looked for once every fourth or sixth year, for it is not claimed that inoculation cures "sickness" and increases the frequency with which leguminous crops can be grown. Even a 50 per cent. increase in crop, useful though it would be, would in these circumstances hardly effect any particular revolution in agricultural practice. We are therefore unable to follow the author when he remarks:—"For a few thousand pounds the 21 million acres of poor barren land in this country could be made productive and rendered capable of finding work for and supporting such a population that both the food problem and the unemployed problem would be easy of solution. . . . Waste land reclaimed and made fertile for 6*d.* an acre! . . ." It would have been better if the author had induced an agricultural friend to revise this estimate. We are told on pp. 8 and 10 that inoculation will be a failure when the soil is too acid and in need of lime, when it is deficient in phosphates and potash, when the physical conditions of the soil are unfavourable, or when drainage is needed. Barren land in England commonly suffers from several or all of these defects. How far would sixpence an acre go in putting them right?

At a time when the farmer needs, and is willing to accept, all the assistance the scientific investigator can give him, the fact that an enthusiastic worker like Prof. Bottomley has directed his attention to agricultural botany is a matter for congratulation, and we can only regret that in this, his first appeal to the practical man, his enthusiasm should have outrun his judgment. However, although we must regard the present production as unsatisfactory, we still look forward to sound work from the author on this subject, and we wish him success in his work on the numerous and difficult problems connected with soil inoculation.

E. J. R.

MATHEMATICAL EDUCATION AND RESEARCH.

THE annual meeting of the Mathematical Association was held at King's College, London, on Saturday, January 25. The proceedings bear abundant testimony to the great changes which are taking place in the methods of teaching mathematics, and show that these changes are not confined to the subject of elementary geometry. Mr. W. J. Dobbs showed what useful work could be done by means of simple home-made apparatus in the teaching of mechanics, his apparatus consisting merely of spiral springs with cardboard scales attached for illustrating applications of the parallelogram law, and suspended sticks for illustrating the principle of the lever and the balance. He further showed how the solution of problems on accelerated motion could be greatly simplified by the application of direct methods not involving such restrictions as to units as are necessary in working with "poundals" or "slugs." Mr. C. O. Tuckey made a distinct step in advance in his suggestions as to the methods of introducing the properties of convergent series to students who require these series principally in the study of the calculus, and it is interesting to compare his views with those which prevailed twenty or thirty years ago, when the calculus was regarded as something sacred which should not be handled by students until they had passed through a lengthy period of probation in working with algebraic series. Mr. F. J. W. Whipple's lantern-slides, showing how the convergency of certain trigonometric series could be illustrated by diagrams drawn by mere beginners, were a revelation to those who had approached the subject by the study of pages of long formulæ. Mr. W. E. Bryan suggested a very original way of introducing similar figures in geometry, a method which, however, may well form a basis of further discussion and criticism. An apparatus for drawing rectangular hyperbolas was shown by Mr. H. L. Trachtenberg.

In his presidential address Prof. G. H. Bryan, F.R.S., dealt with the uses of mathematics and the training of mathematical teachers. It was necessary that the public should be made aware of the important part which higher mathematical research had played, and was destined to play, in practical applications on which the prosperity of a nation depended. As an instance, Prof. Bryan referred to the seemingly unpractical and uninteresting study of the properties of imaginary quantities, without which modern applications of electricity to purposes of commerce, including wireless telegraphy, could never have reached their present developments. In order to overcome the existing lack of public interest in mathematical matters it was important that the university training of every mathematical teacher should afford him some insight into the research aspect of some one branch of the subject, and the experiments that had already been made in this direction in the university colleges of Wales showed that this ideal was quite capable of attainment. Turning to the teaching of mathematics in elementary schools, Prof. Bryan expressed the opinion that the children of the working man should learn to measure and calculate correctly in order that they might become more efficient and improve their positions in the labour market. If their teaching was conducted in such a way as merely to stimulate in them a spirit of luxury and discontent as distinct from a desire for self-improvement, the working classes had quite as much cause for complaint as the tax-payers. But in the training of elementary teachers, antiquated and unpractical methods are still prevalent, and are often greatly encouraged by examinational requirements.

RADIOGRAPHY IN PEARL FISHING.

THE products of the sea are commonly wasted to a very deplorable degree by those who gather and use them. In no instance is this waste more marked than in the search for pearls. By the old method, which is still in vogue as a general rule, an enormous number of the so-called oysters are taken from their habitat and destroyed without any thought of economy. It is said that only one pearl is found in 100 oysters, and only 1 per cent. of the pearls found are of any commercial value. Thus some 10,000 of the precious molluscs are sacrificed for every useful pearl obtained. Among these victims there must be a vast amount of immature pearls or seed, pearls *in posse*, which might grow and become valuable gems, which are deprived of that possibility by premature destruction.

In the year 1901 Prof. Raphaël Dubois took radiographs of pearls *in situ* within the shell of *Unio prolifera*, and obtained a clear view of their size and situation in spite of the thickness of the shell in which they were encased. He showed these radiographs at the Linnean Society of Lyons, and remarked that the X-rays might receive a novel application if used in the fisheries of Ceylon, and the destruction of a vast number of the prized molluscs might thus be avoided.

The difficulty of applying the X-rays to many thousands of shells *per diem* seemed sufficient to deter the ordinary person from such a laborious attempt. However, a few years later an electrical engineer of New York, Mr. John J. Solomon, who took an interest in the question of pearls, was struck by the same idea of using the X-rays to detect the existence of pearls within the shell of the living animal. He was then unaware of the earlier experiments of Prof. Dubois, but promptly set himself about the work from a commercial point of view.

He found that an exposure necessary to obtain a good picture did not in any way injure the animal, and even an exposure of ten times as long could be applied without causing its death from the effect of the rays. The dangers lay rather in the removal of the bivalve from its normal attachment and in the time required for its transit from its bed to the laboratory of the photographer: for the pearl oyster is really a kind of mussel, which holds on to some fixed object by a brush of fibrils (*byssus*) growing from its body.

Thus the fundamental principle of Prof. Dubois, to save the life of unremunerative bivalves, bids fair to be carried out by American ingenuity and capital.

For practical purposes, where many thousands of shells have to be radiographed daily, a completely novel kind of plant had to be devised. This was done, and final success was considered to be well in view, when 100 clear radiographs could be taken on an average every fifteen seconds.