

(and a more essential one) in the Tridacnidae. But all of these animals are naturally herbivorous and the powers of resistance to digestion by the algae are limited, particularly in the Spongillidae. In *Convoluta roscoffensis* and *C. paradoxa* the algae are certainly digested, the former species finally losing the power of feeding altogether, and becoming completely parasitic on its contained algae. This appears to be the only case of an animal which becomes completely dependent on the algae for nutrition.

Several points of interest emerge from this discussion on the possible food value to the animals of the algae. One is that in herbivorous animals the power to resist digestion by the animal entails specialisation on the part of the algae (for example, in *Paramecium bursaria*); another is that the ability to feed on the algae represents a specialisation on the part of the carnivorous animals such as *Convoluta*, though in this case the absence of a cellulose wall around the algae is possibly of significance. The presence, on the other hand, of an exceptionally stout cellulose wall around the zooxanthellae of corals and other Anthozoa possibly explains the inability of such animals to obtain nutriment from these even after they have died in the tissues. In *Tridacna*, where the zooxanthellae are otherwise very like those of the corals, I have been unable to find so thick a cellulose wall. The passage of organic matter from the algae to the host, as in *Paramecium* and *Convoluta*, probably involves specialisation by the plants, but it also indicates that these are in a position to produce more food than they need themselves for maintenance and multiplication. In the corals the endoderm is invariably packed with zooxanthellae (as many as 25,000 may occur in a single planula

of *Pocillopora*) and these increase as the coral grows. There is never likely to be any superfluity of food under these conditions; indeed, as already stated, the zooxanthellae will extract phosphorus from the surrounding water.

This summary will have indicated, if nothing else, that the nature of the association between animals and unicellular algae varies greatly in different cases. If by symbiosis is meant only a relationship which is mutually advantageous to both parties, then the only adequately investigated cases which meet this requirement are *Paramecium bursaria*, *Chlorohydra* and the reef-building corals (and probably all Anthozoa). In every other instance, one party in the association is exploited in some measure by the other.

In conclusion, I wish to record my thanks to the Royal Society of London for a grant which has assisted the investigations from which many of these conclusions have been drawn, and also to Mr. H. G. Smith for kindly permitting me to mention the results of certain unpublished work.

- <sup>1</sup> Buchner, "Tier und Pflanze in Symbiose", Berlin; 1930.
- <sup>2</sup> Yonge, *J. Con. Intern. Explor. de la Mer*, 6, 175; 1931.
- <sup>3</sup> Hastings, *Sci. Repts.*, G. Barrier Reef Expedition, Brit. Mus., 4, 69; 1931.
- <sup>4</sup> Berkeley, *Quart. J. Micr. Sci.*, 73, 465; 1930.
- <sup>5</sup> Wilson, *Phil. Trans. Roy. Soc. Lond.*, B, 221, 231; 1932.
- <sup>6</sup> Goetsch, *Z. Morph. Okol. Tiere*, 1, 660; 1924.
- <sup>7</sup> Van Haffner, *Z. wiss. Zool.*, 126, 1; 1925.
- <sup>8</sup> Keeble and Gamble, *Quart. J. Micr. Sci.*, 51, 167; 1907.
- <sup>9</sup> Keeble, *Quart. J. Micr. Sci.*, 52, 431; 1908.
- <sup>10</sup> Yonge and Nicholls, *Sci. Repts.*, G. Barrier Reef Expedition, Brit. Mus., 1, 135; 1931.
- <sup>11</sup> Yonge and Nicholls, *ibid.*, 1, 177; 1931.
- <sup>12</sup> Brandt, *Mitt. Zool. Stat. Neapel.*, 4, 191; 1883.
- <sup>13</sup> Van Trigt, *Tijdschr. d. Nederl. diertk. Vereenig.*, 2nd ser., 17, 1; 1919.
- <sup>14</sup> Pringsheim, *Arch. Protistenk.*, 64, 289; 1928.
- <sup>15</sup> Parker, *J. Exp. Zool.*, 46, 1; 1926.
- <sup>16</sup> Naville, *Rev. Suisse Zool.*, 33, 251; 1926.
- <sup>17</sup> Yonge, *Sci. Repts.*, G. Barrier Reef Expedition, Brit. Mus., 1, No. 11 (in preparation).
- <sup>18</sup> Yonge, Yonge and Nicholls, *ibid.*, 1, 213; 1932.
- <sup>19</sup> Yonge, *NATURE*, 128, 309, Aug. 22, 1931.
- <sup>20</sup> Brandt, "Fauna und Flora des Golfes von Neapel", 13; 1885.

## Obituary

PROF. A. P. CHATTOCK, F.R.S.

PROF. ARTHUR PRINCE CHATTOCK, emeritus professor of physics in the University of Bristol, died at his home in Clifton, Bristol, on July 1 at the age of seventy-three years. Educated at University College School, University College, London, under Carey-Foster, and at Stuttgart, he started his career as an electrical engineer in the firm of Siemens. In 1885, however, he was appointed as the first lecturer in physics in University College, Bristol. He spent the following year in Liverpool under Sir Oliver Lodge and then returned to Bristol to take up the duties of a newly created chair in this subject.

From 1887 until 1910 Prof. Chattock was known to a generation of students of physics at Bristol as an inspiring and self-sacrificing teacher, and to his contemporaries as an experimenter who, despite meagre facilities, carried out pioneer work of the first rank. Among these researches may be mentioned that on the mobility of gaseous ions, and the Chattock-Fry pressure gauge originally designed for the work of Stanton on the wind

pressure on structures, and later incorporated in wind tunnel measurements. An ingenious magnetic potentiometer devised by him deserves notice, as also an attempt, though negative in result, to verify Weber's theory of electromagnetism.

The foundation of the University of Bristol in 1909 brought additional responsibilities to his office. Modest and retiring almost to a fault, Prof. Chattock felt that he could not face them, and to the great regret of his colleagues, both lay and academic, he retired from his post to live in the country. There he stayed for ten years, engaged in poultry farming and on work for the Ministry of Agriculture on the physics of incubation.

In 1920, however, Prof. Chattock was induced to return to the University laboratories for a few years under the terms of his emeritus professorship, with facilities for continuing his researches in physics. In this later period, he carried out with L. F. Bates a classical determination of the gyromagnetic effect in iron. This, coupled with later work by Bates and Sucksmith, and more recently on paramagnetic substances by Sucksmith in the

Bristol laboratory, has had important consequences in the study of modern physics. He was awarded the honorary degree of D.Sc. by the University of Bristol in 1911, and was elected a fellow of the Royal Society in 1920.

#### DR. T. G. PINCHES

WE regret to record the death of Dr. Theophilus Goldridge Pinches, the distinguished Assyriologist, which took place at the age of seventy-eight years, at Muswell Hill, London, on June 6. Dr. Pinches originally was engaged in his father's business as a die-sinker; but, taking up the study of cuneiform inscriptions, he joined the staff of the British Museum in 1878, retaining that position until 1900, when he retired on pension. He was lecturer in Assyriology at University College, London, and in the University of Liverpool, resigning the latter post, owing to ill-health, only a year or two before his death.

At the British Museum Dr. Pinches' work was especially noted for the beauty of his copies of cuneiform texts. He was responsible for the text of parts of vol. 5 of the "Cuneiform Texts from Babylonian Tablets" and "Cuneiform Inscriptions of Western Asia" published by the Museum; and he compiled a guide to the Nimroud Saloon. For many years, Pinches was one of the foremost workers among the group which included Sayce, Thureau-Dangin and Bertin. He was recognised as an expert in the Assyro-Babylonian and Sumerian languages and had studied Hebrew, Aramaic, Ethiopic and Arabic. He was especially

active in connexion with the work of the Society of Biblical Archæology, the periodical publication of which contains a large number of contributions from him. He was also its editor. For some time he was a member of council of the Royal Asiatic Society.

A very long list of books, monographs and papers on Assyriology stands to Dr. Pinches' credit. He edited and translated the Amherst tablets (1908), the Berens Collection (1915), and the texts belonging to Sir Henry Peek (1888). He also contributed translations to "Records of the Past" (second series). One of his most interesting discoveries was the bilingual story of the Creation which was published in "The Old Testament in the Light of the Historical Records of Babylonia and Assyria" (1908). Among his works of a more popular character may be mentioned "Religion of Babylonia and Assyria" (1906).

WE regret to announce the following deaths:

Mme. Curie, professor of general physics in the Faculty of Sciences at the Sorbonne and director of the Laboratoire Curie at the Institut du Radium, Paris, known for her work with her husband, Pierre Curie, leading to the discovery of radium, and for subsequent researches on radioactivity, on July 4, aged 66 years.

Sir James Fowler, K.C.M.G., K.C.V.O., consulting physician to the Middlesex Hospital, formerly dean of the Faculty of Medicine, University of London, on July 3, aged 82 years.

### News and Views

#### Honorary Members of the Royal Society of Edinburgh

ON July 2, the following were elected honorary fellows of the Royal Society of Edinburgh to commemorate the completion of its 150th year: *Foreign*, Björn Helland-Hansen, Geophysical Institute, Bergen; Prof. Bernardo Houssay, professor of physiology, National University of Buenos Aires; Prof. Frank R. Lillie, professor of zoology and embryology, University of Chicago; Prof. T. H. Morgan, professor of biology, California Institute of Technology, Pasadena; Prof. Paul Sabatier, professor of chemistry, University of Toulouse; Dr. Theobald Smith, formerly director of the Rockefeller Institute for Medical Research, Princeton, New Jersey. *British*, Prof. H. E. Armstrong, emeritus professor of chemistry, Imperial College of Science and Technology, City and Guilds (Engineering) College, London; Prof. J. S. Haldane, director of the Mining Research Laboratory, and honorary professor, University of Birmingham; Prof. Karl Pearson, emeritus Galton professor of eugenics, University of London; Prof. E. B. Poulton, lately Hope professor of zoology, University of Oxford; Sir G. Elliot Smith, professor of anatomy, University College, London; Prof. W. W. Watts, emeritus professor of geology, Imperial College of Science and Technology, London.

#### Dr. Robert J. D. Graham

THE newly elected professor of botany in the University of St. Andrews, Dr. Robert J. D. Graham, is a native of Perth. He was a student in the University of St. Andrews at University College, Dundee, and at the United College. He graduated at St. Andrews in arts and science and held at the University a Carnegie research scholarship in botany. He spent eleven years in the Indian Agricultural Service, where he did important administrative work as economic botanist to the Government of the Central Provinces in organising botanical study, plant-breeding, etc., in these Provinces. He was granted the degree of D.Sc. by the University of St. Andrews for a thesis on "The Economic and Systematic Botany of the Central Provinces, India". During the War he served in Mesopotamia and was released from military service in 1920 with the rank of Lieutenant-Colonel. When, in the following year, he retired from the Indian Service, he was appointed to a post in the Botany Department of the University of Edinburgh and he has been attached to that Department until now under the late Sir Isaac Bayley Balfour and Sir William Wright Smith. He has had an extensive and varied experience in the teaching of students of botany. A long series of