study of muscles in relation to skeletal parts is the approved method of homologization of the parts of the exoskeleton. Because the exoskeleton is completely resecreted after each ecdysis evolutionary changes in skeletal areas occur in bewildering variety. Primitive sutures fuse and primitive plates later become sutured. The attachments of muscles are frequently more reliable evidence of homology than are the edges of sclerites. They are attached to the inside of the cellular wall, which in some ways is a more stable condition phylogenetically than that of the exoskeleton, which is merely a hardened secretion.

The discussions in general are confined to adult insects, although very few of the insects that the professional entomologist meets in the field are adults. At times the author touches on the structure of larval stages, but in no part of the book does he discuss pupal stages and metamorphosis. Because of lack of space in even six hundred pages, Snodgrass has been compelled to omit the many curious and unusual specializations of structure found in all orders of insects.

One of the general characteristics of the Insecta is the morphological adaptability of the group. At each of the several or many ecdyses the body wall becomes embryonic, not one embryonic period to an ontogeny but several, in any of which profound changes of structure may be introduced. On this substratum of repeated embryonic periods has been built the supermechanism of complete metamorphosis. Hardly anything in the general phenomenon of organic growth is more strange than the development of the fly's head, inside out, in a sack opening into the mouth cavity of the maggot. On pupation the sack everts which brings the various head organs into position on the outside as found in the adult. The high development of special larval organs which in a few days' time are digested and have their substance rebuilt into the adult organs, is another commonplace of the protean adaptability of insects. The study of the great variety of adult and larval organs is a biological goldmine. It is these high specializations which Snodgrass is compelled to omit. These omissions suggest to the reader the extent of the problems of insect anatomy and more than anything else impress upon him that this work deals only with the more far-reaching fundamentals.

An elaborate terminology has been avoided, and such terms as are used have been chosen as far as possible to agree with the terminology of current writings on the subject. The volume has freshness of ideas and style, due largely to the fact that nearly every point discussed has been studied in actual insect material by the author himself, who has devoted his time almost without interruption for over thirty years to a study of insect anatomy. Further, it is well written from cover to cover. It is not a volume expanded from a few chapters of lecture notes, but the last chapter is as carefully written as is the first.

The illustrations are a striking feature of the work, as the majority are by the author, while those borrowed have all been redrawn in a style uniform throughout the volume. It is this remarkable ability to see things, then to draw them in a superb style that makes an outstanding anatomist. Snodgrass is one land zoologist who did not rush to the seashore, but who by patient exploration found greater riches in the common insects all about on land. This ability to see the riches in the common and abundant, to organize and interpret the commonplace is one of the characteristics of genius.

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THE PUNCHED-CARD METHOD

Practical Applications of the Punched Card Method in Colleges and Universities. Edited by G. W. BAEHNE. xxii + 442 pp., 7 by 10 inches. Columbia University Press, New York, 1935. $4.50.

THE principle of the punched-card method of tabulation goes back to the beginning of the nineteenth century when Babbage invented his "analytical engine." The modern method as used on the machines of the International Business Machines Corporation has grown out of the perfections introduced by Dr. Herman Hollerith. For fifty years the punched-card method of tabulating and accounting has been used with increasing success by government and business. More recently it has found application in colleges and universities, in administration offices as well as for research purposes.

The tabulating card consists of 80, or 45, numbered equidistant columns, each having twelve punching positions. These are numbered from zero to nine, with two additional positions at the top of the card. With the use of an electric punching machine having a keyboard of twelve keys the operator can punch holes in any punching position of any column. In each application the card is divided into fields consisting of a single column or of groups of columns each of which is to contain a particular type of information. Any information that can be expressed in numbers can be so recorded, if necessary by special codes.

The two essentials are a sorting machine and a tabulator. In all cases the operating principle is the same, with different details in different machines. In the case of the sorter:

A tabulating card, acting as an insulator, passes between a wire brush and a brass roller. A hole punched into the card causes the brush and the brass plate to make contact and closes an electric circuit which, in

turn, actuates an electro-magnet. In the case of the sorting machine this magnet opens a chute along which the card slides until it falls into the proper receptacle.

In the tabulating and accounting machines a row of brushes, corresponding to the columns of the card, takes the place of the single brush. . . . The contacts, similarly made, energize counters or print banks.

Because they are operated by electrical rather than by any mechanical means, flexibility is an inherent feature of all electric tabulating and accounting machines. To attain this flexibility the more complex machines employ a plugboard which is similar in principle to a telephone switchboard.

A tabulator with four counters can, with an automatic control device, carry individual items, sub-totals, intermediate totals and grand totals in different counters. It prints at will each item or total as it is produced on the counters.

The original tabulator could perform additions only. In order to make the machine perform a subtraction it was necessary to feed into the machine a card on which the complement of the number to be subtracted was punched. A more recent machine is the direct subtraction tabulator.

Auxiliary machines which may be of major importance in some applications are the "verifier," the "reproducing punch," the "gang punch" and the "automatic interpreter," the last being a device for *printing* on the card the data already punched.

Among the important newer types are the "alphabetic punch," the "automatic summary punch" and the "multiplying punch." The summary punch produces summary cards during the process of tabulation. It eliminates the manual preparation of such cards from the printed record. The multiplying punch performs direct multiplications of numbers up to eight digits; it can be made to perform operations of the type $A \pm (B \times C)$.

The power of the Hollerith method, in addition to its flexibility and reliability, is the superhuman speed with which the machines operate. These speeds vary with different designs of the same machine. The following are quoted: A sorter will handle 400 cards a minute, the tabulator 150 cards a minute. The multiplying punch is slow compared with these speeds. It performs 1,500 operations per hour for 3-digit multipliers, and 740 per hour for 8-digit multipliers.

Only the first twenty pages of the book deal with the development and principles of the method, and with descriptions and illustrations of various tabulating machines and special devices. The bulk of the volume consists of thirty-eight chapters on various applications, grouped into nine parts.

Of particular interest is the part on miscellaneous research applications by Professors Hooton (anthropology), Eckert (astronomy), Spengler (economics), Fletcher (literature) and Johnson (social science). This part and that on methods of solution of statistical problems give, more so than the remainder of the volume, an insight into the great variety of possible applications of the Hollerith machines. They show that the machines can solve problems of almost any description. An experienced user of the machines has learned to adopt his procedure to the types of operation that the machines will perform. An interesting example of this adaptation is the Mendenhall-Warren-Hollerith correlation method, by which the coefficients of the normal equations in the method of least-squares are formed with a sorter and tabulator only. These coefficients are the sums of products of the coefficients of the observation equations, yet no direct multiplication is performed.

The chapter on astronomy by Eckert is the most tersely written article of the collection. It covers a wide range of applications in this field. It is regrettable that this article does not give more details. Due credit is given to Comrie's pioneer work in this field. Fletcher's chapter on applications in literature describes the use of an alphabetic punch in the construction of word indices and of concordances, an excellent use of the Hollerith method.

Every one reading this book, wholly or in part, will recognize that it has excellent qualities. Almost every single article is suggestive, interesting and worth reading. The book as a whole, however, hardly deserves such a favorable comment. There is too much irrelevant material; there are too many applications of the same elementary type. It is the reviewer's impression that the editor could have welded these thirty-eight articles into a smaller volume giving more condensed information.

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REPORTS

PRINCIPAL DECISIONS CONCERNING NOMENCLATURE MADE BY THE SIXTH INTERNATIONAL BOTANICAL CONGRESS, AMSTERDAM (1935)

(1) GENERAL acceptance of the text of the "International Rules of Botanical Nomenclature," ed. 3 (1935), as representing the decisions of the fifth International Botanical Congress, Cambridge (1930).

(2) Special acceptance of the date, January 1, 1935, recommended (instead of January 1, 1932) by the editorial committee of the "International Rules," ed. 3, (1935) as the starting-point for obligatory Latin