



Fig. 3. Uniformly reduced residual  $M_2$ -tilts on the European Continent. Thick line: approximate direction of border of the Baltic Shield

different areas that have more or less independent oscillations. In fact, when the observations of the residual terms due to  $M_2$  on the Continent are reduced in a uniform way, a pattern of the residual tilts emerges which is remarkably well tied to the tectonic structure of the Continent (Fig. 3). Especially noteworthy are the influence of the Alpine structure at station 5 and that of the Baltic Shield at stations 3, 4 and 7. It seems, therefore, that such measurements may help in revealing tectonic structures and their connexions, especially when the tilt observations, as at Winsford, can be connected with gravity measurements, so that local tilts can be distinguished from extended ones.

Another feature emerges from these measurements. Continuous observations over several years show that there exists a period of great steadiness of the upper strata of the earth during a period extending from April to approximately the end of October. With a fairly sudden change, quite another type of very strong and varied tilting with periods of several days begins, showing a strong activity in the earth's crust. The regularity of this effect is not connected with any variations of temperature in the mine; the temperature is very constant, and its influence on the pendulums has been studied. Nor is it connected immediately with meteorological disturbances or microseisms, as these are comparatively ineffectual during the 'quiet' period. Although the effect is in its special expression quite local, as is shown by the amount of tilt, it seems to be connected with a quite general adjustment of the earth's crust caused by the change of the seasons. A certain parallelism with periods in the productivity of oil-wells in England and with the periodicity of earthquakes seems possible?

In regions of high instability, where earthquakes are frequent, sudden tilts have been observed several days before the occurrence of earthquakes. In the region of Alma Ata, 'tilt storms' are followed by earthquake activity in 85 per cent of cases, and for California the figure is 74 per cent<sup>8</sup>. But also in Europe such conditions seem occasionally to exist. Haid<sup>9</sup> reports that he had to suspend his observations with a horizontal pendulum at Freiburg (Baden), situated at the edge of the 'Rheingraben', a considerable time before the earthquake in Messina, as observations became impossible due to the varying strong tilts.

Thus the sensitive instruments, used in recording earth tides, not only reflect the inner constitution of the earth's interior but also reveal an unceasing activity going on in the upper strata of the earth as a response to the external forces and its own inner stresses.

<sup>1</sup> See Tomaschek, R., *Ergebn. exakt. Naturw.*, **12**, 70 (1933); *Naturw.*, **25**, 177 (1937).

<sup>2</sup> See Lambert, W. D., and Darling, F. W., *Rap. gén. No. 10*, Trav. Assoc. Géodésie, Bruxelles (1951), and former reports; see also Jeffreys, Sir H., "The Earth", 3rd ed. (1952).

<sup>3</sup> Bullen, K. E., *Bull. Seism. Soc. Amer.*, **30**, 235 (1940); **32**, 19 (1942).

<sup>4</sup> Takeuchi, H., *Amer. Geophys. Union Trans.*, **31**, 651 (1950).

<sup>5</sup> Tomaschek, R., *Mon. Not. Roy. Astro. Soc., Geophys. Supp.*, **6**, No. 5, 286 and 372 (1952) and 1954.

<sup>6</sup> Tomaschek, R., *Geofis. pura e appl.*, **25**, 17 (1953).

<sup>7</sup> Tomaschek, R., *J. Inst. Petrol.*, **38**, No. 344, 591 (1952).

<sup>8</sup> Bonchkovskij, W. F., *Akad. Nauk, USSR, Publ. Inst. Seism.*, No. 99 (1940).

<sup>9</sup> Haid, M., *Verh. 17 allgem. Konferenz internat. Erdmessung*, Hamburg, 1912 (Beilage A.X.).

## THE ATOMIC ENERGY CORPORATION IN GREAT BRITAIN

IN the course of a debate, initiated by Viscount Falmouth, on atomic energy in the House of Lords on December 14, the Lord President of the Council made a long general statement of the Government's policy on atomic energy. Lord Salisbury said that the atomic energy project is expanding to such an extent that it may shortly be among the major industries of Great Britain in terms of capital investment, if not of workers employed. It is, he assumed, generally agreed that in accordance with a decision taken by the previous Government, industrial undertakings should not be under direct Civil Service control, and the present Government is applying the conception of the statutory corporation to atomic energy. The project would differ from other statutory undertakings to the extent that it is likely to have very little revenue of its own, most of its finances depending directly on the Exchequer. It will also be an executive and not as those other bodies, an advisory body, and its expenditure is likely to be of the order of tens of millions of pounds a year. For these reasons overall policy must remain firmly in the hands of the Government, and the

financial dependence on voted monies is a reason why the Government would be responsible to Parliament for the general financial requirements of the corporation in a way which does not apply to anything like the same extent in the case of other nationalized bodies. Since also the whole of the staff at the outset would be taken over from the Civil Service, the corporation would require to have exceptionally close links with the Government. This does not mean that it would be suitable for detailed Civil Service control; on the contrary, being at once a research project, working all the time on the frontiers of human knowledge and, at the same time, a large production organization with wide problems of factory management, it requires a flexible organization capable of speedy decisions.

With regard to the chairman of the Board, Lord Salisbury pointed out that what is required is not so much distinguished technical qualifications as wide administrative experience and outstanding general ability. This is what the Waverley Committee recommended, and the Government has accepted, rightly in Lord Salisbury's view, this recommendation; he thought that no man is more outstandingly qualified, by experience and abilities, than Sir Edwin Plowden for this post.

The Government has been anxious from the first to ensure that the administrative changes should cause the minimum disturbance to the work of the project, and this is why consideration of the change was postponed until after the Monte Bello explosion. In practice, two stages are involved in the change: first, that of making the project a distinct administrative entity within the Civil Service, and second, the creation of separate administrative common services which hitherto have been provided by the Ministry of Supply; this must necessarily be taken in hand well in advance of the date on which the corporation itself comes into existence. It is undesirable to complicate this task by dealing with it at the same time as the totally different problems associated in the transfer from the Civil Service to the corporation. Preparatory work has already shown that it would be out of the question to undertake the creation of a separate Civil Service entity and, at the same time, to deal with the problems of transfer to the corporation. These would be dealt with in the second stage. All that could be said at present was that the rights of the existing Civil Service staff would be respected and that there would be close consultation with the staff associations.

With regard to the choice of the Lord President of the Council as the responsible Minister, Lord Salisbury pointed out that, when the atomic energy programme was first initiated during the War, supervision was entrusted to the then Lord President, partly because he was the Minister in charge of Government science projects generally. After the War, responsibility was transferred to the Minister of Supply, mainly because the immediate object of the project in its initial phase was the making of weapons. When the present Government came into office, it was already clear that this situation was changing, and that power reactors for industrial purposes were becoming a practical proposition. The decision to transfer the responsibility to a non-departmental organization was taken when the Waverley Committee was appointed, and accordingly the decision to set up the non-departmental organization was not within the scope of that Committee. The need for a co-ordinating Minister of high Cabinet

rank, without departmental interests of his own, led naturally, Lord Salisbury thought, to the selection of the Lord President of the Council. It would be his function in the new scheme to keep the balance in atomic energy matters between defence and power, and he would have to carry this task of maintaining the balance into his consideration of all aspects of the corporation's activities. He would also have to bear in mind the biological applications of atomic energy, which might have a growing importance in future.

As to the civil application of atomic energy, the major interest in the future of atomic energy is in the possibilities for power production, and Lord Salisbury, commenting on the present rate of consumption of existing fuels, said that in the United States one-half of all the coal ever consumed has been burned since 1920, and one-half of the oil and natural gas ever consumed has been burned since 1940, while the annual world burn-up of sources of energy in 1950 was ten times that of 1850. Whether atomic energy would avert a shortage of sources of energy depends on the world reserves of uranium and thorium, and until new and more economic methods of using these, in particular the breeder reactor, have proved successful there is not much hope for the continuous supply of energy over the centuries to come. Given such success, it has been roughly estimated that if the whole of the uranium and thorium which can be recovered at reasonable costs could be used, reserves of these materials would be equivalent to from three to six times the world economic reserves of coal and some twenty to forty times the world reserves of oil and gas.

So far as his information went, Lord Salisbury stated that the only way in the foreseeable future in which the fission process could be made commercially useful is to produce heat, and presumably the main object would be to use the heat generated in atomic fission to produce steam and from that steam to generate electricity, which would be fed into the grid. Without making any statement about the nature of the future relations between the Atomic Energy Corporation and the British Electricity Authority, Lord Salisbury said that the main objectives of the atomic energy project over the next thirty to forty years are likely to be, first, the production of sufficient electricity in nuclear reactors to enable the rapidly growing demands of Britain for electricity to be met without imposing an intolerable additional burden on the coal industry, and, secondly, so far as possible, the replacement of some portion of the 30-40 million tons of coal which are now used annually in the generation of electricity.

The rate of progress will obviously depend on technical and economic factors, and until the Calder Hall plant is working it is impossible to say, with complete confidence, that all the initial problems in generating electricity from atomic energy have been overcome.

Intervening in the debate, under the limitations that the Government had decided that the facts and considerations set out in detail in the Waverley Report were confidential, Lord Waverley said that the investigations of the Committee, which had visited all the main establishments, had indicated that there are great and obvious advantages in bringing the best available engineering experience to bear throughout organizations which have hitherto been conducted as separate and distinct establishments. Similar considerations apply to research, and

there are also biological aspects of continually increasing importance to be considered. With regard to the functions of the directors of the new organizations, Lord Waverley explained that the arrangement does not imply functional management. Directors will not be responsible for particular establishments; but they will have a collective responsibility, and that is of the greatest importance in maintaining the balance between the different applications of nuclear energy. He thinks that there will be greater elasticity, greater freedom and less difficulty in maintaining the proper relations between those who are concerned in this work and scientists and technicians employed outside if it is organized in the way proposed under a non-departmental board than if it is under a public department of the conventional type.

Lord Waverley, and also Lord Salisbury in concluding the debate, referred to the question of salaries, and said they were both satisfied that this is likely to be handled more easily under the proposed arrangements than under Civil Service conditions. Lord Salisbury reiterated that what the Lord President of the Council will be concerned with is main questions of policy—financial and otherwise—and, in particular, the balance of the use of this atomic material between the needs of defence, power, biology and so on, so as to ensure that the broad needs of Government policy in Great Britain are satisfied. With regard to budgeting, he added that only experience could show what system would be most appropriate. While it is not surprising that, for the present, the Government should wish to keep a firm control on the overall policy, grants in aid and quinquennial budgets may be required in future.

## NATIONAL WEED CONTROL CONFERENCE

IN the United States, Canada and Great Britain the post-war expansion in the use of herbicides is an almost unique example of the rapidity with which scientific discoveries have become integrated into agricultural practice. Between 1947 and 1952 the acreage of treated crops in the United Kingdom has risen from a few hundred thousand acres to more than two million. It is symptomatic of such a rapid rise that the science and technology concerned with chemicals for the selective or total destruction of plant life is yet without a name, while in Britain the interchange of results and technical information between research centres, the chemical industry, the manufacturers of equipment, spraying contractors and the farming community has so far been without adequate facilities. It was this need for a common meeting-ground that led to the setting up late in 1952 of a committee to organize a National Weed Control Conference, and on the committee were representatives of the Ministry of Agriculture, the Agricultural Research Council, the Association of British Insecticide Manufacturers, the British Agricultural Contractors Association and the National Farmers' Union. A three-day conference, under the presidency of Sir James Scott Watson, was ultimately held at Margate during November 3–5, 1953, and the attendance of 320 members is a measure of the spontaneous desire for the exchange of information.

The programme of the conference consisted of papers reviewing the place and value of herbicides

in the several fields, together with a series of research reports and discussions at the end of each session. The economic losses due to weeds and the general role of herbicides in agricultural practice were reviewed by Sir James Scott Watson and by Dr. E. Holmes (Plant Protection, Ltd.), while the more specialized problems arising in vegetable production, fruit culture and in forestry were considered respectively by the directors of the Vegetable Research Station and of the East Malling Research Station and the chief research officer of the Forestry Commission. The director of the Grassland Research Station and G. Maxwell Davies (National Agricultural Advisory Service) discussed the contributions that herbicides could make to grassland improvement, while the significance of weed seeds in relation to crop production was outlined by the director of the National Institute of Agricultural Botany. Various aspects in the design and performance of spraying machinery were surveyed by Dr. H. G. H. Kearns (Long Ashton Research Station), Dr. W. E. Ripper (Pest Control, Ltd.) and J. Cameron Gifford (Weed Control, Ltd.), while papers on the control of vegetation in ditches and on roadside verges were given by C. V. Dadd (National Agricultural Advisory Service) and E. C. Boyce (county surveyor, Gloucestershire).

The first research session was devoted to a consideration of the problems that have arisen in practice when the chlorinated phenoxyacetic acids, in particular, are applied to spring-sown cereals. The papers were concerned with three general aspects, namely, the direct effects of spraying on the crops, and on the weeds, and the overall effects which follow from treating a weed-infested crop. J. D. Fryer and J. G. Elliott (Oxford) gave an account of the field investigations which have been carried out during the past three years in conjunction with officers of the National Agricultural Advisory Service. For these cereal trials, weed-free crops were selected so that the variation in response due to the stage of development at the time of application could be directly assessed. Of the compounds tested, most attention was paid to the triethanolamine salt of 2:4-dichlorophenoxyacetic acid, which was applied at varying dosages (0.5–2 lb./acre) either as a relatively concentrated spray (7 gallons of solution per acre) or in a more dilute form (80 gallons per acre). In all, during the three years some ninety-six field experiments, involving about three thousand plots, were laid down, and the trials were so sited as to cover most of the cereal-growing areas in England.

The results have brought out the great importance of timing correctly the application, since the proportion of malformed inflorescences and the type of malformity are highly correlated with the stage of development in the post-emergence phase. The results also demonstrated that the phase of maximal susceptibility occurs at a different stage of growth in oats as compared with wheat and barley. For a given dosage, oats, over all stages, are by far the most susceptible, and tentatively the conclusion has been reached that, in order to combine efficiency with the least risk of damage, the plants should be treated shortly after emergence above ground, that is, when they possess two leaves and have not yet started to tiller. In contrast, with both wheat and barley the stage of maximal susceptibility occurs when there are less than four leaves on the main stem, and the plants are most resistant when tillering has been completed. Within each cereal type there