of the specific inductive capacity of dielectrics. The experiments by which this result was reached were extremely difficult to carry out, and subject to many sources of error, but these were finally overcome, and Faraday at last felt justified in recording the conclusion in note 4184 that "From the above and the other results, I cannot resist the impression that there *is a difference of inductive capacity in body.* I do not see how it can be explained away, though I try all I can for that purpose."

The rest of this volume is filled with records of experiments on the electric discharge in different gases, which led to no important conclusions; on the electric properties of the gymnotus; and on the origin of the electric current in voltaic cells, which Faraday ascribed to chemical action in opposition to the contact theory of Volta.

This last study runs over into Volume IV, but the entries are less numerous than in the earlier volumes. There are very few in 1840 and there is a gap of more than a year in which nothing is recorded. Faraday's strenuous labors had exhausted him. He was troubled with fits of giddiness and loss of memory, for the cure of which he was ordered a complete rest. To some extent he recovered his strength and was able to work again, but his defective memory still persisted, and indeed became more pronounced as the years went on, so that at least in one case he found when he had finished a long series of experiments that he had covered the same field eight months before. Faraday began work again in January, 1842, on the production of electric charge by steam issuing in a jet, a fact which had been discovered by Sir W. Armstrong. There is a gap of a year from February, 1843, to February, 1844, before he took up anything else, and then he returned to his earlier work on the liquefaction of gases, which he carried on with a certain measure of success, though he never attained the goal which he sought, the liquefaction of oxygen, nitrogen and hydrogen.

In the year of Faraday's inactivity Joule published his first paper on the mechanical equivalent of heat. The question of the "Correlation and Conservation of the Physical Forces" began to be discussed. Faraday saw in this question a field for experimental investigation, and much of his work from then on is concerned with this problem. He first set out to discover some relation between light and electricity, by sending a polarized ray through an electrolyte. He found no effect on the light. Nor was there any effect when the light was sent through various transparent bodies under electric stress. He then turned to magnetism, and after many trials with various transparent bodies without success, he finally introduced into the magnetic field a block of his heavy glass. In many positions of the glass in the field he found no effect. But, when contrary magnetic poles were on the same side, there *was an effect produced on the polarized ray,* and thus magnetic force and light were proved to have relation to each other."

After spending two months in the search for other bodies possessing this property and the proof that the effect was a rotation of the plane of polarization, Faraday suspended a short block or rod of his heavy glass in the field of a powerful electromagnet and found that it swung to point itself equatorially or across the lines of magnetic force. He had thus discovered diamagnetism. By an analysis of the phenomena he proved that the bodies which he called diamagnetic moved from the stronger to the weaker parts of the magnetic field, in contrast to magnetic bodies, which move in the opposite sense. This was Faraday's last great contribution to experimental physics.

In the following years Faraday investigated the magnetic properties of many substances and studied the peculiar action known as magnecrystallic. He tried to find some way of producing the electric current by the action of polarized light, without result.

In Volume V is recorded his famous attempt to connect gravitation with electricity, in which he also failed. In this volume appears also his experimental study of the lines of force about a magnet, which led him to a clearer conception of their properties. With this work the volume closes.

Faraday. By THOMAS MARTIN. "Great Lives." Duckworth, London. pp. 144.

THE author of this little book is the editor of the monumental edition of Faraday's Diary, which is now being issued as a memorial to that great experimental philosopher. He is in position to write with authority. The outline sketch of Faraday's life and work is exceedingly well done. The book is interesting and, within the limits permitted to the author, complete. One can see that his long acquaintance with Faraday's records of work has given him a vivid conception of Faraday's character and mental processes. The book is an excellent example of a short biography.

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APPLIED ENTOMOLOGY

Applied Entomology—An Introductory Text-book of Insects in Their Relation to Man. By H. T. FERNALD. Third edition, viii + 403 pp., 384 illus. McGraw-Hill Book Company, Inc., New York and London, 1935. $3.50.

THE Massachusetts College of Agriculture at Am-

herst has long been known as the trainer of very many applied entomologists of high rank. Once, in an address, I discussed the subject of the education of the entomologists in the federal service and I found that many of the best of them had studied under the Fernalds. And so when the first edition of this book was published in 1921 I greeted it with great interest, knowing that from it I should find out something of the way in which these good men had been taught.

This last edition, just published, contains much new matter, and much of the rest has been rewritten since the second edition was published in 1926, and the last ten years have been especially noticeable for advances in the fight against insects as well as in the new problems that have confronted the rapidly increasing army of workers.

The dedication of this edition appeals to me especially. It reads: "To the Memory of my Father, Professor Charles H. Fernald; one of the first teachers of Economic Entomology to College Students in this Country." I knew the elder Fernald well. He was a truly great teacher and he will be remembered for many years. Henry, the author of the present volume, had greater educational advantages than his father (I remember that he studied at Johns Hopkins fifty or more years ago under W. K. Brooks and his colleagues) and greatly profited by these advantages as well as by inherited aptitude and constant association with his father. His whole career was spent at the college, and he constantly mixed with the leaders in the federal and state services and was at one time the president of the big association of economic entomologists.

This new edition is admirable. I marvel at its scope and thoroughness, and I marvel at the wonderful way in which the author has concisely put such a mass of information. No one, with the least tendency to ramble, could have told the stories of the cotton-boll weevil, the San Jose scale, the gypsy-moth and the other great pests as Fernald has done, competently, concisely and readably. And the book could not have been done until to-day. On examining it, old-timers, like myself, must say to themselves, "Oh, if I could only have had a book like this when I was young!" But there could have been no such book then. The good old times were not so good after all in many ways. Of course we old fellows after such a thought as that shrug our shoulders and grumble, "Well, they were not so bad either in many other ways."

But to the book: There are four chapters on the place of insects among other animals and on their structure and development; one on nature's control methods; four on man's method of control; one on the relationships of insects; 23 on the different orders, and a final chapter on the animals, not insects, with which the entomologist is expected to deal—a necessary chapter, since it includes ticks and mites, eel worms, millipedes and so on.

The 23 chapters on the different orders contain accurate, condensed, but sufficient information upon the different injurious species with a statement as to remedial treatment in each specific case; and all these can be readily traced from the very competent index.

The make-up of the book is excellent. It is of convenient size and is fully and admirably illustrated. Think of 384 illustrations to 384 text pages! Many of these illustrations are original and the others are borrowed from other good books. The selection of the latter has been very careful and shows a very wide reading on the part of the author.

For some years now, Dr. Fernald, having retired from teaching, has been living for most of the time at Orlando, Fla., which has now become rather a center for entomologists. There he has worked away almost uninterruptedly on his rewriting of much of the second edition in constant touch with W. W. Yothers, W. V. King and other well-known workers whose advice and help he acknowledges in his readable preface.

I congratulate Dr. Fernald very heartily. I can see that this book will be of great value not only to teachers and students, but to every one who even temporarily wishes to know the answer to some question about injurious or beneficial insects. I shall give the book to the library of the old country club in the Catskills where I am writing this, since many of the families have beautiful gardens and there are many children growing up with most inquiring minds. I predict that it will be read and reread.

Its admirable composition and its thoroughness explains to me in a large part the high rank of the entomologists who have come from that laboratory of the Massachusetts Agricultural College.

L. O. HOWARD

SPECIAL ARTICLES

X-RAY REFLECTIONS OF LONG SPACING FROM TENDON

THE proteins which have given crystalline x-ray diffraction patterns fall into two groups. One—the soluble proteins that can be grown in recognizable crystalline forms—give the long spacings to be expected from true crystals composed of very large molecules. Pepsin,[1] hemoglobin[2] and insulin[3] belong