observed in the animals at birth are highly specific to the age at the time of irradiation, marked differences being seen in some cases when the age is varied by only a few hours. It seems that each region of embryonic tissue has a very short period of extremely high sensitivity to radiation damage, and that this period is the time during which the cells in the region become differentiated and the main line of their future development is laid down. There is a hope that such experiments may throw light on the mechanisms of growth and differentiation, which are still altogether mysterious.

The last article in the book, Practical Aspects of Radiation Injury by Hempelmann and Hoffman, discusses case-histories of people injured by atomic bombs, reactor accidents, and chronic exposure to radiation. These matters have an obvious topical interest to the general public, and the article is highly recommended to anyone who desires exact information and is content with a less colorful presentation of it than is given by the *Saturday Evening Post.*

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Crystal Growth and Dislocations. By Ajit Ram Verma. 182 pp. Butterworths Scientific Publications, London, England; Academic Press Inc., New York, 1953. $5.00.

One of the most significant recent developments in the physics of solids has been the almost dramatic success of the dislocation theory of crystal growth. From the viewpoint of a crystal grower the crystals that grow by the dislocation mechanism form a very small and highly special class. From the viewpoint of research in solid state physics, however, the dislocation growth mechanism is immensely important. The studies in this field have thrown light on a number of fundamental problems. In particular they give the most direct experimental evidence for dislocations and open up one of the most powerful techniques for studying dislocations. The success in this field has been due to the combination of three recent developments: (1) The theory of the atomic nature of a crystal surface in contact with its vapor or dilute solution and the associated theory of surface kinetics and nucleation; (2) the dislocation theory; in particular, the geometrical concept of a screw dislocation which, as F. C. Frank showed, removes the need for nucleation in growth on a close-packed crystal face; (3) the powerful techniques of phase contrast microscopy and multiple beam interferometry which reveal the details of a growth surface on an atomic scale and resolve steps only a few Ångstroms high. These subjects have all been treated before but never in a single book and from a unified viewpoint. Dr. Verma's book is a welcome and timely contribution.

No special postgraduate knowledge of physics is presupposed and no knowledge at all of crystal growth or dislocations. The topics are presented in physical and pictorial terms with the aid of line drawings and illustrative micrographs. Following a brief introductory survey, Dr. Verma introduces the atomic theory of growth of a perfect crystal. He then defines dislocations and describes the geometrical properties that are the basis of their role in crystal growth. A chapter is devoted to optical techniques and in particular phase contrast microscopy; two chapters follow dealing with the experimental observations. Here Dr. Verma is reporting on a phase of the work in which he has made some of the most outstanding contributions. Interferometric techniques are discussed for measuring step heights of a few Ångstroms. The last of the nine chapters discusses miscellaneous subjects including the origins and the motion of dislocations.

The book is clearly written and well-organized. It will be appreciated by physicists, metallurgists, and chemists interested in a specialized but highly important subject.

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Communication Theory. Papers Read at a Symposium on "Applications of Communication Theory", London, 1952. Edited by Willis Jackson. 532 pp. Academic Press Inc., New York, 1953. $11.00.

The mathematical theory of communication (information theory) has been developing for about thirty years; it reached maturity with Claude Shannon's paper in the *Bell System Technical Journal* in 1948. The publication rate since then has been high. A person not working primarily in communication engineering, but interested in its possible applications to his own work, can hardly read every paper; to such a person, the volume under review will be very useful. It can be read, with reasonable understanding, by a reader initially acquainted only with Shannon's paper. It covers a number of different areas of application. And it has been put together with unusual editorial skill: it has a continuity of subject matter and a uniformity of symbolism seldom attained in a symposium collection.

The basis of the new theory is a quantitative definition of *amount of information.* When an event occurs whose probability was p, the event is said to communicate an amount of information log $(1/p)$. This definition makes information additive for independent events, and dependent in a reasonable way on the probability: for instance, an event that we know is going to happen $(p=1)$ conveys no information by happening. If n independent symbols have probabilities $p_1, p_2, \ldots, p_n$, then an N-symbol message with N_1 occurrences of symbol 1, N_2 of symbol 2, etc. communicates an amount of information $-\Sigma_i\ N_i \log p_i$. Previously (1922), R. A. Fisher had based his theory of statistical estimation on essentially this same quantity; he applied the term "information" not to it, but (1925) to a quantity derived from it. Fisher remarked (1935) that information (in his sense) "is strikingly similar to entropy"; that "irreversible processes . . . may be accompanied by a loss, but never by a gain". In Shan-