SCIENCE

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MSS. intended for publication and books, etc., intended for review should be sent to Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

ACADEMIC EFFICIENCY[1]

ABOUT ten years ago I was asked by the president and general manager of a large manufacturing corporation to advise him how to improve the performance of his boiler house. During the previous winter it was pushed to its utmost to deliver enough steam to run the engines and to keep the buildings warm, and the next winter, on account of extensions to the factory and increased output, the demand for steam would be still greater. Before beginning my work the president told me something of the history of the company, and of how he came to be the general manager. It had grown in fifty years from a small concern to a large one, occupying several blocks of ground. The business was the manufacture of a variety of shelf hardware. He had for several years been a director and the manager of the sales department, and on the death of the former factory manager the directors insisted on his taking the place, although, as he said, he knew nothing about running a factory. He started in to learn how by calling in the best outside expert advice available. He was paying $10,000 for a year's services of a highly skilled expert in machinery, jigs and methods of manufacturing, who was making a revolution in the shop, which amply justified the high price paid for his services. This man said he knew nothing about boilers, and therefore I was called in to tackle the boiler problem. Incidentally the president told me that the catalogue of the products made by the concern con-

[1] A paper presented at the Boston meeting of the Society for the Promotion of Engineering Education, June 28, 1912.

The first chapters explain the principle of operation of the gas engine, and describe in detail the various constructions that are employed in the engines on the market. The remainder of the book is given up to practical explanations of the setting up of a new engine, the economical operation of engines, engine care and maintenance, and explanations of the troubles to which engines are subject, together with their remedy and prevention. The book is written with the greatest possible simplicity of expression. The illustrations are especially prepared line drawings made by the author, each one specifically illustrating some particular point of construction."

The book is well written and admirably covers the ground claimed for it, though at times at the expense of scientific accuracy. It should not only prove an excellent guide to the amateur and the operator of small stationary plants, but it will be found extremely useful to those more scientifically inclined, as it supplies numerous details of construction and methods of operation that can not be given space in a scientific work, such as the details of carbureters, ignition systems and spark plugs.

In attempting to explain electrical and thermodynamic phenomena, the author at times uses illustrations that would not stand the test of scientific accuracy and that would be misleading to those who had no further knowledge of the subject. In the first chapter he repeatedly speaks of converting water into a gas and gasoline into a vapor. If the term "vapor" could be understood by the reader in one case there should be no difficulty about it in the other. In comparing the relative efficiency of gas and steam engines, he states on page 6 that: "When a fire is built under a boiler only a small part of the heat is actually applied to heating the water, for most of it passes up the chimney or is otherwise wasted." The author evidently confuses the chimney wastes with the exhaust wastes. Boiler efficiencies of 70 per cent. are not uncommon.

On page 10, the statement, "The compression of the charge turns any liquid gasoline to vapor" might be open to question.

The most serious misconception that the reader might gain is that electricity is a substance like water or air and that there is an unlimited store of electricity in all substances which only has to be set in motion to do work. This is certainly contrary to the ordinary conception of electrical energy and could only be defended by resorting to the electron theory, which would be beyond the scope of the work. The author regards a dynamo as a machine for setting electricity in motion.

In describing the principle of action of the Bosch high-tension magneto, when the current in the primary coil is broken, the author states, on page 145, that "The sudden rush of intense primary current into the secondary winding raises sufficient pressure to enable the current to jump across the spark plug gap," ignoring the real cause for the induced current in the secondary. This action was probably inferred because the diagram shows the secondary winding to be in series with the primary, for in describing other types, where the windlings are separated, he correctly assumes the high-tension current in the secondary to be caused by the rapidly dying magnetism or change of magnetic flux in the iron core.

C. R. JONES
WEST VIRGINIA UNIVERSITY

SCIENTIFIC JOURNALS AND ARTICLES

THE closing (October) number of volume 13 of the *Transactions of the American Mathematical Society* contains the following papers:

W. A. Hurwitz: "On the pseudo-resolvent to the kernel of an integral equation."

G. A. Miller: "Infinite systems of indivisible groups."

J. K. Lamond: "Improper multiple integrals over iterable fields."

T. H. Gronwall: "On a theorem of Fejér and an analogon to Gibbs's phenomenon."

W. H. Roever: "The southerly and easterly deviations of falling bodies for an unsymmetric gravitational field of force."

Dunham Jackson: "On approximation by trigonometric sums and polynomials."

Also notes and errata to volumes 7 and 13.

THE opening (October) number of volume 19 of the *Bulletin of the American Mathematical Society* contains: "Surfaces of revolution of minimum resistance," by E. J. Miles; "Shorter Notices": Riquier's Les Systèmes d'Équations aux Dérivées partielles, by Edward Kasner; Study's Ebene analytische Kurven und zu ihnen gehörige Abbildungen, by Arnold Emch; Coffin's Vector Analysis, by J. B. Shaw; Berichte und Mitteilungen der Internationalen mathematischen Unterrichtskommission and Auerbach und Rothe's Taschenbuch für Mathematiker und Physiker, by E. W. Ponzer; Bonola-Carslaw's Non-Euclidean Geometry, by Arthur Ranum; Barbarin-Halsted's Géométrie rationelle, by R. C. Archibald; Smith and Granville's Elementary Analysis, by Jacob Westlund; Hawkes, Luby and Touton's Second Course in Algebra, by J. V. McKelvey; Jacob's Calcul mécanique, by C. C. Grove; Schwahn's Mathematische Theorie der astronomischen Finsternisse and Haret's Mécanique sociale, by Kurt Laves; "Notes," and "New Publications."

THE November number of the *Bulletin* contains: Report of the nineteenth summer meeting of the society, by F. N. Cole; "A few theorems relating to Sylow subgroups," by G. A. Miller; "Theorems on functional equations," by A. R. Schweitzer; "Double curves of surfaces projected from space of four dimensions," by S. Lefschetz; Review of Southall's Geometrical Optics, by E. B. Wilson; "Shorter Notices": Rogers-Salmon's Analytic Geometry of Three Dimensions, by Virgil Snyder; Volume 3 of Picard's edition of the Works of Charles Hermite, by James Pierpont; Heiberg's Naturwissenschaften und Mathematik im klassischen Altertum and Mannoury's Methodologisches und Philosophisches zur Elementar-Mathematik, by D. E. Smith; Weber und Wellstein's Encyklopädie der Elementar-Mathematik, volume 3, part 1, and Korn's Freie und erzwungene Schwingungen, by J. B. Shaw; Richard's Assurance complémentaire de l'Assurance sur la Vie, by C. C. Grove; Vahlen's Konstructionen und Approximationen, by E. W. Ponzer; "Notes," and "New Publications."

THE December number of the *Bulletin* contains: General report of the fifth international congress of mathematicians at Cambridge, by Virgil Snyder; Report of Section I of the Congress (arithmetic, algebra, analysis), by A. B. Frizell; "Shorter Notices": Boehm's Elliptische Funktionen, Part 2, by L. W. Dowling; Darboux's Eloges académiques et Discours, by G. A. Miller; Hedrick and Kellogg's Applications of the Calculus to Mechanics, by D. C. Gillespie; "Notes," and "New Publications."

CONDITION OF THE EARTH'S CRUST

THE results of measurements of the force of gravity at various points on the earth, as well as the results of triangulation operations, were early recognized as indicating that the earth's crust is in a condition of approximate equilibrium, to which the name "isostasy" has since been given.

The development by Mr. Hayford of a new method of reduction of gravity observations, in which for the first time the effect of the topography of the whole earth has been taken into account, has furnished strong additional proof of the general fact that the condition of isostasy exists, that elevated regions, whether plains or mountains, are, so to speak, floated on the earth's surface by reason of the lesser density of the underlying materials, and that ocean bottoms are depressed because of the greater density of the materials beneath.

The question of how close is this adjustment, of how local is the compensation of surface irregularities, is of considerable interest. If the compensation is quite complete for each small topographic feature, so that a single mountain or hill or canyon is exactly compensated by a less dense or a more dense material beneath, the surface of the earth would in detail be in a condition of nearly perfect equilibrium, and would largely be free from stresses due to the supporting of topographic features; on the other hand if the compensation is more general such features of moderate