Standards

The International Bureau of Weights and Measures, 1875–1975. CHESTER H. PAGE and PAUL VIGOREUX, Eds. Translated from the French edition. National Bureau of Standards, Washington, D.C., 1975 (available from the Superintendent of Documents, Washington, D.C.). viii, 248 pp., illus. Paper, $3. National Bureau of Standards Special Publication 420.

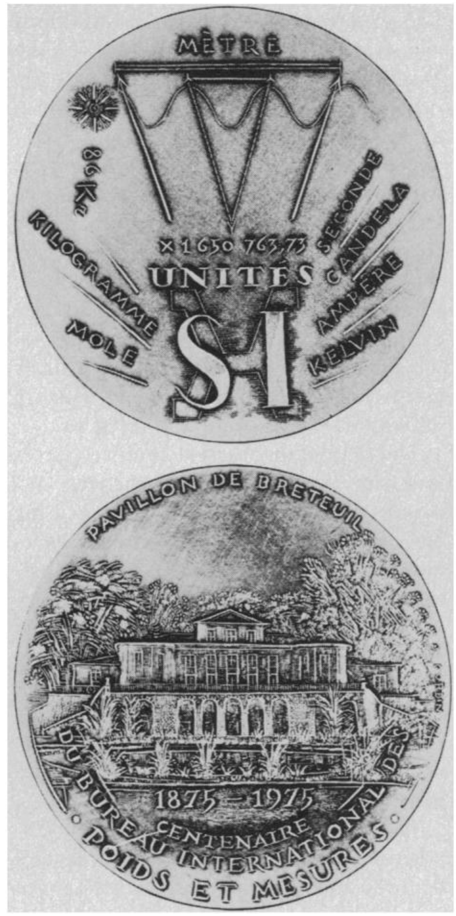
All of us know that the United States is at long last about to adopt the metric system, surely by our bicentennial year. Few know, however, that we did indeed legally adopt the metric system over a hundred years ago (in 1866) and then reaffirmed this decision in 1875 when the United States and 16 other countries signed the so-called Treaty of the Meter. At that time the meter and the kilogram became our official standards, but we simply redefined the foot and pound in terms of these metric standards and remained comfortably in "customary" units.

This volume is a history of the first hundred years of the International Bureau of Weights and Measures at Sèvres (just outside Paris), which is the organization charged with maintaining the primary metric standards.

When the French Academy first began debating (in the 1790's) the need for a standard of length, some other scientists (including Huyghens and the British Royal Society) favored the length's being that of a pendulum with a period of one second, but the French Academy preferred the length to be one ten-millionth of the distance from the pole to the equator along the meridian through Paris. This ultimately became the standard meter, although for practical purposes it was defined as the distance between two scratch marks on a platinum-iridium bar housed at Sèvres.

After Michelson had invented his two-beam interferometer, it occurred to him that he could accurately measure the meter by counting the number of fringes of a spectrally pure light source. (That achievement in fact was the principal basis for his Nobel Prize in 1908.) Later we had the much sharper spectral line of a pure isotope, Kr^{86}; and now we have highly monochromatic laser light sources, and the meter is now so well defined that even if some calamity should melt the primary meter we could produce another that would be just as good.

Our standard of mass, the kilogram, is still that arbitrary chunk of metal at Sèvres: there is at present no proper redefinition of this in terms of other physical quantities (although it is rather close to the mass of a cubic decimeter of pure water at its maximum density). The unit of time, the second, is even more elusive: it was a certain fraction of a day, and days vary slightly through the year (and years also wobble a little), so the year 1900 was picked to define the second. Should all the clocks stop one night would we have to get the astronomers to go back to 1900 and remeasure the second? Happily we now know the speed of light with sufficient accuracy that we can reconstruct the second of time also from spectroscopic data.



Medal commemorating the centennial of the Convention of the Meter and the International Bureau of Weights and Measures. Designed by R. Corbin, Monnaie de Paris. [From *The International Bureau of Weights and Measures, 1875–1975*]

As years went by the standards group at Sèvres added other basic standards to their repertoire: the gravitational constant, the absolute temperature scale, the ampere and related electrical units, standard lamps for photometry and measurements of radioactivity, x- and gamma rays and neutrons. Each of these standards is described in a chapter that tells how the unit was first defined and then what techniques were designed to measure and maintain the standard and to prepare secondary standards.

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Theory of Catalysis

The Mathematical Theory of Diffusion and Reaction in Permeable Catalysts. RUTHERFORD ARIS. Clarendon (Oxford University Press), New York, 1975. Two volumes. Vol. 1, The Theory of the Steady State. xvi, 444 pp., illus. $39.50. Vol. 2, Questions of Uniqueness, Stability, and Transient Behaviour. xiv, 218 pp., illus. $25.75.

One of the central problems for the chemical engineer is the design of catalytic chemical reactors in which a fluid stream of reactants is brought into contact with a solid catalyst, producing chemical products more rapidly than they can be produced in the absence of the catalyst. Since the rate at which the reaction proceeds depends critically on the amount of catalytic surface that is exposed to the reactants, it is customary to impregnate porous carriers with catalytic material. Thus before the reaction can take place the reactants must diffuse through the pores and after the reaction its products must diffuse out. It is this problem that is treated in this book. It is not only an important problem, it is an extremely interesting one. Aris assumes throughout a linear coupling of diffusion and reaction for the isothermal case and a linear coupling of diffusion, heat conduction, and reaction in the nonisothermal case. The interest of the problem resides in the fact that the mathematical models for such systems lead to a system of second-order nonlinear differential equations of boundary value type with enough pathology to interest modern-day mathematicians. This pathology involves unsymmetric, multiple, and oscillatory solutions.

In the first volume Aris discusses in an exhaustive way steady-state time-independent solutions for a single reaction with and without heat effects. The treatment is limited to the case in which the diffusion of the separate species is uncoupled so that a single differential equation needs to be considered. Some attention is given to multiple reactions, the normal industrial case, but here the mathematical complications are severe and the pathology has not been elucidated. The book is rich in graphs, diagrams, and illustrations of the numerical results. The writing is superb, the treatment is rigorous, and the whole is a tour de force that not only should be useful to engineers, but will also be a source for mathematicians and an education to chemists.

The second volume treats the unsteady or transient state, so the mathematical model always leads to nonlinear systems of partial differential equations of parabolic type. Engineers with a bias toward theory and mathematicians should find this vol-