IT will, I think, be a satisfaction to you to hear the arrangements that we in Leh " made for the reception of poor Stoliczka's remains, and to learn that the interment took " place on the 23rd instant with all outward tokens of respect.

" The procession, which was escorted by a company of horsemen, reached Leh on the " evening of the 23rd, and was met at the entrance to the compound of the British Joint " Commissioner by Mr. Forsyth and the officers of the mission, who were all in uniform. " The body was at first placed in a room of the rest house which stands in Capt. " Molloy's garden, and Dr. Bellew made a post-mortem examination, which proved that " death had resulted in consequence of over-exertion in strenuous endeavours after informa- " tion, and the great height at which Gordon's detachment journeyed.

" After the coffin was closed, the Union Jack was spread over it, and it was borne by six " soldiers to the grave. The interment was attended by the whole of the followers of the " mission, natives, Mahomedans, Sikhs, and Tartars, and the greatest sympathy was shown " on the occasion. The burial service was read by Mr. Forsyth. Besides us, there were " present Capt. Molloy, the British Joint Commissioner, Mr. Johnson, Wazir of Ladak, and " Capt. Carre, R.H.A. The grave, of stone work, was situated in a willow plantation in a " garden next the house of Capt. Molloy. The place where we laid our much lamented " companion to rest will certainly be at all times maintained and cared for. It was to all of " us a sad gratification to have the opportunity of showing the last proof of our respect and " affection for him; the sorrow and pain that we feel at his loss will be to each of us of long " duration.

" I have, at this distance, no opportunity of sending papers with the customary notice for " his friends' information. I also do not know poor Stoliczka's age; will you, therefore, " have the goodness to do what is necessary for me."

" Your most obedient servant,
" E. F. CHAPMAN."

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* The original of this letter not being available, it has been re-translated from a German translation published in Ver. der K. K. Geol. Reichs. Wein, 1874, p. 284). This will account for verbal differences.

Deep and widespread was the grief caused by the sad intelligence conveyed in these letters. Ample testimony of the esteem which was felt, both for the personal qualities and the scientific ability of the deceased, will be found in the numerous obituary notices, references to some of the more important of which, omitting those in the daily press, will be found below.†

The Government of India in due course took steps to place a suitable inscription over the grave, by means of which their high appreciation of Dr. Stoliczka as a public servant and as a man of science was fully recorded. The Austrian Government voted 100*l.* for the purpose of having a bust executed for Vienna of one who as an Austrian subject had by his distinguished career done honour to the country of his birth, as well as to that of his adoption.

The Asiatic Society of Bengal, remembering the eminent services of their Natural History Secretary, lost no time in forming a committee for the purpose of collecting subscriptions in order to perpetuate Dr. Stoliczka's memory at the scene of his principal labours. To their appeal for this purpose a ready and generous response was made, and a sum of nearly 350*l.* was collected, part of which was expended in obtaining a marble bust, which now stands near the entrance of the Indian Museum in Calcutta, and the remainder was devoted to procuring a painted portrait, which is hung in the apartments of the Asiatic Society of Bengal.

It needs not that this narrative should conclude with any special panegyrics on the merits of the scientific work accomplished by Dr. Stoliczka. The story of his short and active life which has been set forth in these pages, much of it being told in his own words, will enable readers of it who had not the privilege of knowing him to form their own opinion and pass judgment on the facts herein set forth. If this memoir has been written as the subject deserved that it should be written, those whose knowledge of the man dates only from the reading of these pages can scarcely fail to join in the chorus of testimony which unanimously declared the loss science had suffered by his untimely death at the age of only 36. It avails not to speculate now upon what has been lost to the world by the sudden cessation of the work which proceeded from that well stored and industrious brain. But while we give Dr. Stoliczka's memory all honour for the great work which he accomplished, we must not, nay cannot, omit to accord the still higher honour which should belong to the memory of one of so unselfish, generous, and upright a character, and of whom it can truly be said that though he was at times subject to causes of irritation arising from the severity of the climate and from ill-health, and though his superior judgment in scientific matters might have tempted him to be severe, still his published and unpublished letters, no less than his printed papers, are totally devoid of anything which could cause annoyance to any of his contemporaries.

As an author and scientific authority it is perhaps not too much to say that he might have secured for himself a wider reputation if he had published more largely in European journals, and if he had become a contributing member of some of the scientific societies in London;

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† Obituary Notices of Dr. Stoliczka.

By Col. Hyde, President, A.S.B., and Mr. H. B. Medlicott, Proc. As. Socy. Bengal, 1874, p. 153.

Verhandlungen der K. K. Geologischen Reichsanstalt, 1874, pp. 253 and 279.

By Dr. T. Oldham. Annual Report of the Geological Survey of India: Rec. Geol. Survey of India, Vol. VIII, 1875, p. 1.

By Mr. H. B. Medlicott. Records of the Geological Survey of India, Vol. VII, p. 81.

Geological Magazine, Decade II, Vol. I, 1874, p. 382.

Ibis, 3rd Series, Vol. IV, p. 470.

By Mr. W. T. Blanford. "Nature," X, p. 185.

but he never swerved in his loyalty and efforts to raise the standard of the scientific periodicals of the country of his adoption. Whatever of his was published in Europe during his Indian career consisted either of old work done in Austria or of *resumés* sufficient merely to indicate the scope and results given in full in Indian publications.

As he won for himself the esteem and regard of those who surrounded him in his last moments, but who a few months previously had been all unknown to him, so also he obtained the sincere and hearty friendship of many wherever he went. In the majority of cases these friendships were maintained on both sides by frequent and sympathetic correspondence, and were only terminated on that fatal morning of the 19th of June 1874.

CATALOGUE OF 79 SCIENTIFIC PAPERS AND PUBLISHED LETTERS WRITTEN BY DR. F. STOLICZKA BETWEEN THE YEARS 1859 AND 1874, INCLUSIVE.

1. 1859. Ueber eine der Kreide-formation angehorige Süsswasserbildung in den Nordöstlichen Alpen. Wien. Sitz. Ber. XXXVIII, 1859, p. 482.

2. 1861. Ueber die Gastropoden und Acephalen der Hierlatz-Schichten (1860). Wien. Sitz. Ber. XLIII, (Abth. 1), 1861, p. 157.

3. 1861–62. Tertiar Petrefacten aus dem Südalpen. Wien. Geol. Verhandl. XII, 1861–62, p. 16.

4. 1861–62. Ueber das eigenthümliche Auftreten Crystallinischer Schiefergebilde im Südwestlichsten Ungarn. Wien. Geol. Verhandl. XII, 1861, 1862, p. 114.

5. 1861–62. Die Geologischen Verhältnisse der Bezirke des Oguliner und der Sudlichen Compagnien des Szluiner Regimentes in der Karlstädter K. K. Militärgrenze. Wien. Jahrb. Geol. XI, 1861–62, p. 526.

6. 1862. Oligocæne Bryozoen von Latdorf in Bernburg (1861). Wien. Sitz. Ber. XLV, Abth. 1, 1862, p. 71.

7. 1862. Ueber heteromorphe Zellenbildungen bei Bryozoen (*Cœlophyma*, Reuss.). Wien. Zool. Bot. Ver. Verhandl. XII, 1862 (*Abh.*), p. 101.

8. 1862. Beitrag zur Kentniss der Molluskenfauna der Cerithien- und Inzersdorfer Schichten des Ungarischen Tertiarbeckens. Wien. Zool. Bot. Ver. Verhandl. XII, 1862, Abh., p. 529.

9. 1863. Bericht uber die in Sommer 1861 durchgeführte Uebersichtsaufnahme des Sudwestlichsten Theiles von Ungarn. (1862). Wien. Jahrb. Geol. XIII, 1863, p. 1.

10. 1863. Ueber das eigenthumliche Auftreten crystallinischer Schiefer-Gebilde im Sudwestlichen Ungarn. Pressburg. Corresp. Blatt. II, 1863, p. 76.

11. 1864. Critische Bemerkungen zu Herrn. Fr. A. Römers Beschreibung der Norddeutschen tertiären Polyparien. Neues Jahrb. Mineral. 1864, p. 340.

12. 1864. Note on *Lagomys curzoniæ*. J. A. S. B., Vol. XXXIV, Pt. II, p. 108.

13. 1865. On the Character of the *Cephalopoda* of the South Indian Cretaceous rocks. Geol. Soc. Quart. Jour., XXI, 1865, p. 407. Phil. Mag., XXIX, 1865, p. 550. Wien. Verhandl. Geol., XV, 1865, p. 17.

14. 1865. Geologische Schreiben aus Simla (1864). Wien. Sitz. Ber., Vol. L, 1865, p. 379.

15. 1865. Geological Sections across the Himalayan Mountains from Wangtu Bridge on the River Sutlej to Sungdo on the Indus; with an account of the formations in Spiti; accompanied by a revision of all known fossils from that district. Mem. Geological Survey of India, Vol. V, pp. 1–152.

16. 1866. Summary of Geological Observations during a visit to the Provinces Rupshu, Karnag, South Ladak, Zanskar, Surzoo, and Dras of Western Tibet in 1865. (Dated Calcutta, March 1866.) Mem. G. S. I., Vol. V., pp. 337-354.

17. 1866. Eine Revision der Gastropoden der Gosauschichten in den Ostalpen. Wien. Sitz. Ber. LII, 1866, p. 104.

18. 1866. Geologische Schreiben aus Kaschmir. Wien. Sitz. Ber., LII, 1866, p. 664.

19. 1866. Einige Betrachtungen über den Charakter der Flora und Fauna in der Umgebung von Chini, Provinz Bisahir, im Nordwestlichen Himalaya Gebirge. Wien. Zool. Bot. Verhandl., XVI, 1866 (Abh.), p. 849.

20. 1866. Catalogue of the specimens of Meteoric Stones and Irons in the Museum of the Asiatic Society of Bengal, Calcutta, corrected up to July 1866. Stoliczka, Dr. F., and Blanford, H. F. J. A. S. B., Vol. XXXV, Part II, p. 43.

21. 1863–1866. Cretaceous Fauna of Southern India. Pal. Ind. I. The Cephalopoda. 13 parts. (*Belemnitidæ* and *Nautilidæ* by H. F. Blanford, pp. 1–40, pls. 25.) *Ammonitidæ*, pp. 41–216, pls. 69 (six double).

22. 1866. Additional observations regarding the Cephalopodous fauna of the South Indian Cretaceous deposits. Rec. Geol. Survey of India, Vol. I, p. 32.

23. 1866. General results obtained from an examination of the Gastropodous fauna of the South Indian Cretaceous deposits. Rec. G. S. I., Vol. I, p. 55.

24. 1867–1868. Cretaceous fauna of Southern India. Pal. Ind. II. *Gastropoda*, pp. xiii–500, plates 28.

25. 1868. On Jurassic deposits in the North-west Himalaya. Geol. Soc. Quart. Jour., XXIV, 1868, p. 506.

26. 1868. Calcutta Schreiben an Herrn Hofrath Ritter v. Haidinger 20 Jänner 1868. Wien. Verhandl. Geol., 1868, p. 94.

27. 1868. Die Andaman Insel, Assam, u.s.w. Wien. Verhandl. Geol., 1868, p. 192.

28. 1868. Arbeiten an dem Geological Survey in Calcutta (aus einem Schreiben an Herrn Hofrath Ritter v. Haidinger, Calcutta, 11 Juni). Wien. Verhandl. Geol., 1868, p. 244.

29. 1868. Naturwissenschaftlichen Arbeiten in Indien (aus einem Schreiben an Herrn. Hofrath Ritter v. Haidinger, Calcutta, 15 Nov. 1868). Wien. Verhandl. Geol., 1868, p. 415.

30. 1868. Note on *Pangshura tecta* and the other species of *Chelonia* from the newer Tertiary deposits of the Nerbudda Valley. Rec. G. S. I., Vol. II, p. 36.

31. 1868. On *Nanina pollux* and *Helix propinqua*. P. A. S. B., 1868, p. 263.

32. 1868. On the anatomy of *Sagartia schilleriana* and *Membranipora bengalensis*. P. A. S. B., 1868, p. 275, and J. A. S. B., XXXVII, Part II., p. 28.

33. 1868. On the eclipse of 18th August 1868. P. A. S. B., 1868, p. 275.

34. 1868. Ornithological Observations in the Sutlej Valley, N.W. Himalayas. J. A. S. B., XXXVII, Part II., p. 1. Introduction translated and reprinted in Petermans Mittheilungen, XVI, 1870, p. 8.

35. 1868–9. The Malacology of Lower Bengal and the adjoining provinces. No. 1. On the genus *Onchidium*. P. A. S. B., 1868, p. 255; 1869, J. A. S. B., XXXVIII, Part II., p. 86.

36. 1869. Osteological notes on *Oxyglossus pusillus* (*Rana pusilla*, Owen) from the Tertiary frog beds in the Island of Bombay. Mem. G. S. I., Vol. VI, p. 387.

37. 1869. Observations regarding the changes of Organs in certain Mollusca. P. A. S. B., 1869, p. 187.

38. 1869. Contribution towards the knowledge of Indian *Arachnoidea*. P. A. S. B., 1869, p. 157. J. A. S. B., XXXVIII, p. 201.

39. 1870. Reisen in Hinter Indien auf die Nikobaren und Andamanen (1869). Wien. Verhandl. Geol. 1870, p. 23.

40. 1870. Observations on *Chamæleo vulgaris*. P. A. S. B., 1870, p. 1.

41. 1870. Note on the Kjokkenmoddings of the Andaman Islands. P. A. S. B., 1870, p. 13.

42. 1870. Note on a few species of Andamanese land shells. P. A. S. B., 1870, 86.

43. 1870. A contribution to Malay Ornithology. P. A. S. B., 1870, p. 237. J. A. S. B., XXXIX, Part II, p. 277.

44. 1870. Note on three species of *Batrachia* from Moulmein. P. A. S. B., 1870, p. 272.

45. 1870. Malayan *Amphibia* and *Reptilia*. P. A. S. B., 1870, p. 103. J. A. S. B., XXXIX, Part II, p. 134. Ann. Mag. Nat. Hist. VI, 1870, p. 105.

46. 1870–1871. Cretaceous fauna of Southern India. Pal. Ind. III. *Pelecypoda*, pp. xxii. and 537.

47. 1871. Observation on Indian and Malayan *Telphusidæ*. P. A. S. B., 1871, p. 84.

48. 1871. On the anatomy of *Cremnoconchus*. P. A. S. B., 1871, p. 108.

49. 1871. Notes on terrestrial Mollusca from the neighbourhood of Moulmein (Tenasserim Provinces) with descriptions of new species. J. A. S. B., XL, Part II, pp. 143, 217.

50. 1871. Notes on some Indian and Burmese ophidians. P. A. S. B., 1871, p. 191. J. A. S. B., XL, Part II, p. 421.

51. 1871. Note on *Testudo phayrei*, Ann. Mag. Nat. Hist., VIII, 1871, p. 212.

52. 1871. Geologische Arbeiten in Indien. Wein. Verhandl. Geol., 1871, p. 109.

53. 1871. Tertiary Crabs from Sind and Kach. Pal. Ind. pp. 16, pls. 5.

54. 1872. Notes on the Reptilian and Amphibian fauna of Kach (Cutch). P. A. S. B., 1872, p. 71.

55. 1872. Notes on Reptiles collected by Surgeon F. Day in Sind. P. A. S. B., 1872, p. 85.

56. 1872. Observations on Indian *Batrachia*. P. A. S. B., 1872, p. 101.

57. 1872. Notes on some new species of *Reptilia* and *Amphibia* collected by Dr. W. Waagen in N.W. Punjab. P. A. S. B., 1872, p. 124.

58. 1872. Note on a few Burmese species of *Sauria*, *Ophidia* and *Batrachia*. P. A. S. B., 1872, p. 143.

59. 1872. Notes on various new or little known Indian Lizards. P. A. S. B., 1871, p. 192. J. A. S. B. XLI, Pt. II, 86–117.

60. 1872. Postscript to the monograph of Himalayan and Burmese *Clausiliæ*. J. A. S. B., XLI, Part II, p. 207.

61. 1872. Notice of the mammals and birds inhabiting Kach (Cutch). P. A. S. B., 1872, p. 211. J. A. S. B., XLI, Part II, p. 211.

62. 1872. On the land shells of Penang Island, with descriptions of the animals, and Anatomical Notes. Part 1st, *Cyclostomacea*. J. A. S. B., XLI, Part II, p. 261.

63. 1872. F. Stoliczka and W. Theobald. Notes on Burmese and Arakanese land shells, with descriptions of a few species. J. A. S. B., XLI, Part II, p. 329.

64. 1873. On the land shells of Penang Island, with descriptions of the animals, and Anatomical Notes. Part II. *Helicacea*. Pls. I.–III. J. A. S. B., XLII, Part II, p. 11.

65. 1873. Notes on some species of Malayan *Amphibia* and *Reptilia*. J. A. S. B., XLII, Part II, p. 111.

66. 1873. Notes on the Indian species of *Thelyphonus*. J. A. S. B., XLII, Part II, p. 126.

67. 1873. Contribution towards a monograph of the Indian *Passalidæ*. J. A. S. B., XLII, Part II, p. 102, and P. A. S. B., 1873, p. 112. (Kaup's theory.)

68. 1873. Description of two new species of Indian land shells. J. A. S. B., XLII, Part II, p. 169.

69. 1873. Note on some Andamanese and Nicobarese Reptiles, with the description of three new species of Lizards. J. A. S. B., XLII, Part II, p. 162.

70. 1872–1873. Cretaceous fauna of Southern India. IV. *Brachiopoda, Ciliopoda, Echinodermata*, Corals, &c. Pal. Ind., pp. v. and 202. Plates 29. [Total for the four parts, pp. xl. and 1414. Plates 176.]

71. 1874. Letter to the Editor of Stray Feathers, dated Leh, 10th September 1873. Calcutta S. F., Vol. II, 1874, p. 461.

72. 1874. Letter to the Editor of Stray Feathers, dated Panja Wakhan, 25th March 1874. Calcutta, S. F., Vol. II, 1874, p. 463.

73. 1874. A brief account of the geological structure of the hill-ranges between the Indus Valley in Ladak and Shah-i-dula on the frontier of the Yarkand territory. Rec. G. S. I., Vol. VII, p. 12.

74. 1874. Geological notes on the route traversed by the Yarkand Embassy from Shah-i-dula to Yarkand and Kashgar. Rec. G. S. I., Vol. VII, p. 49. *See also* Jour. Geol. Soc. London, Vol. XXX, 1874, and Geol. Magazine, 1874, p. 430.

75. 1874. Note regarding the occurrence of Jade in the Karakash Valley, on the southern borders of Turkistan. Rec. G. S. I., Vol. VII, p. 51. *See also* Jour. Geol. Soc. London, Vol. XXX, 1874, and Geol. Magazine, 1874, p. 330.

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77. 1874. Note on the Pamir. Calcutta. Rec. G. S. I., Vol. VII, p. 86.

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