Meetings and Societies

Elementary Particles, Atomic Power, and Drift of Continents

Last year once more 22 Nobel prize winners from eight different countries were brought together in the last week of June for their yearly meeting by their common bonds, the Nobel prize and natural science. Aside from the stream of congresses in a quiet corner on the Bodensee, Lindau became through physics, for a few days, a republic of scientists.

Today we know that atoms consist of numerous elementary particles. Especially in the past few years we have learned many new things about these particles. Werner Heisenberg (Göttingen) discussed in his lecture—which may well have been the most important of this year's meeting—his position on the problems in the theory of elementary particles. Today we know approximately 25 such particles which are very similar to the building stones of matter, some of which decay, however, in a fraction of a second. At the end of the 1920's theoretical physics attempted to describe these particles mathematically by applying quantum theory to wave theory. Actually, however, no basic results were obtained with these methods. There exists a conflict between quantum mechanics (uncertainty relation) and the space-time structure of the special relativity theory, according to which all effects are propagated only with the velocity of light. Using the approximation theory by altering the basis of the quantum and the relativity theory, and through recalculations by Bethe that resulted in a correction of the previous theory by Sommerfeld and Dirac, calculations that agreed well with experimental measurements were performed. However, it seems impossible with these operations to unite the 25 elementary particles into a common mathematical system of formulas.

The Göttingen investigations by Heisenberg deal with a new mathematical equation that attempts to embrace all elementary particles and to reduce them to a common denominator. The resulting basic equation is supposed to play the part of a model which represents a system of elementary particles and which is simpler than the real one occurring in nature. By applying the new system of formulas, new perceptions result which agree with experimental results. This model of elementary particles is surely too simple. The new system of mathematical equations advocated by Heisenberg lacks a degree of freedom that still has to be built into it in the near future. One will be able then, according to Heisenberg, to explain nearly all conservation theories of elementary particles and in this way find a formula for the experimental results.

The lecture of Hideki Yukawa (Kyoto, Japan) also dealt with elementary particles. He was able in 1953 to report in Lindau about his research toward creating a common theory for elementary particles. Yukawa now has to depart in many points from his former conceptions.

P. A. M. Dirac (Cambridge, England) dealt in his lecture with one particle only, namely, the electron, for which there is yet no complete theory available. According to the classical picture, the electric field around an electron at rest is *circularly symmetrical* close to the electron. According to the new conception, the electric field is totally concentrated in a single "Faraday" line of force emanating from the electron. Therefore we might have to say good-by to the circular symmetry, so Dirac thought.

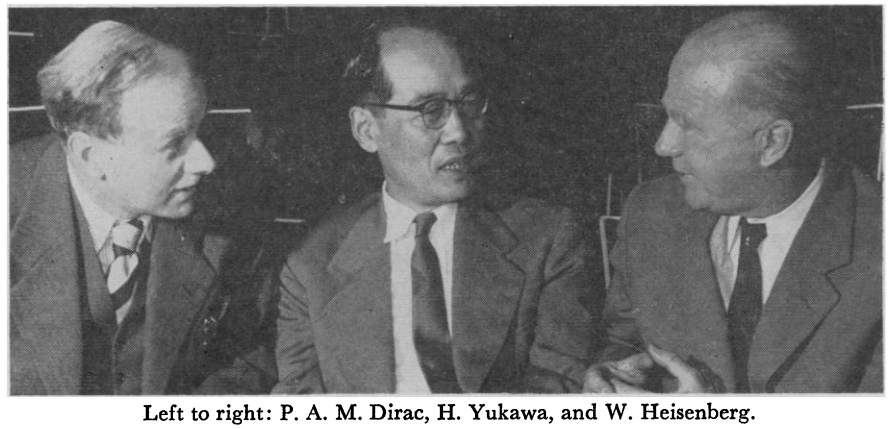
"We shall now embark into a great scientific and technologic adventure to tame nuclear energy in order to make a new source of power accessible to the world in addition to energy sources from fossil fuels. For this purpose we shall use the heat developed in splitting uranium in nuclear reactors in order to produce steam for operating the turbines of alternating-current generators of power plants." With these words the English atomic physicist, John Cockcroft (Harwell, England) started his lecture that entered into the scientific and technical problems of utilization of atomic energy. Today we know many types of nuclear reactors, and more will be added in the future. However, up to now two types have mainly been developed, the first type in England and France, the other mainly in the United States and the U.S.S.R.

The English reactors use as fuel mainly natural uranium and a graphite moderator with gas as heat exchanger. The reaction of nuclear fission in the first reactor in the British Calder Hall station started some time ago, when for the first time uranium rods were introduced into the machine. One assumes that the two reactors are going to be in full production at the beginning of 1957 and that the station is going to deliver 70,000 kilowatts to the electric supply net.

The first industrial nuclear energy stations to be built for the electric power authorities, in which two reactors each produce heat, are in the planning stage. They are supposed to have a considerably larger capacity than Calder Hall. In this kind of reactor—a heat source of 2000 to 3000 kilowatts per ton of uranium—the fuel elements may remain from 1000 to 1500 days before the central uranium rods have to be replaced. In applying a systematic, repeating sequence, it is possible to produce for each ton of uranium an amount of energy equal to 30,000 tons of coal, and in this way the raw material costs of these reactors can be kept down.

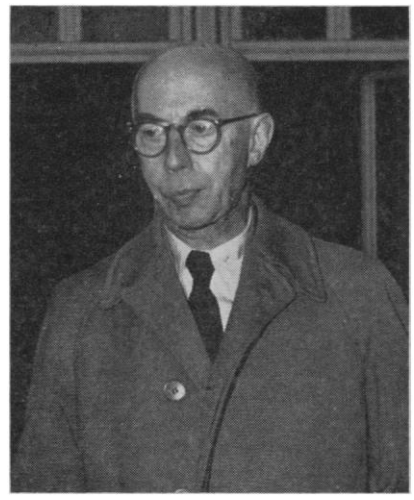
The second type of nuclear energy station utilizes ordinary water as moderator and as heat exchanger. Despite the inherent difficulties connected with this type of station, enough heat can be produced to develop up to 180,000 kilowatts of electric power. The use of water results, unfortunately, in difficult corrosion problems in addition to the task of planning the machinery.

Two other reactors may become com-



Left to right: P. A. M. Dirac, H. Yukawa, and W. Heisenberg.

John Cockcroft.



G. Hertz.

P. M. S. Blackett.

petitors of the water-cooled machines. One uses an organic liquid—for example, diphenyl—in place of water and thus reduces the corrosion problem. The other uses a graphite moderator and liquid sodium as heat exchanger.

Breeder reactors are another important group of reactors. The Harwell reactor, Zephyr, was built for the study of nuclear properties of breeder reactors of fast neutrons. In Dounreay, Scotland, a breeder reactor designed to develop 60,000 kilowatts is being built.

Another possible breeder reactor, the homogeneous water reactor, uses uranyl sulfate as liquid fuel in heavy water. It is a breeder reactor of slower neutrons. This reactor may have very low fuel costs; however, it has corrosion difficulties which have not yet been solved. In Great Britain it is the opinion that a gas-cooled reactor with graphite as moderator and natural uranium as fuel is completely suitable for solving the problem of new energy sources for the United Kingdom.

In this connection, the separation of isotopic mixtures plays an important part. The isotopes that accumulate in the reactors have to be separated as elegantly and profitably as possible. Gustav Hertz (Leipzig), a specialist in the field of isotope separation, described in his lecture the different separation methods which are applied according to the composition of the mixture. For example, the magnetic separation method is, with the exception of rare gases, basically suitable for all elements. The capital investment in this method is, however, very great, and to get only a few grams, several days of operation are necessary.

Contrary to the magnetic-separator method, which with a single application makes an almost complete separation of the isotopes possible, the method using the thermal motion of the molecules produces a small result with only a single stage. One distinguishes here two groups: (i) in the first group, a procedure is involved in which a stream of the gas mixture to be separated is split up into two parts of different composition; (ii) in the second group, a stationary condition is involved in which a different isotopic composition exists at different points, separated by space.

As an example of the first group, a separation by diffusion through a porous wall was shown as well as the so-called "separation jet" in which the outer layer of a gas stream flowing into a vacuum is peeled off. Examples of the second group are separations in the gravitational field which are applied in the centrifuge, thermodiffusion, as well as the method of diffusion against a vapor stream. The latter arrangement is used for the construction of a separation pump which at the same time separates an isotope mixture and provides the necessary circulation in a multiplicator circuit.

Very useful in the procedure of the first group is a diffusion circuit, a commonly used series connection in which each separation link passes its light or heavy fraction to its neighbor. In the procedures of the second group, the principle of countercurrents in a separation tube, which was first developed by Clusius, is used. It can be shown that the same rules are valid for both arrangements so that the countercurrent columns can be treated in the same way as the diffusion circuits.

It has been known for years that a volcanic rock—for example, lava—becomes magnetic when cooled below its Curie point. This magnetism receives a direction parallel to the direction of the surrounding fields and an intensity proportional to the field. This thermomagnetic remanence provides a method for following the direction and magnitude of the earth's magnetic field through geologic history. Many sediment minerals

Left to right: H. Yukawa, R. Kuhn (behind him G. Hertz, Fritz Zernike), Max Born, A. Butenandt (behind him Th. Reichstein), O. Hahn, W. Pauli, C. V. Raman (behind him G. Hevesy), W. Heisenberg.

are found magnetized in nature too, but they are much more weakly magnetized than are volcanic minerals. In recent years instruments that permit measurements of this magnetism have been developed.

The results which P. M. S. Blackett (London) obtained from magnetic changes of minerals were discussed in the last lecture of the meeting. On the basis of many measurements, Blackett arrived at the assumption that England has drifted toward the north in the last 150 million years, from a place much closer to the equator than it is today and that it turned clockwise more than 30 degrees. There exists a certain probability for the relative enlargement of the space between America and Europe, as is usually stated in the theory of Wegener of continental drift. Measurements on Indian stones prove without doubt that India was situated south of the equator 70 million years ago. Measurements in South Africa furthermore point to the fact that the African continent has drifted directly over the South pole in the last 300 million years. Considering these preliminary results, one can safely state that during the earth's history single land masses have traveled large distances relative to the poles. We do not yet know for certain whether the earth's crust as a whole has moved rigidly toward the poles or whether the large motions of the continents were only relative to each other. It is, however, nearly certain that a polar migration, as it is temporarily called, has taken place with probably remarkable drift value. There can be almost no doubt that in the next decade it will be possible to trace the major movements of the great continents during the earth's history in a fairly reliable manner in order to examine experimentally the old theory of Wegener.

The following lectures are mentioned briefly: Max V. Laue (Berlin) reported on, "From Copernicus to Einstein." The struggle of the world systems found an end only with Einstein, who was able in 1908–15 by his general relativity theory, rejecting Euclidean theory, to embrace the field of mechanical, electromechanical, and optical phenomena as well as the facts of gravitation. The text of this lecture will be published in full in *Naturwissenschaftliche Rundschau.* The advancements in physical optics were discussed by Fritz Zernike (Groningen, the Netherlands), who in 1932 introduced the phase-contrast procedure into microscopy through which a contrasting effect of uncolored objects through phase displacement of the light source is achieved. Max Born (Bad Pyrmont, Germany) in his contribution remarked on the foundations of the gas theory, and C. V. Raman (Bangalore, India) discussed the physics of crystals. He entered into the question of the new conceptions concerning the behavior and the properties of crystalline bodies as developed by himself and his coworkers on the basis of theoretical and experimental research.

The following Nobel prize winners were also present as discussion partners and listeners: K. Adler (Cologne), A. Butenandt (Tübingen-Munich), G. Domagk (Wuppertal), H. v. Euler-Chelpin (Stockholm), O. Hahn (Göttingen), G. Hevesy (Stockholm), R. Kuhn (Heidelberg), P. H. Mueller (Basel), W. Pauli (Zürich), Th. Reichstein (Basel), L. Ruzicka (Zürich), and F. Soddy (Brighton, Great Britain).

H. Rotta

Stuttgart, Germany

We are indebted to H. Rotta, Stuttgart, editor of Naturwissenschaftliche Rundschau, *for permission to publish his report* [Naturw. Rundschau **9**, 441 (1956)] *and to Mrs. A. M. Akeley, department of physics, Purdue University, for the English translation.*

Development and Growth

The 16th annual symposium of the Society for the Study of Development and Growth will be held at the University of Rhode Island, Kingston, 19–21 June. The symposium topic will be "Developmental cytology, changes in nuclear and cytoplasmic constituents during development and differentiation." The speakers will include J. R. Preer (Pennsylvania), C. Partanen (Harvard), T. C. Hsu (Texas), G. Klein (Stockholm), W. Beermann (Marburg), H. Stich (National Cancer Institute of Canada), D. v. Wettstein (Stockholm), D. Fawcett (Cornell Medical School), A. Lehninger (Johns Hopkins), and S. Spiegelman (Illinois). The annual business meeting of the society and a smoker will be held on the evening of 20 June.

Saline Water Conversion

An International Symposium on Saline Water Conversion is now planned for the first part of November 1957 under sponsorship of the Office of Saline Water of the U.S. Department of the Interior, and the National Academy of Sciences–National Research Council. The program for the meetings, which will be convened in Washington, D.C., has been developed by a committee of six scientists and engineers. It covers such topics as power distillation, electrodialysis, osmosis, solar distillation, freezing, and other scientific approaches to the problem of conversion of saline water for agriculture, municipal, and industrial uses. The objectives are to bring together, on an international scale, active workers in these fields, in the interest of reviewing and recording progress and stimulating new approaches to this important aspect of basic and applied science.

Approximately 30 invitational technical papers will be presented by participating scientists and engineers from the United States, the United Kingdom, Europe, Africa, and other areas of the world concerned with these problems. The scientific papers presented during the 3-day conference will be published by the NAS–NRC in its numbered series of scientific and technical monographs. Further details will be available by early summer. Inquiries should be addressed to the Division of Physical Sciences, National Academy of Sciences, 2101 Constitution Ave., NW, Washington 25, D.C.

Society Elections

■ Federation of American Scientists, Executive Committee: chairman, Paul M. Doty, professor of chemistry, Harvard University, Cambridge, Mass.; v. chairman, Hans A. Bethe, professor of physics, Cornell University, Ithaca, N.Y. (and wartime head of the Theoretical Physics Division at Los Alamos Scientific Lab); sec., Paul F. Zweifel, Manager, Theoretical Physics, Knolls Atomic Power Lab, Schenectady, N.Y.; treas., Christian B. Anfinsen, biochemist and Chief of the Laboratory of Cellular Physiology and Metabolism, National Heart Institute, Bethesda, Md.

■ Society for American Archaeology: pres., George I. Quimby, Chicago Natural History Museum; 1st v. pres., Alex D. Kreiger, Riverside Municipal Museum; 2nd v. pres., Kenneth E. Kidd, The Royal Ontario Museum; treas., James L. Swauger, Carnegie Museum; sec., David A. Baerreis, Dept. of Anthropology, University of Wisconsin, Madison. The representative to the AAAS Council is Dorothy C. Jensen.

■ Georgia Academy of Science: pres., William H. Jones, Emory University; v. pres., Stephen Gray, Agnes Scott College; pres.-elect, M. H. Goodwin, USPHS Communicable Disease Center; sec., Marion T. Clark, Emory University; treas., James G. Lester, Emory University. The representative to the AAAS council is William H. Jones.

Forthcoming Events

July

3–6. Current Problems in Crystal Physics, conf. IUPAP and NSF, Cambridge, Mass. (J. S. Slater, Massachusetts Inst. of Technology, Cambridge 39.)

8–10. Astrophysical Symp., 8th internl., Liége, Belgium. (P. Swings, Institut d'As-

trophysique, Université de Liége, Liége.)

8–10. Endocrine Aspect of Breast Cancer, Internatl. conf., Glasgow, Scotland. (A. P. M. Forrest, Dept. of Surgery, Western Infirmary, Glasgow, W.1.)

8–12. Inter-American Cong. of Philosophy, 5th, Washington, D.C. (R. M. Chisholm, Brown Univ., Providence, R.I.)

8–12. Poliomyelitis Conf., 4th internatl., Geneva, Switzerland. (Secretariat, 4th International Poliomyelitis Conference, Hotel du Rhone, Geneva.)

8–20. Legal Medicine and Law-Science Problems, 1st American cong., Chicago, Ill. (Law-Science Inst., c/o School of Law, Univ. of Texas, Austin 12.)

9–11. Biological Symp., 8th annual, Univ. of Michigan, Ann Arbor. (B. L. Baker, Dept. of Anatomy, Univ. of Michigan, Ann Arbor.)

9–13. European Molecular Spectroscopy Conf., Freiburg, Breisgau, Germany. (R. Mecke, Dept. of Physical Chemistry, Univ. of Freiburg, Freiburg.)

9–13. International Cong. for the Study of Social Insects, Paris, France. (G. Richard, International Union for the Study of Social Insects, Faculty of Sciences, University of Rennes, Rennes, France.)

10–12. Thermodynamic and Transport Properties of Fluids, conf., IUPAC, London, England. (Institution of Mechanical Engineers, 1, Birdcage Walk, Westminster, London, S.W. 1.)

10–17. International Union of Crystallography, 4th genl. assembly, Montreal, Canada. (G. A. Jeffrey, Chemistry Dept., Univ. of Pittsburgh, Pittsburgh 13, Pa.)

11–13. Applied Cytology, European Symp., Brussels, Belgium. (Secretary, Comm. on International Cong., American Cancer Soc., 521 W. 57 St., New York 19, N.Y.)

14–19. International Assoc. of Gerontology, Merano, Italy. (A. I. Lansing, Dept. of Anatomy, Univ. of Pittsburgh, Pittsburgh 13, Pa.)

14–20. Clinical Pathology, 4th internatl. cong., Brussels, Belgium. (M. Welsch, Service de Bacteriologie et de Parasitologie, Université de Liége, Blvd. de la Constitution, Liége, Belgium.)

15–18. Biochemistry of Lipids, International Colloquium, Oxford, England. (Dr. Sinclair, Laboratory of Human Nutrition, Oxford.)

15–19. Institute on College Administration, annual, Ann Arbor, Mich. (A. D. Henderson, 2442 U.E.S., Univ. of Michigan, Ann Arbor.)

16–19. American Malacological Union, annual, New Haven, Conn. (Miss M. C. Teskey, P.O. Box 238, Marinette, Wis.)

16–24. International Cong. for Pure and Applied Chemistry, 16th, Paris, France (R. Morf, Secy. Genl., IUPAC, Sandoz, S.A., Basel, Switzerland.)

20–21. Medical-Sociological Aspects of Senile Nervous Diseases, internatl. symp., Venice, Italy. (S. N. Feingold, Jewish Vocational Service of Greater Boston, 70 Franklin St., Boston 10, Mass.)

21–28. Neurological Sciences, 1st internatl. cong., Brussels, Belgium. (P. Bailey, National Institutes of Health, Bethesda 14, Md.)

23–24. Modern Electrochemical Methods of Analysis, Internatl. symp., Paris, France. (G. Charles, Ecole Superieure de Physique et de Chimie, 10, rue Vauquelin, Paris 5e.)

25–26. Structure Properties Relationships of Polymers (IUPAC), Paris, France. (International Union of Pure and Applied Chemistry, 4, Avenue de l'Observatoire, Paris 6e.)

25–29. Protein Chemistry Symp., IUPAC, Paris, France. (J. Roche, College de France, Place Marcellin Berthelot, Paris 5e.)

26–27. Experimental Psychology and Animal Behavior Section of International Union of Biology, Brussels, Belgium. (H. S. Langfeld, Dept. of Psychology, Princeton Univ., Princeton, N.J.)

26–27. Linguistic Soc. of America, Ann Arbor, Mich. (A. A. Hill, Box 7790, University Station, Austin 12, Tex.)

26–27. Military Psychology, internatl. symp., Brussels, Belgium. (National Academy of Sciences, 2101 Constitution Ave., NW, Washington 25.)

26–31. International Humanist and Ethical Union, 2nd cong., London, England. (American Humanist Assoc., Gate House, Yellow Springs, Ohio.)

26–1. International Congress on Nutrition, 4th, Paris, France. (Quatrième Congrès International de Nutrition, CNERNA, 71, boulevard Péreire, Paris 17e.)

(*See issue of 17 May for comprehensive list*)