

PRESIDENTIAL ADDRESS

C. E. CHALLIS

ON this occasion last year I announced a recruitment drive for new members, underpinned by what we hoped would be attractive incentives. One of these, a contents listing to our *Journal* from the beginning to the present time, has now been edited by our Director, and will be available for distribution to new members from the beginning of 1991. It is a substantial document of some seventy pages and I am quite sure that it will prove to be both valuable and popular. Existing members of the Society may purchase the listing at what we hope will be a nominal price.

The new membership medal, which was our second incentive, has progressed equally well. The financial support for which I was looking this time last year did indeed come readily to hand, thanks to the generosity of a number of individuals whom I approached, a handsome grant from the U.K. Numismatic Trust, and the splendid gesture of the Royal Mint which offered to absorb the whole cost of die preparation by designating our medal a training exercise. To my great satisfaction Raphael Maklouf, chairman of the Tower Mint and designer of the present obverse of Her Majesty on our coins, and Mark Jones, the new Keeper of Coins and Medals in the British Museum, very kindly agreed to join with Graham Dyer, Tim Webb Ware and myself to form a small committee to arrange and judge a competition for the design of the new medal. We asked six artists to submit designs and were rewarded by a response which enabled us to make a choice amongst several quality options. Precisely what these options were you will be able to see for yourselves when we publish in our next *Journal*, by way of record of what the competition involved, all the designs together with notes on the artists. In the event, we favoured, for both the obverse and the reverse, designs by John Lobban, an artist very much in form and with whose work many of you will be familiar through the reverse designs he did for the £2 coins issued last year to commemorate the tercentenary of the Bill of Rights and the Claim of Right. Subsequently, so well did our designer cooperate both with the Committee, which asked for a few small alterations to the designs as submitted, and with the Royal Mint, which actually produced the medal, that we were able to keep to a tightly set timetable which has resulted in the medal being finished in time for this evening's meeting. I hope that you will agree when you see it, as you will in a moment when I put on some slides, that we now have a medal of great distinction, entirely apposite and of great charm. I wish to thank most warmly everyone who has been involved in its production. Graham Dyer, who advised me with such professional skill and serviced our committee with such ease, deserves particular mention.

Our third initiative, allowing new members to purchase the five immediately preceding volumes of our *Journal* at the reduced rate of £10 per volume, could be implemented from the very start of this year and I am delighted to say that, in the event, it did prove popular and was undoubtedly one of the reasons why our admissions were higher this year than at any time since the late 1960s. There were thirty-six in all, bringing our total membership, allowing for three deaths and five resignations to 555; of these 427 were ordinary, 6 junior, and 122 institutional. Deducting the ten amovals I have just announced, we are left with a larger and healthier Society than any of us here tonight can remember.

The three members we have lost through death were, in their different ways, equally special: John Brand, Helen Frizzell, and Roy Osborne. John Brand who died on 10 October, 1990, aged fifty-nine, had been a member of our Society for thirty years. When John and I first met in the early 1970s, he had already retired for reasons of health from his chosen profession, accountancy. Subsequently, what accountancy lost, we gained, as he threw himself with vigour and determination into our activities, serving first as Director (1975–80), then as President (1981–3), production editor of the *Journal* (1981–2), and, finally, Librarian (1984–7). His terms of office coincided for the most part with difficult times and it is with no exaggeration that I say that, but for his endeavours, we would not have survived as well as we did, and been able to go on to become the bigger and better Society that we are today. Best known for his expertise on the Short Cross series, John retained his scholarly interests long after his coins were sold, studying first for an MA degree and then for a doctorate, which he was awarded only a matter of months before his death. John set an example to us all not simply through his work or the loyalty and devotion to the Society to which I have already alluded. He had another, very real, strength – that of caring, especially for the young – and I know that I am far from being alone in being able to recount how a friendly and sincere word from John encouraged a prospective student to take numismatics seriously and give tangible expression to this by joining our Society.

Though never a publisher of numismatic work, Helen Frizzell who died on 20 March, 1990, was as well known as any in our circle; partly through her employment at A.H. Baldwin and Sons Ltd., partly through her work on publicity for the British Art Medal Society, and partly through her membership of this and the Royal Numismatic Society. In writing to her mother to express my own sympathy and that of the Society, I

encapsulated my own feelings in the following words: 'of all the many women it has been my pleasure to have had contact with in my professional or numismatic life, none has been more outgoing, more genuine, or more positive than she. Being a northerner myself means, perhaps, that I was particularly well placed to appreciate her cheerful, forthright manner, but her wide circle of friends can leave no doubt of how generally popular and appreciated she was. I shall miss her very much.' These words are as true now as they were then, and may stand. Save only with the addition that, with characteristic generosity, Helen remembered the friends she left behind by generous bequests, of which one in the sum of £5,000 was to our Society.

Roy Osborne died suddenly, aged seventy-seven, on 4 May this year while visiting hospital for a routine check. At the time he was living at Gorleston on Sea, Norfolk, not so very far from Clare where for many years he had worked as a pharmacist and built up a collection in which two specialities stood out: coinage of local mints at Ipswich and Sudbury and the coinage of Charles I. It was to this last that he devoted most of his time and it was in connection with his article on this subject that I first made his acquaintance. It was a very complicated manuscript, compiled over many years, but, as editor of our *Journal* I was determined if at all possible to see it in print. The day was windy and very wet when he kindly agreed to meet me at my flat in London and, as his waterproofs hung dripping in the kitchen, we settled down elsewhere to an absorbing discussion. After several hours, in which there was give and take on both sides, we came up with a mutually agreeable solution: the article would be slimmed down leaving its essential core of pictorial analysis intact and would go into the next *Journal*, printed with the help of a generous donation from him.

At midday our deliberations had been punctuated by a modest meal, during the course of which we touched on the unlikely subject of margarine. You may question if this was so and why, even if it were. I should make mention of it now. The answer is simple. On his maternal side, he told me, one of his ancestors had been instrumental in the development of margarine, a substance which his relative believed to be of such importance to the improvement of the diet of the poor working man that he freely made his knowledge available rather than restricting it through patent for his own pecuniary gain. Roy Osborne was deeply impressed by this act, and was in turn to display precisely the same instincts in using his own substance to further causes in which he himself believed. We were the principal of those causes and under the terms of his will are to receive from the sale of his coins, no less than £50,000. This handsome gift – the largest by far in our whole history – we receive with deep appreciation. We must ensure that we use it wisely so that the Society enjoys, as Roy himself would have wished, the best possible advantage from it.

In our programme of lectures this year were included not only our old friend Marion Archibald, threading her familiar academic way in the scrupulous analysis of hoard material – this time the Wicklewood, Norfolk, hoard of coins of Stephen and Henry II – but also a band and a most welcome band at that, of new faces. Mr Bonser shared with us his thoughts on single finds, a subject he has done so much to foster and elucidate, and M. Dhémin teased us with the numismatic conundrum of an Offa sceat from France. Four others – the Rev. Rice, Mr Wager, Mr Stott and Mr Egan – trod a slightly unfamiliar path in their exposition of King James's gun money, Birmingham workhouse tokens, medieval London tokens and leaden cloth seals. Initially, I know, some members feared not a little for their numismatic safety at the prospect of being exposed in the course of one year to so much base metal, but the excellent audiences we enjoyed on these occasions were vindication enough of our Director's decision to ring the changes and show that we are indeed a broad church. Our final speaker was, fittingly, the greatest in stature, Professor Henry Loyn, our second Linecar lecturer. Of all my distinguished colleagues in the field of early medieval history, none is better qualified than he to bridge the gap between history and numismatics and he delighted his audience with a finely crafted lecture, delivered with memorable style and eloquence.

Coupled with our thanks to Robert Thompson for the programme we have just enjoyed must also go our thanks to him as a retiring officer. Robert's other commitments, commendably numismatic, I hasten to add, in the form of publishing the Norweb collection of tokens, mean that he has found himself uncomfortably stretched in recent months and has felt it only right to step down as Director. He leaves behind two programmes of lectures: the first for our normal monthly meetings and the second for a one-day conference to be held in Oxford on 15 June 1991, on the coinage of the reign of Stephen. This, the latest in our series of meetings outside London, will bring together distinguished historians and numismatists and I very much hope that many of you will be able to join us.

Robert Thompson is succeeded by Dr Donal Bateson who, by reason of being an Ulsterman yet for some years now earning his living as Keeper of the Hunter Cabinet in Glasgow, gives us two flavours of the Celtic fringe in one. A third comes from the National Museum of Wales in the form of Mr Besly, to whom, as you will remember, it was my pleasure to present earlier in the year Council's prize for the encouragement of research by younger scholars. Mr Besly replaces Dr Cook as production editor of our *Journal*; Dr Cook replaces Mr Dyer as literary editor. In extending our thanks to Mr Dyer for his efforts during his brief spell of office, we should also recognise, as I know he himself would, the particular debt we have to Dr Cook for providing an efficient and steady element of continuity in our editorial team.

Efficiency and continuity are the characteristics also of our Treasurer, Tim Webb Ware, who once again has handled our monies with masterly precision. I am sure that it is as much a comfort to you as it is to me to know

that our financial affairs are in such good hands. Of the two remaining officers who retire this year the first I should mention is Mr Bland, our Librarian. During the past twelve months he has continued to apply himself to the question of cataloguing our library on computer, and, although not all the books have yet been entered up, the new system is in essence in place and we are all greatly indebted to him for this and for his other work, done quietly and with great efficiency, as Librarian.

Finally, it is my pleasure to say a few words about Wilfrid Slayter, our retiring Secretary. Since his appointment in 1962 he has seen off more Presidents, served with more officers, and, indeed, been an officer himself for longer by some margin than any other member of our Society.

During that time Wilfrid has acted with unswerving loyalty, painstaking attention to detail and gentle good humour. Today, as I have already reminded you, we have more members than ever before. Of course, Wilfrid would not claim either to have been our sole recruiting officer or to have magical powers over the ballot box. Nevertheless, it is the case, at least so far as I am aware, that during his term of office all the votes have fallen at ballot time into the 'yes' compartment, thus ensuring that all our nominations have finished up under Wilfrid's watchful eye as full subscription-paying members. What more can one ask of a Secretary?

Wilfrid has served us with more devotion than we deserve, for longer than we had any right to expect, and with a selflessness that is a model to us all. Today we say thank you, and we do so not just in words but also through two gifts.

The first is a subscription from his many friends throughout the Society; it was gladly made and it is with great pleasure that I shall in a moment present it to him on their behalf. The good wishes which accompanied these contributions and the expressions of thanks for his good offices over many years – especially from our overseas members – are eloquent testimony of how widely and warmly he has been appreciated. The second gift is also from his friends within the Society, but from a rather special group. As I said at the outset, he has a unique place in our history by virtue of serving longer in any office than anyone else, and I thought it right that this should be commemorated in a special way. Accordingly, I have commissioned his own portrait medal which comes to him from the present officers of the Society and all those who have served with him since 1962 in one capacity or another and are still with us today. As officers we salute our most special officer.

The portrait was done for us by Mr Bob Elderton, who I am very pleased to say is with us this evening, and the Royal Mint did the casting. They have combined to give us a handsome piece of which there is one unique example in silver – this one, which is Wilfrid's. There are also eight in bronze: three for Wilfrid to dispose of as he wishes; one for the artist; one for the British Museum; one for the Royal Mint; one for Baldwin's collection of medals relating to numismatists, kept for historical rather than commercial purposes; and, finally, one for the American Numismatic Society, in token of the excellent Anglo-American numismatic relations we have enjoyed over many years, and which Wilfrid has done so much to foster. This is not just a special medal it is also a very limited one.

It is my pleasure now to present these gifts to Wilfrid on behalf of the officers and all his many friends and admirers within the Society. He leaves us with our very best wishes for a long and happy retirement – none has been more deserving (pl. 37, 1).

Customarily at this point your President reads out a list of hoards found in Great Britain and Ireland in the past year but this evening, when our presentation has had pride of place, time presses. With your permission, therefore, I shall break with precedent and omit the recital, promising the while to include a full list in the printed version of my text.

[The list which follows was very kindly supplied by Dr Bateson, Mr Besly and Dr Cook.

SCOTLAND

none

WALES

Llanafan, Dyfed. March 1990. 30 sovereigns and 3 halves, Victoria–George V (1913)

ENGLAND

Celtic

Winterbourne Monkton, Dorset (additional). November 1989. 46 Durotrigian silver coins, 1st century BC.
Fring, Norfolk. March 1990. 152 Icenian silver coins, early 1st century AD.

Roman

Barway, Cambs. 1987–9. 12 AR denarii to Antoninus Pius.
Membury, Wilts. (additional). Throughout 1989. 3 AR denarii, c. 43 AD.

Great Melton, Norfolk (additional). May 1989. 5 AR denarii to Marcus Aurelius.
 Waddington, Lancs. October 1989. 30 AR denarii, to Hadrian.
 Sutton, Suffolk (additional). April 1990. 3 AR denarii, c. 43 AD.

Medieval and Modern

Springthorpe, Lincs. Aug–Sept. 1990. c. 46 AR, pennies and fragments of Edward the Confessor. Helmet type, c. 1055.
 Torksey, Lincs. Spring 1990. 10 AR, William II *BMC* type III, c. 1073.
 Wingham, Kent. Throughout 1990. 531 AR pennies, Edward I, mid 1290s.
 Sutton-on-Sea, Lincs. September 1990. 21 AR, halfgroat and pennies, 1380s.
 Reigate, Surrey. September 1990. 135 AU, c. 6,700 AR, Edward I–Henry VI, c. 1460.
 Barrow Gurney, Avon. June 1990. 59 AR, c. 1605.]

LAST year, the second part of my address ended with both a conclusion and a promise: the conclusion, based on close scrutiny of manuscripts written contemporaneously with the experiments of Eloy Mestrell in mill-struck coinage, was that that coinage was indeed produced, notwithstanding some recently expressed doubts, by a press; and the promise was that I would report back to you as soon as may be on experiments which I had set in train to ascertain, first, what electron microscopy could tell us about the structure of Mestrell's coins and, second, what a series of trial strikings in a screw press, using blanks differing in thickness and in hardness and without the restraining effect of a collar, could tell us about observed characteristics of Mestrell's coins, such as fish-tailing. I am happy to say that these experiments are now complete and it is my pleasant duty readily to acknowledge my debt to David Sellwood for his helpful advice in general; to my colleague in the University of Leeds, Dr Christopher Hammond of the School of Materials, Dr Peter Hatherley, Manager Materials Development at the Royal Mint, Neil Philips and Gillian Prosser of the same institution who between them conducted the microscopy work; and to Mr Haydn Walters and his colleagues in the Royal Mint who undertook the trial strikings. It is to the results of these two sets of investigations that I now wish to turn.

My remarks on the question of striking begin with a report on experiments made under contract to the Royal Mint in 1974 by the Tribology Centre at the University College of Swansea, entitled 'An Investigation into Coining under Controlled Conditions'. The report, kindly brought to my attention by my old friend Vincent Newman, formerly Chemist and Assayer at the Royal Mint, covered 'the coining of three materials, cupro-nickel, nickel and stainless iron of various gauges, using dies of a simplified design with different forms, viz. flat and hemispherical. Other important variables investigated were the use of different collar sizes with the two die forms, and the effect of blank lubrication'. In its choice both of metals and the use of collars the investigation introduced variables from the Mestrell situation, in which silver is coined without a collar, and obviously it is important, therefore, not to assume that everything that was observed in 1974 has relevance for an understanding of what happened 400 years previously. This said, the report is highly instructive, especially for what it has to say on coining load. 'The coining load required to produce full relief', it says, 'depends on the coined material'. 'The thinner the blank used the greater is the coining load required to give full relief.' And 'the required coining load decreases when the amount of die form is increased'.

Put another way, metal moves more easily between dies with form, i.e. dies which are curved. As the dies close, the domes meet the blank before the rest of the die surface and metal displacement occurs progressively. Since this characteristic of easier metal displacement is found again as the thickness of the blank increases, the consequence is that dies with form, stamping a blank of reasonable thickness, need to be operated with much less tonnage or force than dies which are flat, operating on thin blanks.

With these observations in mind, let us turn to our striking trials at the Royal Mint, in

which dies for the current 2p were used. Given that these dies had form we could have predicted that the designs would be better struck up at the same force on the thickest blanks. Here we have three silver blanks of 1 mm, 2 mm and 3 mm, struck in a small screw press. None is fully struck, but the 3 mm blank is the best. The precise weight of the blows delivered in this screw press we had no ready means of knowing, so in order to do a proper growth experiment in which we could see at what precise tonnage a particular degree of coining was effected we made use of a modern press controlled to strike one coin at a time, with or without the use of a collar.

We discarded the collar and did two runs, striking at five tons and then at approximately five ton intervals, using, first, annealed or softened blanks and, second, unannealed or hard blanks. First, the annealed blanks. Since we used the same dies with form as in the screw press it was not surprising that the central design began to be struck up at fairly low tonnages and at 30–40 tons we observed fish-tailing on some letters; i.e. metal displacement was outwards from the centre into the letter shapes but, there being no collar to stop this movement at the edge of the coin, there was no back extrusion of metal finally to make the letters completely (pl. 37, 2). In the 50–60 ton range fish-tailing became less distinct and dropped to only a hint from 70 tons to 90 tons, our upper limit (pl. 37, 3). At these higher tonnages we may suppose that it was sheer compression that caused the letters to be fully made. The overall flow of metal outwards became so marked from 55 tons onwards that the flan buckled and spread to as much as 22 per cent above its original size. At no point in the whole growth experiment was the coin design ever fully made.

In the second run, using hard blanks, there were strong similarities. The central design came up fairly quickly and at 30 tons fish-tailing began to appear (pl. 37, 4). At 55 tons buckling of the blank once again began and the flans at the end of the run were once again approximately 22 per cent above their original size. Once again, at no point was the whole coin design made (pl. 37, 5).

Against these similarities must also be set distinct differences. First, at 60 tons the blanks began to split and it was concluded that this was the maximum loading which could be given without damaging the dies. Second, far from the fish-tails disappearing as the loading was increased above 50 tons they remained well formed. Clearly, the metal was too hard to allow further compression to occur as on the annealed blanks to enable the letters to fill completely.

The significance of these simple experiments for our discussion of Mestrell are several. To begin with, because neither trial produced coins as Mestrell had been able to do, almost invariably well-struck up and neatly finished at the edges, it seems clear that whatever the precise shape of his dies they were not formed. Secondly, we can offer an explanation of why there are Mestrell shillings of three sizes – large (32 mm or more) intermediate (30.5–31 mm), and small (30 mm or less). All these shillings are undated but must in all probability have been struck contemporaneously with Elizabeth I's hammered shillings made during the great recoinage of 1560/61. It will be recalled that the range of silver recoinage denominations ordered in November/December 1560 – shilling, groat, half-groat and penny – was replaced a year later by a new range consisting of the sixpence, threepence, three-halfpence, and three-farthings. The evidence of the experiments would lead one to suppose that Mestrell started with the large thin blank and finished up by trial and error, taking in the intermediate blank size on the way, with the more satisfactory small blank which was thicker and more easily struck. Logically, too, we may suppose that it was precisely because this small blank proved to be so satisfactory that experimentation stopped and Mestrell struck most of his shillings at that size. This is precisely what the numismatic evidence suggests and I wish to acknowledge here how pleasurable and beneficial it has been to discuss this particular aspect of the problem with Mr Christopher Comber. The large shillings, some of which incidentally display edge splitting, come first

and are scarce. The intermediate come next and are more plentiful. The small come last and are plentiful. Significantly, the small blank shilling is only known from one set of dies. These conclusions about the satisfactory nature of Mestrell's small flan may at first sight appear to be jeopardised by the small flan shilling in the Welsh National Collection, to which I referred last year. That, you will recall, had fish-tails and can hardly be said to be technically satisfactory. A quick glance back at my second growth experiment suggests a ready explanation. In that experiment, you will recall, fish-tails appeared but never went away despite increased coinage load – the blank was unannealed and simply too hard to allow complete filling of the letters. It may very well be that it was the hardness of this small Mestrell blank which caused the fish-tailing. If this was so, since fish-tailing on Mestrell's coins is rare, we may conclude that his mistakes in annealing were exceptional.

Finally, the experiments at Swansea and in the Mint have relevance for our Mestrell discussion in the following way. If thin blanks are more difficult to strike and require a greater coining load it follows that wear and tear on dies must be considerable. In practice, therefore, we should expect Mestrell's dies to have lasted for relatively short periods of time and that when they gave out they were shattered beyond use rather than damaged in some small area which could be remedied by repair. Once again, the numismatic evidence which shows considerable die variety and, so far as I am aware, no sign of die repair, bears out these expectations.

Let us turn now to look at the experiments involving electron microscopy. Eight coins were selected, six being of Elizabeth I and two of Charles II. The first and third were Mestrell sixpences of Elizabeth bearing mm.star and the date 1562. These were die duplicates, having been struck from the same dies, with the dies in identical alignment. Coins 2 and 4 were also sixpences this time hammer struck bearing, respectively, mm.ermine and the date 1573, and, mm. Greek cross and the date 1578. Coins 5 and 6 were threepences, one of mm.sword, 1582, was in the hammered series, and the other, mm.crown, 1684, was of the milled series of Charles II. Finally, there were two half-groats, coin 7 being hammered, mm.bell (1582–3), and coin 8 milled, mm.crown (c. 1662).

This selection, which was made possible partly by my own purchases but also by the generosity of A.H. Baldwin & Sons and my own University's Coin and Medal Collection, permitted comparison, first, of hammered and milled coins of the same denominational size, and, second, of milled coins of Elizabeth with those of the Restoration period.

Each coin was cut in quarters to provide three surfaces for examination: a face, a vertical section and a horizontal section (pl. 37, 6).

As you may know, copper and silver are two metals which show complete liquid solubility but limited solid solubility, which means that when they are mixed in the proportions normally used for English coinage, 92.5 per cent silver and 7.5 per cent copper, about one per cent of the copper becomes entirely absorbed, rather like salt is dissolved in water, and the rest appears as particles embedded in the silver. These particles, themselves not entirely pure for they contain about two per cent silver, were what I wished to examine on the three surfaces of the coins just described. Since I was interested in directional flow, it was important that we polished, rather than etched, the three surfaces as finely as we could. All three were mounted in a bakelite mount and then ground with silicon carbide paper. Subsequently, polishing was achieved on a vibromet – a felt pad impregnated with one micron alumina slurry and gently vibrated for several hours. Washed in methanol and dried without in any way being touched, the sections, now roughly half the thickness of the original coin, were ready for examination. This was done through a Reichert inverted light microscope at a magnification of $\times 50$. The bright field illumination meant that the particles appeared as black specks or short lines.

Coin 7 is a fairly typical hammered piece with, as was so often the case, a distinctly

ragged edge in places. Here the particles swirl about in no particular direction and this is very much what we would have expected. The coin was hammered and as the blows of the hammer fell randomly, so the particles moved accordingly. The same was true of coin 2 (pl. 37, 7) and coin 5. At first sight, there seemed to be some directionality of the particles in coin 4, running at roughly ninety degrees to the outer edge. However, since this directionality did not alter as the section was turned round, we concluded that the particles were moving in a radial direction and were, therefore, not indicative of a rolling action. Examination of another part of the face, where there is a completely random pattern, made the point conclusively.

Coin 6 presents an entirely different appearance. The particles are elongated and run in clear directional lines. This sheet had been through Blondeau's rolling mill (pl. 37, 8).

In coin 8 directionality is less clear than in the previous coin but the particles which are fairly elongated, as one would expect in rolled strip, do flow fairly consistently. Why the particles in the coin of 1662 do not look exactly like those in the coin of 1684 can only be conjectured but one possibility must be that in the twenty years which intervened between the two striking rolling technique was significantly improved. (pl. 37, 9).

With these observations in mind concerning the different arrangement of particles in the hammered coins of Elizabeth and the milled coins of Charles II, let us now turn to the two coins of Mestrell which we examined in the experiment. Here we see further elongation and further directionality though much less clearly than before (pl. 37, 10-11).

If it is correct to suppose that the explanation of this may be attributed to the inability of the one-horse mill of Mestrell to roll at the same even pressure as a three-horse mill of the 1680s one must also allow for the effect of Mestrell doing his rolling three, four or five times between the cutting of the first blanks and the cutting of the second. Even if we suppose that Mestrell made every effort to put his blanks through the rollers always in the same line this must have been very difficult to achieve in practice, and with every deviation that occurred the directional flow of the copper particles must have become increasingly obscured.

To investigate what was happening at the edge of the coins where it appeared that there was some deformation we looked at the cross sections of the samples. On the two Mestrell coins nothing very clear emerged but on coins 8 (pl. 38, 12) and 6 the vertical sections showed clear signs of turning down.

How was this turning down achieved? Was it the result of edge rolling, or was it simply the result of the punching out process? On a modern 2p blank, turning down is very clear (pl. 38, 13).

To throw further light on the subject we looked at the sample again; this time etching up the grain structure with chromium trioxide-sulphuric acid. Whereas previously we had only observed copper particles in a silver matrix, now we were looking at the grain structure established during the final annealing in the production process. Essentially, the grains are polygonal with a Widmanstätten precipitation of copper (formed during cooling because of the reduced solubility of copper in silver as the temperature diminishes).

A cross section through the edge of coin 1 revealed an equi-axed, i.e. undisturbed, grain-structure which continued to the extremity of the edge and so we have no evidence here of edge working. Also note that there appears to be a flow of copper particles into the top right corner; the result of an earlier deformation process – presumably blanking (pl. 38, 14).

A second cross section of coin 1, this time through the struck face, illustrates the local distortion of the grains at the surface and shows the sort of structure we should expect to see if there had been any edge rimming. The distortion here, of course, has been caused by the downward pressure of the die (pl. 38, 15). A section through the edge of coin 3 revealed some evidence of edge deformation on what is in general a poor edge profile. This could be due to damage in circulation but is more probably the result of the manufacturing

process. Sections through the edges of coins 6 and 8 revealed a silver enriched layer on the outer face, an equi-axed structure and a flow of copper particles which indicated the blanking action (pl. 38, 16–17).

To conclude. In the first place we have an apparent conflict of evidence in respect of the machine-made coins of Charles II. When we look at the directionality of the copper particles we see a distinct change at the edges of the coins, suggesting that these edges have been treated in some way. When, however, we look at the grain structure there is no sign of edge deformation. Thus, one must conclude that the degree of deformation in the grains was too small to measure; *or* that the coins were *not* edged, i.e. the copper particle evidence means nothing; *or* that the coins were edged, i.e. the grain structure evidence means nothing because the coins had been re-annealed subsequent to edging. This problem is, presumably, capable of solution by a further experiment using both the etching and the polishing techniques on a coin which we know definitely to have been edge-rolled.

Second, as far as Mestrell is concerned, there are three, related, points which need emphasis: blank thickness, die life, and metal preparation.

Blank thickness Thicker blanks, we have seen, enable the design on a coin to be brought up more easily, using a smaller coining load. Mestrell seems to have understood this principle and followed it in the manufacture of shillings but, if so, why we may reasonably ask did he not apply it to his principal denomination, the sixpence? One conjecture is that the range of silver denominations at that time made it difficult, if not impossible. If we are correct in assuming that the shilling was struck in 1560/61, the nearest denomination to it was the groat and, even when the 6d was introduced in 1561, the smallest flan shilling was still appreciably larger and could not be confused with a smaller denomination. This clear differentiation did not exist between the sixpence and the groat and, had he significantly reduced his sixpence blank size, confusion would have followed. There were those still alive in Mestrell's day who could recall that in 1549 the 8oz shillings had had to be discontinued specifically because their small size had rendered them likely to be confused with groats.

Die Life Thin blanks, requiring heavier coining loads to bring up the coin design, reduce die life; and so too does the use of flat, or unformed dies. Since Mestrell's blanks were thin and his dies unformed he worked in conditions which were far from ideal and which eventuated in heavy die loss. How far he was able to minimise this by forging his dies to a higher standard than was customary for hammered coins we have no available means of knowing.

Metal preparation What we can say is that he was well seized of the importance of preparing his metal properly prior to striking and went to some lengths to achieve this. On this our experiments and documents agree.

On this hammered coin, coin 2, the edges have been eaten away by the etchant, indicating that some corrosion/oxidation has occurred (pl. 38, 18). This, in turn, is a sign that a great deal of hammering had taken place. Another section of the same coin shows clearly the poor quality of the struck face, which is cracked (pl. 38, 19).

Our analysis showed that Mestrell's coins were of much better quality than this; his metal was much less damaged and contained fewer impurities. He rolled his blanks several times and annealed them as many as five times to give his dies the best possible chance of success. He may even have filed off minor edge imperfections, which could account for the edge deformation which we saw on coin 3. However this may be, his labours were not in vain for, as we all know, he produced perhaps the most handsome coins of the entire Elizabethan Age.