farther apart at the end of the series, clearly showing the increasing speed, and were always alternating from one side to the other.

The length of flights observed varied from two or three feet to perhaps 400 feet and all intermediate distances. Many flights were timed with a stop watch, and the longest observed was twenty-eight seconds. Since the ship speeds were eight to ten knots and the fish could generally keep ahead, their flying velocity may be as much or more than fifteen feet per second.

One evening while the ship was at anchor a seaman caught one and brought him to me while still alive. The fish was about eight inches long and while held in my hand vibrated the after part of his body very vigorously at a frequency, as near as I could estimate, of about twenty complete cycles per second. This was repeated several times for intervals of a few seconds. There was no tendency to move his wings in his struggles, as does a bird when held.

My opinion is that the flight is gliding, entirely, the necessary speed being attained by a process similar to sculling.

HERBERT GROVE DORSEY

U. S. COAST AND GEODETIC SURVEY

LAURENCE

DR. I. R. LESAGE, of Huntington, W. Va., tells me that formerly it was customary among many people of that region, and may still be, to use the term "laurence" when referring to the display of shimmering which one often sees over a hot surface, such as a stubble field on a calm, cloudless summer day.

This term fits the subject precisely because the phenomenon alluded to, being caused by the unequal light refractions of innumerable columns of air of different temperatures, is most pronounced when the surface over which it appears is very hot and therefore remindful of the martyrdom of St. Laurence (Rome, A.D. 258) by roasting alive on a griddle.

Certainly the boy sweating in the harvest field, with never a breath of air stirring and the sun stalled in mid-heaven, can testify to the everlasting appropriateness of the term "laurence" for the shimmering of the burning and blistering heat he must endure. Indeed the term is so altogether fit as to deserve a much wider usage than it appears now to have.

W. J. HUMPHREYS

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SCIENTIFIC BOOKS

MINERALOGY

Introduction to the Study of Minerals. By AUSTIN FLINT ROGERS. Third edition, 626 pp, $5.00. McGraw-Hill Book Company. 1937.

IN this new edition of his "Introduction," Professor Rogers has, in the main, followed the form and style of previous editions. It covers the entire field of mineralogy in four parts: the properties, description, occurrence and determination of minerals.

Those who are interested in crystallography will welcome the full and clear treatment of this subject, especially the correct description of the symmetry of each of the classes. The Groth-Fedorow nomenclature of classes and forms is used. It is to be hoped that this terminology, which is rapidly gaining in favor, will soon be generally adopted.

A new chapter by Dr. Lloyd W. Staples on microchemical analysis calls attention to methods that have generally been ignored in mineralogical texts.

The descriptive part contains discussions of 222 minerals. The recommendations of the committee on nomenclature of the Mineralogical Society of America, 1935, have been followed in the naming of minerals. The German and French equivalents of each name are given and the origin of most names is explained. References to occurrence are chosen to throw the greatest possible light on the origin and associations of each mineral.

Though nearly twenty pages are devoted to a discussion of crystal structure there is no mention of the structure of individual species in the descriptive part. To the reviewer this seems no great drawback except for the silicates. The structural classification of this most important group of minerals is now so well established that it ought to be generally used.

Professor Rogers' text is very clear and is aided by many simple drawings, convenient subheads and the judicious use of heavy type, which make for easy reading. With these desirable features and a thorough treatment of fundamentals the book is well adapted to the needs of students.

ADOLF PABST

UNIVERSITY OF CALIFORNIA

Oyster Biology and Oyster-Culture. The Buckland Lectures for 1935. By J. H. ORTON. 211 pages, 57 figures. Longmans, Green and Company, New York. Price, $2.00.

AFTER many years of research on the biology of the European oyster, *Ostrea edulis,* and its methods of cultivation, Dr. J. H. Orton has written this book in which he summarizes the principal results of his productive investigations. Following a brief discussion of the anatomy and relations to other mollusks, the author deals more extensively with the habits of the organism, giving particular attention to shell movements, mode of feeding and to shell growth. The sex change of this species, which has been the principal problem of Dr. Orton's research during the last years, is described with greater details. In the second part of the book dealing with the modern problems relating to oyster culture, the author discusses the ecology of the oyster, its reproduction, methods of obtaining spat, fattening, and the protection of oysters against the attacks of various enemies. The last pages are devoted to the unfavorable environmental conditions, mortality, pollution and purification of oysters. Written in non-technical language, the subject is treated in a scientific manner stressing the idea that fundamental biological research forms the only sound foundation for practical oyster culture. Many references are made to the American oyster, the biology of which is extensively studied in this country. The book is well illustrated with numerous half-tone and line drawings. It is regrettable, however, that for the illustration of the act of spawning of the male and female American oyster the author reproduced a diagram (Fig. 29) which is obviously incorrect. The sperm is always discharged in this species through the cloaca, whereas the illustration shows its emission through the ventro-posterior part of the shell. This oversight does not reflect, however, on the high quality of the book which may be profitably read both by the biologists and those who are interested in the practical aspects of the cultivation of oysters.

There is a selected list of more recent literature and a glossary of terms. Unfortunately there is no index.

PAUL S. GALTSOFF

SPECIAL ARTICLES

THE ENERGY OF ACTIVATION OF PROTEIN DENATURATIONS

IT has been recognized for a quarter century that the kinetics of protein denaturations in general and of enzyme destructions in particular are frequently characterized by exceedingly large temperature coefficients or correspondingly large energies of activation as shown in Table 1.

TABLE 1

Substrate	E (activation)	s = steric factor
Pepsin	64,500	10^{28}
Hemoglobin	60,000	10^{22}
Egg albumin	140,000	10^{72}
Trypsin	150,000	..

With the development in recent years of theories of the absolute rate of reactions,[1] it has become increasingly evident that these reactions are of great interest, since they do not conform to the ordinary laws of chemical kinetics.

The purpose of this paper is to direct attention to the fact that the universally accepted method of calculating the energy of activation may yield fallacious results when applied to reactions which are sensitive to hydrogen ion concentration; that in at least one well-investigated case—the alkaline inactivation of crystalline swine pepsin—the kinetic paradox disappears when it is resolved in terms of a simple mechanism employing definite and familiar concepts.

The velocity constant k may be expressed as

$$k = \nu s e^{-E/RT}. \qquad (1)$$

E is the energy of activation defined through the Arrhenius equation as $RT^2\left(\frac{\partial \ln k}{\partial T}\right) = E$; the quantities to be held constant in the differentiation will be treated below. The frequency ν may be set equal to Z, the collision number in that variant of the theory[2] or to k T/h in Eyring's more elegant statistical treatment.[3] $Z \simeq 10^{11.4}$ (Sec^{-1}) and $k\,T/h \simeq 10^{12.8}$ (Sec^{-1}). Values of this order of magnitude are observed empirically for gaseous reactions and for many of the simpler reactions in solutions.[4] Minor deviations from $\nu = Z$ have been ascribed to the steric factor, *s*, to allow for the specific orientations of the molecules necessary for a fruitful collision. For reactions having measurable rates at room temperatures E lies normally between 16,000 and 24,000 cal.

The large values of E quoted above require values of the steric factor which range from 10^{22} to 10^{72}! These astronomical values of *s* at once expose the absurdity of considering these reactions entirely from a collisional point of view.

In this country it has become customary (ref. 2, 3) to express the deviations from normal behavior in terms of the entropy of activation (S) since formally $s = e^{S/R}$. It should be pointed out that although a representation of kinetic abnormalities in terms of an entropy of activation instead of a steric factor has theoretical justification and merit by avoiding the absurdities inherent in the simple collisional theory, an expression of results in terms of entropy of activation *per se* does not constitute an explanation. Only when a definite mechanism is proposed which permits of a numerical comparison of observed and computed entropies of activation can it be claimed that an explanation has been achieved. It should also be men-

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[1] The reader is referred to the forthcoming reports of the Symposium on Reaction Kinetics of The Faraday Society (Manchester, September, 1937) for a presentation and critical discussion of these theories.

[2] La Mer, *Jour. Chem. Phys.*, 1: 289, 1933.

[3] Eyring, *Jour. Chem. Phys.*, 3: 107, 1935.

[4] Moelwyn-Hughes, "Kinetics of Reactions in Solutions." Oxford Press, 1933. Chap. IV. Also pp. 50 and 297.