PER SØRENSEN

AN EVALUATION OF THE EARLY SOAN CHRONOLOGY

It was on the 30th May 1863 that R. Bruce Foote came across what he himself later described as "-- a genuine chipped implement among the material turned out of a small ballast pit dug in the lateritic gravel on the parade ground at Pallavaram to the southward of Madras. The correctness of my recognition of the Pallavaram specimen as a genuine palæolith was fully confirmed by a great find of such artifacts, made in company with my friend and colleague Mr. William King, Junior, in the valley of the Attrampakkam nullah 40 miles northwest of Madras city. This was in September 1863. In January 1864 I had an opportunity of revisiting the Pallavaram ballast pit and found two further palæoliths of typical shapes in the material exposed by enlargement of the pit. Not long after I made several finds of polished neolithic implements and then became a confirmed collector of prehistoric remains, --"[1]. About fifty years later, when Bruce Foote wrote the above quoted passage, he had discovered or collected prehistoric implements from no less than 459 sites, of which he himself recognized 42 as palæolithic. In other words, what he describes is not only the first discovery of palæolithic tools in India, but also in a way one of the early beginnings of systematic archaeological research in India - even if finds are known to have been made much earlier[2]. As evidence of the Palaeolithic, it is related to the present theme, even if this will be concerned less with the so-called "Madras" Hand Axe culture, to which Bruce Foote's finds belong, than with other Early Palaeolithic tradition known from the South Asian subcontinent, the so-called Soan culture.

The Soan culture was first discovered in Puñjab and Kashmir along tributaries of the Indus river, mainly the Soan river. Following previous attention to the occurrence of palaeolithic implements from this area[3], the culture was primarily made known through the research of the Yale -

Cambridge Expedition in 1935, headed by Helmuth de Terra of Yale and T.T. Paterson of Cambridge University[4]. Later on sites with Soan culture implements were also found along other rivers in the Punjab,e.g. the Beas and Banganga; and in a zone across the Indian peninsula, largely between the rivers Ganga and Narmada, Soan implements were often found in sites in a context otherwise characterized by the "Madrasian" Hand Axe culture, which also totally dominates the southern half of India[5]. This distribution, with the Soan in the northern part of the subcontinent, the "Madrasian" in the southern part of the Indian peninsula, and a zone of "co-existence" of these two technically different cultures in between, may be interpreted A) either as two distinct cultures with a zone of contacts in between, or B) as evidence of a chronological development beginning with the technically less developed Soan culture, which is characterized by simple monofacial flaking of water-rolled pebbles or cobbles. This culture gradually moves southwards and progressively develops bifacial elements, until in new climatic and ecological surroundings - or for other reasons - it becomes in the south exclusively dependent on the use of bifacially flaked implements. This latter "horizontal stratigraphy" development is of course totally speculative and unproven chronologically for India, although it has had its advocates and so could bring the development within South Asia in concordance with that of East African evidence and development of the Oldowan[6]. However, with Mohapatra it is agreed that until more conclusive evidence is on hand in India, the Soan should be regarded as a distinctive culture, different from the Hand Axe culture, which - at least in Northwest India - seems to be much later than the Soan[7]. But what is the Soan culture and when did it begin?

The Soan culture traditionally is grouped among the so-called Chopper-Chopping or Pebble Tool cultures[8]. The term "pebble tool", however, as previously pointed out by other authors too[9], is in itself a most inadequate term, and accordingly even less suited to denominate and characterize a culture. This author proposes to define the Soan as a culture, the tools of which are predominantly monofacially flaked core tools. Pebble-sized or cobble-sized stones are used for cores, usually subrounded due to water-rolling, and of a shape preselected with regard to the desired form of the finished tool. The flaking was carried out

from one side towards the other, generally from a slightly flatter lower side towards a slightly more curved upper side. The flaking usually is at one small end or along the rim of one long side, in all cases limited to an absolute minimum. Accordingly the original cortex of the stone is kept, covering large parts of the surface. Such tools were found at several sites in the Soan area, and from the sediments or other geological evidence and the fineness or coarseness of the flaking technique used, from the decreasing size of the tools, from the increasing number of variations within the individual tool types, it was possible to divide the Soan culture into the following relative chronological phases:

A) Early Soan (also sometimes described as Lower Soan),

B) Late Soan A and Late Soan B,

C) Developed (or Final) Soan.

This sequence, which could also be shown to be supported by the local geological evidence, was even shown by de Terra and Paterson to be pre-dated by the so-called Pre-Soan Flake Industry, characterized lithically by some big flakes, which both stratigraphically and also by their heavier patination could be shown to antedate the Early Soan. The term Pre-Soan indicates a certain degree of genetical ancestry, which is most unfortunate and confusing, since it has not been possible to convincingly link these two different technological traditions in the area under discussion. This fact alone makes doubtful the whole Pre-Soan concept, a doubt which gains further support when the list of "Sites, Assemblages and Described Assemblage"[10] is considered. Everywhere the list uses expressions like "Battered pre-Soan", "Worn pre-Soan" very often followed by descriptions such as "Fresh Lower and Middle Soan".

The Pre-Soan Flake industry is made up of some rather big flakes, supposedly detached from big cores in a so-called block-on-block technique[11] which leaves them with an angle between the striking platform and the back side of the flake exceeding 90^{o}, commonly measured at 105^{o} up to as much as 125^{o}. From such flakes other tools could be prepared by retouching along the edge or further flaking of it. However, this cannot be seen to have been the case with the Pre-Soan flakes. They are just there, as blanks "battered" or "worn". Where found in situ, the Pre-Soan flakes were shown by de Terra and Paterson to be in the so-called Boulder

Conglomerate. However, Paterson[12] admits,"the age of these artifacts is not quite certain. They occur worn and water-polished in the Boulder Conglomerate and thus may be either earliest Middle Pleistocene or derived Lower Pleistocene". And it is this dating of the Pre-Soan Flake industry which has continued into the handbook literature unchanged[13] and is the one usually quoted, in spite of the fact that it was critically re-investigated and rejected already in the late 1940's[14]. Besides it was by correlation with the established geological and archaeological evidence from the Soan area that de Terra and Movius in the 1940s and 1950s extended the system to include cultures characterized by monofacially flaked core tools found elsewhere in Southeast and East Asia[15] to form the so-called Chopper-Chopping Tool Complex. Since the geochronological dating of the Pre-Soan Flake industry and the Early Soan thus came to greatly influence the dating and the cultural concept of early cultures in other regions of Asia, it is of the greatest importance to get an idea of what the dating of the Pre-Soan and the Early Soan is.

According to de Terra and his collaborators[4] the Boulder Conglomerate with the Pre-Soan Flake Industry could be shown to rest unconformably on the Tatrot and Pinjor beds, which in the Siwalik series represent the Upper Siwalik deposits, and faunistically equivalate with the Villafranchian in Europe and are datable to the Lower Pleistocene.[16] From the fossil animal bones, the climate during the deposition of the Pinjor sediments was "warm temperate, slightly less sub-tropical than now with forested highlands and more vegetation in lowlands than now". The preceding Tatrot was found to carry indications of a glacial period and frost action in its sediments, and together the two were considered to represent the first Himalayan glacial (Tatrot) and interglacial (Pinjor) period, and accordingly to be considered contemporaneous with the European Günz and Günz/Mindel interglacial periods respectively. The Pinjor was terminated by a diastrophism, earth crust movements resulting in continued folding of the Himalayas. Then the Boulder Conglomerate should have been deposited, in thickness varying from about 350 m to 1.400 m, and in the top of this Boulder Conglomerate were the Pre-Soan flakes, battered and worn. In consequence of the previous dating of the Tatrot and the Pinjor, and with traces of "glacially facetted erratic boulders" in the upper

half of the deposit (where also are the Pre-Soan flakes) the Boulder Conglomerate is considered to represent a deposit contemporary with the Second Himalayan glaciation, in turn equivalated with the Mindel glaciation in Europe. After this follow erosions, which shape the present drainage system and accordingly the old river terraces, of which the uppermost naturally is the oldest. In consequence of the previous dating the first terrace was ascribed to the second Himalayan Interglacial period - in European terms the Mindel/ Riss Interglacial. It is in the sediments on this uppermost river terrace that the Early Soan monofacially flaked core implements were found. The tools of Late Soan A and Late Soan B were in the Potwar Loess sediments at the second terrace, ascribed contemporary with the Riss glaciation[17]. Finally the third terrace was thought to represent the Riss/Würm Interglacial, and terrace four with the Evolved (or Final) Soan should then represent the Fourth Himalayan glaciation, which should equivalate with the Würm of Europe.

Already in 1944 G.E. Pilgrim[18] corrected the concept of the Lower Pleistocene Tatrot as representing the First Himalayan glaciation. He suggested instead to consider the Bain Boulder Beds, which on palaeontological evidence are datable to the Pinjor (or later), as evidence of the First Himalayan glaciation, meaning that the lower Boulder Conglomerate was evidence of the First Himalayan Interglacial period. It was, however, W.D. Gill, who in a lecture given in 1951 at the Geological Society of London, most convincingly showed that decisive elements in de Terra's interpreation of the geological development were basically wrong[19].

The area under discussion - to be slightly more specific - is the Potwar Plateau, which is bordered in the West by the Indus River, and by the rivers of Jhelum and Poonch in the East, by the Pir Panjal in the North and the Salt Range in the South. Geologically the area is definitely extremely complex due to repeated orogeny throughout its geological history. It serves, however, to the credit of Gill to have shown that especially for the period under discussion here, the development is less complex and dramatic than the one described by de Terra. In summing up Gill's discussion of his own evidence and that of others, and de Terra's misinterpretations, he himself concludes[20]:"In the Soan area, the complete Siwalik succession from the Kamlial Stage (Lower Pliocene) to the Pinjor Stage (Villafranchian) is free from any marked unconformities,

but is overlain with strong unconformity by post-Siwalik Pleistocene beds - the Lei Conglomerates."[21] In other words, what de Terra and Paterson conceived as a post-Siwalik Boulder Conglomerate, dating from the early Mid-Pleistocene and resting unconformably on the Upper Siwalik Lower Pleistocene Pinjor, is shown by Gill to be what he calls Siwalik Conglomerate. This rests conformably on the Pinjor and is a part of the Pinjor Stage. This is followed by the strong folding movements, which in turn are followed by a period of denudation. Then the area is "subjected to extensive peneplanation" and immediately after this further depositions took place. This deposition was of Lei Conglomerates in the Potwar (Tawi Conglomerate near Jammu, etcetera) and these Lei Conglomerates contain so much material from the Siwalik Conglomerate that they could be said to be redeposited Siwalik Conglomerates. No fossil fauna has been found in this Lei Conglomerate, but it was this which contained the so-called Pre-Soan Flake Industry. On this background the scattered finds of flakes do not gain in credibility as evidence of an Early Palaeolithic activity of man in the Soan area, but are perhaps rather the kind of incidental or "accidental" Eoliths, which occur when e.g. two boulders hit each other during river transport. In all events, even if they should turn out to be genuine flakes, their place of origin is then so highly debatable due to the mixed composition of the Lei Conglomerates that they are at best better left unconsidered for the time being. Accordingly, the earliest reliable evidence of early man's activities in the Soan area is then the Early Soan monofacially flaked implements in the deposits on the first or uppermost river terrace, and thus the oldest one. But how old is this uppermost, oldest terrace and its embedded finds?

Gill[22] accepts the Bain Boulder beds as evidence of the First Himalayan glaciation, and that the Bain Boulder beds on "clear faunal evidence" are slightly later than the Pinjor, like the Siwalik Boulder Conglomerate. He also accepts the evidence of moraines interbedded in the Lower Karewa lake beds in Kashmir, which he - following Pilgrim - correlates with the Siwalik Boulder Conglomerate, and concludes "-- it seems unquestionable, however, that there were glaciations before the Siwalik orogeny, though the precise dating and correlation of the beds in which this evidence occurs remains an important problem". However, throughout the discussion Gill also refers to the Siwalik Boulder Conglomerate as "post-Pinjor",

and repeatedly equivalates the Pinjor with the Villafranchian in Europe, the end of which, for lack of better definitions is now placed by most researchers approximately at the Brunhes/Matuyama magnetic event of about 700,000 years ago[23]. However, Maglio,[24] in listing the principal vertebrate faunal localities from Asia, places the Tatrot and the Pinjor as Late Pliocene, the Boulder Conglomerate and the Karewa beds as Early Pleistocene, and the Narmada and Godavari faunas as Early mid-Pleistocene. It should further be noticed that in doing so, Maglio includes both Kretzoi's Villanyian (which largely corresponds to the Villafranchian) and Kretzoi's Betfia phase of the Central European Biharian faunal stage in his Early Pleistocene. The Betfia phase (on microvertebrate fauna) is described as an "Upper Villafranchian"[25]. Maglio[26] further elaborates on the Early Pleistocene: "Also included are the Mogok cave deposits of Burma, the Karewa beds of Kashmir, and the Boulder Conglomerate of the Siwalik series in India". He continues: "Climatic phases have been recognized within this period, one characterized by lowered temperature and ice advance in the highlands--". And later: "Attempts have been made to correlate such phases with classical glacial stages of European stratigraphy, but on present evidence any such relationship remains highly suspect". This author has no intention of proposing any such relationship,[27] but he may suggest that the Bain Boulder glacial evidence following Gill and in consequence of Maglio is considered late Early Pleistocene and dates before the Brunhes/Matuyama magnetic event, i.e. more than 700,000 years, and is followed by the Siwalik orogeny, but the problem of whether the orogeny was before or after the Brunhes/Matuyama (or perhaps contemporary with this event - maybe caused by it?) remains unsolved at the moment. What is known is that the orogeny - still following Gill - was followed by a period of unknown extension of denudation, then of peneplanation, and that this was in turn followed by the deposition of the Lei, the Tawi and other such redeposited conglomerates. And it is these conglomerates "which Paterson and de Terra established as merging into the boulder-moraine of the second glaciation towards the mountain tract"[28]. The Lei conglomerates - according to Gill - contain no fossil animals, and if they did, where did they then originate from? Tatrot? Pinjor? Siwalik Boulder Conglomerates? From the Lei the age of the Second Himalayan

glaciation cannot be determined, nor is it possible uncritically to correlate it with the "Mindel". The deposition of Lei and the similar conglomerates is followed by degradation - the shaping of the existing set of river terraces, and it was - as previously mentioned - in deposits of the uppermost terrace that the Early Soan implements are found. Mohapatra[29], basing himself in this respect on de Terra and Paterson, states that "a comparatively warm climate is indicated by the occurrence of a fauna of Lower Narmada type in these terrace deposits". If this is so, then the Early Soan according to Maglio's dating of the Narmada/Godavari could be Early mid-Pleistocene, the end of which in Europe dates about the beginning of the Holstein interglacial about 300,000 years ago.[30] In other words, the Early Soan is likely to be dated somewhere between the Brunhes/Matuyama event at 700,000 and the Early Mid-Pleistocene boundary tentatively dated at about 300,000 B.P. Considering the uncertainty mentioned above on the duration of the Post Siwalik orogeny, the subsequent denudation, the peneplanation, the deposition of the Lei Conglomerates (equivalating at least in part with the Second Himalayan glaciation) and the eroding of the deposits down to the level of the first terrace, there is accordingly good reason to suggest that the actual dating of the Early Soan is closer to the 300,000 B.P. boundary than to the 700,000 date. It should, however, be borne in mind that this rests on the assumption that the Lower Narmada/Godavari faunas existed only in the Early Mid-Pleistocene. On the contrary, Sankalia[31] recently wrote:"The Narmada gravels and to some extent the gravels of the Godavari and the Pravara, as well as gravels of a few other rivers like the Belan in Uttar Pradesh might be dated broadly to the Middle Pleistocene period because of the presence of such fossil fauna as Bos namadicus and Elephas antiquus. At present we have no other means of dating more precisely the earliest occurrence of artifacts in India". If this is so, then the Early Soan is not bound by the Early mid-Pleistocene date of the Narmada fauna, as dated by Maglio, and consequently they can be even much later. They could perhaps be of the same age as the Lakhuti-I finds from Central Asia[32], which are dated at 200,000 years B.P. by Thermoluminescence directly on the loess over and under the artifact-bearing horizon. Ranov, in his discussion of the

origin of this Central Asian group states:"It is certainly too early to conclude that the Lower Paleolithic pebble industries of Soviet Central Asia have any direct connection with the chopper-chopping tool tradition of South and Southeast Asia, but in terms of gross typological and technological similarity the Soviet Central Asian Lower Paleolithic appears to be closer to East Asia than to the West." Ranov further indicates that any possible connections with South Asia may have been around eastern Iran due to the contemporary climatic conditions. Mohapatra[33], commenting on Ranov's article, mentions that "--- the tools from Karatau I are few, typologically and technically most of them are virtually indistinguishable, but for the raw material, from those of the Early Soan". He further points at geotectonic and palaeoenvironmental uniformities between the two areas. Exactly the same could be said of typological and technical resemblances between Early Soan implements, e.g. the tools from Guler[34] and those of the Lannathaian in North Thailand[35], particularly those of the Phrae Sites (e.g. P.-S.III). The tools of the Lannathaian, both those of the Lampang sites, which are often older than the Brunhes/Matuyama border at 700,000 B.P., and those of the Phrae sites, which are estimated for most sites to be between 700,000 and 500,000 years old, are typologically and technically similar on either side of the chronological border, and are in most cases indistinguishable from e.g. those of the Early Soan. There may be slight differences in the composition of the different types probably due to differences in palaeoenvironment, and minor differences technically, as evolution and local needs make it necessary to introduce changes. But in general it may be stated that only geological, palaeontological or other dating evidence can indicate whether these technically simple tools are over 700,000 years old or just 200,000 years old. That is the shown age of the Central Asian finds; the Early Soan may be of a similar age, but is probably closer to 300,000 years.

Notes

1) Foote 1916, p.V.
2) Bruce Foote's importance for the early years of prehistoric research in India was rightfully honoured, when a Robert Bruce Foote Memorial Volume was published in 1966. In this he is claimed to be "-- pioneer, aptly described as the Father of Indian Prehistory" (Sen & Ghosh (eds.) 1966, p. vii). However, other persons although more anonymous in their work and approach, were definitely active in prehistoric studies, or collecting of prehistoric items long before Bruce Foote. Thus the famous Danish archaeologist J.J.A. Worsaae in a paper read on the 19th November 1878 at the monthly meeting of the Kgl. Nord. Oldskriftselskab mentions (translation by this author) "-- the Asiatic Society in Calcutta in Bengal (year 1838) sent two samples, a strange primitive sword and an equally peculiar lancehead, to the Nordic Society of Antiquities in Copenhagen --" (Worsaae 1879, p. 305). The artifacts had been discovered following a landslide together with many similar ones near the village of Nioraī in the province of Etāweh between the rivers Ganges and Jumna in the interior part of Hindukush. A metal analysis had been made on the weapons already in 1838, and was mentioned in the Annual Report p. 12-13. This - probably the first ever metal analysis on an Asian prehistoric metal implement - surprisingly enough showed "--almost pure copper and none or extremely little tin or other substances --". This indicates an interest both in India (by the collector) and in Denmark in Indian prehistoric artifacts earlier than Bruce Foote. It is in no way meant to reduce the importance of Bruce Foote, but is mentioned here only for the sake of interest in the history of prehistoric research. Written as it is in Danish it might otherwise have passed unnoticed by such authors.
3) A more detailed find history is given in Paterson & Drummond 1962, p. 7. (Note: The manuscript of that publication was finished already in 1947).
4) Terra & Paterson 1939.
5) Although outdated long ago by subsequent finds, the map in Lal 1956, p. 87, still gives a good impression of the situation described here (for easier reference the map is also shown in Wheeler 1959, p. 59, Fig. 11).
6) An extremely critical, but sober and balanced discussion of the evidence on hand and the whole problem concerning the relationship between the Soan and the "Madrasian" is given by Mohapatra 1975.
7) Mohapatra 1975, pp. 15-16.
8) Movius 1948, and subsequent writings.
9) E.g. Ghosh1974, p. 222, Note 2,rightfully argues that "tools made on pebbles but devoid of pebbly surface can not be recognized as pebble tools."This of course is most logical, and as a consequence a true coup-de-poing may very well be made from a pebble. This, however, does not in any way make it a pebble tool. It may be added that a coup-de-poing may as well be made on a flake, which is flaked and chipped so thoroughly and neatly that it is hardly possible to discover that the "blank" in casu was a thick flake. In other cases what seem to be pebble tools have ultimately turned out to be tools made on a flake retaining so much of the original cortex of the flake core that it now appears almost like a pebble tool. What is usually understood by a pebble tool is an implement made on a pebble, which has become so exposed to the effects of water-rolling,

usually in a river, that it has got a smooth surface. Besides it turns out that the stone (pebble or cobble) usually has been pre-selected from the shape, e.g. slightly elongated sub-rounded shape with thick oval cross-section. From this preselected stone has been detached as few flakes or chips as necessary to form the desired working edge or suitable form. Accordingly, during a thorough excavation of a settlement one has to expect at least one flake or chip for each tool produced, but a rate of five to ten chips per finished tool may easily be found. This, however, does not mean that with e.g. 200 tools and 1.000 chips, the inventory represents that of flake/chip industry. The tools are still those made on pebbles, i.e. they are core tools, and this more than anything else characterizes and determines the nature of the culture. Quite apart from this, it is a fact that a pebble is usually understood to be a subangular stone of a certain size, usually not exceeding the size of a big fist. However, in many cases it is apparent that the original size of the stone prior to its being flaked and chipped into shape was rather that of a cobble than of a pebble. This further adds to the inadequateness of the term. This author accordingly prefers to distinguish between core tool dominated/ flake tool dominated/blade tool dominated cultures, i.e. with the majority of work tools e.g. of cores, flakes or blades. From this it will be understood that the Soan is a culture characterized by mono-facially flaked and chipped core tools.

10) Paterson & Drummond 1962, p. 39-40.
11) This technique, also known as the Clactonian after a well known industry first found in England, is clearly distinct from the later so-called Levallois technique, which is characterized by prepared cores, from which more regular-shaped flakes were detached, and where the striking platforms appear facetted due to the pre-shaping to a tortoise shield resembling core. Prepared core or unprepared, plain striking platform or facetted, thick flake or thin, this author still has to admit that he has always had his doubts concerning the validity of the theory of the block-on-block technique. Considering the size - and often very regular size of such flakes within the single site - it is absolutely incredible than any prehistoric "primitive" man, depending on the utility of such flakes for his and his family's subsistence, should ever depend on and be able to survive using such a haphazard technology.
12) Paterson & Drummond 1962, p. 59.
13) E.g. Wheeler 1959, p. 38. In a footnote the author, however, admits other datings have been proposed.
14) Gill 1952, pp. 375-394.
15) Terra & Movius 1942; Movius 1948; Movius 1955.
16) For a brief survey of details Paterson & Drummond 1962, pp. 12-19, may be recommended.
17) It was not till a very late stage of the Late Soan that Acheulian elements entered this Himalayan area, whereas in the Narmada river sites/Godavari/Pravara may be dated broadly to the Middle Pleistocene from the presence of fossil fauna such as Bos namadicus and Elephas antiquus (Sankalia 1976, p. 11).
18) Pilgrim 1944.
19) Gill 1952. Of particular interest is also the discussion following Dr. Gill's lecture, which is pp. 413-421.

20) Gill 1952, p. 375.
21) The geologist Dr. Gee, who participated in the discussion following Dr. Gill's lecture, stated (Gill 1952, p. 415) that he " — had had the opportunity, during the past winter, of examining the Soan area, and considered Dr. Gill's interpretation of the geology there to be correct". T.T. Paterson, who was also present, admitted (Gill 1952, p. 416) "he had discussed the Grand Trunk Road section - - - with de Terra and Teilhard de Chardin in 1935 and his own interpretation was similar to that now advanced by the author". Because of this statement this author feels more inclined to follow Dr. Gill's interpretation of Soan geo-chronology.
22) Gill 1952, pp. 392-393.
23) Both ends of the Mid-Pleistocene (towards the Lower and the Upper Pleistocene) are difficult to determine. The problems were discussed at a Burg Wartenstein Symposium in 1973. The important contributions from this symposium were edited by the organizers: Butzer & Isaac 1975.
24) Maglio 1975.
25) Jánossy 1975.
26) Maglio 1975, p. 446.
27) It is very unfortunate that our Indian colleagues continue to correlate the Himalayan river terraces with European terms such as Günz, Günz/Mindel, Mindel, Mindel/Riss, Riss, Riss/Würm, etc., particularly since these terms largely are "climatic misinterpretations of geomorphological features, especially of the Alpine terraces" (Kukla 1975, p. 178).
28) Gill 1952, p. 392.
29) Mohapatra 1979a, p. 110.
30) There is some uncertainty as to the dating of the Holsteinian Interglacial in Europe. Brunnacker 1975, p. 206, Table 4, gives a K/Ar date of between 140/150,000 and 220/260,000 years B.P., while Hammen, Wijmstra and Zagwijn estimate its age in Holland at about 300,000. Kukla 1975, pp. 167-169, however, indicates an age about 415,000 B.P., as it is older than his Loess subcycle E 3, likely to fall within the older cycle F. It is in this connection further interesting to note that Kukla mentions Early Palaeolithic pebble tools from an abandoned brickyard pit at Letky in Czechoslovakia from soils of the C cycle, which is datable between 245,000 B.P. and 128,000 B.P.
31) Sankalia 1976, p. 11.
32) Ranov & Davis 1979.
33) Mohapatra 1979b.
34) Lal 1956.
35) Sørensen 1976.

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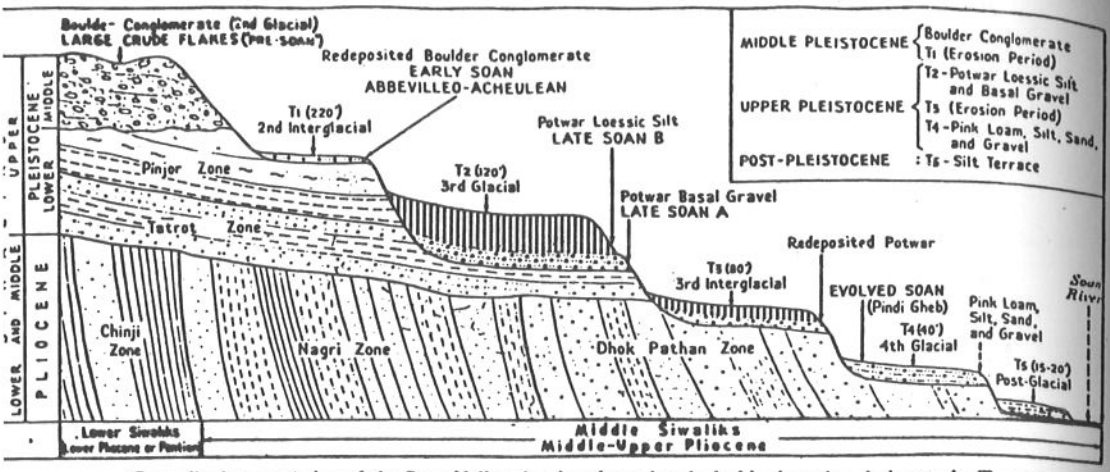
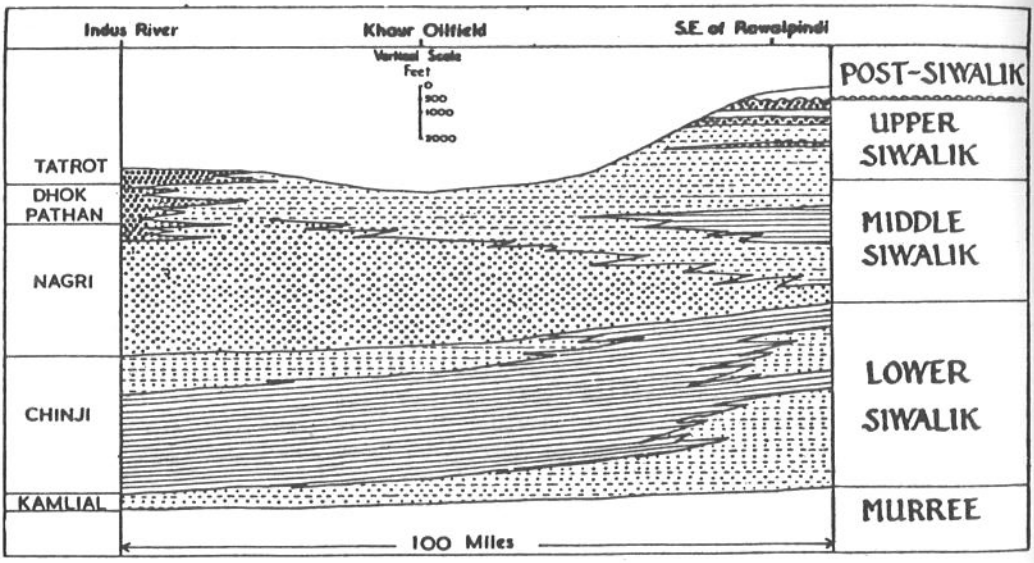


Generalized cross-section of the Soan Valley showing the archaeological horizons in relation to the Terrace Deposits and the underlying Siwalik Beds. (Not to scale.)

Figure 1. The traditional concept of the geological stratigraphy of the Soan area. (From Movius 1948, p. 338, Fig. 4.)



SIWALIK FACIES IN THE NORTHERN POTWAR, PAKISTAN

Conglomerate — 66% Sandstone — 80% Sandstone — 66% Clay and shale

Figure 2. W.D. Gill's revised concept of the geological stratigraphy of the central section of the Soan Valley. (From Gill 1951, p. 389, Fig. 2.)

Summary of the Stratigraphy of the Soan Syncline

Stages	Local Groups	Thicknesses in feet: North Flank — Kalas Kas	North Flank — Jarai Kas	North Flank — N.W. Railway–Soan Gorge*	South Flank — Kas Dovac	South Flank — Ling River*
	Recent river gravels and other alluvium					
		Unconformable junction				
	Potwar Loessic Silt	0	–		200	
		Unconformable junction				
	Lei Conglomerate	0	–		350	
		Major unconformity				
TATROT-PINJOR	Group 6: Siwalik Conglomerate	2600 in centre of basin				
TATROT-PINJOR	Group 5: Brown sandstones and deep-red clays		3000		3500	
DHOK PATHAN	Group 4: Variegated and orange clays; thin white and brown sandstones		1661		1311	
		4907	4373	3565	3493	3005
NAGRI	Group 3: Nagri sandstones; red and drab clays		2712		2182	
CHINJI	Group 2b: Chinji red shales, grey and buff sandstones	5,368	4722	3536	3393	2613
CHINJI	Group 2a: Riwat Beds; ridge-forming sandstones, deep-red shales			1400–1500	844	1300 (approx.)
	Total of groups 2–4	10,273	9095	8501–8601	7130	6918
	Group 1: Kamlial ridge-forming sandstones	1944	2125	2152		200

* Figures for these sections derived from cross-sections; otherwise from surface measurements.

Figure 3. Summary of the stratigraphy of the Soan Syncline. (From Gill 1951, p. 382, Table II). Note that the position of the "Major unconformity" is Post-Pinjor.