Book Reviews

Catalytic Models in Epidemiology. Hugo Muench. Harvard University Press, Cambridge, Mass., 1959. xi + 110 pp. Illus. $4.50.

Analysis of the behavior of infectious disease in the host population by the development of mathematical models has been of perennial interest to the relatively few individuals having both the requisite knowledge of mathematics and an interest in this highly specialized facet of ecology. The earlier models, beginning with the Ross malaria equations in which the vector as well as the host and parasite populations were taken into account, and extending through those of Reed and Frost, Soper, and Greenwood, are of the point-infection type. These models were developed as binomial expansions in which the stages of the evolution of the host-parasite relationship are described as the successive terms. Such models may become complex by, for example, assumptions of inhomogenous mixing, as by variation in family or other subgroup size in the host population, leading to binomial chains. These models are essentially deterministic, and they are based on the assumption that any future state of the population can be precisely determined if variables such as the numbers of susceptible and infected persons, and of attack, birth, and death rates are known.

More recently there has been a tendency to introduce a stochastic element into such models, as in Bartlett's development of the probability generating functions for the numbers of susceptible and infected persons by regarding infection and removal as random events. Similarly, introduction of the frequency distribution of the probabilities given by binomial expansion brings a stochastic element into the point-infection type of model. Stochastic treatment of the continuous-infection type of model as it was developed by Bailey becomes relatively complex.

The extent of simplification necessary for the construction of mathematical models, even in complex form, is at the same time both a weakness and a strength. In the first instance, the continuous-infection model of Kermack and McKendrick, for example, illustrates the use of the so-called threshold theorem, or the critical proportion of susceptibles occurring at the peak of the epidemic wave, to define with apparent precision herd immunity, or a state of the host population that prevents the disease from reproducing itself. Attempts to make use of such deductions, for example, in arriving at the portion of the population to be immunized against a disease as well-known as diphtheria, have been disappointing because of the relatively wide discrepancies between the prediction and the observation, between groups of preschool and school children in this instance. At the same time, a theoretical model may contribute useful information; one solution of the Martini formulation of immunizing disease, which predicts a damped periodicity in the incidence of such disease, seems to have no clearly defined counterpart in human disease. Measles, the example par excellence, shows periodicity but as yet no appreciable damping, but in experimental epidemiological studies of mouse typhoid, damping has been achieved, resulting in the predicted invariance in specific death rate, by infection rates much higher than those observed in naturally occurring disease.

Equated against this general background, Muench's book stands out as a valuable contribution. It is a source of great personal satisfaction to me to find perpetuated here the deceptive simplicity characterizing a high order of pedagogical acumen; that of Lowell J. Reed and W. H. Frost (from which this book is descended) was such that the most abstruse material appeared to be almost self-evident to the student. Muench notes in passing (almost casually but very effectively), the relevant mathematical background. As indicated in the title, the model developed is described by the catalytic function and by variations of it. The simplicity of the presentation is further enhanced by the use of the method of moments for fitting to observed data and by the provision of nomograms for approximation of the relevant constants, together with detailed examples. Thus, even the arithmetic necessary to fitting by the least squares or maximum likelihood methods is eliminated. It is difficult to imagine a simpler and clearer, but at the same time precise, presentation of the subject matter. The solutions of the various equations used and calculation of their moments are given in an appendix for those who may be interested.

This method of analysis is applied to the impact of infectious disease on the host population as shown by the age distribution of historical or immunological evidence of infection. Histories were used in the case of measles, whooping cough, and yaws, and immunological evidence of past infection in the consideration of yaws, yellow fever, diphtheria, tuberculosis, and histoplasmosis. Reversion of seropositivity is considered as a simple reversion described by a reversible catalytic curve, and as successive reactions described by the two-stage catalytic curve. The possibility of variable rates of infection, and reversion, is discussed in connection with several infectious diseases.

The utility of mathematical models is shown by the consistency of the deductions that may be drawn from their application rather than by criteria such as goodness of fit. In the model described here the significant constant is r (infection rate). It is regarded as a measure of the "force of infection" (infection pressure in the terminology of some writers), and corresponds to Frost's rate of effective contact. The usefulness of the catalytic curve as a model is shown, for example, by the behavior of r in comparisons of the incidence of measles and whooping cough in rural and urban areas, which have resulted in conclusions that are fully consistent with the known behavior of these diseases. At the same time, this model did not allow informative deduction concerning the occurrence of variable rates when tested by survival ratios in hypertension. Earlier, Zinsser and Wilson described similar failure in the application of binomial expansion of the point-infection type of model to the question of possible variation in virulence of the microorganism during the evolution of the epidemic wave. It is probable that such distinctions, if and when they may occur, are too subtle to be made in simple mathematical models.

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Man-Made Textile Encyclopedia. J. J. Press, Ed. Textile Book Publishers (Interscience), New York, 1959. xxx + 913 pp. Illus. $27.50.

Review of Textile Progress, 1958. vol. 10. M. Tordoff and C. J. W. Hooper, Eds. Textile Book Publishers (Interscience), New York; Butterworths, London, 1959. 494 pp. $8.

Physical Methods of Investigating Textiles. R. Meredith and J. W. S. Hearle. Textile Book Publishers (Interscience), New York, 1959. ix + 411 pp. Illus. $13.

Friction in Textiles. H. G. Howell, K. W. Mieszkis, and D. Tabor. Textile Book Publishers (Interscience), New York, 1959. 263 pp. $6.75.

Man-Made Textile Encyclopedia, with authoritative contributions by 148 textile scientists, presents concisely and interestingly an unbelievable amount of information on over 100 technical subjects. These subjects are grouped into chapters on the molecular properties of raw materials; fiber manufacturing, characteristics, and identification; processing into yarns, threads, cords, and fabrics; textile engineering principles; dyeing, printing, and finishing; standards for specific uses; apparel manufacturing and renovation; economics and statistics; world fiber trade marks; and glossary and indexes. Many excellent photographs, illustrations, and tables are found throughout the book.

In sharp contrast to this encyclopedia is the *Review of Textile Progress, 1958*, the tenth volume of this important series, in which the main contributions of more than 3000 papers published during 1958 are condensed. The subjects covered include fiber physics; the chemistry of cellulose, wool, silk, regenerated protein, synthetic, and bast fibers; the production of cotton, long vegetable, wool, animal, silk, cellulose, and synthetic polymer fibers; the conversion of fibers into yarns; warp sizing and sizing materials; weaving preparation and weaving; knitting; coloring matters, dyeing, printing, and finishing of fabrics; chemical and physical testing; laundering and dry-cleaning; building and engineering; and, finally, industrial applications of textiles. This monumental survey reviews the contributions made during one year to the textile industry throughout the world.

Physical Methods of Investigating Textiles describes modern experimental methods and techniques used for determining the structure and physical properties of textiles, including x-ray techniques; infrared spectroscopy; electron microscopy; optical microscopy; fiber dimensions; density, moisture, and swelling; yarn and fabric structures; mechanical properties of fibers, yarns, and fabrics; transmission of heat, moisture, and air; frictional behavior of textiles; optical properties; electrical properties; and the applications of nuclear physics. The text includes many excellent illustrations and photographs, and most of the reviews contain extensive and up-to-date references.

Friction in Textiles covers a most timely subject since the surface or frictional properties of fibers greatly affect their spinning and processing potentialities, the mechanical properties of spun yarns, and the performance of the final textile products. Part 1, entitled "Theory of friction and lubrication," consists of three basic chapters. The first gives an excellent discussion of the mechanism of friction, which is applicable to any material in general; the second extends this general discussion specifically to plastics and fibers, and the third discusses the mechanism of lubrication. Part 2, entitled "Friction in textile processing," includes chapters on friction of wool; friction in spinning, winding, and during conversion of yarns into fabrics; the effect of interfiber friction on the strength of tire cord; and friction in fabrics. Part 3, entitled "Test methods," includes chapters on the measurement of friction of yarns and of fibers, the control and measurement of tension in processing, and the measurement of abrasion. The book includes 10 pages of tables on some typical values of friction for yarns and fibers. Excellent diagrams are used throughout the book, and extensive references to literature are given at the end of each chapter.

I feel that these four books fill an important gap in textile literature and are an excellent indication of the scientific stature of the textile industry in all of its many and complex phases. The books are recommended not only to scientists and technical personnel working in the industry, but to those interested in authoritative information on modern textile science and technology. They provide important source material that can be used by the libraries of the schools, colleges, and universities training the future leaders of the textile industry. Finally, the thought-provoking discussions and the challenging problems presented in these books should offer inspiration and guidance to the talented and searching minds of students and teachers.

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Some Problems in Chemical Kinetics and Reactivity. vol. 2. N. N. Semenov. Translated by Michel Boudart. Princeton University Press, Princeton, N.J., 1959. x + 330 pp. Paper, $4.50.

Some Problems of Chemical Kinetics and Reactivity. vol. 2. N. N. Semenov. Translated by J. E. S. Bradley. Pergamon Press, New York, 1959. x + 168 pp. $5.

The first volumes of these translations were reviewed by Harold S. Johnston and Henry Eyring, respectively [*Science* **129**, 1419, (1959)]; in my estimation, these reviews cannot be improved upon as evaluations of Semenov's work, and no attempt will be made to do so. However, since two translations of this important work were made, a comparison is in order.

I believe it to be axiomatic that what we want to read is what Semenov has to say; therefore, the truer the translation and the less tempering by the translator the better. In the Pergamon edition, chapter 1 of part 4 is called "Thermal ignition," while in the Princeton edition it is referred to as "Thermal explosions." In the original it is called "Thermal inflammation" (in the ballistic not medical sense), but in the preface Semenov states that he included a chapter on "Thermal explosion"; this gives some justification to the Princeton version. On page 96 of the Princeton version there is a statement ". . . the agreement . . . is not bad at all. . . ." This is a literal rendition of the Russian (page 433), but whereas in Russian the *not bad* is a reserved, toned down