the reasons should apply to the individual, not to a nation; and they should be such as would cause him to exclude an American as quickly as a German, an Italian or a Russian. Science itself is imperilled far more than is any hateful political system when those engaged in the search for truth utilize courses of scientific instruction, scientific laboratories or scientific journals as weapons in political warfare.

In closing let me emphasize the fact that what I have written is in no sense a plea for toleration of totalitarian ideology. I am not among those who believe that it is a Christian duty to regard with toleration things which are utterly intolerable. And surely nothing could be more intolerable than the enslavement of the human spirit practiced under the totalitarian form of government! What I have done is to record my plea that scientists fight political battles with political weapons, and that they do all within their power to keep our academic halls and research laboratories sheltered from political storms, safe havens of intellectual sanity, calm judgment and free search for truth in a world gone mad.

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SCIENTIFIC BOOKS

INSULIN

Insulin. Its Chemistry and Physiology. By HANS F. JENSEN. New York: The Commonwealth Fund. London: Oxford University Press. 1938. Pp. 252.

IT may be stated immediately that Dr. Jensen's book is an excellent one. More than ten thousand reports on insulin have been published since 1922, and an adequate study of this subject now touches upon many aspects of physiology and of protein chemistry. For this reason it is extremely difficult for one author adequately to cover all aspects of the subject, but Dr. Jensen has enlisted the aid of experts in physiological matters, and he, himself, is admirably suited to discuss the problem from the chemical view-point. By the same token, it is expedient for the reviewer to secure opinions from his colleagues who have worked along lines on which he is less competent to comment. One is happy to find that the chemists who have been consulted and who have first-hand knowledge in this field are very enthusiastic about Dr. Jensen's contribution.

In the first chapter an accurate and concise account of the history of insulin is given. In the second, the various methods for the preparation of the hormone are described, and a table showing the yields of insulin secured by the various procedures is given. Here it may be remarked that, as many of the reports express the yield in terms of some absolute unit, results can not be accepted at their face value. The general trend, however, is clear. The preparation and chemistry of crystalline insulin is then discussed. What would appear to be a mistake in a date will be found in the preface, where it is stated that crystalline insulin was prepared in the year 1922. The report of this work was, of course, published in 1926. The fourth chapter deals with the standardization of insulin and is very well handled; the fifth deals with its administration, and the sixth with substitutes for insulin. Here the author gives more prominence to "Duodenin" and "Incrétine" than the reviewer would be prepared to do. The author remarks that it is probable that "all these workers were dealing with the same substance in spite of differences noted in the effect on depancreatized animals." An equally probable interpretation is that none of the workers were dealing with any active substance. The last chapter deals with the physiological action of insulin and provides a very useful review of this phase of the subject.

It has not been possible in the space available in this book to discuss in a comprehensive manner all the aspects of the situation. One feels that this volume should provide an excellent text for students and that lectures on the chemistry and physiology of insulin could well be based on it. For some courses the book would be adequate, for others it would have to be supplemented by more detailed comments.

There are a few places in which the author has made an interpretation of the results which differs from that which the reviewer feels is correct. This merely means that there are still many problems associated with insulin which have not as yet been settled.

The book is well written, the pages are of a convenient size and the type is good. The bibliography and the author index have been, with a few exceptions, carefully prepared and add greatly to the value of the publication.

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MATHEMATICAL SNAPSHOTS

Mathematical Snapshots. By H. STEINHAUS. G. E. Stechert and Co., New York[1] (printed in Poland; profusely illustrated), $2.50.

THE only way to review this beautifully made book is to describe its rich and extraordinarily varied content in some detail. It is mathematical recreations at a new level of simplicity, interest and unusualness, somewhat reminiscent of Lucas at his best, but less formal. Each page has one or more excellent illustra-

[1] The Polish copyright date, pasted over, appears to be 1936.

tions, some in two colors, and a pair of colored spectacles is provided for use with the anaglyphs. The pocket also contains a colored self-folding dodecahedron and a set of cards for mathematical movies. Perhaps "visual mathematics" describes the general character of the recreations. Wisely, the author has refrained from attempting to teach anything, although any one who can turn the pages without learning something must be singularly stupid. As in all good recreations, the concealed mathematics sometimes lies very deep. In this sense the book is scientific. But it can be enjoyed by any one with a grammar-school education.

As the contents are so unusual, we give a partial summary of the topics touched so lightly and so effectively by the author (who, by the way, is a distinguished mathematician). We find: dissections of rectangles; noughts and crosses; the slide rule; chess problems, Euler's 36 officers, the 15 puzzle; musical scales; simple nomograms; the golden section, Fibonacci's sequence and phyllotaxis; tesselations; the triangle of forces; Peaucelier's linkage; anaglyphs; straight-edge constructions, roulettes, cams; Minkowski's lattice theorem; the limaçon, conics, the tractrix; space-filling curves; the regular solids, crystals, densest packing, soap-bubbles; orthodromes and loxodromes; ruled surfaces; the resolution of cusps on skew curves; topological problems—unicursal patterns, the bridges of Konigsberg, knots, Möbius' strip, existence of a bilateral surface with a knotted edge, the map problem for a torus; Pascal's triangle and the "board of fortune," the Gaussian distribution—amusingly illustrated by an experiment on digitalized frogs, which inspires the author to rechristen the normal curve "the frog-line"; the law of biologic growth, and finally, a somber mortality graph for the U. S. in 1910. Scholarly historical and mathematical notes (184) conclude this most fascinating book. It should perform a genuine service by popularizing mathematics.

E. T. BELL

SPECIAL ARTICLES

CHARACTERIZATION OF GONADOTROPIC HORMONES OF THE HYPOPHYSIS BY THEIR SUGAR AND GLUCOSAMINE CONTENT[1]

CHEMICAL purification of the anterior pituitary hormones has been impeded by their protein nature and by time-consuming bioassays. In the case of the gonadotropic hormones, the situation is further complicated by their established interrelations. Chemical differences in these hormones traced by quantitative analytical routine would naturally prove a boon in purification efforts. Thus the purification and crystallization of insulin speedily followed the discovery of the high sulfur content of this hormone.

It has recently been found[2, 3, 4] that gonadotropic preparations from the pituitary as well as from other sources are rich in *carbohydrate*. We therefore determined the carbohydrate content (orcine method) of the 40 per cent. alcohol extracts of acetone dried sheep pituitaries which served as our starting material, and of purified FSH and ICSH fractions prepared therefrom. The method of fractionation was based on salting-out procedures[5] and subsequent acid-acetone fractionation. When assayed in our hypophysectomized female rats the total M.E.D. of the best FSH and ICSH preparations was between 0.005 mg and 0.01 mg. The starting material contained about 9 per cent. carbohydrate. FSH fractions have a high carbohydrate content (10.3 to 13.1 per cent.) increasing with purification; ICSH fractions[6] a conspicuously lower carbohydrate content (5.4 to 3.6 per cent.), decreasing with purification. All other available hormone fractions from the pituitary showed a low carbohydrate content (see table 1). Although, as mentioned, FSH fractions have an increasing carbohydrate content with increasing purity, a high carbohydrate content in any pituitary fraction can not be taken as a measure of its FSH potency, for inert proteins isolated from FSH mother-liquors had a content of 19 per cent. carbohydrate.

In search for a more specific chemical characterization of gonadotropic hormones, *glucosamine* was determined by the Elson-Morgan method. Gonadotropic fractions contained more glucosamine than any other pituitary preparations investigated. Glucosamine increased with the increasing purification of both FSH and ICSH. The best FSH contained 8 per cent. glucosamine, ICSH 3.8 per cent., while inactive fractions contained approximately 3 per cent., thyrotropic hormone approximately 3 per cent., growth hormone 1.8 per cent. and lactogenic and adrenotropic no glucosamine. Thus glucosamine determination may well be taken as a measure of gonadotropic potency in pitui-

[1] Aided by grants from the Board of Research of the University of California and Rockefeller Foundation of New York.

[2] M. Hartman and F. Benz, *Nature*, 142: 115, 1938.

[3] G. Fleischer, E. Schwenk and K. Meyer, *ibid.*, 142: 835, 1938.

[4] S. Gurin, C. Bachman and D. W. Wilson, SCIENCE, 89: 62, 1939.

[5] H. Jensen, M. E. Simpson, S. Tolksdorf and H. M. Evans, *Jour. Biol. Chem.* (in press).

[6] Attention must be drawn to the very striking difference in the carbohydrate content of pituitary ICSH (3.6 per cent.) and of chorionic ICSH—that in pregnancy urine (ca 18 per cent.).