sample. Where analyses, with their range of confidence, straddle a division, in spite of clear divisions established on the bulk of results, they would have to be considered as being assigned to more than one group, with final association related to other factors of the archaeological context. It is perhaps significant that no account seems to have been taken of admitted analysis error limits in SAM 1 and SAM 2.

Most difficult of all, perhaps, is their statement that 'Using these criteria, it is never possible to assign to a particular group on the basis of a single analysis. Group determination is possible only from a number of analyses.' Many of the objects included in the groupings in SAM 2 are, in fact, stray finds. Surely they do not mean that the groups were primarily established from the archaeological context of the objects!

The reason that group C2 has arisen is because the objects here have a similar origin and an almost uniform composition, well within the limits set (Table 1, SAM 2·2)—this is the way a group is established. The 'explanations' given are not relevant and do not, in any case, stand metallurgical scrutiny:

(a) Segregation is a function of the redistribution of solute arising under varying conditions of cooling,—rapid cooling, giving rise to non-equilibrium conditions, may result in greater interdendritic segregation, as for example in the case of inverse segregation (H. McKerrell, *PPS*, 1973, 39).

(b) Segregation is more likely to occur in complex alloys. For example, in our four-element system the lower melting points of the eutectic series of bismuth with lead and tin means that the freezing range is extended and the likelihood of macrosegregation increased.

(c) Clearly, multi-sampling gives the best chance of a true analysis. Merely choosing a particular wall thickness will be of little help since the degree of segregation will not only be related to this but also to the pouring temperature of the metal, the conductivity and mass of the mould, the way in which the metal is introduced and feeds the mould and the position of the section in relation to the casting as a whole. The JSS material covers a very wide range in casting size and shape.

It is not clear to us what the argument is in relation to the 'C2' groups in comparison with E11 A and E11 B. We believe that it is a matter of fact that E11 B metal is very similar to C2, but that E11 A is in two distinct groups, one like A metal except for the nickel content, the other apparently individualistic.

Whether or not different measured analyses in terms of bismuth content arise from the mixing of sources or from remelting and alloying with other material, it is certain that melting in air should reduce the bismuth content, as in normal copper refining, and thus lessen the incidence of its variation by segregation. The accentuation of normal segregation by slow cooling is clearly possible, and in castings where this has occurred single samples are likely to be non-representative.

Our original paper was mainly concerned with the presentation of experimental evidence demonstrating the significance of segregation in castings in relation to the danger of basing analyses on single, small, samples where the results are to be used with a rigorous classification scheme. For well-understood metallurgical reasons, bismuth and lead are particularly liable to segregate and divisions made using such elements are liable to include error. We see no reason to modify our warning in response to this reply by Otto and Sangmeister.

Wessex as a social question

The rich graves of the early second millennium BC in south Britain, termed the Wessex culture by Stuart Piggott (1938), are still the subject of controversy. The real nature of the material as a closely related assemblage is still in question as also its date and whether or not those who used it were in contact with the Aegean world.

At the same time several points of agreement are emerging. In the first place it is clear that the sarsen structure of Stonehenge (IIIa) was built rather early. Christopher Hawkes has rightly stressed that there are no very strong

arguments to link this phase of the monument with the Wessex culture, and that it could belong to the preceding 'Beaker period'. On the other hand, as R. J. C. Atkinson indicated at the recent conference on Wessex held in Newcastle, if the Wessex graves did begin as early as some have suggested, they and Stonehenge IIIa could still be contemporary. There is now, in any case, no argument for linking the major construction of Stonehenge with Mycenae, either in date or origin. At the same time, however, the radiocarbon date of 1240 ± 105 bc (I–2445) for Stonehenge IIIb/IIIc, calibrated to *c.* 1500 BC, compares with radiocarbon dates now available for later Wessex. So Stonehenge was still in use, and undergoing alterations, during the late Wessex period, and in this sense, at least, was 'contemporary with the Golden Age of Mycenae' (Selkirk, 1972, 225).

The second, more fundamental point is that, whether or not exports from Mycenae or Egypt were reaching Britain, there is no evidence that such contact had any discernible influence upon the development of British society or its technology. At the Newcastle conference Keith Branigan reiterated the case for Aegean exports to Europe in the early bronze age (cf. Branigan, 1970), but the opposing view was clearly presented by Anthony Harding. The only unequivocal evidence for Wessex-Mycenae contacts which he recognized was in the Mycenaean world, not in Wessex, and in the form of Baltic amber. My own view inclines to that of Harding, although Branigan can justly reply that the private collectors of Aegean artifacts in Britain, France and Germany in the eighteenth and nineteenth centuries AD must then have been exceptionally and singularly careless to loose all those artifacts, unfortunately without secure archaeological contexts, which go to make up his distribution maps.

The fascinating case of the faience beads is also relevant here. Their Mycenaean or Mediterranean origin has been called into question (Newton and Renfrew, 1970; Aspinall, *et al,* 1972), but defended by McKerrell (1972). The matter is still undecided, principally because analyses show them consistently to contain more tin than the majority of those from any other region. Stanley Warren pointed out to the Newcastle conference the very strong grounds for doubting a Mycenaean or Egyptian origin, and stressed that clearly some special recipe was being used to prepare the colouring agent for the beads. Until we really understand how this was prepared, a conclusive demonstration of their origin may elude us, and McKerrell may yet prove to be right. But it is now becoming generally accepted, following the work of Harding, Warren and Aspinall (cf. Harding, 1971; Harding and Warren, 1973), that the 'faience' beads of central Europe were locally made with local ingredients. If there, why not here? My personal inclination is still towards a British manufacture, but in the face of McKerrell's reasoned arguments this is as yet far from established.

No-one today, however, would claim that a Mycenaean or Egyptian origin for these beads, if accepted, has any very weighty bearing upon Wessex origins. For this reason the problem of chronology is less important for its impact upon possible Mycenaean links than for its relevance to our understanding of the internal development of the British early bronze age and its relations with its north European neighbours.

Until about a year ago the calibrated radiocarbon dates for north European graves, with daggers and other objects related to those of Wessex, coupled with the assumption that the Wessex culture could not have lasted more than a few centuries, suggested dates for it between *c.*2100 and 1700 BC (Renfrew, 1968). Coles and Taylor, using the latter's close study of the goldwork, proposed a 'minimal view', a 'relatively short period' (Coles and Taylor, 1971, 13), 'which in radiocarbon years is likely to be in or around the 17th century bc, and in calender years the 20th century BC' (ibid., 8). There are now three sites with radiocarbon dates for graves with Camerton-Snowshill daggers, which may lead us to modify this picture. These are Hove (date 1239 ± 46 bc—BM 682), Earls Barton (1219 ±

51 bc—BM 680; 1264 ± 64 bc—BM 681), and Edmondsham (1119 ± 45 bc—BM 708). After calibration they suggest that such graves were being constructed until after 1500 BC in calendar years. We are therefore left with a dilemma, if we accept that these British dates may be taken at their face value. Assuming that the calibration has at least an approximate validity—and McKerrell's rather special use of the Egyptian dates to set up a new 'calibration' for the period (1972) was strongly questioned on statistical grounds by Malcolm Clark at Newcastle (cf. Clark and Renfrew, 1973)—we have two choices. Either the continental relations of early Wessex must be sacrificed, so that Wessex could begin as late as may seem desirable and the minimal view upheld; or the Wessex graves *did* begin early, probably before 2000 BC, and the minimal view, while possibly applying to the goldwork, as Taylor argues, must be discarded for the Wessex series taken as a whole. My own preference is for the latter view, which would imply a Wessex duration of five centuries, from *c.*2000 BC to *c.*1500 BC. And this question of *duration* now seems of greater interest for the understanding of the nature and origins of Wessex than that of *absolute date*. Further progress can only come from new radiocarbon dates, and from the long-awaited publication of Sabine Gerloff's important corpus and analysis of Wessex graves.

But what, in fact, is 'Wessex'? This is a question which much of the discussion of chronology or of beads and contacts manages to avoid. Ian Longworth showed at Newcastle, in a masterly analysis, how disparate are the ceramic associations among graves which are termed 'Wessex' on the basis of an appropriate dagger, or gold, or faience or amber among the grave goods. His phrase, 'a brief spell of conspicous sepulchral deposition', comes to the heart of the matter, although the brevity, as we have seen, is still in question. The Wessex 'culture' consists solely and entirely of a number of individual burials beneath round barrows, singled out especially in Wiltshire, Dorset and Hampshire from many more, for the apparent wealth of their grave goods.

In attempting to explain the phenomenon, we are dealing in the first place with this custom of individual burial beneath barrows, a custom associated at an earlier date with beakers, alongside which gold objects occasionally occur. The size of some of the barrows, and the rather exotic assemblage (although the actual weight of gold is always small), are what create for us the 'Wessex problem'.

An important component of any explanation is likely to be found in the preceding late neolithic, where the size and distribution of the major henge monuments, in precisely the same areas where the rich Wessex graves later occur, indicate the emergence of larger social groups, possibly with some hierarchical structure, which might be termed chiefdoms (Renfrew, 1973). I have shown elsewhere (1972a) that these late neolithic chiefdoms, like those of neolithic Malta or even parts of Polynesia (e.g. Tongatapu) may be thought of as *group-oriented*—which implies that the community works are more prominent in the archaeological record than any striking display by individuals or any conspicuous consumption of personal wealth.

In the succeeding early bronze age in north Europe as a whole there is again evidence of what may still be termed chiefdoms, in the rich burials of north Germany, Brittany, Wessex and elsewhere. But we see them now as something different—these are *individualizing* chiefdoms, where the personal wealth of the chief and its prominent display assume as much importance to the community as did formerly the great tribal meeting places and monumental works. The growth of hierarchically organized societies, with emphasis on the personal wealth of the 'chief' is yet more clearly seen in the Aegean early bronze age a few centuries earlier (Renfrew, 1972b, ch. 18).

Both there and in north Europe this social feature occurs together with the first regular use of bronze, not only for tools (mainly axes) and ornaments (e.g. pins) but above all for weapons—daggers. In all these cases attractive materials for personal adornment, including gold, are regularly used for the first time. In each the regular placing of rich grave goods

beside individual burials makes its appearance.

The outline of an explanation is now beginning to take shape, and it is primarily a social one. The inception of bronze manufacture introduced into society a new form of wealth. The scope for potential peaceful competition within society which this offered was supplemented by the development of a totally new weapon for hand-to-hand combat, the dagger. (Its only rival, the battle axe, had been introduced only a little earlier, and was still in fashion.) My suggestion is that the powerful impact of the new technology, with all it implied for wealth, for display and for armed competition, is reflected in the shift in south Britain from group-oriented to individualizing chiefdom society. The old solidarity of the late neolithic, seen in the great henges and culminating perhaps in Silbury Hill and Stonehenge IIIa, developed with the impact of the new technology into a materialistic, acquisitive, aggrandizing society. Personal wealth and display became the recognized means by which leaders communicated their eminence and their power to those in the group inferior to them in status, hence enabling the group to retain some solidarity about the person of the chief.

A further factor of possible relevance here is the effect of a hypothetical population increase, with consequent pressure upon natural resources (cf. Sherratt, 1972). This too may have contributed to a competitive situation, where the emergence of charismatic leaders, well-armed and skilled in war, could have been of adaptive value to the group. The appeal to a social explanation does not, therefore, imply a rejection of the environmental approach, for the two are closely interrelated. Indeed the subsequent development of the bronze age, with the emergence of a trade in raw materials and of local specialist industries is very much the story of the changes in the technological field (or subsystem) of society brought about in response to the demands set up in the social subsystem.

We are, of course, largely ignorant of whatever form wealth and display may have taken in the neolithic period. Who knows what perishable objects in Britain may have fulfilled the same function as the wooden prestige artifacts of the Polynesian chiefdoms? Yet it does seem striking that amber beads and ornaments are not in fact seen in Britain until the early bronze age, although the material was already known and available from palaeolithic times. Nor was gold, although used in beaker times, prominent until the Wessex graves, as a form of display accompanying the burial.

This little word-picture is only a first step towards an explanation for the Wessex graves. But already there are more detailed arguments supporting it—for instance the presence of the densest concentrations of Wessex barrows in precisely the areas where the late neolithic chiefdoms had their great centres (Renfrew, 1973, cf. Fleming, 1971). And the argument does have the merit of focussing upon the Wessex graves themselves, and keeping well clear of Mycenae. I am hopeful that more systematic work along these lines will justify the final conclusion of an earlier (1968) article, 'Wessex without Mycenae':

> Our understanding of the Wessex culture is thus more likely to be furthered by a consideration of the technical, economic and social processes at work in Wessex than by reference to the Aegean or to Mycenae. In comparison with the need to understand the dynamics of culture change at this important stage in the development of prehistoric Britain, the precise absolute dating of the Wessex culture appears a secondary question indeed.

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The Srivijayan civilization in Southern Thailand

Janice Stargardt is a Fellow of Lucy Cavendish Collegiate Society and also Evans Fellow in South East Asian Archaeology at the University of Cambridge. *In this note, she sets out some of the basic features of the economy of the Srivijayan civilization of Southern Thailand. We suggested that she append a further note (p. 228) on progress made to date, in tests to identify the technology used in the Srivijayan ceramic tradition.*

Until now, the Srivijayan tradition in Thailand was associated only with the admirable bronzes, centred in the South, but found over a wide area. Similarly, the major series of Pre-Angkorian Khmer Visnus from peninsular Thailand have been isolated by time from their original cultural environment. Scholars of South East Asian civilization are aware that major images such as the Srivijayan Avalokitesvaras and the Khmer Visnus would have been fashioned originally as the focal point of a monument. No Pre-Angkorian Khmer monuments or ruins have yet been found in Southern Thailand and only one Srivijayan monument—Wat Boromdhatu, Chaiya—has survived intact, while Wat Chedi Ngam and Wat Sii Yang (FIG. 1) contain a Srivijayan core and ruined pediment respectively. In the summer of 1971, a Cambridge expedition identified a further seven ruined monumental sites of the Srivijayan period at Kok Tong (FIG. 1).

The size and quality of the statues themselves, to which some critical attention has already been devoted (Dupont, 1941 and 1955; O'Connor, 1966 and 1972; Diskul, 1971), suggest that their original monumental context was a developed and prosperous one. The Cambridge South East Asian archaeological expedition has been working in peninsular Thailand since 1970 and the evidence it has uncovered gives us some insight for the first time into the economic, as well as the monumental, aspects of southern civilization. In this note are presented the concise results of a series of excavations relating to the economic bases of Srivijayan civilization.

MODIFICATIONS IN THE ENVIRONMENT

Southern Thailand possesses the largest body of inland waters in South East Asia (FIG. 1) and this vast lake system is separated from the Gulf of Thailand by a long flat strip of land called the Satingpra Peninsula. This strip is part of a continuing process of beach build-up which, as the map shows, is still producing sand, clay and mud banks in the coastal waters. It varies between 5 and 12 km. in width and its greatest elevation is 3–4 m. until it terminates in a single mountain on its southern tip. Upon a deep basic stratum of grey clay there are successive layers of dune sand along the coastal perimeter, while inland, there are areas where the grey clay is overlaid by red-brown and mid-brown clay and some humus.

The Satingpra Peninsula presents most of the defensive features of an island and offers ths additional advantage of sheltered, inland waters for easy access to the isthmian hinterland. On the other hand, its soil was originally poor and it lacked natural watercourses and ponds. These