Annual Meeting of the British Association for the Advancement of Science

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THE 112TH ANNUAL MEETING of the British Association for the Advancement of Science was held in Birmingham, England, August 30 to September 6, 1950. Some 3,700 members registered attendance at the meeting, and local firms and individuals contributed nearly £9,000 to a fund to meet the expenses of the occasion. The theme of the meeting was "Energy in the Service of Man," which was directly linked up with Unesco's discussion campaign on the same theme for 1950–51.

Sir Harold Hartley, in his presidential address, dealt with "Man's Use of Energy." He reminded us that it is only a century since man first studied the full import of the word "energy" and its significance as the driving force of all physical and chemical change and of life itself—what Clerk-Maxwell called "the go of things"; and yet it has been man's use of energy that has shaped so largely the material progress of the human race. Sir Harold's impressive survey began with "man's own needs, the energy by which life is sustained"; it examined man's progress in the art of living ("For a million years man was 'the servant of untamed Nature,' and only when he learned to tame her to his needs, to kindle fires and grow his food, did the social evolution, that made us what we are, begin. 'Man,' said Carlyle, 'is a Tool-using animal. Weak in himself and of small stature, he stands on a basis, at most of the flattest-soled, of some half square foot, insecurely enough. . . . Three quintals are a crushing load for him; the steer of the field tosses him aloft like a waste rag. Nevertheless he can use Tools, can devise Tools . . . without Tools he is nothing, with Tools he is all!' "); the industrial revolution; Watt's steam engine; the development of the laws of energy; and the period from 1850 to 1900 (when, "with the turbine and the high pressure boiler, the polyphase alternator with its rotating magnetic field, steam and electricity entered on a new age of power").

Thus we entered into the twentieth century, in which the world demands for more power have risen daily.

There is a limit to the capacity of the human stomach [Sir Harold continued], but none to man's appetite for energy as he finds new uses for it every day. [The broad outlines are]: The world's consumption of every kind of energy to-day, food for men and beasts, heat, light and power, needs a gross yearly intake equivalent to four thousand million tons of coal. On a thermal basis this demand is met by food from agriculture 20 per cent, by coal and lignite 41 per cent, by wood 6 per cent, by oil 25.5 per cent, by natural gas 6.5 per cent, by hydro-electricity 1 per cent. So that about 30 per cent comes from the current revenue of plant and animal growth and water power, and the remainder from the capital resources of coal and oil. Leaving aside the work equivalent of human and animal labour, and taking into account the efficiency with which the other energy sources are applied by man, their useful contributions to-day are, roughly, solid fuel 56 per cent, liquid and gaseous fuel 37 per cent, water power 7 per cent.

What of the future? Reserves of coal are ample; reserves of oil and natural gas are smaller and harder to define, but fresh fields are being found, and there is no need to fear a shortage for some decades. Before then synthetic oil from coal and the huge reserves of oil in shale will provide substitutes. Output from the world's reserves of water power, if developed, would go far toward supplying the total inanimate energy man is using today. But these reserves are scattered, and many lie in distant regions far from the crowded areas of the world. Like coal and oil, there is a most unequal distribution of resources between nations. The countries north of latitude 20° contain 94 per cent of the world's coal reserves and 83 per cent of the oil reserves, whereas those to the south contain two-thirds of the world's water power potential. The dependence of one country on another was shown in many ways. For example, reserves of phosphates and potash necessary for the growth of food, as well as the metals for the machine age of today, are most unequally divided.

The global sufficiency of energy reserves is but a poor consolation for the countries that have few. The recent State Department Survey shows that half the world's visible reserves lie in the United States or the U.S.S.R., and another third in nine other countries. Of the remainder none can claim as much as one per cent, so that their long term development may call for new techniques. These inequalities are reflected in consumption to-day. At one end of the scale, the United States uses yearly the equivalent of 9 tons of coal per head, while at the other, India and China are using less than one-fifth of a ton per head. The figure for Britain is a little over 4 tons, of which one-third provides domestic needs of heat, warmth, and food, leaving nearly 3 tons for transport and industry.

Sir Harold then went on to examine the prospects of meeting future demands. In the four energy industries—coal, electricity, gas, and oil—the major advances have been made. The most modern types of plant have reached a point where only fractional progress is likely to be made, and where the limits might be the discovery of new alloys, or the higher cost which the gain in efficiency might not justify. Substantial savings can be made by raising the standard of all plants to that of the best practice. With the continuous increase in the demand for electric power and the heavy capital cost of generating equipment, the problem of the combined use of heat and power is of major importance. Inefficiency in the use of heat and power in industry, in transport, and in the home, for one reason or another, combines to make the over-all efficiency of use in Britain probably less than 15 per cent. Here is urgent need for large economies to save the coal that is needed for increased production.

In discussing future possibilities, Sir Harold made an important suggestion about transmission:

The unequal distribution of energy sources will make its transport of increasing importance in the future, and here the possibility of transmitting electric power over long distances by high-voltage direct current has passed the experimental stage and is waiting for development. By this means it should be possible to transmit large blocks of energy economically for perhaps a thousand miles by underground or submarine cable and thus link consuming centres with new and distant sources of hydroelectric power. There is, too, the interesting possibility of linking the British and European grids and thus securing a better balance between capacity and requirements by taking advantage of the seasonal variations in capacity and the diversity of demand. Such a scheme would, of course, be complementary to the distribution of power by alternating current, and it offers an opportunity for us to share in European co-operation without raising the delicate problems of supra-national authority. A link of 250,000 kw. capacity should be of mutual service to both sides by providing the equivalent of a large modern generating station as stand-by plant.

He referred also to energy from the tides and from solar radiation, to increasing the efficiency of photosynthesis, and to the "fuel cell." ("Mayer ended his short prophetic paper in 1842 by saying that the inefficiency of the steam engine justified the attempt to produce 'motion' by other means than the sacrifice of carbon and oxygen, for instance by electricity obtained by chemical means. An economical fuel cell, in which the free energy of the oxidation of carbon is converted into electricity, has so far evaded discovery, but it remains one of the long-distance goals of research.")

So far as nuclear energy is concerned, Sir Harold said, it is clear that the difficulties to be overcome before the use of nuclear energy becomes economical are most formidable, and their solution will require intense effort over a long period. New engineering materials will have to be found with properties never before investigated or required. By-products and radiations of nuclear plants are so dangerous to life that their operation is possible only by automatic controls. The latest chapter in man's use of energy, the new science of automechanisms, seemingly offers a substitute for the human senses—with certain limitations. He reminded his audience that no automechanism has approached the delicate perception of the sensory organ with which his brother chemists are so well endowed. ("Their noses infinitely wise. Their minds being memories of smells.") In the future, he thought, one of the indexes of economic progress should be, not the energy used per worker, but the output of goods and services per horsepower employed.

Finally, he asked: "Have I claimed too much for progress—progress, that missing word among the Greeks? Have we replaced the 'Golden Age' by an Age of Steel? Has man's use of energy brought happiness or not?" Hope lies in man's new understanding of nature's processes, in his more efficient use of her resources, and in the growing recognition of the dependence of one nation upon another. Wendell Willkie saw this so clearly in his classic phrase "to raise the standard of living of one man anywhere in the world is to raise the standard of living by some degree of every man everywhere in the world." The natural wealth of the world, distributed in such an accidental way, can only be used to meet its ever-growing demands if there are inventories of world resources, so that each country may know the resources and potentialities of the rest.

Sir Harold ended: "In all these plans energy will play a vital part. So often its availability will dictate the pattern of development. It may well be the limit, in Bacon's words, 'to the effecting of all things possible.' Throughout the ages it has been the key to progress and it has not lost its power. On man's wise use of energy depends so much the future of this troubled world."

Different aspects of energy were discussed in a number of sections. F. H. Garner, in a review of chemical energy, pointed out that most of the efficiencies attained in its utilization are extremely low. For industrial power and heat from coal the net over-all efficiency has been calculated at 17 per cent; that is, 83 per cent of coal burned is wasted. He emphasized the importance of liberating chemical energy for man's use in the most suitable form for each particular purpose, and referred to the possibility of converting chemical energy directly into electrical energy by means of a voltaic cell.

In the main building of Birmingham University, there was an exhibition illustrating "Energy in the Service of Man." One exhibit was of two recent attempts to design a fuel cell in which the free energy of fuel could be directly converted to electrical energy, as in a battery. The Russian fuel cell devised by O. K. Davtyan in 1947 was shown as a working model. It uses hydrogen as a fuel and operates at room temperature. The claim is that an output of 0.74 volts with a current of 0.01 amperes per square centimeter is obtained. It is believed that more than 30 per cent conversion of the normal fuel energy is realized. The other cell was designed by A. M. Adams, of the British Electricity Authority Research Laboratory. It used carbon as the anode and source of energy but required a molten electrolite and an operating temperature of 1,150° C. Voltage and current were the same as in the Russian cell, but the over-all efficiency was only 2 per cent. As a result, further experiments aimed at the direct use of coal have been abandoned. The general view, however, is that long-term research on this basic problem is still desirable.

Sir John Cockcroft discussed the problems of, and prospects for, nuclear power development. He said: "Valuable experience in the problems of nuclear power development has been gained at Harwell during the last two years from the operation of the second pile (B.E.P.O.), which was designed to develop the equivalent of 6,000 kilowatts of heat energy. One of the problems is to contain the radioactivity developed in the uranium fuel element by sheathing the uranium with an impervious metal container. This has been successfully achieved, and there has not been any leakage of radioactivity from the 16,000 'canned slugs' in the pile." At the same time new metallurgical developments will allow the pile power to be increased to about 10,000 kilowatts. This will probably make it worth while to insert heat exchanges in the outflowing cooling air and to use the heat.

One possible line of nuclear power development may be the invention of a reactor of the type of B.E.P.O. to operate at still higher temperatures. This would require the uranium fuel element to be sheathed by a metal that will withstand higher temperatures than aluminum without absorbing too many neutrons. Metallurgical development is, therefore, proceeding on the use of beryllium and zirconium.

Nuclear furnaces of this kind may be able to operate for 10–30 years without refueling. A power system based on such nuclear furnaces could only be supported by the extensive supply of uranium available in small concentrations in shales, granites, and other natural sources. The possibility of an economical system depends on the extraction of uranium from such ores at a reasonable cost. A mineral dressing and chemical engineering laboratory has been equipped at Harwell for such studies. Longer range studies are proceeding on breeder reactors to make more economical use of uranium, but their operation requires the solution of difficult chemical engineering problems. "It is obvious that nuclear power is in a very early development stage and that there are many formidable problems to be solved before it can be reached on any large scale. It seems likely that the first experimental pilot power producer will be operating within five years. We shall then gain the operating experience which is essential before worthwhile predictions on the future of nuclear power can be made."

Details of the latest discoveries in the production of very heavy unstable mesons in cosmic radiation were described by P. M. S. Blackett. He showed cloud chamber photographs of their disintegrations taken by Carl Andersen at Pasadena, and by the British research team in the observatory at the Pic du Midi. Professor Blackett explained that in Manchester in December 1946, D. G. Rochester and C. Butler got a "very peculiar photograph." There was a V-shaped trail of a kind they had not seen before. They waited for nine months before the V-sign reappeared. The effect then was even stranger. One trail passed through a lump of lead without being deflected. "It was as though a skier tearing down a slope had crashed into a tree and then had gone straight through a dense wood without another collision. Obviously, to do that the skier must have changed his substance. It meant that the particle had lost its electric charge and had become a 'ghost' particle." This phenomenon seemed to indicate the existence of two new particles of a mass of around 900 electron masses, which are spontaneously unstable. One is neutral and decays into two charged particles; the other is positive and decays into one positive and one neutral particle. The masses of the new particles have been estimated to be between 250 and 400 electron masses larger than the sum of the masses of the particles into which they decay. The new large mesons have been named "V-particles," and it is clear that the products of their disintegration are pi-mesons. The cloud chamber at Pic du Midi began to work last summer, and new photographs of V-particle disintegrations are now being obtained about once a week.

In the Physics Section, R. E. Peierls described the use of linear accelerators in the investigation of the structure of the atomic nucleus. He referred to the evidence of the existence of new and heavier mesons that could only be produced in the laboratory by the use of particles of much higher energy than at present available. D. W. Fry, of the Harwell Research Observatory, told how linear accelerators have been designed with energies of 4 and 10 million electron volts. They are considering the construction of an accelerator 100 meters long, which would give energies of 16 million electron volts.

The Physics, Engineering, and Psychological Sections had a joint meeting to discuss the presentation of technical information. R. O. Kapp, of London University, stressed the need for a new technique of good exposition. Reading, writing, listening, and talking are now among the most important tools of science. The efficiency of such tools must be no lower than that expected of a piece of laboratory equipment. A poor presentation of material leads to waste of time and ineffectual work. Good writing, logical and clear presentation, as well as knowledge of those being addressed and of the factors relative to memory and association of ideas, are the three aspects of this technique. Little research has been done in this field, but happily its existence has not gone unnoticed. Like other techniques, it needs special teaching in institutions. In the discussion, the director of a big British publishing firm said that, of 600 manuscripts received in the past ten years, only five could be sent to the printer without delay or query, and most involved lengthy correspondence with the authors.

The Education Section discussed the dissemination of scientific knowledge among nonscientists. Eric James, headmaster of Manchester Grammar School, spoke on science and the general education of the nonscientist, stating that attention is shifting from the need for a wider education for the scientist to the teaching of science to the Arts student, because of the impact of science on contemporary society and ideas. He favors general science education for upper form pupils, aimed at giving them a reasonable amount of factual knowledge drawn from a wide field and, through that, an understanding of the scientific method and of the relation of science to culture, society, and ideas. The notion that scientific method is applicable to all problems and that scientific truth is the only truth must be guarded against, and the limitations and assumptions of the scientific method must be one element in the instruction.

W. E. Flood, of Birmingham University, described to the Psychological Section some investigations into the best way of presenting science to the general public. He found that both sexes are particularly interested in medicine, disease, and health. Male interests are new discoveries, science and industry, and future advances. Female interests are pure and applied biology and psychology. Astronomy came eighth in the list (out of 23 subjects), and neither sex was much interested in aeronautics, public use of science, or textbook fundamentals.

Philip Vernon, of London University, gave details of the first inquiry ever made, in collaboration with the British Broadcasting Corporation, to discover what listeners really learn from the radio. His general conclusion was: if you understand what the B.B.C. talks are all about then your intelligence is above the average. More than half of Britain's radio listeners are baffled by involved themes, difficult words, and overlong sentences. Comparative tests on a sample of 4,600 listeners showed that spoken words have no greater impact on most people than printed words.

Sir Stewart Smith, technical director of Imperial Chemical Industries, discussed the critical importance of higher technological education in relation to productivity. He compared the position in this country with that in the United States, where production has increased at the rate of 3 per cent a year since the turn of the century, in contrast to Great Britain, where the rate was only half that figure. The United States now has an over-all productivity of approximately two and one-half times the corresponding figures in Great Britain. There is one basic factor in which the two countries differ—the relative numbers of those trained in applied science. In the interwar period, the ratio of First degrees for men in all faculties in the United Kingdom remained at about 1.5 a year for over 10,000 of the population, but the figure for the United States increased from 4.7 to 8.0. That leads to the conclusion that, for a given level of fundamental scientific knowledge, the chief influence on the long-term trend of productivity is the rate at which applied scientists are trained and used in industry. At present, Britain's pure science is out of balance with applied science, which means that we are really presenting things to other people to develop. The solution lies largely in the hands of the schoolmasters and the academic staffs at the universities, who can do much to influence the right sort of pupil to take up applied science.

Redcliffe N. Salaman, in his presidential address to the Anthropological Section, spoke on "The Influence of Food Plants on Social Structure." He illustrated his thesis with the potato, although he believes that as rich, and possibly more satisfying, a harvest awaits students who investigate the social repercussions of rice or maize. There is a great future for this research into human ecology. He showed that an easily grown, cheaply produced, substantial, efficient, and pleasant-tasting food may, under certain political and economic conditions, fatally menace the social well-being of the people who adopt it. When, in the past, the poor have had to rely upon the potato as their staple food, this automatically prevented a rise in wages, and their standard of life was kept at a low level. The potato economy not only depressed the standard of life to an irreducible minimum in Ireland; it went a long way toward shaping the life of the people. In fact, "the political and economic degradation of the Irish people has been intentional, and the use of the potato made it absolute."

E. H. Neville, in his presidential address to the Mathematical Section, discussed the complexities of mathematical notation. He thought the whole history of mathematics is fit gossip for a school of scandal. This is notorious in geometry; for example, no one ever pretended that Euclid succeeded in defining a straight line. It is equally true in the other great divisions of the subject. That two apples and two more apples compose four apples was plain enough; there is evidence to prove arithmetic, but an abstract "two"—two apples with the pomaceousness removed—never existed and never can exist. This "two" was not merely a fiction, but an inconceivable fiction. The most irritating of notational misfortunes are those where mathematicians would all like a slight modification in a usage that has become classical. The one thing we must not do is to use π with a new meaning.

Discussing the secular changes in the earth's magnetic field, S. K. Runcorn, of Cambridge, said that the conclusion of seismologists that the earth may have a liquid core has provided the essential clue. The origin of the secular change cannot be located in the solid mantle of the earth, where appreciable changes occur only over geological time. Motions in a liquid core can be assumed to be taking place, even though the details of the processes by which they alter the field are not at present understood. In particular, the remarkable westerly drift of the points of most rapid change of the geomagnetic field, which may be traced back to 1500, and which proceeds at a rate of 0.5 degrees longitude yearly, seems hard to interpret unless it is connected with a fluid motion. These motions seem to be of the order of 0.01 centimeters a second, and their origin may be of a dynamical or thermal nature. Thermal convection would occur if the core is homogeneous, and if the temperature gradient exceeds about 0.5° C per kilometer. This flow of heat is calculated to be about one-eighth of the heat flowing out through the crust, which is supposed to be due mainly to the radioactivity of its upper layers. The source of heat in the core is also assumed to be radioactive decay.

R. J. Brocklehurst, as president of the Physiological Section, dealt with the hormones of the digestive tract —a group he described as an independent system that, unlike the endocrine group, is strictly localized in action. Perhaps the most striking feature of these mechanisms of the digestive tract is their independence of the nervous system. Each mechanism is brought into play when needed by a particular event in the sequence of digestive processes. Investigation of the actual cells of origin of each has barely begun, but their study has already revealed the fascinating nature of the chemical methods of coordination that are at work in the digestive system.

Modern trends in the classification of plants were discussed by E. E. Turril, in his presidential address to the Botany Section. Up to quite recently, in most universities, taxonomy has been, at best, relegated to the position of Cinderella. However, it is now coming back into its own along modern lines, and younger students need have no fear that, if they become taxonomists, they will be specializing in an out-of-date subject with only artificial interest. Nevertheless, the satisfactory taxonomist is born, not made, at least in the sense that he must have a certain number of innate qualities, including a methodical mind with a liking for bringing order out of chaos, and a keen aesthetic perception of the beauty of shape, color, and the relationship of parts. Those qualities, usually considered the peculiar attributes of the artist, allow an appreciation of curves and other outlines and of balance of organs, which aid comparison at every stage of taxonomic practices.

R. Birley, headmaster of Eton College, led a discussion in the Education Section on economic determinism and education. He said that belief in Communist determinism, in the sense that the ultimate explanation of all such human manifestations as political institutions, law and moral standards, art and religion, is to be found in man's economic development, was not the invention of the founder of Communism. Economic determinism in itself attaches no meaning to history, though Communist variations most certainly do. The real strength of Communism seems to depend on the fact that it restores a meaning to history. We have had to restore the ideal of social utility to humanist education, and to recognize the danger that an education which seeks to work through the medium of great ideas and great literature may easily become merely academic. The solution is to be found only through a change in our methods of teaching—through the conception of a sense of social obligation and a social consciousness in the teacher.

A. Davies, of Exeter University, suggested that the discovery of America was made five years before Columbus reached it in 1492. It was probably made by Dualmo in a voyage from the Azores. The conviction of Columbus that he would reach land 750 leagues west of the Canaries, and certain falsifications in his record of the voyage, have for long been controversial issues. Professor Davies explained them on the basis of a previous Portuguese discovery of America, of which Columbus had knowledge through his brother Bartholomew, who was employed as a cartographer by King John of Portugal. Two Portuguese maps of 1502 were shown, which charted such distinctive features as Florida, Yucatan, and the Gulf of Mexico. Referring to Columbus' visit to Lisbon on his return voyage, in spite of the danger of arrest, Professor Davies said that the interview with King John was to convince him by means of the false records that the land discovered was not that already discovered by the Portuguese. King John was willing to accept this claim because, knowing that a large landmass barred the western trade route to the Spice Islands, he wished to divert Spanish attention westward while Portugal was exploiting the recently discovered eastern route and establishing itself in the Spice Islands. This did, in fact, result in the agreement giving the western half of the world to Spain and the eastern half to Portugal, and by the time the Spaniards had circumnavigated South America and Magellan had reached the East Indies, the Portuguese were already well established.

The 1951 annual meeting of the British Association for the Advancement of Science is to be held in Edinburgh, with H.R.H. the Duke of Edinburgh as president.

Preview of the 117th Meeting, AAAS, Cleveland December 26–30, 1950

General Information

The 117th Meeting of the American Association for the Advancement of Science will be one of the best balanced in the history of the Association, now in its 103rd year. All 17 of the AAAS sections and subsections have programs of from three to thirteen sessions each; thus no principal field of science is unrepresented. Forty affiliated societies and other organizations are participating in this Sixth Cleveland Meeting of the Association—some with an annual meeting of many sessions, others with one or two essentially regional meetings, and still others as co-sponsors of sessions with a AAAS section. The sections have arranged twenty-two symposia; the AAAS Cooperative Committee on the Teaching of Science and Mathematics, one; and the Association, four other, more general symposia. The programs of the participating societies include a number of important symposia, panels, and seminars in addition to their sessions for contributed papers.

In the Annual Science Exposition, which fills the street-level Arena of the Public Auditorium, 104 organizations have exhibits in 154 booths. The latest products of leading publishers, instrument makers, manufacturers of all types of laboratory equipment, and the large scientific supply houses have been joined by other nationally prominent firms, which have *technical* exhibits. An artificial kidney, an electronic problem-solving "brain," one or more types of color television, an electron microscope, models of atomic piles, a revolutionary new loom for the textile industry—these are but a few of the exhibits that make the outstanding Exposition.

The six different four-hour programs of the AAAS Science Theatre comprise 66 titles of the latest foreign and domestic scientific films—a great many of them in color, and nearly all several reels long. For those interested in visual education, these programs alone would require a total of twenty-four hours to see and would be worth many times the Association's low-priced Registration Fee, which also admits registrants to the AAAS Reception, the Biologists' Smoker, and the Annual Science Exposition.

The Sixth Cleveland Meeting will be a convenient one: The Public Auditorium, one of the best-designed convention halls in the country, is within two to eight blocks of the downtown hotels. Most of the sessions of the sections and a number of the special sessions will be held in the Auditorium, which also houses the Main Registration Desk, the Tours Booth, Information Center, and Visible Directory of Registrants, as well as the Annual Science Exposition and the Science Theatre. A good lunch concession will be operated. The sessions of the participating societies will be in the Hotels Statler, Hollenden, Carter, and Allerton; for one afternoon, two of the zoological societies will meet on the campus of Western Reserve University.

Hotel room accommodations are adequate, with reservations being handled by the experienced Housing Bureau of the Cleveland Convention and Visitors Bureau. The hotels have made their public space available without charge and, as in 1949 and preceding years, no partici-