

removal of tissue by a medical corrosive may appear to justify this use of the term; but the essential part of both those processes is not the solution, but the excavation or pitting of the material attacked. Hence Merrill's\* description of rocks etched by solvents as "corroded surfaces" is fully justified.

The word "corrode" comes from the Latin *corrodere*, to gnaw away, which consists of *cor*, from *com*, the intensive prefix, and *rodere*, to gnaw. Its primary meaning as given in the Oxford Dictionary is "to eat into;" and it implies penetration into a body rather than the general gnawing away of the surface.

There seems no advantage in the limitation of the term "corrosion" to chemical action. The term "solution," used by Chamberlin and Salisbury in 1904,† is adequate and self-explanatory; there seems no need for a special term for rock solution as an agent in denudation. If there be, the introduction of a new term would be better than the misapplication of an old one; for the use of the term "corrosion" in physiography for the filing action of transported sediment seems etymologically more correct than for the chemical solution of rocks.

It may be objected that this paper looks upon scientific terms from an altogether impracticable standpoint, and that it is useless at the present day to attempt to limit the meaning of words by etymological considerations. I am quite prepared to follow well-established usage, even in those cases when a term is adopted in the exact opposite to its original meaning; but when there are alternative meanings in use it seems to me that the etymological test is of value; for the closer a term agrees with its strict interpretation, the less excuse is there for its being misunderstood.

It will be unfortunate if the important geographical terms considered in this paper should come to have different meanings in Europe and America, and I have submitted this statement as to their diverging use in the hope that it may lead to some more general agreement.

It seems to me convenient, in the mean time, to use the terms as follows:—

- denudation for the wearing down of the land by any agency;
- erosion for the widespread lowering of the land by wind, rain, and weather and by rivers and glaciers acting laterally;
- corrosion for the excavation by rivers and glaciers of their beds;
- corrasion dismiss as a synonym of corrosion;
- abrasion for the attack of the sea on the land, though when used in this restricted sense it is well to refer to the process as marine abrasion;
- solution for the action of solvents.

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## THE SURVEY OF THE HIMALAYA.

By Dr. T. G. LONGSTAFF.

THE publication of Synoptical Volume XXXV. by the Trigonometrical Survey of India will be welcomed by many students of Himalayan problems, for much information is thereby made conveniently accessible which formerly could only be gathered piecemeal from scattered annual reports.

\* G. P. Merrill, 'A Treatise on Rocks, Rock-Weathering, and Soils,' p. 250, pl. 16 (not 17, as in text). 1897.

† T. C. Chamberlin and R. D. Salisbury, 'Geology,' vol. 1, p. 116. 1904.

This volume, the North-East Longitudinal Series, covers the Central Himalaya from longitude  $78^{\circ}$  to  $88^{\circ}$ . It also includes those peaks situated between longitude  $88^{\circ}$  and  $92^{\circ}$ , which were observed from stations in the North-East Series, but which properly belong to the Assam Longitudinal Series, as yet unpublished in this form. The long delay, almost inevitable under the circumstances, which occurs between work in the field and final publication of the results, probably accounts for the scant recognition by geographers and travellers of the labours of the Indian Survey in the Himalayan region. This delay is particularly regrettable in the case of the important survey operations so successfully carried out in connection with the recent mission to Tibet.

The present volume deals with the Himalayan region from Simla to Punakha, filling the gap between Volume VII. of the North-West Series, which covers Kashmir and the adjacent regions, and Volume XXII. of the Assam Valley Triangulation. The computation and classification of the data have been superintended by Mr. J. Eccles, M.A., and during his absence by Captain H. H. Turner, R.E. The preface is written by Colonel S. G. Burrard, R.E., F.R.S., and deals with some novel problems of great interest. Mr. H. G. Shaw's series of observations during the last four years are passed under review. They prove conclusively that refraction is greater in autumn than in spring; but they also indicate that there must be some other cause, besides differences in refraction, which produces discrepancies in the altitudes obtained for the same peak from different stations. The height of Trisul is discussed by way of indicating the difficulties of determining the actual height of any high mountain. The value 23,406 feet is found on both the official maps of Kumaon and British Garhwal (1872-75), and was obtained by the survey officer, Colonel Carter, from a small secondary series of triangulation which he carried through Kumaon and Garhwal. The height of the peak is given differently on the map and in the book, for individual observers have had different ideas about refraction and other corrections. When once the data have been handled and published, the preliminary values entered upon the maps are to be considered as cancelled. The writer has seen no explanation of the fact that heights on the maps are usually higher than those in the books. The value 23,360 feet, now officially accepted, was derived from observations of the peak obtained between 1841 and 1850 from distances of 29 to 84 miles. They vary from 23,441 to 23,280 feet, and the true height is taken as between 23,350 and 23,380 feet. Even here we have a further element of uncertainty, for it has been stated that when in future we come to correct heights for the disturbances produced by Himalayan attraction in the levels of theodolites, we shall probably have to add 60 or 70 feet to the values now accepted. In the present volume Colonel Burrard points out that gravity also causes the datum-level surface to be heaped up under the mountains, so that we are in doubt what surface we are measuring the heights of peaks from, for in trigonometrical operations we assume the

surface of the spheroid to be our datum, and in spirit-levelling we measure from the surface of the geoid. In the present state of our knowledge it certainly seems wiser to follow Colonel Burrard and ignore this additional complexity.

These volumes are indispensable to travellers undertaking any fresh topographical explorations of these regions, for they give the officially accepted height and position of the great Himalayan peaks and also full data from which can be ascertained the precise degrees of accuracy with which these have been determined. In the "degree charts," published in a separate volume, all peaks and stations have been plotted by Messrs. W. M. Kelly and J. H. Nichol, on a scale of 1 inch to 4 miles. This is particularly useful, as some of them are not shown on the topographical sheets of the Indian Atlas. An excellent innovation is the labelling of all peaks with a letter and two numbers by which they may be at once referred to their proper degree-square and identified without possibility of error.

The introduction by Captain H. H. Turner, R.E., deals firstly with the main triangulation carried through the fever-haunted Tarai between 1841-1851, and then with the topographical survey of Kumaun and Garhwal from 1864 to 1877, and the Sikkim survey of 1878 to 1885. The second portion contains a few scanty references to various ascents by the indefatigable officers of the survey, which mountaineers will regret are not given in much greater detail. Some additional information can, however, be obtained from the Annual General Reports of the Survey of India.

During the previous operations in Kashmir and the adjacent districts, the officers of the Survey showed repeatedly that the physical obstacles of such a country were powerless to defeat them in the execution of their duty. They set up their theodolites on 10 stations of over 20,000 feet; they visited 20 other stations of over 20,000 feet and 5 of over 21,000 feet. By far the greater number of these ascents were in Ladak, and none of them presented such difficulties as the Nela peak, 19,069 feet, in Bashahr which was successfully ascended on June 22, 1854, by W. H. Johnson with a 12-inch theodolite. This peak had baffled the surveyors for two seasons and had defeated three previous parties. But the officers of the Survey of India lay no emphasis in their reports on achievements so remarkable, achievements each one of which would be enough to send many a modern traveller headlong to his publishers. As an instance of this, I may mention the case of the peak Shilla 23,050 feet, shown as a station on p. 259 of Volume VII. This peak is shown on Atlas Sheet 46 as "Parangla No. 2 Station 23,064 feet." On reference to headquarters at Dehra Dun I was furnished with the following particulars: It was observed from two stations, each of which was above 20,000 feet. When it was being observed the observer intended to visit it and to observe from it. But he never carried out this intention. It was visited by native Khalassis, who erected a staff. The name was changed to Shilla in the office at Dehra Dun.

When in the present volume we meet again with the names of such

officers as Carter, Thuillier (now Sir Henry R. Thuillier, K.C.I.E.), and foremost of all Montgomerie, supported by such tried mountain surveyors as W. H. Johnson, W. G. Beverley, E. C. Ryall, and others, we may expect to find some reference to mountaineering achievements comparable to those already accomplished in Kashmir. It should be remembered, however, that General Walker had, in the present instance, instructed the Topographical officers not to attempt accurate surveys above 16,000 feet, the department not being in a position to afford the cost in time and money. Hence areas of perpetual snow were occasionally mapped from sketches made from considerable distances, and much less climbing of high peaks was attempted. Many stations, however, were established at over 17,000 feet in Kumaon and Garhwal, and a few at over 18,000 feet, while along the borders of Hundes three peaks of over 19,000 feet were utilized. In 1874 in the Upper Mana valley the *average* height of Mr. I. S. Pocock's plane-table stations was 19,500 feet and his maximum height visited was 22,040 feet, this being so far the highest authenticated plane-table station in the Indian Survey.

Ryall's successful survey of a large part of Hundes is merely referred to. His own brief account was published in the General Report for 1877-78. Ryall and Kinney's map is, for much of the country, still the best which has ever been produced of this most interesting corner of Tibet. The Introduction includes a brief account of Captain H. J. Harman's survey of Sikkim in 1879. His feet were badly frostbitten on the Donkia pass (18,100 feet), and although he continued his work for three and a half months and in 1881 made an attempt to reach the neighbourhood of Kinchinjunga, he was obliged to take leave in November, 1882, and died early in the following year, having never completely recovered.

In the course of these several operations the surveyors, in addition to the privations inseparable from such work, suffered much from fever, to which several of them actually succumbed. Captain Basevi died at his post in 1871 on the exposed plains of Lanak. Dr. Stoliczka, of the Geological Survey, died on his way back to Leh in 1874, while in 1878 of the members of this branch 34 per cent. died or were incapacitated! The great Montgomerie died at the early age of forty-eight, his death being generally attributed to his long and severe service in the Himalaya.

It is to the arduous, conscientious, and unadvertised labours of these surveyors that both mountain climbers and explorers of these regions owe, and must continue to owe, a great debt of gratitude. The delineation in the Indian Atlas of topographical details in the regions of ice and snow is admittedly imperfect. The accuracy of maps is merely a question of degree, for no ordinary scale map can possibly be free from error; but it should be remembered that there is no other mountain region of the world at all comparable in extent to the northern frontiers of India, the physical features of which have been laid down with any approach to such a degree of accuracy.