composition of commercial meat extracts. This valuable investigation is not even catalogued in the historical summary (p. 397) though less pretentious earlier and later contributions are included. The heterogeneous character of some of the descriptive text is shown by the inclusion, in the chapter on meat products, of statements like the following: "Diastatic enzymes occur in the saliva, pancreatic juice, blood, lymph and liver," etc. Why figures of wasp's muscle or fibers from the human vocal muscle or sketches of smooth muscle nuclei from the dog's artery should be incorporated in the text descriptive of serological identification of meats is not clear. The expression "xanthine bases" begins to have an antiquated look, now that the word "purine" has come into common use.

Shortcomings might be pointed out in other chapters. The vegetable enzyme papain, which is a widely sold commercial product, is dismissed with three lines taken from the British Pharmacopœia. The hæmometer of v. Fleischl is pictured and described in the text, with mere footnote reference to its improved successors. Some of the parts, like that on mucin, should either have been brought up-to-date or omitted. The standard work of Gies and his collaborators, and other comparatively recent contributions and working directions are not even mentioned (*cf.* p. 628). This is in striking contrast with the modernized chapters on proteins in other parts of the book. Elastin is described under fibroids and said in one paragraph to "contain no sulphur," whereas in another the content of sulphur is summarized in tabular form (p. 631). The word "keratoid" appears to be coined as a synonym for keratin. Typographical errors, particularly in the foreign proper names, are not missing. In some cases one is at a loss to know from the context whether the form presented is a mistake or an intentional innovation; for example, protase (p. 290); glutenins (glutelins?) (p. 34); spoilage (p. 309). The chapter on proteins of milk by L. L. Van Slyke, by way of contrast, is an illustration of how a very diffuse literature can be reviewed critically by an expert and presented in a brief yet comprehensive fashion in its theoretical and applied aspects.

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Some Minute Animal Parasites or Unseen Foes in the Animal World. By H. B. FANTHAM and ANNIE PORTER. London, Methuen & Co., Ltd. 1914. Pp. xi + 319. Frontispiece and 56 text-figures. 5s. net.

This interesting and valuable addition to the general literature of protozoology will be welcomed by those students of the protozoa who are chiefly interested in the practical or pathogenic side as opposed to the theoretical and speculative. It deals only with parasitic forms responsible for some diseases of man and animals and gives a full account, in simple words, of the known life history in each case and as it appears to the writers.

Of the sixteen chapters the first and last two are more general, giving, in brief outline, the chief types of protozoa, and the more general aspects of the parasitic forms. Here the authors come dangerously near the theoretical or at least controversial grounds which they appear desirous to avoid. The second chapter is devoted to *Trypanosoma gambiense* and sleeping sickness, the third to other species of trypanosomes and to the allied genera *Crithidia* and *Herpetomonas*. The fourth chapter deals with the spirochætes in a manner "which shall be as non-controversial as possible, and which will consist of facts and not the speculations so fashionable nowadays" (p. 64). The authors adhere so consistently to this promise that the reader would never know from the text that thousands of others have worked with these organisms and that there is good ground for different points of view from those presented. He would also look in vain for a description of the spirochæte of syphilis, probably the most important member of the group. In the fifth chapter there is a very good, although somewhat dramatic account of the malarial organisms of man and birds, with excellent practical suggestions regarding the breeding of mosquitoes and means

of exterminating them. The sixth chapter, dealing with coccidiosis, gives an excellent account of some common diseases of the poultry yard, but omits even a reference to coccidiosis in man. The seventh chapter is devoted to the organisms of amœbic dysentery; the eighth to yellow fever, the authors being noncommittal as to the nature of the organism producing it and confining themselves to the clinical aspects of the disease and to the mosquito which transmits it. The ninth chapter is devoted to species of the genus *Babesia* (*Piroplasma*) and the cattle diseases caused by them; the tenth to the organisms of kala azar and oriental sore. The eleventh chapter treats in a convincing manner of the microsporidian diseases of bees and silkworms, and the twelfth of myxosporidian diseases of fish. The thirteenth and fourteenth deal with parasitic ciliates, and with *Sarcocystis, Rhinosporidium* and *Neurosporidium.*

The book is written in simple style and with the untrained reader in mind. The result is a perfectly clear and intelligible account of the part played by different types of protozoan parasites and by their intermediate hosts, while the life histories are sketched with sufficient detail to permit of effective prophylaxis by amateurs. To the scientific reader, however, the style is somewhat aggravating and the arrangement of material more so. He is told in the opening chapter that the Protozoa are distributed in five great groups: *Sarcodina, Mycetozoa, Mastigophora, Sporozoa* and *Infusoria,* but from this point on there is no effort at systematic treatment. Certain flagellates are first described in detail; next come a few members of the spirochæte group which are regarded as lying "on the border line between animals and plants" (why not between flagellates and bacteria?). Then the reader jumps to the *Hæmosporidia* to learn about malaria and mosquitoes, which the authors speak of sometimes as gnats, sometimes as flies, correctly enough, to be sure, but somewhat colloquial. This is followed by an extended account of intestinal diseases of poultry due to certain species of *Coccidium* which the authors persistently call *Eimeria.* The next jump is to the parasitic amœbæ of man which are skilfully treated. The reader then skips back to the *Hæmosporidia* to learn about piroplasmosis, and then back again to the flagellates to read about leishmaniosis, while another saltation brings him once more to the Sporozoa, where he finds an excellent treatment of microsporidiosis of bees and silkworms and a less satisfactory account of myxosporidiosis of fish. To the mind of the reviewer the book would have been materially improved by more systematic treatment along the lines of either taxonomy or mode of infection, *e. g.,* by contamination, by flies and other insects, by arachnids, leeches, etc. Why should *Trypanosoma, Herpetomonas* and *Crithidia* be widely separated from *Leishmania,* to which they are closely related systematically? Or why should *Plasmodium* be widely separated by intervening coccidia and rhizopods from *Babesia?* Yellow fever also, in our ignorance of the causative agent, would have been better placed after malaria as a mosquito-borne disease.

Editorially the work is prepared with care, and comparatively few slips have passed unnoticed. Some uncertainty exists in regard to the termination in words like leishmani*asis,* microsporidi*osis,* myxosporidi*asis,* etc., but as both forms are in current use it can not be called an error. "Sex" is used in the sense of fertilization by union of two cells (p. 3). Inheritance of acquired characters is credited to some Protozoa (p. 287 and p. 297). A peculiar expression is found on p. 264: "Multiplication among Ciliates is abundant"; and another on p. 162: "It was then that the cases of yellow fever that have visited England were chiefly notified." A mis-statement is made in connection with the nuclear reorganization of ex-conjugants, on p. 265; and another in which it is implied that all free-living ciliates bear trichocysts, on p. 264; and an oversight in proof-reading was responsible for the slip: "each of the two give rise" (p. 178). These, however, are small matters which take away nothing from the value of the book. On the other hand, its value might be enhanced by better arrangement of material and by a

critical treatment of their own and of others' work, together with a more generous appreciation of the possibility that some other investigators might also be gifted with the powers of correct observation.

GARY N. CALKINS

SPECIAL ARTICLES

DIRECT PROOF THROUGH NON-DISJUNCTION THAT THE SEX-LINKED GENES OF DROSOPHILA ARE BORNE BY THE X-CHROMOSOME

IN "Non-disjunction of the Sex-chromosomes of *Drosophila*," *Jour. Exp. Zool.*, November, 1913, the following case was presented:

1. In certain strains involving sex-linked characters, females arose which could not be explained upon the ordinary mechanism of sex-linked inheritance. These females were maternal in appearance, showing those *sex-linked characters* which the mother showed, but no influence of those borne by the father.

2. Breeding results showed that genetically as well as somatically these exceptional females were exact duplicates of their mother in that they carried no sex-linked genes introduced by the father.

3. Such exceptionally produced females inherit directly from their mother the power of producing like exceptions; for these females, in turn, gave in F_1 when outcrossed to any male, five per cent. of daughters like themselves somatically and genetically. The remaining daughters are, in appearance, of the types expected on normal sex-linkage.

4. Exceptionally produced females gave in F_1 a class of sons (five per cent.) complementary to the matroclinous daughters in that these sons both somatically and genetically were purely paternal, having no sex-linked characters introduced by the mother.

5. The entire set of sex-linked genes of the mother, or the entire set of sex-linked genes of the father, appeared without addition or loss in the matroclinous daughters or patroclinous sons, respectively. This result was independent of the particular composition of the mother or father and held when the mother was mated to any male.

6. The exceptional F_1 males (patroclinous) when outcrossed to unrelated females did *not* give rise to exceptions in F_1.

7. By breeding in each generation from the exceptional daughters a "pseudo-parthenogenetic" line was maintained in which a given sex-linked constitution was handed down indefinitely from daughter to daughter.

8. The exceptional daughters resulted from the fertilization of an egg of the mother by a normal sperm from the father, as was proved by the introduction into the exceptional daughters of *non*-sex-linked genes from the father. The inheritance was uniparental with respect to sex-linked genes, and biparental and quite regular with respect to non-sex-linked genes.

9. The cytological work of Miss Stevens was referred to as showing that in *Drosophila* the female has two X-chromosomes and the male an unpaired X. (See, however, section 17.)

The explanation advanced for this series of facts was that *the sex-linked genes were borne by the X-chromosome, and that ten per cent. of the eggs of the exceptional females retained both X-chromosomes or, conversely, lost both to the polar body.*

It was suggested that the cause of the non-disjunction was itself a sex-linked gene.

Work which has been carried out since the previous paper was published enables me to add the following points:

10. Half of the expected class of *daughters* from a non-disjunctional female by any male, inherit directly from their mother the same power of producing five per cent. of matroclinous daughters and patroclinous sons. For example, white non-disjunctional females mated to wild males gave in F_1 the following:

Expected classes.	Exceptions.
95% of both sexes.	5% of both sexes.
Wild type ♀; white ♂.	White ♀; wild type ♂.

Half of the wild-type daughters (all were heterozygous for recessive white) when outcrossed to barred males (barred is a dominant sex-linked character) gave exceptions as follows:

Expected classes.	Exceptions.
95% of both sexes.	5% of both sexes.
Barred ♀ (2); wild type ♂ (1); white ♂ (1).	Wild type ♀; barred ♂.