therefore concludes that the two processes are not directly connected.

In an analysis of *Drosophila* chromosomes, Fahmy and Bird found that diepoxide and triazine produced a higher proportion of small deficiencies than did x-rays or mustard gas. Lethals with rearrangements increase more than linearly in relation to dose, while lethals without chromosome rearrangements show less than a linear relation to dosage.

The section on secondary and spontaneous breakage involves a heterogeneous collection of articles. La Cour's analysis of *Hyacinthus* chromosomes shows that chromatid reunions at the second division must be attributed to deferred union or deferred breakage. Koller finds that chemically induced tumors in rats occasionally show recurrent chromosome breakage. This spontaneous breakage was suppressed when the tumor was grown in tissue culture. A somewhat similar dicentric chromosome cycle was found in *Narcissus* by Darlington and Wylie. The cycle is permanent, but union of broken chromosomes ends may be limited by spatial or physiological limitations. In *Agropyron* also, the breakage-fusion-bridge cycle of dicentrics may fail if the breakage is not proximate, because of healing of broken ends. Hair found that some of the new chromosomes produced by breakage of dicentric bridges improved the efficiency of pairing and the genetic balance. Rees describes abnormal chromosome separation at anaphase in *Scilla* following irradiation, and due to the physiological effects of x-rays. Auerbach's analysis of the sensitive stage of *Drosophila* gonads shows that x-rays and mustard gas are most mutagenic at the stages of active nuclear synthesis, but that formaldehyde is most effective on the mature spermatozoa. This variation in sensitivity to mutagenic agents may provide data of value in the analysis of the causal factors in mutation.

The general section of the symposium deals largely with chemical factors in chromosome breakage. Irradiation not only decreases mitotic activity and results in chromosome breakage, but it also depresses the synthesis of deoxyribonucleic acid (DNA). Howard and Pelc used P^{32} intake in *Vicia* roots to measure DNA synthesis, and found that neither repression of division nor chromosome breakage caused by irradiation seems to be associated with DNA synthesis; but, as Walker points out, the determination of the amount and nature of DNA is subject to error.

The molecular orientation of the chromosome in relation to breakage is considered by Ambrose and Gopal-Ayengar. A comparison of fresh salivary gland chromosomes and oriented nucleoprotein fibers indicates that the longitudinal cohesive forces are due largely to hydrogen bonds. Certain chemicals could act directly on the hydrogen bonds, but others such as the diepoxides and nitrogen mustards probably result in a defect of synthesis. Ionizing radiation could disperse the bonds by localization of energy or by producing radicals which break primary bonds. A mechanism for uniting broken ends of chromosomes, one which would not disturb the reproductive system, is described. Loveless proposes the rather unorthodox suggestion that the chromosomes do not have a structural continuity, so that the problem of chromosome breakage is based upon failures in chromosome synthesis.

The variation in the time frequency and nature of induced chromosome breaks in different tissues and organisms, the differential effects of various mutagenic agents, and the effects of modifying factors, all indicate the complexity of the problems of chromosome breakage. The great variation does, however, provide a method of analysis of the various factors involved in chromosome breakage and reunion. The complexity of the problems of chromosome breakage are even greater than the symposium would indicate, because the conclusions on the action of ionizing radiation are based largely upon the work of the John Innes cytologists. The symposium has raised far more questions than it has answered.

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Stochastic Processes. J. L. Doob. New York: Wiley; London: Chapman & Hall, 1953. 654 pp. $10.00.

This book, one of the volumes in the series of Wiley Publications in Mathematical Statistics, is written for mathematicians. It seems to me that the author's hope that it may be accessible to readers familiar with the manipulation of random variables conditional probability distributions and conditional expectances is rather optimistic.

The first chapter describes the probability background of stochastic processes and in the second chapter the author describes the various classes of stochastic processes which are discussed in detail in chapters III to XI. These classes are processes with mutually independent random variables (ch. III), processes with mutually uncorrelated or orthogonal random variables (ch. IV), Markov processes (with discrete parameter, ch. V; with continuous parameter, ch. VI), martingales—the fortune of a gambler taking part in a fair game is a typical example of a martingale—(ch. VII), processes with independent and orthogonal increments (chs. VIII and IX), and stationary processes (chs. X and XI). The last chapter discusses prediction theory and the book concludes with a supplement giving the necessary elements of measure theory, an appendix with historical notes, a bibliography to this appendix, and a subject index.

Stochastic Processes seems to give a comprehensive and authoritative account of the mathematical background of the subject. The references to applications, which to my mind are far too few, are excellent and lucid. It is to be regretted that probability theory has now developed into a branch of measure theory and that modern developments in this subject are often couched in a language that is almost incomprehensible to ordinary experimental scientists and to most theoretical physicists. Since the language used in this

book is so highly specialized and technical, it is regrettable that the author did not include an extensive glossary of the symbols and notation used.

A personal point of regret was that, although the author mentions that in many modern problems in physics or astronomy it is necessary to abandon the requirement of normalizability of probability, he did not discuss some applications to cases where this impossibility of normalizing the probability would occur. This problem is, for instance, important for the discussion of the attainment of equilibrium in open star systems.

Concluding I can only congratulate the author and the publishers on producing this volume which for quite some time will be the main reference book for mathematicians on stochastic processes, if the signs do not deceive me.

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Inorganic Thermogravimetric Analysis. Clément Duval. Amsterdam–Houston: Elsevier, 1953. 548 pp. Illus. $11.00.

Occasionally a book appears which attracts special attention because an old subject is treated from a new approach. Here for the first time in a monograph is given a complete study of the stability to heating between 20 and 1000° C of 967 precipitates which have been proposed for inorganic gravimetric analysis. The results of the investigations of the author and his co-workers have been published in *Analytica Chimica Acta*. There is also a historical review of the development of the subject since the thermobalance was introduced by Honda in 1915, and a complete description of the Chenevard balance which was used.

The pyrolysis curves show the temperature range in which relatively constant composition is obtained. In some cases it is now evident that excessive heating of precipitates with a blast lamp to obtain a constant weight is unnecessary. For example, magnesium ammonium phosphate reaches a constant weight in an open crucible above 477° C and it is useless to ignite at 900° C. On the other hand, the asbestos mat on a Gooch crucible remains constant after the water is driven off as far at 283° C. Above this temperature there is a gradual loss of water which is complete only at 879° C.

The pyrolysis curves for all the precipitates are given in 152 illustrations with a critical discussion in brief paragraphs for each of the precipitates. There are also 980 references to the literature. About 210 methods were selected as satisfactory for gravimetric determinations and about 80 new methods were brought to light.

The book is well written and is undoubtedly a valuable source book for those interested in inorganic gravimetric methods.

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Books Reviewed in THE SCIENTIFIC MONTHLY

October

Africa: A Study in Tropical Development. L. Dudley Stamp. New York: Wiley; London: Chapman & Hall, 1953. 568 pp. Illus. + maps. $8.50.
Reviewed by George B. Cressey.

Explorations in Science. Waldemar Kaempffert. New York: Viking Press, 1953. 296 pp. $3.50.
Reviewed by G. G. Simpson.

The History of Astronomy. Giorgia Abetti, trans. by Betty Burr Abetti. New York: Schuman, 1952. 338 pp. Illus. $6.00.

Astronomy for Everyman. Martin Davidson, Ed. New York: Dutton, 1953. 494 pp. Illus. $5.00.
Reviewed by James Stokley.

Man and the Chemical Elements. J. Newton Friend. New York: Scribner, 1953. 354 pp. Illus. + plates. $6.00.
Reviewed by Hubert N. Alyea.

Hungry People and Empty Lands. S. Chandrasekhar. Baroda, India: Indian Institute for Population Studies, 1952. 306 pp. Illus. $3.50.
Reviewed by Warren S. Thompson.

Man's Foods. J. B. Jensen. Champaign, Ill.: Garrard Press, 1953. 278 pp. $4.50.
Reviewed by Martha F. Trulston.

Elements of Cartography. A. H. Robinson. New York: Wiley, 1953. 254 pp. Illus. $7.00.
Reviewed by George F. Jenks.

Weather Inference for Beginners. D. J. Holland. New York: Cambridge Univ. Press, 1953. 196 pp. Illus. $6.00.
Reviewed by Charles C. Bates.

Adventures in Artificial Respiration. Peter V. Karpovich. New York: Association Press, 1953. 303 pp. Illus. $7.50.
Reviewed by William R. Amberson.

Our Physical Environment: A Problem Approach. Leonard W. Gaddum and Harold L. Knowles. Boston: Houghton Mifflin, 1953. 625 pp. Illus. $5.50.

Man and His Physical Universe. Richard Wistar. New York: Wiley, 1953. 488 pp. Illus. $4.75.
Reviewed by W. Paul Gilbert.

Conferences on Drug Addiction Among Adolescents. New York: Blakiston, 1953. 320 pp. $4.00.
Reviewed by Manfred S. Guttmacher.

Spadework in Archaeology. Leonard Woolley. New York: Philosophical Library, 1953. 124 pp. Illus. + plates. $4.75.
Reviewed by Carleton S. Coon.

The Social Insects. O. W. Richards. New York: Philosophical Library; London: Macdonald, 1953. 219 pp. Illus. + plates. $4.75.
Reviewed by Charles D. Michener.