when produced by the most economical means, meet the challenge of the new synthetics?" Prof. Gee's answer was "Yes", provided the natural rubber industry continued and intensified its fundamental research and technical development in the right directions. He showed that no single elastomer is supreme in all respects and that each of them, including natural rubber, can hold its place in the expanding market. He also described the striking results which may be obtained by blending natural and synthetic rubbers and how the presence of the reactive groups influences this blending.

There can be little doubt as to the success of the conference in bringing current ideas on natural rubber research into sharper focus and in stimulating new approaches to the many problems raised. The proceedings of the conference are to be published early in 1961, and those wishing to obtain copies should write to the Director, Rubber Research Institute of Malaya, P.O. Box 150, Kuala Lumpur, Malaya.

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ELEVENTH GENERAL CONFERENCE OF WEIGHTS AND MEASURES

THE eleventh General Conference of Weights and Measures was held in Paris during October 11–20 under the chairmanship of M. Barrillon, president of the Academy of Sciences. Thirty-two States were represented at the Conference, which was held at 19 Avenue Kléber, in the former Hotel Majestic now taken over by the Ministère des Affaires Étrangères for use partly as offices and partly as a meeting place for national and international conferences. One epoch-making scientific decision was taken, namely, to re-define the metre in terms of a natural atomic standard, the wave-length of light, thus deposing the platinum-iridium metre bar—the International Prototype Metre—from the supremacy it has held in the field of length measurements since 1889. Three very important administrative and financial resolutions were passed which are crucial to the future development and efficiency of the weights and measures organization. Before dealing with these and other decisions and with an unfinished effort of the Conference to modernize the international treaty on which its authority is founded, it would be well to give a brief outline of the history and development of the whole organization.

International co-operation in scientific metrology depends on the Convention du Mètre, a treaty signed in Paris by the plenipotentiaries of seventeen sovereign States on May 20, 1875. An agreement was thereby made to establish and maintain, at joint expense, a central laboratory and office, known as the Bureau International des Poids et Mesures, with the primary duties of maintaining, improving and extending the use of the metric system. The treaty organization, which the United Kingdom joined in 1884, now represents thirty-eight States (Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Chile, Czechoslovakia, Denmark, Dominican Republic, Finland, France, Germany, Hungary, India, Indonesia, Ireland, Italy, Japan, Korea, Mexico, Netherlands, Norway, Poland, Portugal, Rumania, Spain, Sweden, Switzerland, Thailand, Turkey, the United Kingdom, the United States, Uruguay, the U.S.S.R., Venezuela and Yugoslavia (Indonesia and Venezuela joined after October 1960). It acts under the authority of the General Conference of Weights and Measures, constituted by delegations nominated by the Governments of the member-States meeting every six years, with the aid of the International Committee of Weights and Measures—an elected executive body of eighteen members (each

from a different State) meeting every two years. This Committee administers the scientific and financial affairs of the Bureau International in between general conferences, drafts recommendations relating to units and standards of measurement with the help now of six expert advisory committees and acts as a steering agency during General Conferences.

The Convention was revised on October 6, 1921, mainly to extend the work of the Bureau International des Poids et Mesures to the standards of electricity and photometry. Up to that date the Bureau International, as custodian of the International Prototypes of the Metre and Kilogramme, was chiefly concerned in its laboratory work with the maintenance, by means of periodical comparisons, of the various national copies of these prototypes issued to the member-States in 1889 and afterwards. The derived standards of volume (or capacity), density and atmospheric pressure naturally came within the responsibilities of the Bureau International; and, as the length of a material standard is dependent on its temperature, a practical scale of temperature was maintained. As a consequence of the 1921 revision, high-class electrical and photometric equipment was installed at the Bureau International for periodic intercomparisons of groups of standard resistors, standard Weston cells and standard lamps sent in by the national laboratories. In this way, just as for the national metres and kilogrammes, the uniformity of the electrical and photometric standards maintained by the various countries is readily checked, and any individual divergences from the general average which are unusual are identified and reported.

During recent years the rapid development of applications of radioactivity and the ionizing radiations in the scientific, medical and technological fields has created an urgent need for a central standards laboratory to work on the basic metrology of ionizing radiations and to correlate the standards and measuring techniques developed in the national and other specialized laboratories. In 1958 the International Committee established its expert advisory committee for the ionizing radiations which has produced proposals for a new Bureau International des Poids et Mesures laboratory and equipment, together with a general plan of the work to be done and the staff required. Recommendations embodying these proposals were submitted to the eleventh General Conference by the International

Committee, with others for: (1) increasing the staff and modernizing the equipment in existing sections of the Bureau International; (2) changing the rule by which the total annual subvention for maintenance of the Bureau International is apportioned among the member-States. All these recommendations were unanimously adopted and the Conference thereby sanctioned:

(a) The creation of a new section at the Bureau International des Poids et Mesures for work on the basic metrology of the ionizing radiations, the construction of a laboratory and the purchase of equipment at an overall cost not exceeding 1,800,000 gold francs (about £210,000).

(b) The raising of the total annual subvention made jointly by the member-States from the present figure of about 400,000 gold francs (£47,000) to 900,000 gold francs (about £105,000).

The intentions of these decisions are that the Bureau International, which has hitherto had to work within limits imposed by a much too narrowly restricted budget, should be better able to fulfil its function as a supra-national standards laboratory and to provide it with reasonable funds for this purpose.

To enable the Bureau International to initiate as early as possible the new section on the ionizing radiations, the Ford Foundation has made a grant of 32,500 dollars to cover the period intervening until the new funds voted by the Conference become payable by the member-States on January 1, 1962. The National Research Council of Canada has temporarily seconded to the Bureau International Dr. C. Garrett, head of the Ionizing-Radiations Section of its Division of Applied Physics, who will take charge of the new section during this same period. His duties will include detailed planning of the ionizing-radiations laboratory and the ordering of its equipment; he will also advise the director of the Bureau International des Poids et Mesures on the selection and appointment of staff for the new section.

Despite its partial revision in 1921, the Convention du Mètre retains many clauses, suited both scientifically and politically to nineteenth-century circumstances, which tend to hinder adaptation of the organization to the rapidly changing and complex needs of scientific metrology and international relationships in the twentieth century. Accordingly, a special commission of the International Committee had been working on the draft of a revised treaty since the last Conference in 1954 and this draft had been sent to Governments for comment some months ago. The scientific clauses were easy to settle, but it was soon realized during the eleventh Conference that there was no hope of securing immediate and unanimous approval of the political and administrative clauses of a modernized treaty by the various delegations, so the matter was left to proceed by negotiation through diplomatic channels.

The fundamental scientific resolution unanimously adopted by the Conference re-defined the metre as equal to 1,650,763.73 vacuum wave-lengths of the orange line (6058 Å., spectroscopic designation $2p_{10}-5d_5$) emitted by the krypton atom of mass 86. The source of this radiation, recommended in October 1960 by the International Committee, is an Engelhard type of krypton-86 hot-cathode discharge lamp^{1,2} enclosed in a cryostat maintained at the triple-point of nitrogen (about 63° K.). The specification of the conditions of excitation and observation ensures a

reproducibility of the new optical metre to about 1 part in 100 millions, and there are good expectations of improving on this very soon. Recent experimental work at the National Research Council (Ottawa) and the National Bureau of Standards (Washington) indicates that continuity of the unit metre distance is maintained to the accuracy with which it was represented by the separation, at 0° C., of two parallel defining lines engraved on the prototype platinum-iridium bar, namely, 1 part in 4 millions. Moreover, according to the new definition, the angstrom unit (Å.) becomes equal to 10^{-10} metre exactly³.

It is interesting to digress here by noting that the Weights and Measures Bill now before Parliament proposes to define the yard as equal to 0.9144 metre exactly. The same value has already been adopted by the National Physical Laboratory (and five other national laboratories) for non-metric measurements of length in science and technology⁴. If the Bill is enacted, the yard for all purposes in Britain will therefore be effectively based on the new primary wave-length standard through the adopted relationship with the metre.

Among other scientific resolutions adopted by the Conference are the following relating to units and standards of measurement:

(1) Ratification of the improved astronomical second of time⁵, with a rider urging standards and other laboratories to proceed as actively as possible with the work to establish a second based on an atomic frequency standard.

(2) Provisional retention of the Potsdam gravimetric system⁶ for use in physics until the results of certain absolute determinations of gravity now in progress are made known.

(3) Approval of a detailed list of the international system of units⁷ (designation *SI*) founded on six basic units (metre, kilogram, second, ampere, degree Kelvin and candela).

(4) Approval of a new draft of the International Temperature Scale (1948)⁸, henceforth to be known as the International Practical Scale of Temperature (1948).

(5) Inviting the International Committee to study, and if possible resolve, the confusing situation due to the difference of 28 parts in a million between the cubic decimetre and the litre⁹.

The eleventh General Conference was by far the most interesting and stimulating of the three Conferences held since the end of the Second World War. Besides giving official recognition to a fundamental change in the definition of the metre, some very difficult administrative and financial questions were resolved in such a way as should engender a new look for international scientific metrology during the next decade.

This article is published by permission of the director of the National Physical Laboratory, who led the United Kingdom delegation at the eleventh General Conference.

H. BARRELL

¹ Engelhard, E., Symposium held at the National Physical Laboratory in May 1951 on Recent Developments and Techniques in the Maintenance of Standards, 19 (H.M. Stationery Office, 1952).

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³ Barrell, H., *Nature*, 180, 1387 (1957).

⁴ *Nature*, 183, 80 (1959).

⁵ *P.V. Com. int. Poids Mes.*, 25, 77 (1956).

⁶ Kaye, G. W. C., and Laby, T. H., "Tables of Physical and Chemical Constants", twelfth ed., 17 (Longmans, 1960).

⁷ *P.V. Com. int. Poids Mes.*, 25, 117 (1956).

⁸ *Trav. Bur. int. Poids Mes.* (9e Conférence Générale, 1948), 21, 89 (1952).

⁹ *P.V. Com. int. Poids Mes.*, 22, 94 (1950).