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Book review

WIGGLESWORTH, Sir Vincent B. 1965. *The Principles of Insect Physiology*. 6th Edition. Methuen, London. vii + 741 pp. 407 figs. 4639 citations. 84 shillings.

The appearance of each new edition of Wigglesworth's *Principles of Insect Physiology* serves to quieten the consciences of most of us of lesser stature who have failed to keep up with the literature since its predecessor. This one is no exception. New citations, many referring to several papers, are given new alphabetical sequences, but numbered serially, as Supplementary References B at the end of each chapter. The substitution of a brief statement of the content in English for the original title is continued. This can be a bibliographical nuisance but is perhaps a valid comment on the titling of papers by insect physiologists. The indexes of authors have been consolidated. The fifteen chapter headings are unchanged in wording or sequence. The broad and lucid interpretation of physiology of the earlier editions is maintained and it is an eloquent testimony to the quality of these that changes, by and large, are additions rather than alterations. It is significant too that all other books of this scope in this field have multiple authors and that eleven of us are writing this review. We record here some errors in the book and some comments on it more in the hope of facilitating another edition in the fulness of time than of denigrating this one.

Although Wigglesworth rarely allows recent derivative work to overshadow that from which it stems, the omission of references for many early publications (e.g. Leuckart (1855) p. 2; Malpighi (1669) p. 317) is unfortunate; most of us have been conditioned to expect a reference when a name is followed by a date in parentheses.

The 1557 new citations contrast with the 234 which were added in the 1953 edition. The greatest proportional increase in number of citations is to be found in the chapters on nerve physiology, and especially chapter IV on the muscular system and locomotion in which there are nearly twice as many as in the fifth edition. The smallest increases are in the chapters on excretion and especially respiration in which there is only a 22% increase. The overall increase is more than 50%, as against less than 8% in the fifth edition. All of this is in keeping with our imp-

ression of the distribution of emphasis in research and the increasing pace of this.

In chapter III on growth the enormous accumulations of new material on hormones and diapause have been condensed into a masterful summary in which many of the "doubts and difficulties" referred to in the 5th edition have been laid to rest. Chapter IV contains a very much improved treatment of the action of indirect flight muscles in insects with high wing beat frequencies. No mention is made of the additional structural proteins of muscle, paramyosin and tropomyosin. In the discussion of locomotion on the surface of water (p. 143) volume and mass are treated as alternatives; both volume and mass of course vary as the cube of radius. More importantly, surface tension forces depend on the linear dimensions of the surface acting, not the area, so that the advantages of small size in this context are greater than indicated. Tonofibrillae is printed as two words on p. 133; Sotavalta is misspelled on p. 152 and again in the index of authors on p. 704.

Part of the increase in chapter V on the nervous system comes from two new sections, one on histology and histochemistry and the other on nutrition and ionic regulation in ganglia. There are several new illustrations. While neuromuscular transmission is appropriately discussed in chapter IV, the inclusion of much material on responses and muscle control in chapter V seems to call for a reference back to this.

Chapters VI and VII integrate much recent work on sense organs into an encouragingly traditional account of these structures. Since the dioptric part of the compound eye is far from cylindrical and the image formed by it "has no physiological significance" we think the treatment of image formation by a lens cylinder could be omitted, despite its bearing on apposition - superposition vision. While it is true that as stated on p. 212 the location and nature of the analyser (of the plane of polarization) have not been *fully* determined, this statement seems to contradict that on p. 213 "The analyser for polarized light is clearly in the rhabdomeres". In most places wavelengths have been correctly given in $m\mu$, a $\mu\mu$ still appears on p. 245; on p. 192 (l. 22) for 'on an element' read 'as an element'. The inclusion of other senses in chapter VII might well be noted in the chapter title. Material on hearing in mosquitoes and bat avoiding by moths has been added. There is no mention of theories of olfactory perception, although many publications on these have appeared since 1953; perhaps if nothing good can be said, this is just as well. In chapter VIII on behaviour the outstanding additions are those dealing with communication including pheromones, and rhythmic behaviour and other rhythmic activities.

In chapters IX and X dealing with respiration and the vascular system there is no mention of the important work of Nunome. On p. 326 *Rhodnius* 253 should read *Rhodnius* 252. The work of Thorpe and Crisp (1949) appears in the original list of references (175) and also in the supplementary list (224). The simplification of the classification of haemocytes is to be welcomed.

The additional material on nutrition and digestion (chapter XI) represents supplementary detail rather than major advances, mostly dealing with enzyme secretion, enzyme action, and essential dietary components.

In chapter XII on excretion the work of Schindler (1878) on the surface area of Malpighian tubules has been misinterpreted (p. 505); a comma used for a decimal point in the original German has been read as a "thousands" comma, so that the areas are a thousand times greater than Schindler gives. Schindler's figures however are low since they assume the tubules to be right circular cylinders, whereas they are sinuous, and of course he was unaware of the microvilli. Allowing for these two points increases the area by a factor of about 70, so that Wigglesworth's figures remain high by a factor of about 14. It is remarkable that this mistake should have survived all previous editions, and no less remarkable that it was noticed independently by us and by A. Baynes of Trinity Hall, Cambridge, within a short time of each other, too late unfortunately for correction in the 6th edition.

In chapter XIII on metabolism there is further material on pheromones, an unfortunate, but perhaps unavoidable separation from that under behaviour. The glycolytic pathway is not given under respiratory metabolism, and again a reference back to the chapter on respiration would be helpful. In the discussion of the "surface law" (p. 568) it is said that there is no known reason why the metabolism of cold blooded animals should bear a relation to the body surface, but surely a tendency in this direction is to be expected where respiration depends on diffusion since this proceeds at a rate dependent on surface area. The references given under citation 345 are repeated under 479.

There is a relatively small increase in the content of chapter XIV on water and temperature, in which a somewhat conservative position is taken on, for example, the question of critical temperatures for water loss. Again cross references to other aspects of water balance, especially the integument, rectal glands, and Malpighian tubules would be useful; Beament's work for instance, is unmentioned in this chapter.

The final chapter, on reproduction contains added material on yolk formation, and RNA, DNA and protein synthesis. Woyke's work on diploid drone honey bees is not mentioned; perhaps this was too recent for inclusion.

This is a book which it is a pleasure to review. The binding and format remain unchanged, but the dust jacket in three colours illustrating the musculature of the crop of *Calliphora* and an aspect of the behaviour of *Eristalis*, is an innovation. Those parts of the content which are not already traditional will undoubtedly become so, and it is a final pleasure to record a traditional price.

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