tozoa as secondary, and look upon bacteria as primarily responsible for the lesions. This species is known to occur abundantly in some parts of this country as a parasite of the pig, and its more frequent presence in the human host than records hitherto made would show may easily be disclosed by more careful examination. It should be noted that many of the cases already on record come from the country where the chances of accidental infection are naturally greater. It is there accordingly that one should look for evidence of more extended infection of the human host. Lack of records in the past may well be due to lack of precise examination among the very cases in which the parasite is most likely to occur.

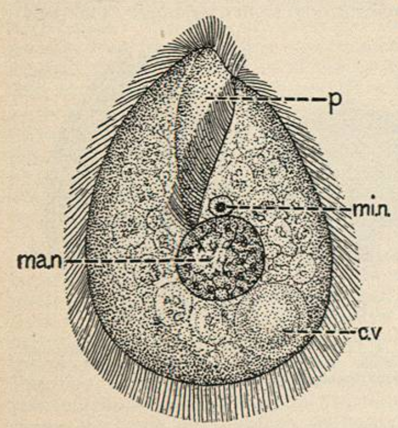

FIG. 5194.—*Balantidium minutum*. Living. Abbreviations as before. Magnified. (After Schaudinn.)

Balantidium minutum Schaudinn 1899.—(Syn.: *Colopoda cucullus* Schulz 1899.)

Body compressed pyriform or oval (Fig. 5194). Length 0.02–0.032 mm.; breadth 0.014–0.02 mm., or in the ratio 3:2. Anterior end bluntly pointed, often slightly twisted dextrad or sinistrad. Posterior end broadly rounded. Peristome a slender cleft, broader anteriorly, pointed posteriorly and deeper; extending from near anterior tip to centre of body; in the living animal continually opening and closing; left margin with hyaline membrane. Adoral cilia heavier and longer than those of the body generally, only on the left peristome margin beneath the membrane. Body cilia long (0.007–0.008 mm.) slender. Hyaline ectoplasm thin, distinct from granular endoplasm, which contains many vacuoles. These are filled with fine granules, and large food masses or excretory crystals are not present. Contractile vacuole single, near posterior end on left side. No permanent cytopyge. Macronucleus spherical 0.006–0.007 mm. in diameter; centrally located. Micronucleus single, anterior to macronucleus at its surface, 0.001 mm. in diameter. Division occurs, but conjugation has not been observed. Cyst oval.

Reported twice, once in company with *Nyctotherus faba* (*q. v.*) and once in Berlin also without that species. In both cases this form was abundant during the diarrhœa, but with the exception of a few cysts, disappeared as soon as the stools became firmer. Purgatives brought the infusorians again in numbers into the stools. This condition indicates that they inhabit the small intestine, perhaps the duodenum, rather than the colon, and make their appearance when carried outward by more fluid contents and rapid passage of the canal. As other species of the genus are harmless commensals in the canal of Amphibia, this species is probably not pathogenic. It should be kept in mind that confusion of *B. coli* and *B. minutum* may occur if the examination is not made with precision, and perhaps some cases of the former, already on record, actually concern the latter species.

As pseudo-infusoria may be designated a long series of structures reported from various sources, and often the object of repeated discovery by those unfamiliar with the field. Thus in mucus or sputum in case of affection of the air passages, bodies moved by cilia have been interpreted as genuine parasites and assigned an etiological rôle in the disease. In contravention of this view may be urged the variable and irregular form of such bodies, their rapid and special degeneration and their source, which amply demonstrate their origin as detached ciliated cells from bronchi, trachea, or nasal cavity. Such bodies are the asthma parasites of Salisbury, and the protozoa of whooping-cough described by Deichler and Kurloff.

Much less worthy of serious attention are the reports of various writers, especially Lindner, that certain forms, well known as free-living species, namely, unstalked vorticellids, are the cause of various gastric disturbances in man and certain domestic animals. The statement of Schaudinn, that he has found repeatedly active vorticellids in fresh fæces, but only after water enemata, is sufficient indication of the means by which such marvellous discoveries as those of Lindner and others are achieved. Quite recently I was asked to examine a slide containing organisms from fresh urine, and these were not echinococcus bladders as diagnosed, but unmistakably free living forms, and probably contracted rotifers whose presence was due to the contamination of the vessel, or possibly of the sample of urine examined.

Henry B. Ward.

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ADDENDUM.

"PROTOZOA IN SCARLET FEVER?*—In four cases of scarlet fever, which came to autopsy at the Boston City Hospital, there was found a series of bodies which strongly suggest the different stages in the development of a protozoon. These bodies occur in the epithelial cells of the skin and tongue, between these cells, and free in the superficial lymph vessels and spaces of the corium (see Plate LXII.). For description they may be divided into two groups.

"The first group consists of a series of bodies varying in size from 2 to 7 μ. Structurally they are composed of a finely granular, closely meshed reticulum. Sometimes they contain small vacuoles. Their frequently irregular and elongated forms suggest fixation while in amœboid motion.

"The bodies of the second group are radiated in structure and measure 4–6 μ in diameter. They contain a central body from which radiate a comparatively large number of narrow segments. All stages occur between radiate bodies or rosettes just forming, and others where the segments are enlarging and leaving the central body to form the small granular forms already described.

"These bodies are brought out best by staining in eosin followed by alkaline methylene blue after fixation in Zenker's fluid. They stain a clear blue in fairly well-marked contrast to the purplish nuclei and the pale pink protoplasm of the cells. Other staining methods give no differentiation of the bodies.

"The evidence that these bodies represent different stages in the growth of a protozoon is based on morphological data only, and necessarily is far from conclusive.

* This communication and the accompanying photograph were not received until the main article had already been set up in type. —EDITOR.

EXPLANATION OF
PLATE LXII.

EXPLANATION OF PLATE LXII.

FIGS. 1 and 2 show numerous large and small scarlet-fever bodies in and between the epithelial cells of the rete mucosum. In Fig. 1 is a large body in a lymph space of the corium just underneath the epidermis. Several of the bodies suggest fixation while in amœboid motion.

FIGS. 3, 5, and 6 are coarsely reticulated forms which may be degenerated forms of the scarlet-fever bodies, or stages in sporogony.

FIGS. 4, 8, and 9 probably represent stages preceding the radiate bodies. In Fig. 9 the bodies lie in a lymph space. It shows also four small forms which apparently have just freed themselves from a rosette.

FIGS. 7, 10, 11, 12, 13, 14, and 15 show different stages in the development of the radiate bodies.

FIG. 10 is the earliest stage; there is a distinct central body and a definite regular arrangement of granules at the periphery. Figs. 7, 11, and 12 show a little later stage of development; 11 and 12 are optical sections, while 7 is a surface view. Moreover, in Fig. 7 the body lies free in a lymph space in the corium. The segments begin to show a certain amount of lateral separation from each other.

FIG. 13 is a still later stage; the segments are increasing in size and are more or less free from each other, although most of them are still attached to the central body. In Fig. 14 the segments are all free and enlarging, although still grouped around the central body. In Fig. 15 three bodies are still grouped around the central body, which is free.

PROTOZOÖN-LIKE BODIES FOUND IN FOUR CASES OF SCARLET FEVER.
(AFTER F. B. MALLORY)
Copied in monochrome tint from the colored drawings in the original paper.
Journal of Medical Research, No. 4, Vol. X, 1904.

Their discovery may, however, prove to be the first step in clearing up the etiology of scarlet fever.

"Morphologically the bodies resemble fairly closely the different stages in the sexual development (schizogony) of the malarial organisms. Comparing them with the tertian malarial parasite under the same conditions of fixation and staining, they seem to be about one-third larger, and to have about twice as many segments in the rosettes.

"The accompanying illustrations (Plate LXII.) are a copy in black and white of the plate of colored drawings in the original paper." *

While these bodies must be studied in the living condition to demonstrate beyond question their protozoan nature, and while still further evidence must be adduced before their etiological relation to scarlet fever can be regarded as demonstrated, yet Dr. Mallory's work is of great importance and a strong presumption in favor of the view which he advocates. For his courtesy in furnishing these results in advance of the appearance of the article itself sincere thanks are due. *H. B. W.*

RADIUM.—Radium is a radioactive substance supposed to be a new element. Professors Curie and Demarcay have isolated in small quantity and tested what they consider to be pure radium, obtaining from their samples a characteristic spectrum, and have determined the atomic weight to be 225. On account of the rarity and great difficulty and cost of isolating radium it is used in the form of a bromide or chloride.

Discovery.—The discovery of radium is due to investigations upon radioactive substances. In 1896 M. Henri Becquerel, member of the Institute of France, reported the discovery that uranium gave off radiant energy having many of the properties exhibited by the radiations from *x*-ray tubes.

The radiations from uranium were given the name of Becquerel rays, from the distinguished scientist who discovered them. These rays have the property of discharging electrified bodies and of producing chemical changes in the silver salts ordinarily used in photography, in these respects being similar to the *x*-rays.

Uranium was first discovered in 1789 by the German chemist Klaproth, and named by him from the planet "Uranus." Uranium, though widely distributed, is never found in large amounts, and forms several minerals. The most common of these is uraninite, commonly known as pitchblende. It contains about eighty per cent. of uranium. The pitchblende which contains the largest amount of radioactive substances is the Bohemian pitchblende; but it is also found in Saxony, Cornwall (England), and in Colorado (United States).

Professor Curie and Mme. Curie, in investigating the Becquerel radiations from uranium found that some samples of pitchblende, from which the uranium had been extracted, gave forth radiations much more powerful than any they had found, having, in fact, four times the radioactivity of metallic uranium. They concluded that uranium being absent, the radiations were due to some unknown substance in the pitchblende, and following out this they discovered, in 1898, a substance to which they gave the name of "polonium." Polonium passes more rays through aluminum than uranium does, but these rays do not penetrate glass, are readily absorbed by minerals, and are cut off by thin paper. In the same year, following up the discovery of polonium, M. and Mme. Curie and M. Bemont isolated a second substance from pitchblende which possesses many of the chemical characteristics of uranium, but is much more powerful. To this they gave the name "radium."

Properties of Radium.—Radium is one of the most peculiar substances known to science, and produces phenomena which were hitherto unknown as existing in any chemical element or chemical combination: (*a*) It glows constantly with a visible light; (*b*) it gives off constantly a certain degree of heat; (*c*) it produces electrical effects similar to those produced by the *x*-rays; (*d*) it causes certain chemicals to fluoresce; (*e*) it reduces the silver salts ordinarily used in photography; (*f*) it transforms white into red phosphorus, and produces other transformations, such as changing the color of glass, porcelain, white paper, rock salt, etc.; (*g*) it has a distinct effect upon living tissue.

Nature of Radium Radiations.—The discovery of *x*-ray radiations and radium radiations has given rise to many ingenious theories, but experiments appear to show a distinct difference between radium rays and *x*-rays and the emanations from radium. Radium rays like *x*-rays pass through glass and substances opaque to ordinary light, while radium emanations are of peculiar character and appear to be more like a vapor. These emanations do not pass through glass, but settle upon all objects with which they come in contact, and like vapor of water may be condensed by extreme cold. The emanations from radium produce radioactivity in other substances, the result being, so far as is known, that all substances may be rendered radioactive through the influence of radium emanations. Substances so rendered radioactive present to a degree all the phenomena which radium itself presents, and when so charged retain the properties of radium for varying periods of time. The Curies have determined that substances thus rendered radioactive retain their induced radioactivity very much longer when guarded in a small enclosure through which the emanations cannot pass. In such cases the induced radioactivity diminishes one-half every four days, while in substances not so guarded it diminishes one-half every twenty-eight minutes.

Nature and Measurements of Radium Radiations.—There are three entirely distinct types of rays emanating from radium. These are known as the "α," "β," and "γ" rays. The α rays are the least penetrating, losing about one-half of their intensity if passed through aluminum 0.0005 cm. in thickness. The β rays are much more penetrating and much longer, and correspond in every particular to the characteristics of cathode rays. They are readily deflected by a magnet, discharge electrified bodies, etc.

The γ rays are the rays possessing the greatest penetrating power. These rays will produce radioactivity through the air at a distance of four feet or more, and are so much more penetrative than α rays that they require aluminum 8 cm. in thickness to reduce their intensity one-half.

The radioactivity of radium compounds is measured in terms of uranium, this element being taken as a standard. Professor Curie states that pure radium possesses one million times the radioactivity of uranium, but from the rarity of the substance and the difficulty of obtaining it in a pure form, the radium compounds which have so far been available for experiment have rarely been above a radioactivity of 7,000. The quantity of radium and radium compounds so far produced has been exceedingly small and the cost is very great. Professor Curie states that it would take five thousand tons of uranium residue to produce a kilogram of radium at a cost of about $2,000 per ton.

Heat-Producing Properties.—Radium has the remarkable property of maintaining its temperature at about 1.5° C. above its surroundings. Heat production like light production from radium appears to be made without any change in the radium and without any loss of weight. This remarkable force production as exhibited by constant heat production can be appreciated when it is understood that radium radiates enough heat to melt more than its own weight of ice every hour, and to continue, so far as is known, this force production for an indefinite period.

Light and Fluorescence.—When a tube containing radium is viewed in the dark it is seen to emit a distinctly visible light. The light emitted is of uniform quality and is produced indefinitely, and, so far as is known, without any change in the radium itself. When the rays from radium are directed upon the double cyanide of platinum and barium, tungstate of calcium, and certain

* Mallory: "Scarlet Fever. Protozoa-like Bodies Found in Four Cases." Journal of Medical Research, No. 4, vol. i., 1904.