The Indian Institute of Science, Bangalore

IN 1926 the Government of India appointed a committee with Sir William Pope as chairman to report upon the Indian Institute of Science, and one of its recommendations was that the activities of the Institute should be subject to review by a committee every five years. Early this year, Sir James Irvine was appointed chairman of the statutory quinquennial committee, and the issue of the report of this committee is awaited with interest. It is untimely, therefore, that the March issue of our Calcutta contemporary, *Science and Culture*, should publish a severely critical article on the present administration of the Institute. Anyone cognisant of the large volume of original work which has issued from the Institute since its foundation cannot doubt that it has more than justified the hopes of its munificent founder, the late Mr. J. N. Tata. The two main heads of the recent criticisms would appear to be (*a*) that the work of the Institute is too academic and (*b*) that, since the students are drawn very largely from South India, it is no longer an all-India research institute.

Whilst it may be true that much of the work carried out in the laboratories of the Institute is concerned mainly with problems of purely scientific interest, it is difficult to see how this could be otherwise. The research work in the Institute is done by young students who go there for a training in the methods of research. If they are not to be discouraged in their early years, it is essential that they should be assigned problems likely to yield results within a reasonable time. Furthermore, we very much doubt if it is possible to undertake *ad hoc* research on industrial problems. The industrial research institutions in Great Britain work in close contact with established industries, and they study fundamental problems related to these. It is very rare indeed that a new industry results directly from an isolated piece of research. We are of opinion that the Indian Institute of Science can best assist industrial development by working in collaboration with industry, as do the universities in Great Britain with Imperial Chemical Industries, Ltd.

The contributions of the Institute to industrial development have not been negligible; we need only instance the valuable researches made in collaboration with the Forest Research Institute at Dehra Dun on the causation of sandal wood disease, the investigations on wireless transmission in the tropics, and the work leading to the establishment of the sandalwood oil and white lead industries.

All industrial advancement is dependent upon pure scientific research, and it is a matter for congratulation that Sir C. V. Raman, the present director, has already built up a school of research in physics and that he was able to attract as a visitor to Bangalore so eminent a theoretical physicist as Dr. Max Born. Whilst the rapid development of research in Indian universities, not foreseen by its founders, has doubtless made necessary a new orientation of the activities of the Institute, we cannot doubt that it will continue to play a great part in the scientific advancement of India.

Progress in Atomic Physics

CONFERENCE AT COPENHAGEN

PROF. NIELS BOHR held a conference on atomic physics on June 17–20 in the Institute for Theoretical Physics at Copenhagen. About eighty physicists attended the discussions, including many from foreign countries.

The outstanding communication to the conference was a paper by W. Heisenberg on the quantum-mechanical theory of cosmic ray showers. Up to the present, no explanation of the fact that particles of very high energy can produce simultaneously, or in a single process, a large number of secondary particles, has been given in terms of the quantum theory of electrodynamics. Such showers of secondary particles have been observed by Hoffmann, Blackett and other experimenters.

According to quantum electrodynamics, the effective cross-sections for the simultaneous formation of n pairs of electrons lead to an extremely small probability for the occurrence of large showers. This calculation was made on the assumption that only the ordinary known electrical forces are of importance in the interaction between charged particles.

The phenomenon of β-disintegration has, however, suggested the idea, as in Fermi's theory, that there exist interaction forces of a new type between electrons and heavy elementary particles such as protons and neutrons. In this new type of interaction, a fourth elementary particle, the neutrino, probably takes part, as has been suggested by Pauli. Without the neutrino, it is impossible to preserve the law of the conservation of energy in the description of β-disintegration. It follows from the existence of these new interaction forces that an electron and neutrino can be created in an atomic nucleus, the electron being emitted as a β-ray, as Fermi pointed out.

Heisenberg has given a general proof that all interaction forces of the type that produce β-disintegration lead to the production of multiple processes and particles, when initiated by particles of high energy. The process may be of the following sort. A high-speed proton strikes a nucleus and produces in the field of the nucleus a great number of β-rays in one elementary action. Heisenberg suggests that the mechanism of the cosmic ray showers is of this type.

He has succeeded in calculating the minimum energy needed by the incident particle to produce this effect, and finds that the order of magnitude is in quite good agreement with the experimental observations of cosmic ray energies.

It is hoped that this new conception of the interaction between elementary particles will suggest methods of solving the difficulties in the theory of quantum electrodynamics, which arise from the incomplete knowledge of the physical laws governing the behaviour of particles of high energy.

V. Weisskopf discussed the Dirac theory of positrons, and showed that its formulation can be simplified, and some of its paradoxes removed. P. Jordan discussed the theoretical possibility of conceiving a light quantum as a pair of neutrinos. M. Born gave an account of his theory of quantum electrodynamics. Kalckar and Bohr gave a detailed mathematical account of their theory of nuclear disintegration. O. R. Frisch and G. Placzek gave an account of the structures of energy levels in heavy nuclei, and the possibility of investigating it by means of the absorption of slow neutrons. Rosenfeld and Bohr discussed the problem of the measurement of charges, and the importance of field and charge fluctuations for the definition of theoretical concepts.

The course of the discussions was, as always, directed by the masterly fundamental criticisms of Bohr. On these occasions, when so many able theorists are gathered together, it is clear that Bohr's physical insight is the power which contributes most to the advance of theoretical atomic physics, and creates the conditions which fertilize the mathematical abilities of theoretical workers elsewhere.

The most interesting and important paper on experimental physics was, perhaps, Jacobsen's account of his repetition of the Shankland experiment (see p. 24 of this issue). Shankland failed to observe coincidences between recoil electrons and scattered quanta when observing with counters at the angles expected according to the Compton theory of the photon scattering process. He used γ-rays from radium, which cover a large range of frequencies. Jacobsen, and Bothe and Maier-Leibnitz have now repeated the experiment with the almost non-chromatic γ-rays from thorium C′. They have taken great care in defining the angles used, and have found the expected number of coincidences. These results are confirmed by some less well-defined experiments by Fermi's collaborators. Thus the suggested failure of the conservation of energy in the Compton effect, so eagerly seized upon by Dirac, in order to get rid of some of the difficulties found in the formulation of a satisfactory relativistic quantum dynamics, is not confirmed. Bohr, Pauli, Heisenberg and other theoretical workers expressed satisfaction at this result, and hoped that further discoveries would mitigate the difficulties on which Dirac comments (see p. 24).

Heitler reported that Anderson has withdrawn his claim that the energy lost by fast electrons in the cosmic rays is much less than expected on general theoretical grounds.

Miss Meitner gave an account of some work on the radioactive effects produced in uranium by the action of slow neutrons. She showed that it is very probable that elements of atomic number 93 and 94 are both formed in the process. Dr. M. L. Oliphant described some recent work carried out in Cambridge, while Goldhaber showed that the mean free path in paraffin of the neutrons produced by the photo-electric disintegration of deuterium does not have the value predicted by the accepted theoretical picture of the interactions between neutrons and protons.

Uhlenbeck described how the modification of the Fermi theory of β-decay, proposed by Uhlenbeck and Konopinski, is in good accord with experiments on the energy distribution of β-particles from both electron and positron emitters of low atomic number. Richardson gave similar evidence in the case of β-emitters of high atomic number.

The general impression left by the conference was that progress in experimental research on the atomic nucleus is very rapid, but that the advance in the theoretical description of the new results is much slower. This is due largely to inadequate theories of the interaction forces between particles of high energy separated by small distances, which are of fundamental importance in the region of the nucleus.

Recent Advances in Wool Research

SEVERAL papers read at the Annual Conference of the Textile Institute held in London on June 3–5 dealt with wool and its characteristics.

Dr. A. B. Wildman, biologist of the Wool Industries Research Association, discussed estimations in the fleece of important wool characteristics, such as fineness variability, length, fleece density and kemp proportion. Emphasis was laid on the necessity for devising speedy and accurate methods of fleece analysis, in order that the relative merits of fleeces from breeders' flocks and from experimental sheep could be accurately measured. A historical résumé of earlier work was given, indicating that conflicting results were often due to lack of representative sampling methods. The author gave an account of his methods, which are subject to statistical control, in commencing analyses of thoroughly sampled fleeces. These investigations are intended to show the kind of variations occurring in fleeces of different types of sheep, and represent an essential prerequisite in the evolution of suitable methods for quality determination.

The quality of a fleece may be modified by exposure to light, air and water. This is attributed by Dr. J. B. Speakman, of the University of Leeds, in a paper on "The Reactivity of the Sulphur Linkage in Animal Fibres", to the oxidation of intact disulphide bonds or their hydrolysis products. More regulated changes of this nature occur in the milling, carrotting, crabbing and blowing processes. Dr. Speakman produced evidence to show that the cystine disulphide cross-linkage is more susceptible to hydrolysis in the stretched than it is in the unstretched fibre. He also showed that the contractile power of treated stretched fibres is dependent on the extent of the hydrolysis of the cystine disulphide cross-linkages, which vary with the pH value of the solution in which the fibre is treated.