direct control of the Royal Society. In 1918 it was absorbed into the then newly formed Department of Scientific and Industrial Research; but the 'management' of the scientific work of the Laboratory remained the responsibility of the Royal Society, the president and Council of which, acting on behalf of the Privy Council Committee for Scientific and Industrial Research, even to-day appoints the General Board and Executive Committee of the Laboratory. This collaboration between a learned society and a government department is possibly unique. It is certainly a source of surprise to many visitors from overseas; but they agree that this arrangement produces the desired results. The collaboration of the Royal Society and the Department of Scientific and Industrial Research in this connexion was well illustrated by the fact that a reception held on January 30 to commemorate the fiftieth anniversary of the founding of the National Physical Laboratory was sponsored by His Majesty's Government, but was held in the rooms of the Royal Society. The guests were to have been received jointly by the Lord President of the Council, the Minister responsible for the Department of Scientific and Industrial Research, and the President of the Royal Society. Unfortunately, the Lord President was unable to be present to receive the guests, but joined the company later in the evening.

Much has been written and broadcast recently on the work of the Laboratory, and it is not necessary to repeat this; but exhibited at the reception at the Royal Society's rooms were apparatus, diagrams and pictures illustrating the principal work of the Laboratory since its inception. Pride of place was taken by exhibits representing the Laboratory's most important work the maintenance of the fundamental standards of mass and length, and of derived standards; particularly interesting were those showing the movement from material to physical standards, as in the cases of the standards of length and light. The method of making precision block gauges and the accurate measurement of angles was demonstrated, as was also progress in the design of engineers' measuring instruments, and such recent developments of measuring methods as the continuous measurement by an air gauge of materials in thread or wire form. Work on fluid flow was represented by exhibits of Stanton's work on compressible flow; models of cargo vessels and illustrations of the laminar and turbulent flow of water around ships' hulls; the development of wind tunnels and wing shapes; work on aircraft stability and control, and on flutter; and examples of investigations in the high-speed laboratory.

Throughout the whole, the work of the National Physical Laboratory in the development of instruments was evident, and here exhibits illustrated work on heat-transfer problems; the measurement of temperature; the precise calibration of microphones; and radiation measurement in connexion with the protection of radiological workers. Larger equipment showed developments in the technique of the measurement of creep of metals over the past thirty years, and one item of the Laboratory's war-work was illustrated by a prototype of bomb disposal apparatus.

Work of general importance, both in industry and the home, was illustrated by exhibits on heat-transfer investigations, including problems relating to refrigerated transport; sound insulation and noise reduction; the development of light alloys and

research on calorimetry. Work on high-voltage measurements, devices for frequency measurement, and instruments for the investigation of dielectrics were shown, as well as illustrations of the progress of research in radio-wave propagation and direction-finding, and radio aids to meteorology. Progress in work on the development of an automatic computing engine was illustrated by a simulator, using relays instead of valves.

An exhibit organised by the Test House showed the testing and certification for industry of instruments such as barometers, hydrometers, thermometers, volumetric glassware, taximeters and petrol jets.

Being largely commemorative, the exhibits dealt mainly with the past work of the National Physical Laboratory—or the 'N.P.L.', to use its familiar title. Its future lies along the road of further applied research in the physical sciences, with particular reference to those problems needing special instrumentation and exact measurement, not only to fulfil the known needs of industry, but even more to provide within its sphere the basic knowledge which is the foundation on which future industrial development will be built.

SEVENTH INTERNATIONAL CONGRESS FOR APPLIED MECHANICS, 1948

THE Seventh International Congress for Applied Mechanics was held at South Kensington, London, in the Imperial College of Science and Technology, during September 5–11, 1948. Among the 882 members who enrolled were large numbers from the United States, France, Holland, Italy, Belgium, Sweden, Czechoslovakia and Poland. Altogether, twenty-nine countries were represented. In spite of the fact that many more people came than previous experience led the organisers to expect, the arrangements worked smoothly. The problem of accommodating so large a party was made easier by the action of the authorities of the Imperial College, who allowed members and their wives to stay in the students' quarters. The task of seeing that everyone, including a large proportion of foreign members, knew what to do and where to go was efficiently carried out by some of the staff and students of the College.

The number of scientific papers presented was so great that it was necessary to divide them into five groups and to maintain each group in continuous session during the working hours of five days. The scientific communications were of two kinds. Five general lectures, intended to cover recent work on subjects which are advancing rapidly at the present time, were delivered by invited lecturers, and 228 shorter papers were given by members about work with which they were connected. The "Proceedings" of the Congress* have now been issued in six volumes, which include nearly all the papers presented. They are not printed but are reproduced photographically

* Proceedings of the Seventh International Congress for Applied Mechanics, London, September 1948. Introductory Vol., pp. 129; Vol. 1, pp. 9–432; Vol. 2, Part I, pp. 320; Vol. 2, Part II, pp. 321–644; Vol. 3, pp. 312; Vol. 4, pp. 358. (London: Organising Secretary, Seventh International Congress of Applied Mechanics (1948). Imperial College of Science and Technology, 1949.)

from typescript provided by the authors. This process involves reducing all pages to the same size, so that the height and spacing of the letters vary from one paper to the next. The Editorial Committee accepted this want of uniformity in order to gain the great advantages of quick publication and low cost. In all cases, even when the author used small type on a large sheet, the typed letters can be read; but formulæ which have been hand-written by their authors are sometimes difficult to read when reproduced on the reduced scale.

Of the five general lectures, three are published in full in the introductory volume. Two of these lectures, by J. Kampé de Fériet and G. K. Batchelor, are on different aspects of turbulent flow in fluids, and the third, by M. Hetényi, is on the present state of development of stress analysis. The two lectures by W. Prager, on recent developments in the theory of plasticity, and by M. J. Lighthill, on high-speed gas flow, are being published elsewhere. An abstract of W. Prager's lecture is printed in the "Proceedings", but M. J. Lighthill's lecture is not referred to, owing, it is understood, to an unfortunate oversight. These lectures illustrate the wide variety which exists in the methods of approach employed by the devotees of applied mechanics. Kampé de Fériet discusses in a most general way the properties of the tensors associated with the spectra of turbulence, and he treats the subject as an exercise in pure mathematics without referring to measurements in actual fluids. Batchelor, on the other hand, avoids mathematics where he can, and concentrates on analytical discussion of experimental work. Prager discusses, from an analytical point of view, the kinds of situation which arise when bodies with ideally defined plastic and elastic properties are strained. Hetényi describes the experimental techniques used to measure distributions of strain which occur in materials as they are used in engineering practice. Lighthill considered the powerful mathematical techniques which have been developed in recent years, partly by himself, for discussing fluid flow at supersonic and high subsonic speeds.

Of the 228 shorter papers presented at the Congress, 211 are published either in full or as abstracts in Vols. 1-4 of the "Proceedings". Vol. 1 contains sixty papers on elasticity and plasticity; Vol. 2 seventy-six papers on aero- and hydro-dynamics, being bound up in two parts; Vol. 3 thirty-two papers on thermodynamics, including heat transfer; and Vol. 4 forty-three papers on dynamics, experimental methods and numerical computations.

Reading the papers in Vol. 1 leaves the impression that the assumptions of the classical theory of elasticity, namely, that strains are small and stresses obey Hooke's Law, no longer satisfy many workers in this subject. Great mathematical difficulties arise as soon as these assumptions are abandoned, and materials are assumed to have properties more like those which occur in Nature. Vol. 1 contains examples of solutions of problems involving large strains in bodies which possess ideal elastic properties, problems about bodies with simple geometrical forms and not so-simple plastic properties, and bodies with ideally simple plastic properties but less simple geometry. It also contains papers like that of A. M. Willis, on the instability of hollow rubber cylinders with axial symmetry, in which no attempt at analysis is made but interesting experiments are described. Many of the papers relate to practical engineering problems like the buckling of straight columns, the behaviour

of continuous beams, the stresses in buildings due to wind load and the behaviour of cantilever spars with shear-resisting skins.

The great variety of problems discussed in Vol. 1 makes it difficult to discern any definite trend in research in elasticity and plasticity. Elastic stability still attracts a number of workers, and the elastic behaviour of structures after suffering collapse due to instability is discussed by A. van der Neut. Two-dimensional problems of flow in an ideal plastic material are considered by R. Hill in several cases where the total strain is large. Plastic waves produced by impact at the end of a wire or rod which possesses a well-defined yield point are discussed by M. P. White and shown to give rise to some curious distributions of permanent strain. Z. Horak writes on the impact of a ball falling vertically on a horizontal plane when it is spinning about a vertical axis.

Vol. 2 contains seventy-six papers, of which twenty relate to flow of compressible fluids, eleven to turbulent flow, six to boundary layers and four to flow with a free surface. The great interest taken in the effects of compressibility was stimulated, no doubt, by the fact that aeroplanes now fly up to, and even faster than, the speed of sound. Fortunately, the subject has proved interesting to some very able young mathematicians who have been willing to keep in touch with experimentalists. The present volume contains evidence that their efforts have proved so successful that it is now possible to understand supersonic as completely as subsonic flow. Among the experimental methods available for studying the flow of compressible fluids, the interferometer, which measures density, has been developed to a high pitch of efficiency by R. Ladenburg, who gives some good examples of its use.

The study of turbulent flow has proved a fertile ground for mathematicians as well as experimentalists. The dynamics of statistically isotropic turbulence, which is very nearly produced experimentally in a wind tunnel by making the air pass through a grid of regularly spaced obstacles, form the subject of papers in the "Proceedings" by Kampé de Fériet, Batchelor, F. N. Frenkiel and C. Lin. In this, the simplest case of turbulent motion, the turbulence is carried along bodily in the air stream, and the dynamical discussion concerns the action of the eddies on one another. The more complicated cases where the mean flow varies from point to point have not yet proved amenable to theoretical treatment; but measurements of turbulence in such cases are here described by A. A. Townsend and by J. O. Hinze and B. G. van der Hegge Zijnen. The effect of damping screens in reducing turbulence is considered by M. L. Dryden and G. B. Schubauer.

A paper by Garrett Birkhoff describes some developments in the theory of fluid flow bounded by free surfaces. The shape of the cavity which can exist behind a body in a stream of fluid is discussed, and the jet theory of the action of a hollow explosive charge lined with metal is explained. Problems involving surface waves are considered by F. Ursell, who gives a theoretical account of the waves produced by the rolling of floating bodies, and by K. S. M. Davidson, who explains why it is that a following sea makes steering difficult in some ships.

Vol. 3 contains thirty-two papers on thermodynamics and heat transfer. Heat transfer between a solid and gas flowing past it at high speeds is rendered a difficult subject by the fact that heat is produced in the boundary layer, and since both

conductivity and viscosity depend on temperature, the equations representing the distribution of velocity and temperature near the solid surface are complicated. W. F. Cope summarizes the results of calculations which he made with D. R. Hartree, and gives numerical examples illustrating the difference between these calculations and the earlier ones of Pohlhausen. The measurement of the temperature of low-density gases moving at high speeds presents considerable difficulties. If the gas is slowed down and a thermocouple is placed in a region of slow flow, the temperature there can be corrected to give the temperature in the fast-moving gas; but the heat transfer from the gas to the thermocouple is so slow that the measured temperatures lag behind the true temperatures. J. E. P. Dunning describes a thermometer in which gas is forced to flow over a thermocouple at sonic speed by applying suction to a pipe surrounding it. This measures nearly the same temperature as the slow-flow thermometer but suffers much less from thermal lag.

Recent progress in the problem of knock in internal-combustion engines is described by Sir Alfred Egerton and N. P. W. Moore. Comparatively simple conceptions like those evoked to explain the experiments of Tizard and Pye cannot explain what is observed when an engine knocks. Chemical actions take place during the compression stroke which 'pre-sensitize' gas which has not yet been touched by the combustion flame. Antiknock compounds affect this gas but do not affect the rate of propagation of the combustion flame. A simple method for measuring the conductivity of liquids is described by E. F. M. van der Held and F. G. van Drunen. This method is useful for corrosive liquids which would damage apparatus commonly used for measuring heat conductivity.

Vol. 4 contains forty-three papers on dynamics, experimental methods and numerical computations. The subjects range from the use of matrices for calculating oscillations of complex elastic structures to papers on the strength of reinforced plastics and a description of a 50-ton dead-weight standard of load for calibrating testing machines. An interesting paper by L. S. Wasserman compares accelerations measured at points on the wing tips and other parts of an aeroplane while landing with accelerations computed theoretically from known elastic characteristics of the machine. Diagrams in this paper show that, in certain positions on the aeroplanes tested, very large accelerations, up to $8g$, occur on landing.

The calculation of the speed at which flutter may be expected to occur in an aeroplane wing has for some time exercised the minds of aeronautical engineers. In the present volume W. Barrois, J. Simon-Suisse and their colleagues give an account of the numerical methods used in France in making these calculations. They also describe electrical analogues which can be used in this connexion. Among the purely experimental papers, one by C. Mylonas on the distribution of stress in glued joints opens new ground. The stresses in the transparent glue are determined by photo-elastic methods.

The high quality and great variety of the papers in these volumes provide evidence that the science of applied mechanics has plenty of vitality, and that it is attracting the attention of many young people, as well as holding the interest of the older workers. The Congresses for Applied Mechanics are usually held at four-year intervals, and the next one will take place in Istanbul in 1952. G. I. TAYLOR

COMMONWEALTH CONTRIBUTIONS TO THE BRITISH DIET

THE Nutrition Society, at its meeting in the London School of Hygiene on January 28, discussed what the British Commonwealth could do to feed Great Britain. In the morning session representatives from those Dominions which are the principal contributors to the British diet, and representatives of the West Indies and the Overseas Food Corporation gave the meeting details of what they are already contributing and what they may be able to do in the future. In the afternoon, the morning papers were discussed, commodity by commodity, by British experts on various foodstuffs. A most valuable symposium resulted.

The meeting opened with a paper by Lieut.-Colonel J. G. Robertson, speaking on behalf of Canada. His Dominion, he said, is the second largest country in the world, but it has a population of only about thirteen and a half million people; it is therefore a large exporter of food. He explained in some detail the remarkable contribution which Canada made to the solving of the British food problem during the Second World War. To do this she greatly increased her production of many foods. In 1938 she exported 160 million lb. of bacon, and by 1944 she was exporting 660 million lb. to Britain; cattle marketings were virtually doubled, and Cheddar-cheese production increased by 58 million lb. Canada has also sent a considerable variety of foods to Britain, including wheat, flour, bacon and hams, beef, mutton and lamb, poultry, eggs (shell and dried), cheese, evaporated milk and milk powder, fruit, vegetables, lard, salmon, honey and maple products.

Colonel Robertson also pointed out that during the war years Great Britain found it impossible to pay for all her war expenditure (arms, equipment and so forth) and still meet the bill for her food supplies. Canada helped her unstintingly in the financial field by making gifts of more than two thousand million dollars and interest-free loans of more than one thousand million and also by conversion of certain British assets in Canada into cash to the tune of some four thousand million dollars. So by these means during the War, Great Britain was able to obtain most of her food imports from Canada without actually paying for them. It is important, in appreciating the great effort made by Canada to help Britain during the War, to realize how unfortunate is the dollar position to-day, which forces Britain to buy in soft-currency markets, and to leave a food industry in Canada, greatly expanded to meet the mother country's war-time requirements, with virtually no markets for many of its products.

The Canadians are also faced with the sight of dollars provided by Marshall Aid being compulsorily spent in the United States on foods which Canada has in abundance for export. In recent years, Canada has added millions of acres to the area of grain production by the development of early maturing varieties of wheat and by creating new varieties of rust-resistant wheats. In this way she has made possible the addition of hundreds of millions of bushels to the cereal supply of the world. Given a proper incentive, the Canadians could divert their food production into whatever channels that are required. For example, they could decrease beef production and increase pork products; they could increase wheat acreage at the expense of oats, barley