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Thermoluminescence and Glozel: a plea for patience

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Last year we published a paper entitled 'Thermoluminescence and Glozel' by the authors of the present paper which declared that the Glozel material was not forged but belonged to the period 700 BC to 100 AD (XLVIII, 265–72). This startling conclusion has caused violent reaction among archaeologists and, in our last issue, some interesting reactions from TL scientists (XLIX, 223–6) in a note entitled 'Thermoluminescence and Glozel: a plea for caution' by Martin Aitken and Joan Huxtable. Here the authors of the original paper reply to the Aitken–Huxtable criticisms. For an Editorial comment see 'Antiquity', 1976, 1.

We have read with care the various comments, both published and from correspondence, of many colleagues interested in the implications of our preliminary paper on the new investigations of finds from Glozel (McKerrell, Mejdahl, François and Portal, 1974). Already, even in the space of one year, much that has emerged reveals the doubts and quite genuine difficulties of many archaeologists in accepting that the material so far examined would appear not to be modern forgery. Dr Aitken and Mrs Huxtable (1975) particularly, as well as Mr Warren (1975) and Professor Atkinson (1975) have all raised various technical points relevant to a clearer understanding of the situation; it may thus be useful to assess briefly how such details do, in our view, affect matters. It is not our intention here to attempt to deal fully with all the queries raised, but rather to amplify briefly what we have published and discussed in order to cover the main areas of concern.

The first of these is the possibility of ceramic forgery, using radiation sources, in order to confuse the laboratory thermoluminescence examinations. We know of no actual instance of any attempt at such deception and the suggestions as to its feasibility at Glozel do usually derive from those quite unacquainted with the complex problems involved. Even so, as a matter of routine, we had made appropriate checks in Edinburgh, prior to our preliminary publication, and these seemed fairly clearly to reduce such possibilities to quite low orders of probability. The diagram below illustrates the principles involved and the three different types of mineral inclusion used in investigation.

In the normal archaeological situation fine grains receive, unlike larger inclusions, a high alpha particle dosage from the surrounding fabric. The accumulated dose thus acquired will be considerably in excess of that for larger inclusions; typically this excess varies from 30 to 80 per cent. For zircon inclusions, present usually only as a small percentage of the total, the high internal radioactivity yields accumulated doses much in excess (by orders of magnitude) of other inclusions or fine grains. By contrast, however, all of these different inclusions will receive the same dose if the source of thermoluminescence is not genuine archaeological accumulation but external radiation from a solid source. (The idea of storage in a near-by uranium mine is another possibility for such external gamma dosage, though this would require somewhere in the order of one hundred years of exposure.) Differences between X-rays and gamma rays are unimportant for the present discussion but a more 'natural' forgery process, involving concentrated or radioactive aqueous uranium and thorium solutions, will not allow of a clear cut decision using only fine grains and larger (non-zircon) inclusions. However,

the zircon technique is, to the best of our knowledge, beyond the range of any attempts at TL forgery (Zimmerman, Yuhas and Meyers, 1974).

For the Glozel ceramics then the question to be asked is: do the various grains have doses in accord with the expectations of a normal archaeological context, or is there any aspect that might point towards forgery? So far, seven samples have been checked in Edinburgh and these provided fine grain to inclusion dose ratios of from 1·4 to 1·8; two samples investigated at Oxford agree well with these figures. Also, through the kindly help of Dr Zimmerman, six zircon tests (on two samples) have been made at St Louis and have yielded doses in the range 28 to 700 k.rads.; about 20 to 400 times greater than the typical inclusion figures. On the basis of all these results it does seem entirely reasonable to doubt any possible TL forgery. Even so, further checks are being made, particularly with the important zircon technique. The suggestion by Dr Aitken and Mrs Huxtable, on the basis of just one sample, that a probability for such forgery of 'a few per cent' might obtain, could then reasonably be regarded as a distinctly upper limit. If we were ourselves to attempt to quantify the situation we might suggest no more than a fraction of one per cent as more realistic. Such hair splitting is, however, somewhat academic; the simple facts are that every test so far applied suggests an entirely normal archaeological situation.

Although we believe these conclusions to be soundly based it will be up to each archaeologist to make his own assessment of the evidence. The view of the editor of ANTIQUITY, a regular correspondent in regard to these problems, when he assures us that: 'I think much of the material has been put there in the last five years and may well have been re-radiated' may perhaps be somewhat extreme but is worth noting.

A most important part of our continuing work over the past year, involving the next aspect of concern to many correspondents, has been to attempt an understanding of the relationship of the Glozel *fosse* to other, more material, objects from the site. Unfortunately, no remains to be with certainty ascribed to that structure itself remain, though sixteen large bricks and many *briques à cupules* still exist. The most positive associations, however, seem to be various mortar-like conglomerates which have clearly been highly fired (sometimes partially fused) and which offer no obvious man-made structure. A number of such specimens have thus been collected and the result of thermoluminescence dating of the first of these was reported at the recent Archaeometry Symposium in Oxford. The date obtained, AD 1090 $\pm$ 70 fits well with the medieval context to the kiln-like structure that has often been suggested. And the date around AD 1200, reported recently by Dr Aitken and Mrs Huxtable (Aitken and Huxtable, 1975) on a fragment of a Glozel *brique* may well be related to this same kiln activity, though the authors rightly stress caution in acceptance of a single wholly unprovenanced sample, and we ourselves could add that their simple two-letter specimen is unique amongst the sixty or so inscribed *briques* we have examined at Glozel. Even so, we do seem to have preliminary dating evidence for a medieval aspect to Glozel that would fit well with an archaeological interpretation of the *fosse* structure—whether related to glass or ceramic technology.

We should stress that this medieval activity, if it can be confirmed, in no way affects the preliminary absolute dating reported last year. The date range suggested then, 700 BC to AD 100 still obtains for the Gallo-Roman or La Tène aspect to the site. The suggestion by Professor Atkinson (Atkinson, 1975) that this date represents a *period* of occupation is not, we believe, necessarily correct. The range comes about simply from the accuracies involved, and a quite short-lived occupation is, on the TL dating evidence alone, as entirely likely as a lengthier span. The dating of this original phase has been made at Risø and Edinburgh with one sample confirmed at Oxford. Dates obtained (Risø and Edinburgh) are: 600 BC, 730 BC, 680 BC, AD 120, 630 BC, and 580 BC. Error limits on each figure are about 300 years and we do thus still prefer a

cautious wide-span accuracy range in view of the known errors involved in dating museum, rather than freshly excavated samples. A carbon-14 date on ox-teeth, found inside one of the Glozel decorated urns, fits well with these figures; the date obtained, SRR-434, being AD 50 ± 80. The sample is illustrated further on along with various carved/decorated bone specimens and fragments derived from the tomb-like structures at Glozel. These also have been collected for carbon-14 dating and chemical analysis. Thus far the only completed aspect, the nitrogen (Kjeldahl) contents, are particularly revealing (PLATE XXVI).

Sample	A1	A2	B	C	D	E	F	G
Per cent nitrogen	2·0	0·1	0·5	0·2	0·6	0·2	0·4	0·5

Sample	H	I	J	K	L	M	N
Per cent nitrogen	0·3	0·7	0·2	0·3	0·5	0·2	0·7

A1 and A2 refer, respectively, to the enamel and dentine of the dated ox-teeth sample (the compact outer enamel exhibiting the expected higher level of nitrogen, relative to the more porous inner dentine); C, D, M and N were carved and decorated specimens; the remainder were from the tomb-like structures. Even without carbon-14 dates it is clear from these chemical analyses that none of the samples we have examined is modern, since fresh bone contains, invariably, some 4 per cent of nitrogen. These 'Piltdown' checks do then adequately testify to a genuine antiquity of, at least, some of the Glozel bone. Whether or not the bone carving is contemporaneous with its age, is of course not feasibly decided by laboratory examination alone, and this touches upon what is perhaps the most puzzling aspect of all at Glozel. For if, as we suspect may finally be confirmed by the technical and other evidence, no forgery of any kind has in fact ever taken place, then the carved and decorated bone specimens must include some which are of the Upper Palaeolithic. Fortunately, carbon-14 dating will resolve this aspect and, in combination with chemical analysis, should sort the very ancient from the Gallo-Roman/La Tène. Even to the eye it is apparent that some such dual-period breakdown of the bonework is likely though this has rarely been stressed previously.

Professor Daniel has, on occasion, referred us to a carbon-14 date, measured also on Glozel bone, which he assures us proved to be modern. Unfortunately, this result has never been published (in *Radiocarbon* or anywhere else) and we thus hesitate to conclude the certainty of modern forgery. However, by the time this note appears in print we shall have completed a further comprehensive sampling programme for bone nitrogen analysis and carbon-14 dating, and this will, we believe, provide a more final understanding of the situation.

Professor Atkinson in his interview with the BBC for their Glozel programme (Atkinson, 1975) mentioned his feeling that the acidic nature of the Glozel clay would have precluded lengthy burial for the more well preserved and smooth bone specimens. It is certainly not our intention here to take issue with one of archaeology's authorities on burial soils, but we do feel it is necessary to stress that bone degradation and collagen loss are very much a function of many parameters. Acidity is certainly important, but it is only one of a number of factors which can combine to provide quite complete extremes of preservation. We might instance the well-known example (Oakley, 1969) of woolly rhinoceros bone of Late Pleistocene date retaining as much as 3·9 per cent of nitrogen, due to burial in clay—precisely the same acidic subsoil that is present at Glozel. Accordingly, we would not regard the well-preserved appearance of some of the bone-work as necessarily any certain proof of forgery. For the samples we have illustrated the bone itself is undoubtedly ancient so that if any deception has taken place, it would have to relate to matters of fresh carving and/or re-burial. It might also be argued that the bone is not even from Glozel but to be set against this is the then rather remarkable coincidence of the age of some of the bone and the La Tène/Gallo-Roman TL dates. This would all be considerably more involved than the generally held

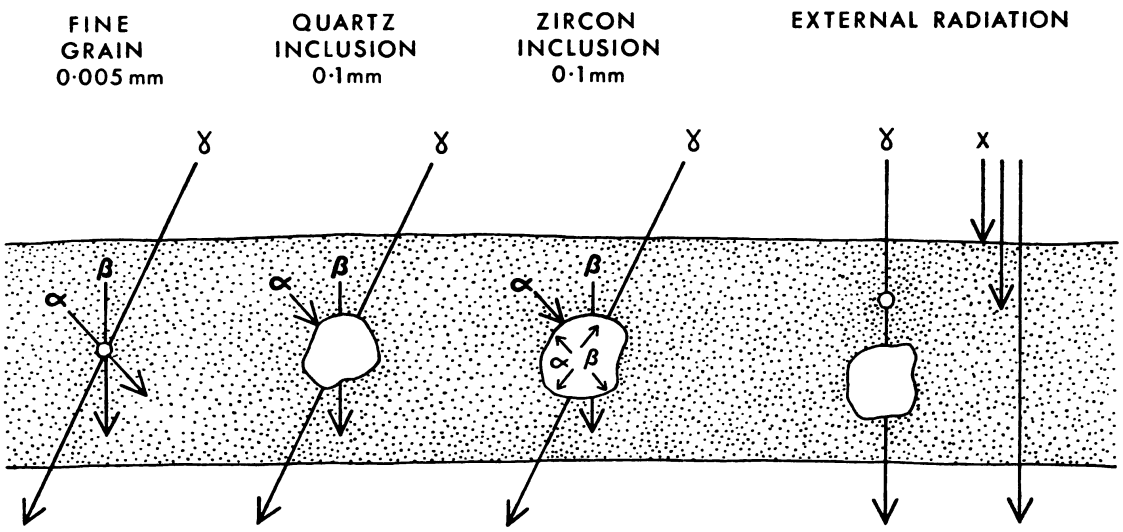

Fig. 1. The three different types of mineral inclusion used in investigation

theory that both the bone and carving are modern; at least such a view had the appeal of simplicity. The alternatives in favour of forgery do, to us, seem too involved to be realistic.

We agree fully with Mr Warren (Warren, 1975) that the surface vitrified inscribed tablets are important evidence; indeed, this was stressed many times by Morlet. We feel quite certain that the vitrification is flux-free and entirely genuine since it is analytically identical (neutron activation) with both inner fabric and the Glozel field clay. Also, TL examination of material immediately beneath the glassy surface does show that the specimens examined are most unlikely to be modern and the important zircon technique (Zimmerman, Yuhas and Meyers, 1974) was applied to one vitrified sample with typical authentic results. The melting point of the glassy layer being around 1100°C does, of course, rather rule out any easy forgery process which would leave intact the TL signals, though it has been suggested to us, by Professor Fremlin, that laser techniques could certainly effect such minimal surface melting as is here involved. However, much of the Glozel material can clearly be identified with illustrations of the pre-laser 1920's and this includes vitrified tablets. At the 1974 Boston conference Professor Fremlin kindly offered to conduct fission track dating examinations of the glassy material and this should certainly be highly informative when completed.

The implications of these conclusions of authenticity for the Glozel script are, of course, considerable since they would suggest that at least some of the letters are entirely genuine. It is on this point alone that we might take slight issue with Professor Renfrew's otherwise concise and accurate summary of discussion held at the recent Oxford Symposium (Renfrew, 1975). Dr Isserlin's paper, presented at that meeting, on the affinities of the Glozel letters with other ancient scripts was a lucid and fascinating exposition of the problems and possibilities involved; and, as Professor Renfrew rightly says, one major conclusion was that it would not be easily feasible to come down firmly in favour of, or against, forgery. But this is in fact a remarkable move away from the total certainty with which scholars have always regarded the Glozel inscriptions as a certain proof of forgery; Dr Isserlin has shown that this is now to be accepted only with caution. Indeed, the cornerstone of the forgery theory, the arguments by the great authority, René Dussaud, that the Eshmunezar inscription was

the prototype for Glozel, would seem today a very difficult proposal to accept. We would urge the editor of ANTIQUITY to persuade Dr Isserlin that a brief publication of his new work would be of the greatest interest to many in Britain, as well as in France, where it is in fact already being published.

A further detail of concern involves the suggestion, by Dr Aitken and Mrs Huxtable (1975) that some of the simple TL authenticity graphs (McKerrell, Mejdahl, François and Portal, 1974, figs. 6 and 7) may be interpolated to extend our preliminary date range—this being separately determined by more rigorous measurements. Their suggestion is, we feel, rather ill-founded since the graphical data are, we must stress, qualitative only; they simply cannot be used for anything other than an ancient versus modern appraisal. To make more of them than that would be distinctly unwise. What these data *do* show is that a wide range of ceramic pieces from Glozel are most unlikely to be modern and would appear to be much, much older than the 1920s. But how much older would not feasibly be extrapolated, with any accuracy, from these graphs alone. More detailed, precise measurements are involved with absolute dating.

We would be the first to concede, however, that the absolute dating outlined is preliminary though six TL dates and a C-14 result are undoubtedly indicative of the general earlier period involved. And in our first paper on the matter we were, of course, primarily concerned to demonstrate that the ceramic objects *were* genuinely ancient, rather than modern forgeries—any absolute dating being distinctly secondary to this first and most important aspect. Whilst Aitken and Huxtable do not dispute this point their use of our authenticity graphs does perhaps add general confusion to the dating period that is involved. That their suggestions are, however, invalid can be demonstrated. They select four of our TL curves as indicative of their concern; three of these they suggest would yield doses of around 500 rads and one nearer 2,000 rads—both figures being outside our own range for the La Tène/Gallo-Roman samples of 900 to 1,700 rads. Yet in this choice of samples these authors ignore our more recent data showing that two out of these four examples have actually had accurate archaeological doses evaluated, and these in fact yield 1,570 rads and 1,600 rads, well within our preliminary range. These data were, we felt, fully discussed in two papers delivered (by V.M.) at Oxford in March 1975, during sessions attended by Aitken and Huxtable. We have no desire to resort to any real recrimination, but we do feel that their criticism is accordingly just a little inappropriate.

The reliable dose range then, so far evaluated, on some six Glozel samples of the La Tène/Gallo-Roman period, is from 900 to 1,700 rads. The variation is quite reasonable and is due to both fabric and burial differences; similar percentage variations have been recorded by Fleming (1970) on Romano-British sherds also dated by an inclusion technique. The corresponding date range obtained on the six Glozel samples is from 700 BC to AD 100.

We do agree with Aitken and Huxtable concerning their suggestion of a possible medieval aspect to Glozel (as discussed above). But again we are puzzled that they choose to neglect our own earlier, preliminary dating for this phase, presented for discussion at Oxford during the same sessions mentioned above.

One further aspect raised by these authors, and which we have examined though not previously discussed in detail, involves the possibility of anomalous TL fading. In all, some eleven samples have been checked for fading at Edinburgh (and one at Oxford) and none has provided any indication, within a 5 per cent accuracy limit, of this feature. On the more general concern of Aitken and Huxtable for some unspecified abnormality in the clay or minerals at Glozel, we find it difficult to imagine that Nature, who normally acts on a rather large scale, should have bestowed such a hitherto unknown feature upon this singular spot. Their suggestion that even a Neolithic dating might possibly be involved surely cannot be seriously entertained. We feel particularly sad that after some two years of private and public discussion on these matters with both authors, the first we should know of their

concern is a final draft of a note to ANTIQUITY. *'Lord defend me from my friends; I can defend myself from my enemies!'*

In all there are now some fourteen departments working with us on various matters involving Glozel. One major objective is absolute TL dating of about thirty ceramic samples to parallel the authenticity tests already published. It will take a further year of work before more final conclusions can be reached, and we do thus urge a plea for patience. Glozel has been waiting for more than fifty years now and surely can wait for the completion of our next step without further speculation and polarization.

Our final point then is to summarize as best we can the present situation. First, there seems no good reason to doubt that a wide range of ceramics from Glozel are genuinely ancient. Also, a second, modern forgery, conducted specifically to deceive TL, however intrinsically improbable, can be discounted from strictly laboratory evidence alone. These points do seem reasonably beyond dispute. On the matter of absolute dating we cannot stress too strongly that our data are as yet preliminary. Some six TL dates and one C-14 date do, of course, suggest that a range of 700 BC to AD 100 will probably obtain for a Gallo-Roman or La Tène aspect. And it does seem possible that medieval dating may apply to the Glozel *fosse* structure. However, for every kind of sample examined and on every aspect that we, as scientists, are competent to judge, we have so far totally failed to discover any clear proof of modern forgery. We should add that with the exception of a few initial pieces we have ourselves selected all our material, often guided by publication illustrations of the 1920s, and accordingly we do feel that the simplistic idea of complete modern forgery must surely be invalid. The major problem this poses relates less to individual postures from the past than the quite obvious confusion for archaeology of such a diverse range of artifacts. The welcome comments by Professor Renfrew (1975) do seem as clear a statement of these difficulties as any we have seen; we do very much hope that this kind of constructive archaeological juxtaposition will be the future manner of approach to the problems presented by Glozel. Certainly we cannot echo too strongly the difficulties presented for archaeologists by the extraordinary range of material involved. That we do not lay particular emphasis upon such points is more a reflexion of our limited qualifications in the matter than any doubts entertained as to the validity and precision of the archaeological assessment. As scientists, however, we must simply present as lucidly as we may be able, our own interpretations derived, as yet, in favour of authenticity, from a range of technical and scientific procedures. We can only hope that archaeologists will not merely accept this at face value, but indeed will put forward their own entirely reasonable objections which clearly do obtain. The truth lies somewhere between these limits.

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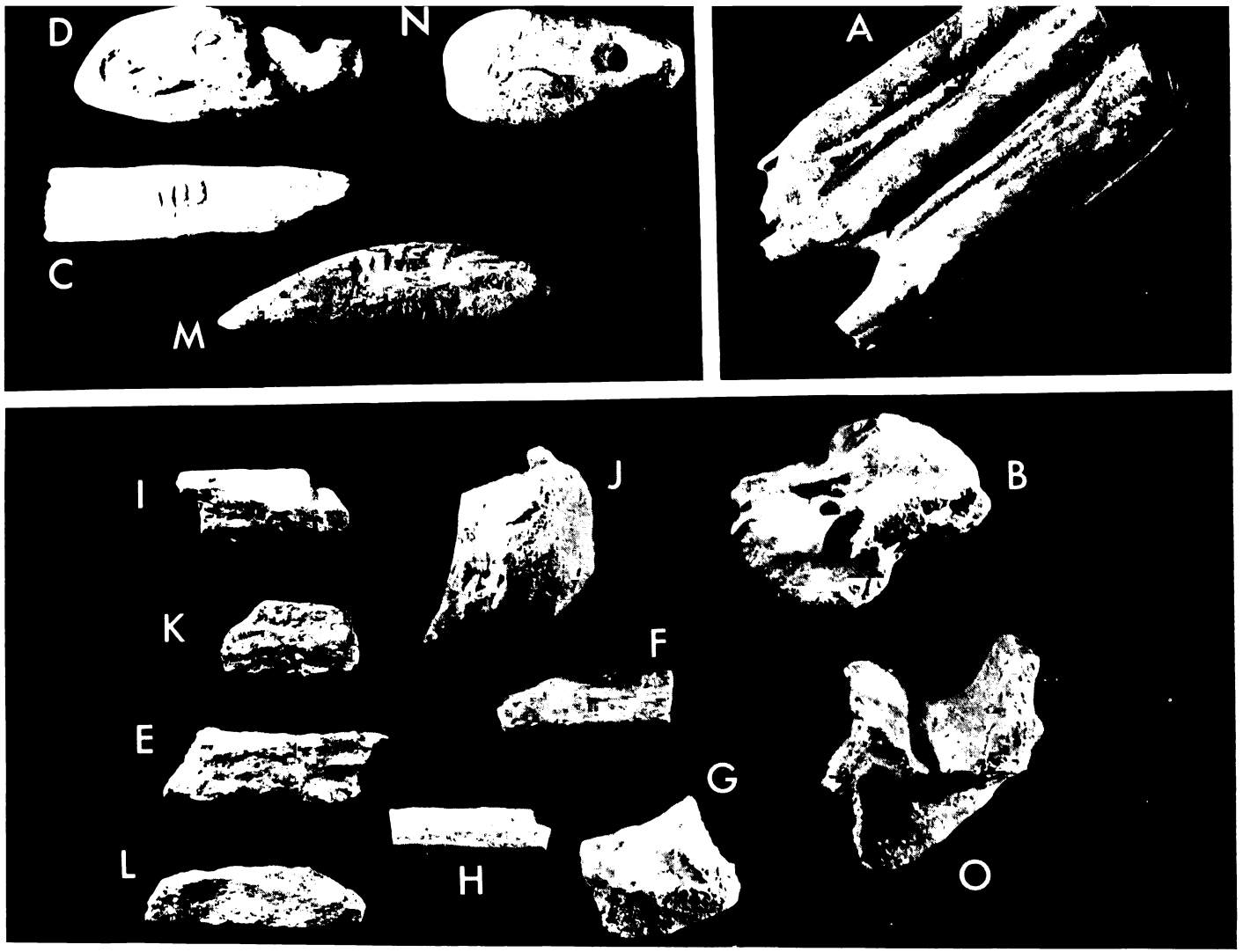

PLATE XXVI: THERMOLUMINESCENCE AND GLOZEL

Bone from Glozel. Upper left, carved and decorated specimens, D, N, C and M. Upper right, A, ox-teeth from decorated urn. Lower, fragments from tomb-like structures I, J, B, K, F, O, E, H, G and L