a parent as one who develops it at a later age? I think there is not a doubt as to the answer to be given; those who become insane before twenty-five, even if they recover, are far less likely to become parents than those who become insane at late ages—many, indeed, of them, considering the high death-rate of the insane, will die before they could become parents of large families. Now Dr. Mott took 508 pairs of parents and offspring, "collected from the records of 464 insane parents whose 500 insane offspring had also been resident in the County Council Asylums," and ascertained the age of first attack. As at present advised, it seems to me that his data must indicate a most marked antedating of disease in the offspring, but an antedating which is wholly spurious. There is, I think, a further grievous fallacy involved in this method of considering the problem; but before discussing that I should like to see if my criticism of this method of approaching the problem of antedating can be met. KARL PEARSON.

Biometric Laboratory, University College, London, November 11.

Is the Earth Shrinking?

I HAVE carefully looked at this question from every point of view which presented itself to me, and doubt very much whether any direct evidence will ever be forthcoming on this subject, unless it should one day be established that the changes of magnetic declination are associated with a slight difference of rotation between the core of the earth and its crust, for such a movement would have to be explained by a difference of rate of contraction between the two.

The foldings and crackings of the earth's surface have been attributed to variations in the rate of cooling of the earth. Thus whenever this rate is accelerated, the surface cools faster than the core, and should crack like a drying ball of clay; whenever the cooling rate is diminishing, as assumed by Lord Kelvin, the core should shrink faster than the skin, like a drying apple, and folding should occur. But to my mind, as recently explained in "Unity in Nature," such effects would be entirely masked by such foldings and crackings as are slowly progressing even to-day, for the sediment which is being constantly deposited on the floors of the oceans must cause the underlying strata to grow warmer and to expand in every direction, resulting in slight local risings, which are most marked near the mouths of large rivers, and in distant bulgings and foldings of the weakest lines of the earth's crust, which are the mountain ranges. On the other hand, the gradual wearing away of the surfaces of the continents and mountain ranges must cause the underlying strata to cool, to shrink, and to crack. This suggestion would certainly more than account for all the foldings, faults, and cracks to be found in the earth's crust, even if a considerable allowance be made for those cases in which the expansions and contractions occur in the same direction, and partly balance each other.

C. E. STROMEYER.

"Lancefield," West Didsbury, November 7.

THE HARDNESS OF COINS.

HARDNESS is a word which is used in various senses. In dealing with metals, it sometimes means the cutting or scratching hardness, but is more often defined briefly as the *resistance to permanent deformation*, a property which is of great importance to all users of metals. It is this kind of hardness with which those engaged in minting are chiefly concerned. When a blank is struck in a coining press, the metal is compressed and at the same time forced to flow into the recesses of the dies, and the ease with which this can be done depends on the amount of resistance offered by the metal to a force momentarily applied and tending to deform it. The hardness should therefore be measured by the effects of a sudden blow, and falling-weight machines, such as Shore's scleroscope, offer a ready means of doing this.

The hardness numbers given below are scleroscope readings, about which it may be said that a piece of metal giving a higher reading is certainly harder than a piece of similar metal giving a lower reading, but that the readings cannot be taken as proportional to the hardness, except as a rough approximation. It cannot be admitted, for example, that a specimen with a hardness number of 40 is exactly twice as hard as one with a hardness number of 20.

The application of hardness tests to the coins of the realm has resulted in some curious and interesting data being obtained.[1] It is found, naturally enough, that the blow of a coining press does not raise soft metal to a state of maximum hardness. A sovereign blank after annealing has a surface hardness of 25·5, and this is raised to 50–53 on being struck in an ordinary press, the maximum hardness of standard gold being about 76. Silver coins of similar size are hardened to much the same extent; but while sixpences, for example, have a hardness number of about 50, florins are only 37. These are the hardnesses of the "table" or flat portions of the coins, but the raised portions of the designs are much softer, especially the highest parts of large thick coins in high relief. Thus in George V. florins the centre of the effigy has a hardness of only 31, that of the annealed blank from which the coin is struck being 27·5. Such coins will evidently wear very differently from coins made in low relief, such as the modern French coins, in which the surface hardness is higher and more uniform.

The hardness of the surface of coins, however, differs widely from that of the interior. The force of the blow seems to be expended chiefly on the surface layers. When these are carefully removed, the hardness of the underlying metal is found to be considerably less. The hardness rapidly falls off with depth, and near the centre even sixpences are almost as soft as annealed silver. Old worn coins are similarly soft.

It is clear, therefore, that a freshly-minted coin has a hard skin and a soft core, and that after the removal of the skin by wear, the loss of weight in circulation will proceed very much as though the coin had been annealed before it was issued. That this is a matter of some importance is illustrated by the fact that the loss by wear of the coinage, which falls on the State, amounts to 30,000*l.* per annum for gold, and somewhat more for silver.

Annealing, one of the oldest processes prac-

[1] Memorandum on "The Hardness of Coins," 42nd Annual Report of the Deputy Master of the Mint, 1911, pp. 107–112.

tised in the arts, has had a surprisingly small share of the attention which has been paid to metals by numerous observers in recent times. Experiments made at the Mint[2] with coins and coinage alloys gave such remarkable results that the experiments were extended to pure metals, and have enabled a fairly complete account of the

FIG. 1.—Structure of pure gold after being rolled. ×11.

course of events in annealing to be clearly stated for the first time. It appears, from a large number of observations, that at comparatively low temperatures metals and alloys, hardened by rolling or hammering, are in an unstable condition, and undergo a gradual change to the soft state. The old standard silver and gold trial plates, for

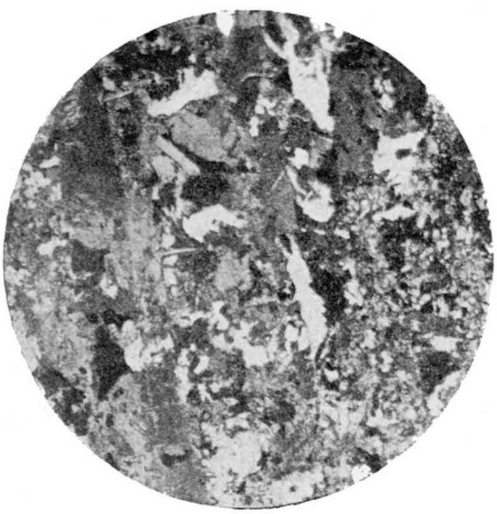

FIG. 2.—The same rapidly heated to 200° and quenched at once. ×15.

example, have in the course of centuries, at the ordinary temperature, become almost completely softened, while lead appears to soften below the ordinary temperature. As the temperature rises the change is hastened, and a *critical range* is passed through, varying in extent for different metals, below which annealing is too slow for practical purposes, while above it metals and alloys revert from the hard to the soft state almost instantaneously. During the critical range, the time required for annealing undergoes a significant reduction with each slight increment in the temperature, while above and below the critical range, the change in the time is small even with great differences of temperature.

Pari passu with softening, recrystallisation takes place, not by diffusion, but by a change in the orientation of molecules *in situ,* as predicted by Dr. Beilby. When the softening is instantaneous, recrystallisation is almost, if not equally, instantaneous. Thus, for example, pure gold, which can be annealed in a few days in boiling water, softens at once at 200°, and the large primary distorted crystals (Fig. 1) break up simultaneously into smaller irregular ones (Fig. 2). The gradual growth of crystals, which has been studied by Ewing and Rosenhain and by others, takes place subsequently without much further softening. T. K. ROSE.

[2] "The Annealing of Coinage Alloys," Journal of the Institute of Metals, September, 1912.

INTERNATIONAL CONGRESS FOR GENERAL AND MEDICAL RADIOLOGY.

THE sixth meeting of the above congress was held this year at Prague, and was attended by a large number of scientific workers. This society has now a membership of 600, and embraces workers of many nationalities. The opening meeting took place in the Landes-Museum on October 3, and was attended by more than 2000 people. At this meeting addresses were given by Prof. Stoklasa, of Prague, who is president this year, and by Prof. Becquerel, of Paris. At the subsequent meetings of the congress, no fewer than 130 papers were read on physical, biological. and medical subjects. Among the excursions made by the members was one to the uranium mines of St. Joachimstal, from which most of the radium in use has been obtained.

The president chose for the subject of his address the action of the rays from radioactive bodies, and of ultraviolet light, on animal and plant organisms. In the first part of his speech he gave a short account of the development of our knowledge of the connection between electricity and life processes during the last two hundred years. He gave next a summary of the results of the last few years of the action of radium rays, and of ultraviolet light, on living organisms. The germination of seeds, and the development of fungi, flowers, and leaves, may be accelerated under certain conditions by these radiations, whilst, under other conditions, these processes may be entirely arrested. An intense source of α-rays from radium, for instance, has a destructive action on plant and animal organisms, while a weak source has a stimulating effect. The action of the more penetrating β-rays is similar to that of the ultraviolet rays of short wave length. These latter rays have a chemical action on the