

were approved by the Council, and include the manufacture of photographic plates in India, a process for preparing pure alumina and sulphur dioxide from bauxite-gypsum systems, utilisation of nepheline syenite rocks, losses on electrical machinery due to open slots, electrolytic production of di-calcium phosphate from apatite, manufacture of santonin and utilisation of cashew-nut shell-oil. These are reasonably wide in scope and although nothing with outstanding utility has yet arisen the Council considered that the prize-offer experiment merits further trial.

The Calcutta session of the Council at which the foregoing matters were considered was opened by the Hon'ble Sir Frank Noyce who expressed satisfaction with the work

already accomplished since the inaugural session a year ago; but could not hold out a prospect that the Government of India would be able in the present circumstances to do much beyond carrying the organisation and furthering the researches conducted by the Bureau. The Hon'ble Mr. A. G. Clow presided and at the conclusion of business the Council inspected the equipment provided for the Bureau at the Alipore Test House, where the work now in progress was explained by the Director of the Bureau, Mr. N. Brodie. The Government of India have taken a wise and hopeful step in the direction of co-ordinating Indian industrial research, and encouraging its fruitful development.

M. O. F.

The Himalayan Uplift since the Advent of Man : Its Culthistorical Significance.

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IN this age of specialisation, which inevitably tends to confine thought in compartments, one is apt to overlook or to underrate the bearings of one branch of science upon another. A palæobotanist or a geologist, accustomed to think of Time in millions of years, stumbles upon an archaeological discovery which at once brings him down to the human epoch. It forces his attention to the wanderings of man since the time he began to leave signs of his handiwork in the form of stone or metal implements, inscriptions, coins, seals or other monuments of his ever-increasing intelligence and power. The object of the present article is to draw attention to the significance of recent geological changes in northern India to the wanderings of pre-historic man.¹

Among the most interesting scientific results of the Yale University North India Expedition,² led by the German geologist

Dr. Hellmut de Terra, is the discovery, recently published, of Palæolithic stone-flake industries in three widely separated parts of northern India. The location of these sites of early human activity is of special interest from our present point of view. One was found by chance at Chitta, southwest of Rawalpindi, in the Potwar plateau; another, also accidentally discovered, was at Pampur, a few miles east of Srinagar, in the Kashmir valley; the third was at Kargil, just beyond the main Himalayan range, on the ancient trade route over the Zoji Pass connecting India with Central Asia, Tibet and China. A few years previously stone implements belonging to two distinct cultures, one Lower to Middle Palæolithic, the other Middle to Upper Palæolithic, had been discovered near Pindigheb,³ in the Attock district, only about 10 miles from the Chitta locality (see foot-note 1).

These relics of the Old Stone Age, discovered at short intervals within the last few years, focus attention upon northern India as an area of unusual promise for our knowledge of early man. The special value

¹ A brief account of the physical conditions in Kashmir during this period, written from the point of view of the general reader, is given in the July number of this Journal, under the title: "The Karewas of Kashmir". The map in that article also illustrates the present paper.

² Hawkes, Hawkes and de Terra, "Palæolithic human industries in the N.W. Punjab and Kashmir and their geological significance," *Mem. Conn. Acad. Arts & Sci.*, 1934. 8. Art. I. i-iv. 1-15, six text-figs., two plates,

³ *Loc. cit.*, p. 9. Another discovery of Palæolithic implements in the Potwar area, by Mr. D. N. Wadia, is mentioned below,

of these discoveries lies in the fact that at least some of the finds are stratigraphically datable, and therefore constitute a valuable link between the time-scales of the geologist on the one side and of the prehistoric archaeologist on the other.

For details the reader must refer to the illustrated memoir by Hawkes, Hawkes and de Terra, published under the joint auspices of the Connecticut Academy of Arts and Science and of Yale University, and to the literature therein cited. Here a few extracts must suffice as a basis for discussion.

At Chitta, numerous flakes of indurated limestone, some of them of a material which must have been brought from a locality half-a-mile off, were found in a terrace overlying a lake deposit regarded as of early Pleistocene age. The geological evidence points to the implementiferous layer being of Middle Pleistocene age. At least four of the specimens are considered to be definitely due to human agency and have been assigned to the Lower Palæolithic. The conclusion is that this race of man flourished here during an interglacial phase or phases preceding the last major Pleistocene glaciation of northern India.

At Pampur, in a Mid-Pleistocene lake deposit of the Upper Karewa formation, Dr. de Terra found, among other relics, a broken flake of trap (volcanic) rock. This is also regarded as being undoubtedly an artifact, and as showing affinity with the Levallois stone-flake industry of Europe, which there stretched from Lower to Middle Palæolithic times. This specimen is said to belong to the same great family of flake industries as those found at Chitta; but being of more refined workmanship it may be of Middle rather than Lower Palæolithic age. Incidentally we may add that in an ancient soil cap covering this lake deposit, about nine feet below the surface, the remains of a very much younger culture were found, including ash and charcoal, with pottery and the clay figure of an ox. So far as I know, these have not yet been described, but their dating would obviously be of the greatest interest in view of recent speculations concerning the distribution of that archaic but highly developed Indian civilisation to which the probably unduly restricted name of the Indus civilisation has been applied.

The Kargil find was a solitary flake of trap, picked up on the surface of an old terrace. It must have originally belonged

to the same family of industries as those recognised at Chitta and at Pampur, but was subsequently re-worked (probably in post-glacial times) into a square-ended scraper which might be of Upper Palæolithic or even of Neolithic date. Although not stratigraphically datable, this surface find "helps to confirm the presence of Palæolithic (and probably Lower Palæolithic) flake-industries in the N. W. Himalayan region".

Of the two industries recognised at Pindigheb we are here concerned mainly with the older, which is regarded as Lower to Middle Palæolithic and clearly related to that of Chitta, although a good deal more refined. In the opinion of the experts "neither the Pampur nor the Kargil flakes would be out of place in the Pindigheb find". Incidentally, some of the Pindigheb specimens indicate contact with the South Indian stone-core culture which thus seems to have extended its influence into northern India, although its original affinities are clearly with Africa.

Further observations of great interest in the present connection are made by Hawkes and Hawkes and de Terra on p. 10 of their memoir. They tend to the important conclusion that the flake implements from Chitta resemble those of Peking man (*Sinanthropus pekingensis*), who is regarded as an early member of the same group of human races as Neandertal or Mousterian man in Europe. We may sum up the entire evidence by saying that round about Middle Pleistocene time, when the main valley of Kashmir was still occupied by the great "Karewa Lake," interglacial man of about the same stage of cultural development as Neandertal or Mousterian man in Europe and as Peking man in the Far East, flourished (a) in the plains of the northern Punjab, (b) on the shores of the Karewa Lake in the heart of Kashmir and (c) just across the Great Himalayan range.

It is to this evidence of contact between early human cultures on the two sides of the main Himalayas and of the Pir Panjal range that I wish to draw the special attention of the reader.

The distribution of primitive man, like that of plants and animals, must always have been largely controlled by natural barriers, such as seas and high mountain chains. The close cultural contacts between India and China during the historic period are not difficult to explain. Not only do we

possess ample evidence of the sea-faring powers both of the Chinese and of our own people in ancient times, but Buddhist pilgrims have long been known for their hardiness as mountaineers. Palæolithic man, on the contrary, if one may say so without insult to his memory,⁴ presumably had no incentives to travel beyond the hunt for the necessities of life. Although he may well have wandered between the Punjab and Kashmir by way of the Jhelum valley, it would be difficult, without special evidence, to explain his crossing even the Zoji-La (11,300 ft.) which is the lowest pass over the Himalayas. It is here that the significance of the recent work on the uplift of the Himalayas during the human epoch comes in. No one, so far as I know, has suggested that *migration across these mountains was possible in palæolithic times because the passes over them were then presumably not so high as to offer a serious obstacle to primitive man.*

On the contrary, Dr. de Terra regards it as "a surprising fact" that traces of a prehistoric human industry should have been discovered "even north of the Central Himalayan range on the border of Little Tibet". It is true that at the present moment we have no adequate idea of the extent to which the Himalayas have been uplifted since Kargil man existed. Not only is the exact date of the Kargil terraces still unknown, but the solitary implement from there was only a surface find; and the evidence of subsequent retouch which it shows further complicates the history of its provenance. But at the same time we have the expert opinion that "in its original form it may certainly be attributed to the great family of Palæolithic flake-industries" known also from Chitta and from Pampur, and that a Lower Palæolithic date is indicated. Considering that in recent years the evidence for Mid-Pleistocene and even late Pleistocene upheavals in the Himalayan zone has steadily accumulated—evidence to which Dr. de Terra himself has made such outstanding contributions—is it not at least a plausible hypothesis that the Zoji-La, if not other passes, afforded to Palæolithic man an easy traverse across the Himalayas?

For this evidence of geologically recent upheavals in northern India we can scarcely

refer to a more authoritative source than Dr. de Terra⁵ himself, who has corroborated and extended the work of his predecessors in the field, namely, Dainelli, Filippi, Middlemiss, Wadia and others.⁶ Although a detailed account of his researches is still awaited, he has told us enough to confirm the old view that in the Himalayan zone the mountain-building movements initiated towards the close of the Mesozoic era continued, at intervals, till as late as the end of the Pleistocene and even into sub-Recent times, that is, till long after the advent of Man in northern India.

In his important work on Prehistoric India (1927, pp. 52-91) Professor P. Mitra of Calcutta has discussed in some detail the changing geological background of the history of primitive man in northern India. But it may not be amiss to give here a brief statement of the outstanding conclusions based upon recent work.

(i) The region of the Himalayas was once occupied by a Mediterranean ocean, the Tethys Sea, separating India (which probably lay south of the Equator) from the Eurasian land-mass in the north. Into this sea India sent out two great promontories: the Kashmir promontory on the N. W. (which according to Wadia was for some time connected to Eurasia by an isthmus) and the Assam promontory on the N. E.

(ii) Following an estimate by R. D. Oldham, de Terra concludes that the width of this ocean in Triassic times was at least 1,485 kilometres (930 miles).

(iii) Throughout the long ages from the Permian period till the end of the Eocene, the bed of this ocean was settling down under the weight of the accumulating sediments, totalling a thickness of well over 15,000 feet.

(iv) With the dawn of the Tertiary era the loaded ocean floor ("geosyncline") began to upheave: the sediments were squeezed, uplifted and folded into a mountain chain by the slow but irresistible movement, towards each other, of the northern and southern land blocks, between which they were caught up as in a vice.

(v) Round the resistant angular promontories the pile of sediments, folded somewhat like a Japanese fan, became bent

⁵ de Terra, "Himalayan and Alpine orogenies," 1934, *Rep. XVI, Internat. Geol. Congr.*, Washington, 1933. See also *ibid.*, 1936, in *Nature*, April 25, pp. 686-688 and *Science*, March 6, pp. 233-236.

⁶ References in de Terra, 1934, and in Wadia's works,

⁴ He certainly had an extraordinary eye for fleeting line and form, and could give points to most of us in the delineation of running animals,

sharply to the southwest (into Hazara)⁷ and to the south (into Burma).⁸

(vi) These "orogenic" or mountain-building movements continued, off and on, throughout the Tertiary era and far into the Quaternary or Pleistocene period, when the greater part of northern India came under arctic conditions during at least three epochs separated by warmer (interglacial) intervals.

(vii) Along the southern border of the mountains, at least, there is clear evidence that, as in the Alps, the folds of the strata followed like waves one behind the other, sometimes leaning over those in front. During the Middle Pleistocene "the Potwar basin was overthrust by Himalayan folds advancing southward,"⁹ and in places broken off portions of the folds ("nappes"), composed of the oldest rocks from the Inner Himalayas, were carried horizontally for several miles to the southwest, riding over the folds of the much younger Siwalik strata.¹⁰

(viii) The final phase of uplift of the Himalayan mountain belt witnessed the folding and dragging up of the youngest Karewa beds on the Pir Panjal range by at least 6,000 ft. and the tilting of late Pleistocene lake terraces round Srinagar.¹¹ The effects of this upheaval were felt in the Potwar and even as far west as the Salt Range, which shows post-Pleistocene deformation.¹² Wadia records that between the Soan and Rawalpindi a thickness of some 5,000 feet of the upper Siwalik Boul-

der Conglomerate (which cannot be older than the Lower Pleistocene) have been tilted into a vertical position. These beds contain fossil bones of the elephant, horse, dog and other familiar animals. In addition Wadia found several hundred human artifacts, probably of Chellean age, which are also suspected to belong to the Boulder Conglomerate and would therefore show that the tilting movement must have taken place after the arrival of man in this part of the World. In the Salt Range, again, Wadia and Anderson have shown that strata as old as the Cambrian have been thrust over Siwalik beds of Late Pliocene age.

On various grounds Godwin-Austen based the opinion that "within a comparatively modern period, closely trenching upon the time when man made his appearance upon the face of the earth, the Himalaya has been thrown up by an increment approaching 8,000 or 10,000 feet."¹³ *Indeed there are geologists who hold it as probable that this movement of uplift is still in progress.*¹⁴ The frequent earthquakes felt all along the southern face of the Himalayas, parallel to the Great Boundary Fault (a plane, or rather a series of planes, of weakness in the strata from Baluchistan as far as Burma), may be cited as proof that stability has not yet been reached. A further argument is derived from the evidence of the far-reaching changes which have taken place in the drainage of the Indo-Gangetic plain within recent times.

The way in which the river systems of northern India responded to the changing aspect of the land has been described in an unusually clear and interesting paper by Wadia.¹⁵ He supports the view of Pilgrim and Pascoe¹⁶ that during early Pleistocene times the drainage of the present Ganges valley flowed *northwestwards* and was *discharged into the Indus* by a great prehistoric river. Of this river, variously called the Siwalik River or the Indobrahm (for the Brahmaputra was a tributary), the lower part is believed to have flowed along a northwest prolongation of the present Jumna river,

⁷ Wadia, "The Syntaxis of the N.W. Himalayas: its rocks, tectonics and orogeny," *Rec. Geol. Surv. Ind.*, 1931, LXV (ii).

⁸ Sahni, "Permo-Carboniferous life-provinces, with special reference to India," *Curr. Sci.*, 1935, IV (6), 388-390, and literature cited; see esp. Figs. 2, 3. The view here expressed as to the southward continuation of the Himalayan mountains into Burma (as opposed to the idea of their eastward continuation into China, once suggested by Prince Kropotkin and J. W. Gregory and now advocated by Kingdon Ward) has been strongly supported on geological grounds by Mr. D. N. Wadia in a paper recently sent for publication in the *Himalayan Journal*. I have had the privilege of reading in advance this admirable exposition, by an acknowledged authority, of the origin and structure of the Himalayas.

⁹ de Terra (1934), p. 8.

¹⁰ Wadia (1931), pp. 215, 219.

¹¹ de Terra (1934), p. 9; Hawkes, Hawkes and de Terra (1934), p. 14.

¹² Wadia, "The Tertiary geosyncline of N.W. Punjab and the history of Quaternary earth-movements and drainage of the Gangetic trough," *Quart. Journ. Geol. Min. & Met. Soc. of India*, 1932, 4 (3); de Terra, 1934, p. 9.

¹³ See Burrard and Heron, "A sketch of the geography and geology of the Himalaya mountains and Tibet," 1933, 2, 74.

¹⁴ Wadia, "The trend line of the Himalayan range: its northwest and southeast limits," *Himalayan Journ.*, 1936 (*vide supra*, note 8).

¹⁵ Wadia, 1932, pp. 86-95.

¹⁶ References in Wadia, 1932.

and then through the broad but now almost deserted channel of the Soan River in the Potwar, to join the Indus near Makhad. With the differential earth movements which converted the old Potwar basin into a plateau, the Punjab section of the Siwalik River was severed from the upper part of the channel, *in which the flow of water became reversed and which became the modern Ganges*. Wadia writes, "There are both physical and historic grounds for the belief that the Jumna, during early historic times, discharged into the Indus system, through the now neglected bed of the Saraswati river of Hindu traditions."¹⁷ In the low plateau, west of Delhi, which now forms the imperceptible watershed between the Indus and Ganges systems, there is plenty of evidence of a varied character in support of this popular belief.

To return to our point. All these changes in the physical background cannot but have exercised a profound influence upon the development of human cultures in northern India. Without more precise data (which a close study of the finely layered clays or "varves" in the Karewas of Kashmir¹⁸ seems to promise) it would be rash to express an opinion about Godwin-Austen's view of the extent of the recent elevation of the Himalayas. But unless his figures are a gross overestimate (which to the present writer seems highly improbable) we have no reason to assume that the Himalayas or the Pir Panjal range were a barrier to the migration of Palæolithic or even Neolithic man.

On the view here adopted *northern India and China must have had direct contacts across the Himalayas since the dawn of human existence*, and the passes over these mountains probably mark some of the most ancient routes trodden by man. If, therefore, signs of Stone Age man were even to be found, say, on the Zoji-La itself, such a discovery would only be in accordance with expectation.

It is for the future to show how far these routes were used by the descendants of

Neolithic man in India, that highly enterprising and intelligent race of people who flourished nearly 5,000 years ago in the Punjab, Sind and beyond, and who were among the first to learn the use of metals. Their distant connections to the west are now well established. They also employed materials of which the nearest known sources are far away in peninsular India. Their knowledge of *śilājīṭ* (a drug of obscure nature used in India since time immemorial) may well indicate that they had explored the Himalayas. And who knows but that the script of Harappa and Mohenjodaro, which still baffles the palæographer, will after all prove to have had early affinities with the ancient Chinese writings?¹⁹

Conclusion.

The main point of this article is that between India and China cultural contacts have probably existed since the very dawn of human existence. Long before man conquered the ocean intercourse between these two ancient countries was possible by the *direct route across the Himalayas* which, during Palæolithic and Neolithic times, were probably not so high as to form an effective barrier.

GULMARG,

July 1, 1936.

Postscript.—I have just read a brief report of the recent discovery by Dr. de Terra (*Science and Culture*, July 1936, 49-50) of an outpost of the "Indus" civilization in the valley of Kashmir, not far from the route connecting Srinagar with the Zoji Pass. The exact locality is the village of Burzahom, only a few miles north of the present site of Srinagar, a city which thus proves to have a far longer history than ever imagined.

This discovery lends point to the suggestion that we may hopefully look for an extension of this ancient culture, marking the end of the Neolithic period, even across the Zoji-La.

July 23, 1936.

¹⁷ Wadia, *loc. cit.*, p. 93.

¹⁸ As explained in a previous article, "The Karewas of Kashmir" (*Curr. Sci.*, July 1936).

¹⁹ See C. L. Fábri, "Latest attempts to read the Indus Script," *Indian Culture*, I (i), p. 53, where the recent work of Dr. G. de Hevesy and of Professor Baron von Heine-Geldern is referred to.