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The Faience of the Indus Civilization

A feature of the Harappan or Indus Civilization is the presence of faience in all its levels. Equally present are copper and tin bronzes. We thus have a mature Bronze Age civilization which gives us a chronological horizon. The writer will argue that the faience helps us further to define this horizon, as faience technology is extremely diagnostic. The civilization is literate, and its multitude of sealings and its weight system imply large–scale trade. Its well–planned cities with sophisticated drainage have been compared with the palaces of Minoan Crete and with those of the Levant, Syria and Mesopotamia. A whole range of artefacts can be compared over the Indo–European axis through Iran, Anatolia to the Danube and along the Makran coast by sea to the Gulf, Mesopotamia, Syria and the Mediterranean. Bronze cast socketed axes, axe–adzes, swords, mirrors and pins form part of this diagnostic repertory, together with stamp seals of copper, stone and faience. The bead corpus of carnelian, etched and plain, is well known, but the range of faience beads is large and their colours distinctive. Together with the beads we have more sophisticated objects of faience: small animals, inlaid lids, small pots and gaming pieces (Marshall 1931: pl. CXXX, nos. 28, 29 & pl. CLV) (*cf.* those of Ur and Mycenae, and (in *kyanos*) of Crete), such as are not found in the Aegean world before 1600 B.C. and a little later in the Mitannian world.

Although described in detail by the excavators, lack of colour printing and poor quality black–and–white photographs have prevented the study of the Indus faience in detail. Further, the objects are now scattered throughout museums in India and Pakistan – Karachi, Lahore, Calcutta, Delhi, Bombay, Madras and at the site museums of Mohenjo–Daro and Harappa. They are often poorly displayed, in dark corners and on high shelves. Colour is vital in the diagnosis of faience and, with new high–speed film together with visits to India and Pakistan in 1976, 1981, 1982 and 1984, the material, with much trial and error, was successfully photographed so that comparisons could be made with similar material in the

Near East, Egypt and the Aegean. To a mere mechanic like the writer, the Indus faience in the round and in the flesh was a revelation, especially the colours and the technique.

The Objects

Segmented faience beads

The important segmented faience beads (see fig. 1), described by Beck (in Vats 1940: 406 & pl. CXXXIII; see also Marshall 1931: pl. CXLVI, nos. 28–30; and Mackay 1938: 511) are also found in Crete in Middle Minoan III (Evans 1921: 491), in 18th Dynasty Egypt (*ibid.*), in Alalakh V and IV (Woolley 1955: pl. LXVIII, no. 22), at Enkomi in Tomb 66 with a cylinder seal of blue faience (Murray 1900: 35), in Shaft Grave I at Mycenae (where they are coloured with cobalt) together with Nuzi–type faience spacers, at Hissar with amber, in Anau III, at Tepe Giyan and in Megiddo level VIII (Dayton 1978: 132 & fig. 277). Throughout Europe this type of bead seems to be very much associated with early copper and bronze metallurgy – in Wessex, Scotland, Leopoldsdorf in Austria, Nitra in the mining area of Czechoslovakia, in the Swiss Lake Dwellings and in the Hungarian Urnfields of the Unetice Culture. Until a few years ago all faience beads were immediately thought of as Egyptian imports, although many of the types are not found in Egypt at all. Stone (1949) analysed beads from Crete and from Harappa and found their composition to be identical, whilst similar beads from Tel–el–Amarna and from Malta, Wiltshire and Scotland were quite different. Newton and Renfrew (1970) have shown from analyses that these beads were manufactured in different areas from distinct types of ore bodies, while Harding and Warren (1973) have shown by neutron activation analysis the difference between British, Central European and Egyptian beads. The Egyptian beads are related to a Central European ore source, the British group is quite distinct, while the Malta group appears to derive from Sardinian or Spanish ore sources. Evans (1921: 403) puts the manufacture of these beads between 1600 and 1200 B.C. and thought they spread from Southern Spain to Crete.

" Nuzi " spacers

Faience spacers of Nuzi type (Marshall 1931: pl. CLVII, nos. 39 & 46) are found at Nuzi itself (Starr 1939: 457 & pl. 130/e) where they are dated to *c.* 1475 B.C., Alalakh (Woolley 1955: pl. LXVIII, 14), in Shaft Grave I at Mycenae, at Ashur in Grave 15 dated to the Middle Assyrian period, at Shah Tepe, Susa and Nippur (Dayton 1978: 258).

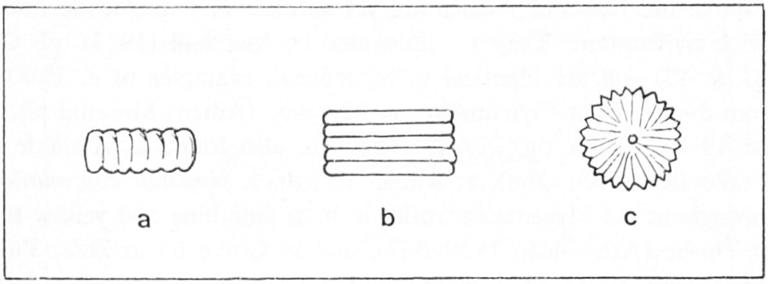

Fig. 1. – *a*) Segmented bead; *b*) 'Nuzi'–type spacer bead; *c*) fluted disc bead.

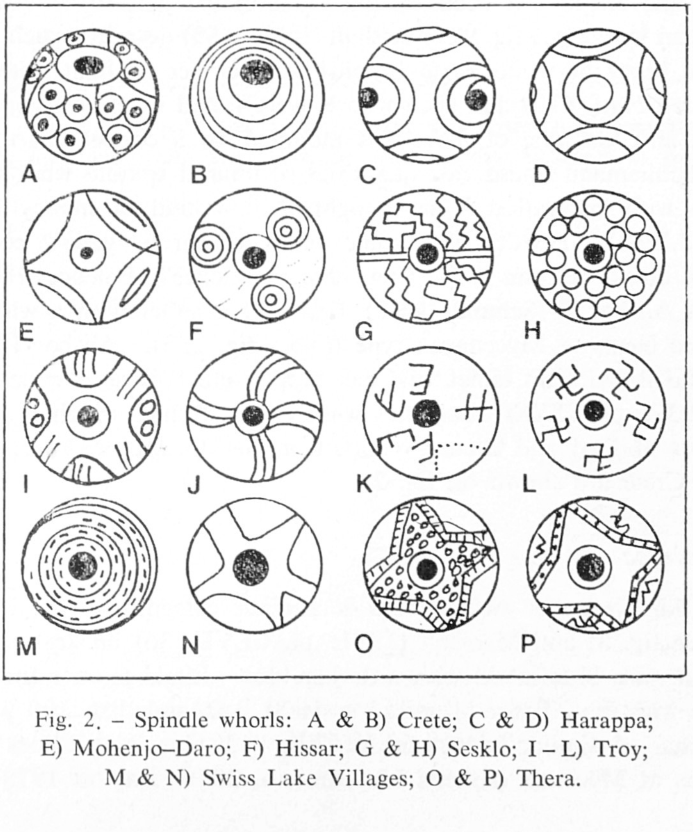

Fig. 2. – Spindle whorls: A & B) Crete; C & D) Harappa; E) Mohenjo–Daro; F) Hissar; G & H) Sesklo; I – L) Troy; M & N) Swiss Lake Villages; O & P) Thera.

Fluted disc beads

Fluted disc beads of faience are yet another very diagnostic find from the Indus civilization. They are illustrated by Marshall (1931: pl. CLVII, nos. 41 & 47) and are identical to Mycenaean examples of *c.* 1400 B.C., *e.g.* from the Tomb of Clytemnestra at Mycenae (Athens Museum no. 2890; Dayton 1978: 426 & fig. 27/4). They are also found at Alalakh V, IV and I (Woolley 1955: 268), at Rimah II (Oates, *personal communication*) and throughout the Mycenaean world, in both pale blue and yellow faience, *e.g.* at Thisbe (Ashmolean 1938–523), and in Grave 66 at Zafer Papoura, Knossos (Evans 1906: 461), where there 1,300 objects of glass and faience including a yellow faience cylinder seal and a bronze mirror.

Whilst discussing beads, a very Egyptian–looking object found in the Indus is the *menat* or terminal to a necklace (Marshall 1931: pl. CXLIX).

Spindle whorls

Spindle whorls of faience are common in the Indus (Marshall 1931: 32, 468–80). Such objects in faience are impractical to use as whorls or weights, and are in fact beads or the heads of the pins so common in the Mycenaean world (see fig. 9). Marshall (*ibid.*: 468) describes such a spindle whorl as being of white paste [inlaid] with circles of light blue faience, and notes (*ibid.*: 470) that such whorls were found in pre–Sargonid graves at Kish, and that one of these was mounted on a copper shaft, *i.e.* was a pin. Schliemann found vast quantities of unused spindle whorls at Troy which – with inspiration – he thought were a kind of money (or trade goods? J.E.D.). He describes some as of a lustrous yellow colour and others of black, red and grey. Can these be faience? Faience whorls were found at Alishar II (Schmidt 1932: fig. 156) together with a whole range of faience beads of Mycenaean type (*ibid.*: fig. 233). Alishar II is dated by an Old Babylonian tablet, and has copper and bronze in quantity. Dunand (1939: pl. CXXXI) illustrates whorls from Byblos which he compares with those of Troy and Crete. Whorls from Sesklo, Hissar, Thera and Late Minoan Crete are shown on fig. 2.

Inlaid faience

Inlaid faience of two colours is another category of the Indus material (see fig. 3) and Marshall (1931: pl. CLVII, 36) illustrates a disc or pot–lid of pale blue inlaid with a darker blue. Inlaid faience first appears in Crete with the 'Town Mosaics' *c.* 1600 B.C. and then 200 years later at Amarna. A similar faience lid in white with blue inlay comes from the Acropolis at Mycenae (Athens Museum no. 3246; Dayton 1978: 425 &

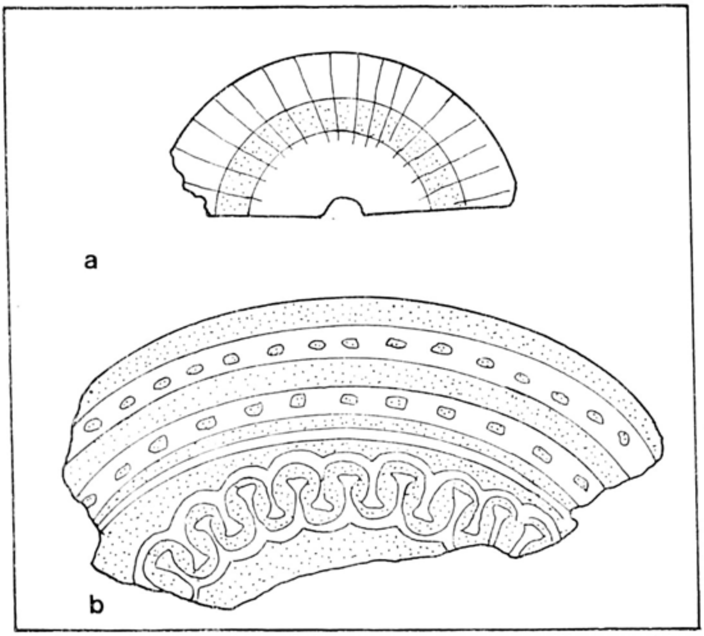

Fig. 3. – *a*) Lid of pale blue faience inlaid with dark blue, from Harappa. *b*) Pale blue and white inlaid faience lid from the Acropolis at Mycenae.

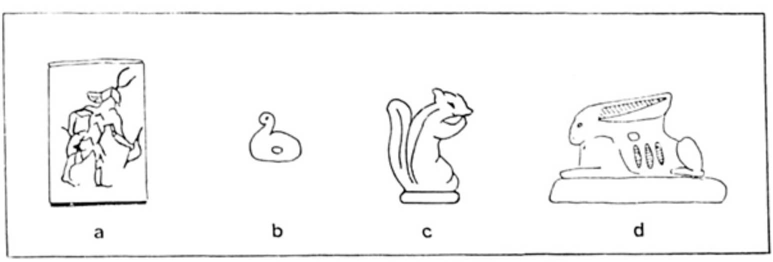

Fig. 4. – *a*) Copper stamp seal from Mohenjo–Daro, showing a horned hunter with a composite bow; *b* & *c*) a squirrel and a duck in glossy green moulded faience, from Mohenjo–Daro; *d*) faience hare from Middle Kingdom Egypt (Cairo Museum no. 4443).

fig. 27/2). It is interesting that Marshall (1931: 469) in discussing polychrome faience should state: " This blue is probably due to cobalt ". Cobalt–coloured glass and faience is a feature of the Mycenaean world, and its discovery will be detailed below. Other inlaid faience consisted of two handles of pale green faience from the HR area at Mohenjo–Daro (*ibid.*: 472).

Faience animals

These are a feature of the Indus civilization – very tiny (15 mm high), finely modelled and with a distinctive dark green glaze (see fig. 4). Included are bears, birds, rams, fish, snakes, hares, monkeys and in particular squirrels (*ibid.*: 346–53, pls. XCVI (no. 7) & XCVII; Vats 1940: 303–4 & pl. LXXVIII, nos. 28–30). Faience snakes remind us of the Snake Goddesses of Knossos, as do the model birds, and animals climbing into cult objects (*e.g.* Vats 1940: pl. LXXVIII, nos. 32 & 33). Serpent houses and dove shrines are also a feature of the Late Bronze Age in Syria (at Brak – Mallowan 1947: 229 & pl. LXX), the Levant (Amiran 1969: 305) and on Mycenaean pottery of the same period (Dayton 1978: figs. 105,b & 232). The Beisan (Beth–Shan) examples occur at a site with rich Mycenaean/Sherden connections from the time of Thothmes III's conquest in *c.* 1482 B.C. In the case of the faience hares the writer was able to find very similar examples in the Egyptian Museum, Cairo (nos. 4443–55), without provenance but tentatively dated to the Middle Kingdom. The writer, however, would date this faience to the Late Middle Kingdom at the earliest and preferably to the Second Intermediate or Hyksos period. Other similar examples come from Brak and which Mallowan (1947: 112–122) wrongly dated to the Jemdet Nasr period, although he dated another faience gazelle (B. 625) to *c.* 2100 B.C. (*ibid.*: 113). It is this chronological confusion that caused Mallowan (*ibid.*: 119) to wrongly date a yellow glazed disc bead to *c.* 3200 B.C. when it is in fact a fluted Mycenaean type as discussed above.

Seals

Over 550 seals were found at Mohenjo–Daro. Marshall (1931: 370) correctly notes that the swastika motif which appears on some of these seals is not known in Babylonia or Egypt, but is found at Susa, in Cappadocia, at Troy and on Crete at Haghia Triadha in an E.M. III context. Cube seals were of yellow paste, grey paste and yellow and blue faience. No. 358 depicts a ' shaduf ', an invention which appears in Egypt with the Hyksos, as does the Indian jungle fowl on no. 338 (*ibid.*: pl. CXI).

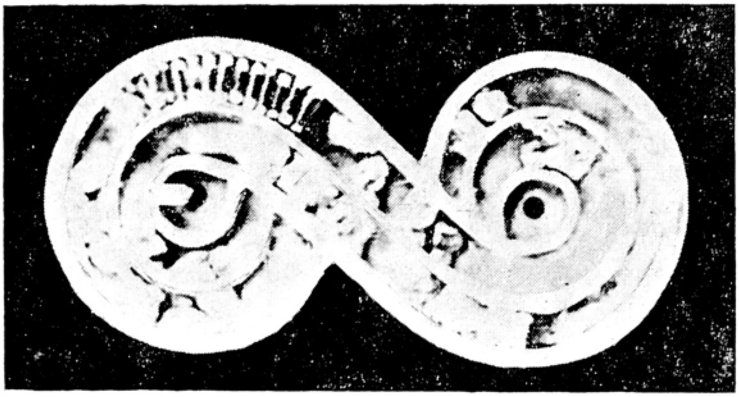

Fig. 5. – A gold guilloche ornament from Harappa, inlaid with the remains of pale blue faience and gold–capped barrel beads.

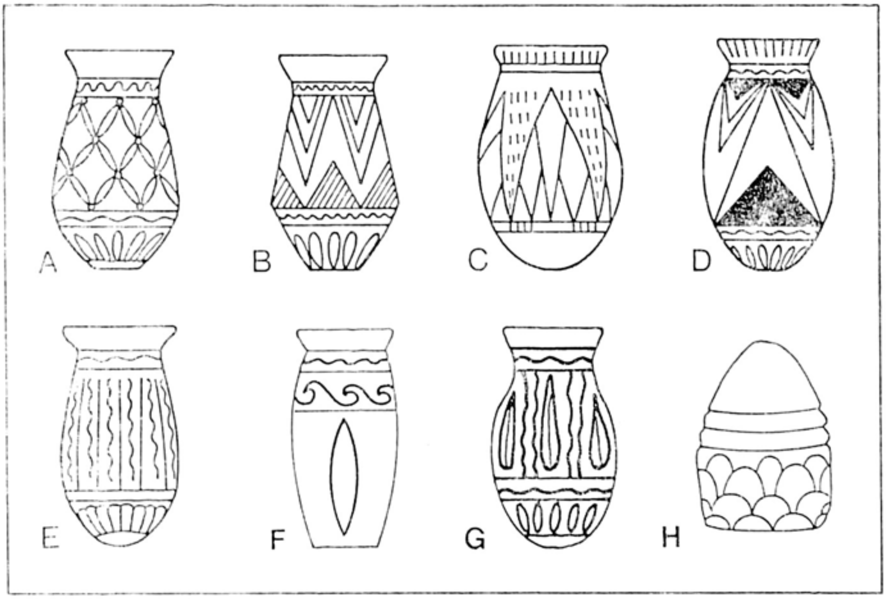

Fig. 6. – Miniature faience bottles from Palestine: A) Tell Beit Mersim; B) Tell Fara Tomb 550 with toggle–pins and scarabs; C) Badari (Egypt); D) Jericho, Tomb 4, with Yehudiyeh, Cypriote and Bichrome wares; E) Gezer, Tomb 3, with Hyksos toggle pins; F & G) Megiddo, Tomb 31, with Hyksos scarabs and Yehudiyeh ware; H) Faience capsule from Harappa, similar to those from Tell al–Rimah, dated to the mid Second Millennium.

Another seal of copper shows a horned hunter armed with a composite bow – yet another Hyksos feature (see fig. 4).

Triangular or three–sided seals in faience (Marshall 1931: pls. CXVI & CXVIII, nos. 10 & 12) are found at Anau III, in Cappadocia and above all in Crete, as are copper tablets, of which no less than 80 were found at Mohenjo–Daro.

Moulded faience

This is invariably of a pale copper–green colour, and is found in the form of fluted bracelets (*ibid.*: pl. CLVII, nos. 22, 43, 45, 51) and open basket–work (*ibid.*: pl. CLVII, no. 27). This basket–work type of faience appears in Egypt with the late Middle Kingdom, and also later in Saite times.

A guilloche of cloisonné type

This unique object in the site museum apparently comes from House 2, Trench IV, Mound F at Harappa and is illustrated by Vats (1940: pl. CXXXVII, 15). Vats describes it (*ibid.*: vol. 1, 65) as " ... a strong flat silver plate to which are soldered three bands of gold symmetrically bent so as to form the figure 8 which is then inlaid with two rows of tiny, cylindrical beads of burnt steatite capped with gold ends. Each of the two loops of the 8–shaped figure has pinholes for attachment. L2 1/4", W 1 1/8". It could have been worn in front by attachment to the dress or on the hair as shown in the terracotta figurine No. 24 on pl. LXXVI ". It is a most remarkable Aegean object with the remains of blue and red gold–capped stone beads (see fig. 5). The guilloche was found in one of a group of ' Workmens ' houses' in Stratum IV, together with many gold beads and hair ornaments, faience and carnelian beads, and a bangle of " ... almost pure silver, free from lead, with a slight impurity of copper " (*ibid.*: 66). One is reminded of the cloisonné work of the sceptre from Curium in Cyprus and other Mycenaean jewellery (Higgins 1981: figs. 222 & 223). Cast copper plates for inlay (? with faience) are common in the Indus civilization (Marshall 1931: 507). Pursuing other Aegean parallels, Marshall (*ibid.*: 508) also compares a gold chain with a similar one from Mochlos.

Faience pots

Tiny pots of apple green and turquoise blue faience, with holes for disc covers, were found at Mohenjo–Daro (*ibid.*: 365) and at Harappa (Vats 1940: 311 & pl. LXXXII, nos. 10, 12, 15–17, 19–28, 30 & 37) and were common *in all strata*. Faience pots, some of which were decorated with manganese paint, do not appear before the late Middle Kingdom or Second Intermediate in Egypt, but are found above all in Palestine in a late Middle Bronze II context (Hyksos), *c.* 1600 B.C., at Megiddo in Tomb 31, Tell Fara Tomb 550, Jericho Tomb 4 with Yehudiyeh ware, and at Gezer Tomb 3 with Mycenaean–type toggle pins (see fig. 6 and Dayton 1978: fig. 270). Small faience cosmetic thimbles with lids identical to those of the Indus are found at Rimah II *c.* 1500 B.C. (Oates 1965: pl. XIX).

Faience arms

From Harappa there is, in pale blue faience, what appears to be a miniature arm. This is identical to those arms from the Temple Repositories at Knossos, and on the Snake Goddesses, and to a piece of faience from Alalakh (Woolley 1955: pl. LXVIII, 6, AT/46/93).

* * *

TECHNOLOGY

If the above represents a remarkable list of stylistic comparisons with Crete and the Mycenaean world of the Aegean and the Levant, when we come to the technology of the faience and its colours, the parallels are even more remarkable. The Indus corpus consists of glazed steatite and green, pale blue, dark blue, manganese black, yellow, red and white faience. This amazing colour range enables us to date the faience on Egyptian and Aegean grounds (and it is unlikely that faience was an invention of the Indus civilization, *pace* Marshall (1931: 580). Further, the Indus faience clearly just pre–dates the peak of faience technology that we find at Amarna *c.* 1365 B.C., where together with the colours mentioned above we have glossy orange, sap green and much cobalt–blue faience.

The development of glazing is inextricably bound up with the development of metallurgy and the smelting of different ores which contribute to its range of colours: copper blue, manganese and iron black, manganese purple, reduced copper red, iron red, antimony–lead glossy yellow, iron matt yellow, cobalt blue, iron–antimony–lead orange, antimony white, emerald green from iron and copper with a little lead. (Note that white tin glazes and clear lead glazes are not known before the Roman period, or even later).

Kyanos

As well as the coloured faience above we have another remarkable substance used for beads in the Indus corpus – the wrongly named 'Egyptian Blue', the *kyanos* of Homer. This is a material that resembles blue chalk and is not glassy at all. It is a double silicate of copper and calcium, $CaO.CuO_4SiO_2$. After a hundred years of experiment, starting with Sir Humphrey Davy, the substance was first synthesized in 1914 by Laurie *et al.* with 64.6 g of powdered silica sand, 7.2 g natron (sodium carbonate), 15.4 g powdered malachite (copper carbonate) and 12.4 g powdered lime (Laurie *et al.* 1914: 418). The mixture did not form until it was heated for six hours at a temperature of 850° C. Analyses of ancient *kyanos* are given in Dayton 1978: 31–33.

Kyanos is virtually unknown in Egypt, but is extremely common in the Mycenaean world and appears *c.* 1400 B.C. when the mines of Laurion were first worked for their rich copper carbonate surface zone. As the host rock at Laurion is calcium in the form of marble, the writer suggests that the copper smelting produced a chalky blue *kyanos* slag, which was recognised as valuable by the Mycenaeans and used for the manufacture of gaming pieces, beads and even pots. We thus have a distinctive Mycenaean type–fossil in the Indus civilization – described by Beck (in Vats 1940: 404) as one of two kinds of blue faience: "one has the colour going right through the bead". Beck, however, did not appreciate that faience is a self–glazing material and that the glaze is not applied to the object, as on a clay pot (see also Wulff 1966; Kiefer & Allibert 1971 on this subject).

Steatite

This is one of the earliest glazed materials and is a hydrous magnesium silicate, very soft and easily carved. When heated at 950° C for two hours it gives off its water and becomes quite hard. Another name for steatite is potstone or soapstone, and, as its name suggests, it is resistant to heat shock and has been used by many primitive peoples for lamps and cooking pots. It is also excellent for moulds for glass and for copper and bronze as it does not shatter on contact with the hot fluids.

When steatite was used as a mould for the first cast copper and bronze, the contact of hot molten copper with the associated potash from a wood fire would have produced a greenish–blue glaze on the mould. Steatite moulds are abundant in the Minoan world (double axe moulds etc.) and in the Mycenaean. It is significant that the first objects of glazed steatite (seals) appear in Middle Minoan Crete and at the same period in Hyksos Egypt, where there was an enormous production of glazed steatite seals decorated with guilloche patterns. Evans noted a black steatite (fire hardened) class of seals and whorls at Knossos (Evans 1921: 68, 120). The decorative whorls were often made of pale blue faience and even covered with gold foil as fake jewellery. Many were inscribed with Linear A signs. A good example is from Chamber Tomb 515 at Mycenae (Athens Museum no. 2845). It is noteworthy that the use of glazed steatite continued in Egypt down to the time of Amenophis III, *c.* 1400 B.C.

Glass

It appears that the discovery of glass precedes that of faience, somewhere in Central Europe, again with the advent of metallurgy. Glass beads coloured with cobalt and copper are found at Nitra in Czechoslovakia in the early Unetice period dated to *c.* 1800 B.C. The smelting of copper with silica present in the gangue will produce a brown glass slag but the smelting of certain rare types of rich silver ore, associated with cobalt and white quartz, which occur in Bohemia, will produce a pretty, dark cobalt–blue glass slag which is another type–fossil of the Mycenaean world. We have seen that Marshall thought that cobalt coloured some of the Indus faience. Glass however does not seem to have been found in the Indus, although it could have decomposed to the point where it looked like faience.

Faience

Faience is quite a complicated and sophisticated material. It is a mixture of silica together with a glass former (usually sodium or potassium) plus a metallic oxide as a colourant. The quantity of metallic oxide is critical – too much copper or cobalt will produce a black instead of a blue. In a closed kiln copper will produce a red. Yellows are even more involved, in that they require a mixture of lead and antimony oxides, and undoubtedly special types of such weathered oxide ores were in time discovered by trial and error to give a yellow faience.

The wet paste consisting of the above three elements is mixed together and then moulded. As the paste dries out the oxide salts and the sodium and/or potash migrate to the surface of the object, and when fired this skin becomes a glass covering the white paste body. Many writers, including Beck, have wrongly assumed that a glaze was applied to the paste body, as occurs in modern pottery. Sometimes crushed glass was added to the faience paste to produce a harder, glassy faience.

The earliest faience was almost certainly produced from crushed broken steatite moulds that had been used for copper casting, and mixed with blue azurite and/or malachite plus potash. The discovery of the effect of the magic ingredient potash (produced from the evaporated washings of wood ashes: lye) – and later of natron (sodium) – when added to the silica and oxide colourant must have been a great technological breakthrough. It is therefore most unlikely that faience production would have been originally invented in an area lacking in metallic ores, such as the Levant, Mesopotamia or the Indus Valley, or for that matter in Egypt. Thus we find, as one would expect, that the earliest faience is coloured blue by copper, or green by a mixture of iron ochre and copper oxide ore. Excluding anachronisms in Old Kingdom Egypt, the first faience seems to appear with the Middle Kingdom in Egypt, but in the writer's opinion, it is introduced in the Second Intermediate by the Hyksos who bring so many technical innovations into the Near East including bronze and advanced metallurgy (or, if you wish, Schaeffer's *Les Porteurs de Torques*: Schaeffer 1948). During this period we have the first polychrome faience in Minoan Crete with the pale blue arms of the Snake Goddess, the red and white of the Town Mosaics and the dull green of the cow and calf plaques (Dayton 1978: pl. 10 & figs. 159, 162 & 163) and where we have the appearance of the inlay techniques that are seen in the Indus faience, and of faience moulded in the round. It is Aegean metallurgical skills that in the writer's opinion bring faience production to Egypt, together with Kamares wares and other innovations. Very elaborate and quite un–Egyptian faience is also present in the Shaft Graves of Mycenae at this time (*c.* 1650 B.C.) together with enormous quantities of tin bronze. It has also recently been shown (Dayton and Dayton 1985) that the famous ox–hide ingots of the Minoan world from Haghia Triadha are derived from Sardinian copper ore.

Technically the first and earliest part of the Indus faience corpus is the same as that of the last phase of Middle Minoan Crete, as found in the Temple Repositories and the Loom Weight Basement. The date of the destruction of Middle Minoan Crete is a subject of great controversy (Matz 1973: 557) but has been lowered considerably since Evans' time, and could be as late as 1500 B.C. (*ibid.*: 579). However, in the Indus repertory we find a *second* and later tradition of faience production. This consists of the little pots with lids which can be paralled in Palestine and Mitanni from *c.* 1600 to 1400 B.C. Finally, we have the very diagnostic *kyanos* or integral blue paste beads which are such a feature of the Mycenaean world of the Chamber Tombs and of the Levant shortly before 1400 B.C. when the copper ores of Laurion and Cyprus are exploited. Coupled with the *kyanos* beads we also have at the same time the very Mycenaean fluted disc beads, the Nuzi spacers, and the appearance of cylinder, stamp and triangular seals in faience in North Syria and the Levant, together with the appearance of yellow faience coloured by iron and cobalt blue. The miniature painted clay pots and the reclining figurines on beds are again typically Mycenaean (Vermeule 1972: pl. XLI,C).

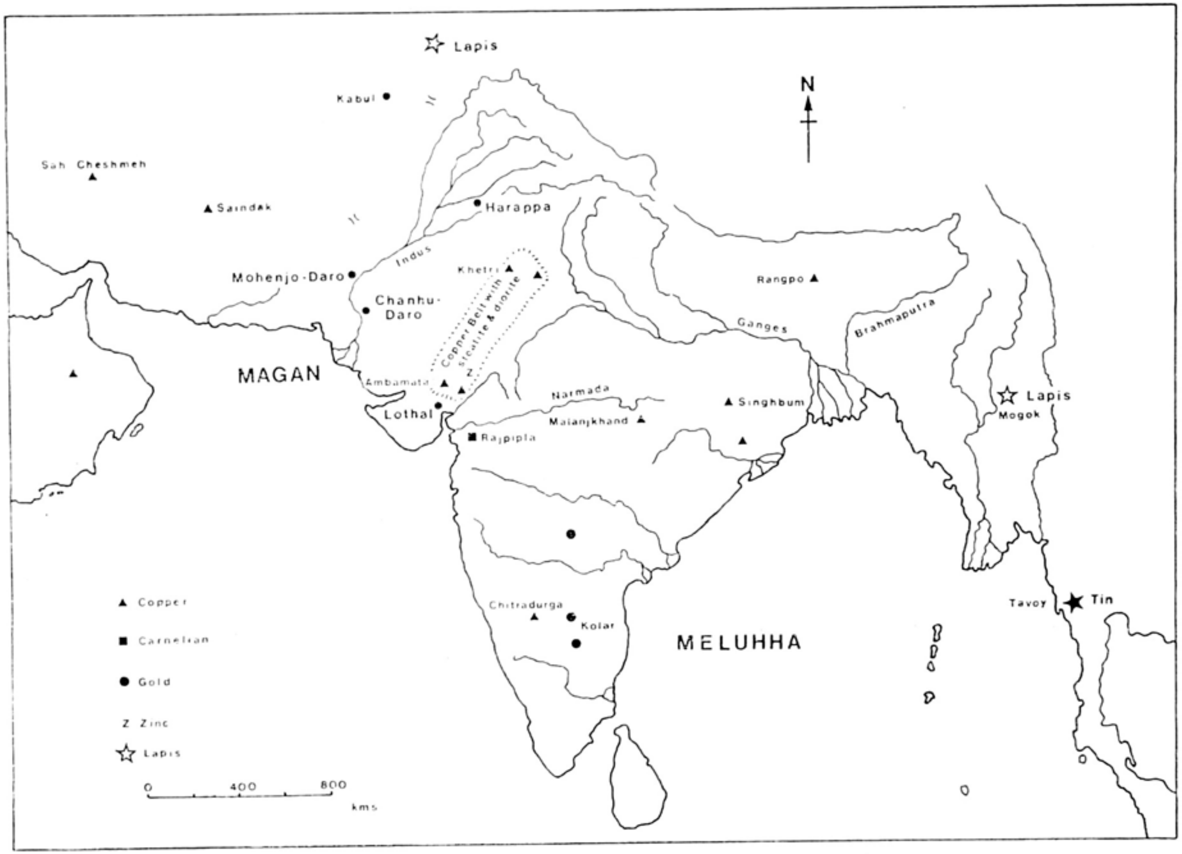

Fig. 7. – Map of India, showing the main cities of the Indus Civilization and the proximity of the copper mines of Rajasthan and Gujarat, and the carnelian of Rajpipla, to the port of Lothal.

The Indus Civilization appears to end before the appearance of the superb glossy polychrome faience of the Amarna period *c.* 1379–1362 B.C., but not before 1400 B.C. On technological grounds the Indus faience is clearly related to that of Minoan Crete and the later Mycenaean trading empire. In return for faience beads, amongst the other goods this empire brought back from the Indus was the lapis lazuli of the Mycenaean and Egyptian world, and perhaps also copper from Rajasthan. Rajasthan and Gujarat are rich in copper ores, whilst Rajpipla appears, from the evidence of many geological museums, to be the only source of gem–quality red carnelian. The Gujarat deposit and Rajpipla are both very near to Lothal (see fig. 7)–a convenient port. As Agrawal points out (1982: 153), sixteen copper furnaces were found at Harappa, copper wrokshops at Lothal, and large quantities of copper oxide found in a pit at Mohenjo–Daro. Plano–convex ingots of copper were also found there (Marshall 1931: 485). It appears therefore that the *raison d'etre* for the cities of the Indus civilization was for trade in perishable commodities, also copper and precious stones, and that this trade ceased with the breakdown of the civilizations of the Minoans, Mycenaeans and Indo–Europeans of the Aegean, Levant and Mesopotamia. The Kassites must have played an important part in this trade as is implied by the find of the Kassite cylinder seals of lapis from Mycenaean Thebes in Greece, one of which was of the time of Burnaburiash II *c.* 1367–1346 B.C. (Porada 1965: 173).

Michael Jansen reported to the Moesgaard conference his findings that Mohenjo–Daro consisted of two distinct planned phases, with an earlier platform reconstructed and enlarged at a later stage. On the evidence of faience technology, does this represent a first Minoan phase and then a later Mycenaean/Mitannian one? Finally, why did the Indus Civilization end? Was it due to the incursions of the Hittites and the troubles in the Levant of the Amarna Period that disrupted the trade to the Mediterranean, or was it due to the chaos caused by the Santorini eruption which has now been precisely dated on the evidence of the Arctic and Antarctic ice–cores to 1390 B.C.? Curiously, this was the only major volcanic event between 2700 B.C. and 1100 B.C. (Dansgaard *et al.* 1975). The dust cloud from Santorini would have lowered the Earth's temperature and caused the great drought which destroyed the Late Bronze Age. As has happened with so many great imperial trading systems from the end of Rome onwards, did the purpose for the Indus trading cities just cease to exist with the end of the dynasty at home? In modern days we have the examples of the French in Indo–China, the Dutch in Indonesia, the Portuguese in Africa, and the end of the British Empire since 1945, when great areas of the globe have declined into chaos and anarchy. Faience beads and the faience heads of pins could well have been the trade goods of the Minoan and the Mycenaean world. Such beads were after all the trade goods of European expansion from the 17th to 19th centuries A. D. – the French Fashoda expedition across Africa in the 1890's carried no less than 30 tons of beads in order to pay their way.

Chronology

The evidence of the Indus faience brings the date for the Indus Culture down to between 1650 and 1400 B.C., with two distinct technological phases. Such dates will be heresy to most archaeologists, but the two phases fit well with Jansen's conclusions of two well–planned phases for Mohenjo–Daro.

It must be remembered that Indus chronology was derived from Mesopotamia, itself derived from Egypt. Petrie's chronology for Egypt was based on the garbled versions of the unreliable Manetho. Petrie lowered his chronology by some 1460 years, from 5546 to 3086 B.C. for the unification of Egypt under the First Dynasty. But Petrie's mistake was greater than this as his own words show. In dating the Abydos deposits – found in rubbish pits – to the First Dynasty, although he noted that the pottery " was identical to that of the Early Mycenaean Period ", he states:

> " *At the beginning of the First Dynasty we meet the art of glazing fully developed, not only for large monochrome vessels, but for inlay of different colours... certainly no advance on new lines appears until the variety of coloured glaze* appeared in the 18th Dynasty. *Last year many pieces of pottery closely resembling the Aegean ware came to light in the Tomb of Mersekha and a few in that of Den. The body of the ware is identical with that of later Aegean or Mycenaean pottery; the patterns are common on Mycenaean pottery; and indeed no patterned Egyptian pottery is known until the 18th Dynasty... this [patterned] pottery of a fabric and form entirely foreign to Egypt, and of European character is now* absolutely *dated to the second king of the First Dynasty about 4700 B.C.* " (Petrie 1901).

For a detailed discussion on chronology see Dayton 1978: 398–419. In the light of the above it is not surprising that the chronology of the Indus may well need revising.

Further, the Indus Valley today lies on the extreme margin of the Indian Monsoon, which varies greatly in its intensity. Cores from the Arabian Sea have shown that the monsoon has been completely absent over all India for as long as 400 years at a time (Schubert & Yuen 1982). It appears that one of these 400 year periods covers the years 2200 to 1800 B.C., when the Indus Civilization is supposed to be flourishing. 1800 to 1400 B.C., however, is a wet period and fits the evidence of the faience.

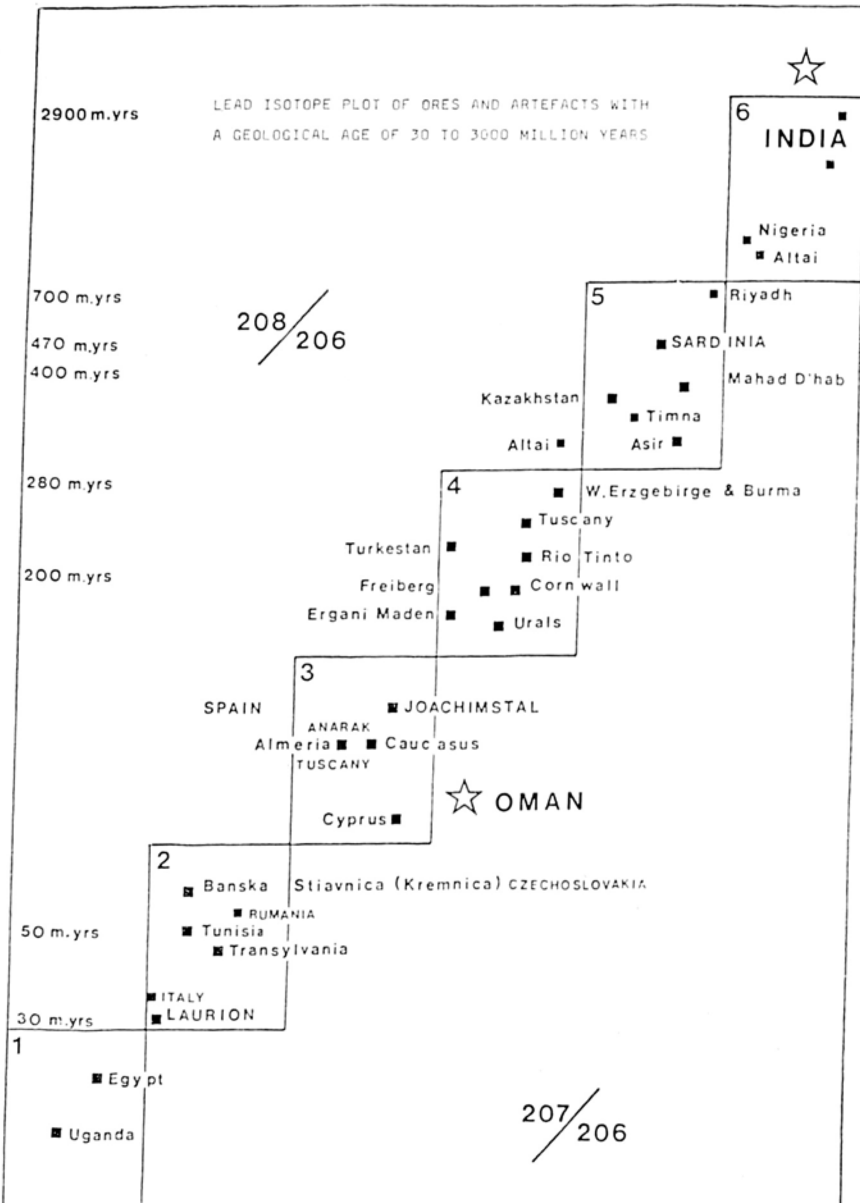

Fig. 8. – Lead isotope plots of ores and artefacts with a geological age of 30 to 3000 million years (note that India and Oman are quite distinct).

APPENDIX I: *The Copper Deposits of India*

The Indian sub–continent has several interesting deposits of copper which are found emplaced in pre–Cambrian granites and these deposits therefore have a distinctive age and lead isotopic composition (see fig. 8). Artefacts made from metal from these deposits could be easily identified by lead isotope analysis.

1. The main deposit extends from Gujarat through Rajasthan to Khetri. Old workings have been found at Khetri, but the ore is chiefly chalcopyrite and difficult to smelt. Evidence of ancient mining activity is found all along the belt but the first recorded reference is from 1590 A.D., when a mine and a mint for copper coinage were operated at Singhana (White 1985: 39).

2. Of more interest to ancient man was the Gujarat extension of the Rajasthan belt at Ambamata (24°20' x 72°53') – closer to Lothal. The town is famous for its *Durga* temple and a Jain temple, both of which have been built on old slag heaps. The old copper workings are found on the top of a ridge which runs north–west from the town and extend for about 1.5 kms. Traces of malachite and much yellow ochre occur together with a large amount of galena (Chhibber 1925).

3. The Malanjkhand copper deposit lies towards the headwaters of the Narmada River, an important route across India. It is of a similar geological age and the oxidised surface cap is rich in malachite, azurite and cuprite (easily worked by ancient man). There seems, however, to be no record of ancient workings (White 1985: 27).

4. The Singhbhum copper belt in Southern Bihar is an ancient mining area, where evidence of working is alleged to date from as early as 1000 B.C. The copper produced contains some 2% nickel (an interesting trace element) together with gold and silver (in the ratio of 10: 1), selenium and tellurium (White 1985: 31).

5. A rich surface deposit of malachite exists at the Pani Mines in the Panchmahal district. The open quarries extend to a depth of 30–40 ft. (Ghosh 1952).

6. Copper is also found at Chitradurga in Karnataka.

7. Amongst the few other economic minerals in India, gold is found:
   a) in the south at Hyderabad in Andhra Pradesh;
   b) in the Bharat gold mines at Anantapur in Andhra Pradesh;
   c) in the Kolar goldfields in Mysore (Karnataka).

These southern deposits have been famous for centuries, as has been the zinc deposit at Zawar near Udaipur.

Appendix II: *The Problem of Magan and Meluhha*

We see that India has gold dust in the south and easily–worked copper ores in Gujarat at Ambamata. Magan produced copper, diorite and timber. The diorite statues of the Ur III period are well known. The Ambamata copper deposits occur with diorite and steatite (Sharma 1968: 127). Oman (proposed as Magan) is not rich in timber and the copper deposits, which are difficult to smelt, do not occur with diorite. Further, they occur with Upper Cretaceous ophiolitic rocks (dated to 100–65 million years), whereas all the copper deposits of India are pre–Cambrian (before 570 million years). It follows that the lead isotopic composition and therefore the age

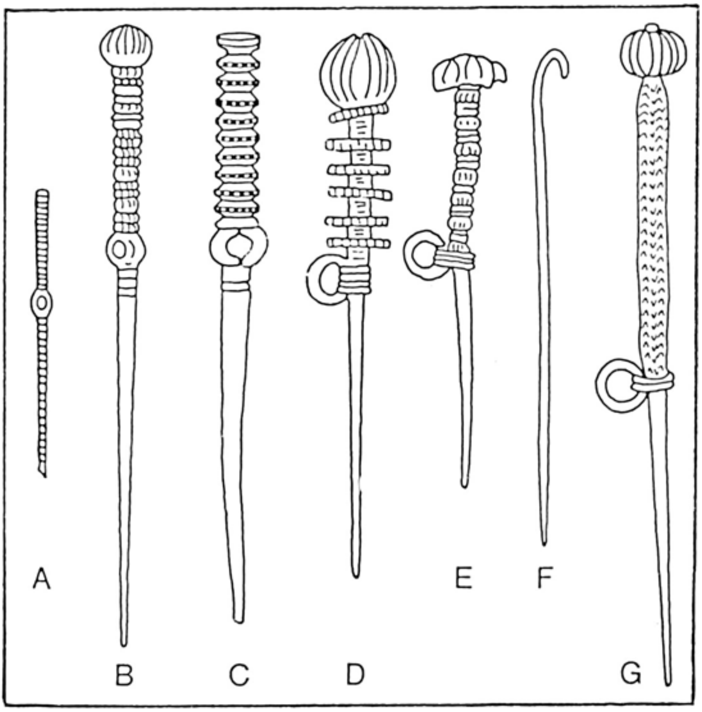

Fig. 9. – Mycenaean toggle–pins from Enkomi, Cyprus. The toggle–pin is the typical artefact of the metal–bringing peoples in the Near East. The Mycenaeans have magnificent pins, often in gold, with rock–crystal or *kyanos* heads, as shown here (B, D & G).

of the Indian and Oman deposits are quite distinct so it would be easy to differentiate artefacts made from either of them (Chen and Pallister 1981). Gujarat is therefore a better candidate for Magan than Oman. Meluhha produced gold and copper, together with carnelian and lapis lazuli. The gold deposits of Andhra Pradesh suggest that Meluhha was Southern India. Tin for the Indus bronzes could have come from Tavoy in Burma, and the lapis lazuli from Mogok, north of Mandalay.

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