equation enables us to calculate the 'Eigenwerte' of α-particles in the nucleus. Discrete positive as well as negative 'Eigenwerte' are obtained, according to initial conditions assumed. The positive 'Eigenwerte' are very interesting, because with certain further assumption they are capable of explaining the γ-rays of the six radioactive elements which have been so far accurately measured. The numerical agreement is very remarkable.

The complete papers will be published in the *Philosophical Magazine*.

A. C. BANERJI.
Mathematics Department,
University of Allahabad,
Dec. 11, 1929.

Nitrifying Bacteria.

DURING the course of investigations on nitrification in soil and in a sugar beet effluent filter bed, several different bacterial strains have been isolated capable of oxidising various ammonium salts to nitrite, as shown by the Griess-Ilosva method. This is interesting because it has usually been assumed that nitrite formation was brought about by the varieties of bacteria known as *Nitrosomonas* and *Nitrosococcus* first isolated by Winogradsky in 1891. There are, however, scattered references in the literature to other organisms capable of producing nitrite from ammonia, but unfortunately the diagnostic characters given are insufficient for sure identification. Among the well-known characteristics of Winogradsky's organisms are the following: inability to grow on nutrient agar or gelatine, inhibiting effect of organic compounds such as sugar, optimum growth at *p*H of 7·7 – 7·9. In contrast to these the organisms isolated in this laboratory grow well and rapidly on both nutrient agar and gelatine (in the case of the soil forms Winogradsky's medium is unsuitable); the presence of 0·1 per cent sucrose in no way inhibits growth, and in the soil forms definitely stimulates nitrite production. Nitrite formation takes place at a wide range of *p*H values varying from 4·5 to 7·9.

Further, morphologically, the varieties of *Nitrosomonas* and *Nitrosococcus* on the whole do not resemble the soil and effluent forms isolated here.

This new group of organisms has up to the present been shown to produce nitrite when grown in a culture solution of the following percentage composition: 0·06 sodium chloride; 0·002 calcium chloride; 0·0005 magnesium sulphate; 0·03 potassium acid phosphate; 0·1 sucrose; the only sources of nitrogen being one of the following ammonium salts, sulphate, phosphate, carbonate, chloride, lactate, or acetate. Some of the strains produce nitrite from all the ammonium salts tested, while others will only produce it from certain of them. On the whole, the organisms isolated from the effluent produce nitrite more freely from ammonium lactate and the soil forms from ammonium phosphate.

A full description of these bacteria, together with their physiological reactions, is in the course of preparation.

D. WARD CUTLER.
General Microbiological Dept.,
Rothamsted Experimental Station,
Harpenden, Herts.

The Life-Cycle of *Bac. saccharobutyricus* v. Klecki.

IN 1927, Cunningham and Jenkins (*Jour. Agric. Sci.*, Vol. 17, pp. 109-117) showed that under certain conditions the motile butyric acid bacillus is capable of producing ærobic micrococci. Studies of this organism continued during the intervening period of three years have demonstrated that it passes through a life-cycle in which at least seven distinct cell types can be distinguished—forms similar to the (1) coccoid, (2) short rod, (3) slender rod, (4) large rod, (5) dwarfed growth, (6) fungoid, and (7) large cell types of Löhnis and Smith. Of these, representatives of types 1 to 4 have been stabilised and the majority have been identified with previously described 'species'.

The cocci consist of white, orange, and red forms corresponding to *M. candicans* Flügge, *M. aurantiacus* Cohn, and *M. roseus* (Bumm) L. et N. The short rods are represented by unidentified white and red types. The more important of the slender rods are *B. putrificus* Bienstock, *B. sporogenes*, Metchnikoff, *B. putrificus* Reddish and Rettger, *B. circulans* Jordan, *Pectinobacter amylophilum* Makrinov, and *B. Globigii* Migula, while the large rods are represented by *B. Ellenbachensis* Stutzer and *B. sphœricus* A.M. et Neide.

Formation and germination of endospores, exospores and microcysts have been observed as well as formation of gonidangia, gonidia, and regenerative bodies. Observations have also been made on the formation of, and regeneration from, the symplasm, and on conjunction with formation of regenerative bodies at the points of contact of the cells. When cultures of the slender rod type produce terminal regenerative bodies they have been found to be capable of decomposing cellulose under anærobic conditions. A detailed account of the results of the investigation will be published elsewhere.

A. CUNNINGHAM.
Department of Bacteriology,
College of Agriculture,
Edinburgh.

Regeneration of the Spines in Sea-Urchins.

IN NATURE of Nov. 16, p. 760, Mr. H. C. Chadwick records a case of regeneration of the spines in *Echinus esculentus*. While working at the Marine Laboratory, Plymouth, last summer, I noticed a number of specimens of *Psammechinus miliaris* behaving in a similar way. The individuals belonged to a small, deep water race obtained from about 15 fathoms near the Eddystone. On July 25 about thirty specimens were placed in a bowl under circulation and kept in darkness. A similar number were exposed to direct sunlight. The former lot remained healthy and underwent no change. About half of the lot kept in the light threw off all their spines except those on the oral surface, which were unaffected. A week afterwards a fresh crop of minute spines began to appear. These grew so rapidly that in two months the majority of these individuals could scarcely be distinguished from those which had not thrown off their spines.

It may be noted that Dr. Mortensen states in his "Handbook of the Echinoderms of the British Isles" (1927, pp. 262-263) that in sea-urchins "The power of regeneration is great, . . . spines and the other external organs are easily regenerated. . . . Autotomy is not known to occur in the Echinoids."

A. D. HOBSON.
Department of Zoology,
University of Edinburgh.

Ruthenium a Superconductor.

IN some experiments recently made in collaboration with J. F. Allen and J. O. Wilhelm, we found ruthenium became superconducting at 2·04° K. The metal was supposedly of high purity, but retained its high resistance down to nearly 4° K.

J. C. McLENNAN.