ATOMIC ENERGY AND ITS IMPLICATIONS

TWELVE discourses given by scientists and economists of the first rank were delivered at a symposium arranged by the American Philosophical Society to discuss "Atomic Energy and its Implications"; they have now been published*. Four of these are purely physical: "Fifty Years of Atomic Physics", by H. D. Smyth; "Resonance Reactions", by E. P. Wigner; "Problems and Prospects in Elementary Particle Research", by J. A. Wheeler; "Methods and Objectives in the Separation of Isotopes", by H. C. Urey. One by R. S. Stone deals with the health protection activities of the plutonium project. E. Fermi contributes a fascinating account of the development of the first chain-reacting pile, leading up to the historic event of December 2, 1942, when on the removal of about eight feet of the last cadmium strip, "the [neutron] intensity started rising slowly, but at an increasing rate, and kept on increasing until it was evident that it would actually diverge". Nuclear energy had for the first time been produced in appreciable quantities under human control. Fermi says that this first successful pile in the squash court at Chicago University proved exceedingly easy to control. "All the operator has to do is to watch an instrument that indicates the intensity of the reaction and move the cadmium strips in if the intensity shows a tendency to rise and out if the intensity shows a tendency to drop." The strips operate by absorbing neutrons which would otherwise multiply by causing fission in uranium nuclei, and so preventing the chain reaction from becoming diverging.

The remaining six papers, by the natural scientists, J. R. Oppenheimer, Irving Langmuir and A. H. Compton, balanced by the social scientists, J. H. Willits, J. Viner and J. T. Shotwell, form a group dealing with the political, social and moral implications of nuclear energy and in particular of the 'atomic bomb'. It is interesting to compare the views taken by the two sets of men of the possibility of some world government arising in time to stop atomic wars. It is not perhaps unnatural that those whose business it is to deal with human reactions should see the difficulties more clearly than those who work with dead matter, which because it is unreasoning is never unreasonable. In fact two at least of them, Langmuir and Compton, seem convinced of the possibility: "The answer is rather to outlaw war itself. And this can be done by a strong world 'police' which has at its disposal more powerful weapons than any recalcitrant nation can hope to acquire" (Compton). "The proposed solution of the problem of the atomic bomb involves essentially a voluntary limitation of sovereignty of powerful nations to the degree necessary to form a world government capable of preventing war. The difficulties are great but the penalty for failure is world disaster" (Langmuir). Set against these the professionals in social relations: "To remake the constitution of the world and place within it an absolute authority for the prevention of war and its greatest weapon, the atomic bomb, involves so many unsolved questions that those who propose settling it all by a single formula are really but adding confusion to our thinking" (Shotwell); "I am forced to the conclusion that the only conceivable ways in which the world even in theory could be effectively organized so as to assure peace are not available now" (Viner); "I see no hope of world government by formula" (Willits). The expert is not always right, but it is to be feared that this view is more realistic than the former. Yet none is hopeless of a gradual move towards conditions which will make the misuse of this new power less likely, and most stress the possibilities of the United Nations Organisation. The symposium occurred before any of the detailed proposals for control were put forward, particularly those of the Acheson–Lilienthal report, but the whole trend of the papers is in general sympathy with such action. It is not a little remarkable that public opinion in America should have shown itself so willing to accept the very great sacrifices required of the United States in the latter proposals. This broad-mindedness is one of the most hopeful aspects of a difficult situation. The trouble is, of course, that those nations which will submit to restraints do not need them, whereas those that need them will not accept them.

Some of the writers consider the military consequences of the new weapon. It is obvious, of course, that the chief targets will be an enemy's cities, at least until the bombs are much commoner than they are at present. It is less obvious whether the bombs are likely to be an incentive to a sudden treacherous attack, or a deterrent from war altogether. A sudden attack, an atomic 'Pearl Harbour', might indeed break an enemy's morale but it would scarcely destroy his stock of bombs, which are certain to be well shielded and well dispersed. Retaliation might well come from a beaten nation like a bite from a dying viper. It seems to the present writer that the main effect of the possession of atomic bombs by an enemy will be to cause the evacuation of all the principal cities, and this even if the bombs are comparatively few. If the cities are evacuated, their destruction would serve no military purpose and only waste bombs, though one might be dropped occasionally to stop the people from coming back. How far existence would be possible without big cities will depend mostly on the preparations made for it in time of peace. Such preparations, at least up to the planning stage, should now be considered the most important part of any scheme of national defence, especially for Great Britain. They will probably include well-dispersed stocks of food.

It is now time to refer to the most striking of this very able series of papers—that by Dr. Oppenheimer. He is profoundly impressed by the shock which this use of its results has given to the moral justification of science. One is tempted to quote too extensively from this very moving address, but the following expresses it better than any paraphrase: "We have made a thing that by all the standards of the world we grew up in is an evil thing. And by so doing, by our participation in making it possible to make these things, we have raised again the question of whether science is good for man, of whether it is good to learn about the world, to try to understand it, to try to control it, to help give to the world of men increased insight, increased power. Because we are scientists, we must say an unalterable yes to these questions: it is our faith and our commitment, seldom made explicit, even more seldom challenged, that knowledge is a good in itself, knowledge and such power as must come with it." Dr. Oppenheimer sees the discovery of atomic energy with its threat to all the peoples of

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the world as an opportunity, unique and challenging, the opportunity to make peace lasting. He believes in a radical solution, but he recognizes that it cannot evolve rapidly; the first steps will inevitably be very modest. Yet in this way alone, he feels, can the faith of science be preserved, the belief in the unqualified value of knowledge and scientific progress.

As a sequel to an interesting and authoritative account of the methods of isotope separation, Urey discusses the motive of such work, strongly maintaining the value of an understanding of natural phenomena for its own sake apart from its usefulness in peace or war. Wheeler gives a stimulating survey of the present knowledge of elementary particles and the prospects for research. In considering the production of high-energy particles, he points out that it would save much scientific man-power if the proposed National Science Foundation would place a contract with a commercial electrical concern for the development of an accelerator. Certainly, in the past a great deal of the best scientific brains have gone to making machines, leaving diminished energy to use them.

The whole pamphlet is full of stimulating ideas and is well worth careful study. G. P. THOMSON

ECOLOGY AND THE STUDY OF CLIMATE

ON May 15 last, a joint meeting of the Royal Meteorological Society and the British Ecological Society was held in the rooms of the Royal Society, Burlington House, at which a series of papers on the relation of ecology to climate was read. The importance of a proper understanding of climatic factors for the elucidation of many ecological problems needs no stressing: nor does the inadequacy of the climatological data usually available at present, particularly when information is needed with regard either to local climates as determined by topographical variations, or micro-climates arising within particular types of vegetation. This meeting was organised as a means of bringing meteorologists and ecologists into closer touch with each other and with problems which have aspects of interest to each and which cannot be solved satisfactorily without their co-operation.

Mr. G. Manley (president of the Royal Meteorological Society) began the discussion with a paper on "Variations in the Length of the Frost-free Period". He stressed the importance of using measurements of temperature obtained under comparable conditions when making comparisons of the length of frost-free periods in different situations. Minimum temperatures taken within a Stevenson screen are, he considers, much more satisfactory for purposes of comparison than grass minimum temperatures, even when these are taken under standard conditions over short grass. This is largely because of the more closely regulated method of exposure within a screen as compared with exposure over short grass in the open. Mr. Manley then gave four interesting examples showing the effect of variations in topography, or soil, on the frequency and severity of night frost, using data obtained from the Monthly Weather Reports of the Meteorological Office. The relatively frosty character of a situation within a narrow and constricted river valley was demonstrated by comparing temperatures taken at Ushew in County Durham, on a hill above the Weir valley, with those taken at Houghall at a point within the valley, 300 ft. lower in elevation: Houghall was, on the average, about 5° colder on frosty nights than Ushew. In the second example, the station at Malvern was compared with that at Perdiswell on the plain below; the lower station again experienced much the more severe frosts. The importance was stressed of the narrow knife-like ridge of the Malvern Hills as providing a poor collecting ground for cold air on nights when radiation frosts occur, since the severity of night frosts partly depends on the size of such collecting area. In the third example, a comparison was made between two different soil types, one the gravelly loam which occurs at the University Farm, Cambridge, and the other the light sandy soil at the station at Lynford, on the Breckland in Suffolk. The topographical formation is very similar at both places and there is no great difference in elevation. Frosts are, however, much more severe and frequent at the Lynford station than at Cambridge. This is largely to be explained by the relatively low heat-capacity and conductivity of the loose sandy soil at Lynford. The fourth example made a comparison of temperatures within and outside a town by comparing the station in Oldham with that at Barton airfield outside the town; in accordance with common experience, the latter proved to suffer very much the more severe frosts. If, using screen minimum temperatures, the frost-free period of the year is determined, its extent will be related to the local climate of the particular situation. Its extent is thus about four and a half months in a relatively low-lying situation in the Midlands, but may be extended for a further four weeks in a more favourable topographical situation. On the other hand, the frost-free period at Lynford on the sandy and frosty Breckland is only just over two months. Finally, Mr. Manley demonstrated the secular trend of minimum temperatures through the last hundred and fifty years. It would appear that in the winter months of January and December frosts are rather less severe than they used to be, but that there has been little or no change in the severity of spring and autumn frost. This agrees with observations made in Scandinavia.

Mr. Manley's paper provided an excellent prelude to the short discussion given by Mr. W. R. Day (Imperial Forestry Institute, Oxford) on "Local Climatic Effects in Tree Growth". In this he referred to the two factors, frost and exposure to wind. Mr. Day stated that the commonly grown larger trees which suffer from frost injury to any serious extent fall roughly into two groups. There are the species, of which European larch and Corsican pine are the most important examples, the growth-cycle of which is markedly out of phase with the annual seasonal cycle. These either begin growth much too early, as with European larch, or continue growth until much too late, as with Corsican pine; and because of this they suffer seriously from frost in many situations. Then there are also the species which naturally would occur late in the woodland succession and so regenerate under conditions in which previously established vegetation would provide an appreciable amount of shelter from frost, but which are used, for economic purposes in forestry in Great Britain, for making plantations in areas where no such shelter exists. Oak, ash, beech, the spruces and Douglas fir belong to this group. The 'out-of-phase' species suffer the more consistently and severely from frost injury, in suitable situations, and this tends markedly to restrict the areas within which they can be grown