afforded an excellent gathering place for flocks of the nitrifying organism. The "nitric ferment" does not, as the Franklands had already shown, grow well upon ordinary gelatine plate cultures; and this is probably the cause of the failure of all previous experimenters to isolate the special ferment.

Before receiving Winogradsky's paper, in the spring of 1890, we had been using in our work, at the suggestion of Mr. Allen Hazen, an ammoniacal solution of the following composition: ammonium chloride (resublimed), 1.907 grams; sodium carbonate, 3.7842 grams; sodium phosphate, .2 grams; potassium sulphate, .2 grams. These salts were dissolved in such a quantity of re-distilled water that the solution contained 100 parts of nitrogen per 100,000, and two equivalents of alkali. Ten cubic centimetres of this solution were mixed with one litre of re-distilled water, and then inoculated as desired. The flasks used have been made chemically clean by boiling with potassium permanganate, and the water used has been twice distilled. The other rigid precautions absolutely necessary in all work of this character have always been taken. The solutions thus prepared have contained from .0001 to .0010 parts per 100,000 of albuminoid ammonia.

Proceeding with this solution by the method of dilution, we at length succeeded in isolating a nitrifying organism. A flask was first inoculated with a few grains of sand from Tank No. 13, at the Lawrence Experiment Station, and when nitrification was at its height in this solution, a small portion was transferred from this to a second flask, and so on. After a large number of unsuccessful attempts, two solutions were finally obtained which nitrified well, but gave no growth upon ordinary gelatine plate cultures, although the plates were allowed to stand for seven days. Microscopic examination of these solutions showed them to be inhabited by a particular form of bacillus, and apparently by that alone. These bacilli are short, of a slightly oval shape, and vary from 1.1 μ to 1.7 μ in length; they are about .8 μ to .9 μ broad. They are grouped very characteristically in irregular clumps, and are held together by a jelly-like material. Each aggregation is indeed a typical zoöglœa. The aggregations of bacteria were found chiefly on the bottom of the flasks, as was also the case with the organism described by Winogradsky. These masses of zoöglœa, obtained as a pure culture from a nitrifying solution, resemble significantly the zoöglœa discharged in considerable quantities from the filter tanks at Lawrence. The bacilli stain with some difficulty with the usual aniline dyes. We have not observed independent movement. Owing to the lack of the usual means of diagnosis, it is difficult to determine in a short time whether this species is the same as the one described by the Franklands and by Winogradsky. On one important point there appears to be a difference between our results and those reached by the above-mentioned investigators. The organism discovered by them oxidizes ammonia to nitrite, but carries it no further. Our own flasks give complete oxidation to nitrate. Whether this be due to a difference of conditions, a difference in the virility of the organisms, or a specific difference in the bacteria, we are not at present prepared to say. The short time at our disposal has made it impossible to settle this and many other questions to our own satisfaction. We are not even prepared to say that there may not have been a mixture of two or more species in our flasks, all agreeing closely in morphological characters, and in giving no growth on gelatine, but differing in important physiological respects. Further investigation is necessary to settle this and other important points regarding the relations of this organism to the process of nitrification.

Whether or not we accept the views of Winogradsky, it is certainly worthy of remark, as he observes, that an organism should exist, which, without chlorophyll and in the apparent absence of organic nitrogen and of organic carbon, should be able to multiply and thrive upon wholly inorganic compounds. It may be well doubted, we think, whether this is really the case. It seems more reasonable to suppose that exceedingly minute quantities of organic nitrogen and carbon are actually present, and escape detection by our present methods of chemical analysis, although in reality sufficient to nourish generations of bacteria.

Our own experience, as well as that of previous investigators, seems to be a warning against a too confiding use of the gelatine plate culture in bacteriological work, since in this instance such confidence has left us for a long time in ignorance of a common and widespread as well as highly important organism.

THE PARASITE OF QUARTAN AGUE.

IN the *Zeitschrift für Hygiene* (x. 137) appears the first of a series of papers by Camillo Golgi, demonstrating by means of photography the development of the parasite found in malarious fevers. This paper, of which an abstract appears in the *British Medical Journal*, deals with the *amœba malariæ febris quartanæ*, the form found in the quartan type. In 1880 Laveran stated that these parasites are present in every case of malaria, and in no other condition, and that they are probably the cause of the disease. His observations have been confirmed by pathologists in all parts of the world, and at the present time the weight of proof seems to be in favor of his contention. In his paper Golgi claims to have been the first to demonstrate that the different forms described as occurring in the blood are simply modifications of one form, and, further, that these metamorphoses follow each other according to a fixed law. This development takes place within, and leads to the destruction of the red blood corpuscles.

At first the amœba-like parasite is small and non-pigmented; it increases in size at the expense of the substance of the blood corpuscles, becomes pigmented, and, after passing through a series of metamorphoses, finally ends in a process of segmentation. This process of segmentation takes place at the same time as, or a short time before, the onset of the febrile paroxysm, and has for its object the formation of a new generation of the parasites. The pigment granules stored up in the body of the parasite take no part in this process of segmentation, and hence, on its completion, escape into the blood plasma, where they are seized upon by the white blood corpuscles and cells of the liver, spleen, etc.

The new brood of parasites at once pass into fresh red blood corpuscles, and so commences anew the cycle of metamorphoses leading up to the next paroxysm of fever. The period of time which elapses between the entrance of the parasites into the red blood corpuscles and their segmentation is exactly three days, and hence arises the periodicity of the quartan type of malarial fever. During the first and second days the parasite passes through the various phases of its development within the blood corpuscles, on the third day segmentation takes place, the new brood is set free and fever results; in other words, the period of apyrexia corresponds with the endoglobular growth of the parasite.

Golgi states that a knowledge of these developmental stages is of immense practical importance for the purpose of diagnosis, by which an almost mathematical degree of accuracy can be arrived at, and that it is no exaggeration to say that by the simple microscopic examination of a few preparations of blood the physician is in a position to tell when the last attack of fever occurred, to foretell the time of the next attack, and further, to recognize what type of malarial fever he is dealing with. The simple quartan fever is explained by Golgi as resulting from the development the blood of one set of the parasites, which ripen every three days, while the double and triple quartan fevers are caused by the

development of two and three sets respectively, coming to maturity on consecutive days. This hypothesis, of course, cannot apply to the tertian type of malarious fever, since in this the febrile paroxysms follow each other with an interval of only one day of apyrexia intervening, instead of two days as in the case of the quartan type.

Golgi is of the opinion that he has brought forward satisfactory evidence to show that tertian ague depends on the presence in the blood of a distinct variety of the malaria parasite, which passes through its developmental phases in two days instead of in three. In regard to classification, Golgi holds that the various clinical types of intermittent fever are caused by varieties of one and the same parasitic species, and that this belongs to the genus amœba. The twelve photographs which illustrate his first paper deal with the development of the parasite of quartan fever, and show, surrounded by normal red blood corpuscles, its successive metamorphoses. The photographs, which are very fine, were taken by means of Zeiss's microphotographic apparatus.

LETTERS TO THE EDITOR.

On some Extinct Vertebrata from the Miocene Rocks of the North-west Territories of Canada recently described by Professor Cope.

AMONG the more recent and interesting additions to the collections in the National Museum, Ottawa, Canada, are the mammalian and fish remains from the tertiary rocks of the Canadian North-west. These collections which were made by Messrs. McConnell and Weston especially have been recently studied by Professor E. D. Cope of the Academy of Natural Sciences, Philadelphia. The results of his observations will soon be made known in a memoir now in print, and to be published by the Geological Survey Department. The specimens in question are now on exhibition in the upright cases of the museum, and from the labels attached the following interesting forms are noticed as of special interest.

Extinct Rhinoceros (*Menodus angustigenis*). — This is the name which Professor Cope has given to the largest species of hoofed animal analogous to the rhinoceros that has ever yet been discovered, and which in early tertiary times was roaming in the then existing forests of the now treeless prairie regions of Canada.

The best portion of the skull of one individual may be seen, about three feet long and eighteen inches across, with the frontal bones and snout preserved; also the two horn-cores and portions of the upper jaw, with several huge molars *in situ*. The lower jaw of the same individual was also found, and the teeth beautifully preserved. Some of these teeth are nearly four inches across and three inches in thickness, being nearly four inches in length, with zig-zag and sharply-cut crowns. The humerus, femur, tibia, many horn-cores, and bones of the pelvic arch and of various other portions of the skeleton, were also found, making in all a beautiful display of fossil bones belonging to as huge and ferocious a beast as prowls to-day in the jungles of an African or Indian forest. Besides this form of *Menodus*, Professor Cope has recognized a number of others, to which he has given separate specific designations, so we find that there existed in Canada not only this huge and ferocious species of *Menodus*, but other allied creatures. These include *Menodus syceras* Cope, *M. Proutii* Owen, *M. Americanus* Cope, and *M. Selwyni* Cope. They all belong to miocene tertiary strata occurring in the vicinity of Swift Current Creek, North-west Territory. These all belong to the family of the *Titanotheridæ*, and form a group of animals analogous to the rhinoceros.

Extinct Horse (*Anchitherium Westoni* Cope). — This is one of the forms which belong to the *Palæotheriidæ*, a family of extinct animals whose affinities seem to place them foremost as the ancestors of the *Equidæ* or horses.

Extinct Boar (*Elotherium Mortoni* Leidy). — Among the specimens on exhibition and collected by Mr. Weston may be seen an almost perfect lower left ramus of this extinct mammal, allied to the modern wild boar and pig, and belonging to the family of the *Chœropotamidæ*. This creature was of huge dimensions, the specimen of the jaw in question being nearly ten inches in length. The teeth are beautifully preserved in a spotted grey and yellow-white lime-rock. This is the first time that this form has been found so far north on the American continent.

Extinct Deer (*Leptomeryx mammifer* Cope). — This new species, a member of the family of the *Tragulidæ*, appears to be one of the ancestors of the deer tribe, being both a ruminant and ungulate mammal. A very well preserved portion of the lower jaw, with several teeth *in situ*, has permitted Professor Cope to establish its relations and affinities, and it forms a valuable addition to the fauna of those times which preceded the advent of the great ice age, when all these types disappeared and made room for the mastodon, the mammoth, and other creatures, including the megalonyx and its allies.

Other Extinct Forms. — Besides the above may be seen a large incisor belonging to a large *carnivore* allied to the modern dog or wolf; the tooth of an oreodont, an extinct hare (*Palæolagus turgidus* Cope) belonging to the family of the *Leporidæ;* also a species of *Trionyx* which Professor Cope has called *Trionyx leucopotamicus*, from the fact that similar forms occur also in the White River series of formations in the southern territories of the United States. But besides the above we find also extinct forms allied to the squirrels (*Hypertragulus riversus* Cope), and also a large number of bones of siluroid fishes belonging to the genera *Amiurus, Rhineastes*, etc. Among these we find *Amiurus McConnelli, A. cancellatus* (all described by Cope); also *Amia macrospondyla, Amia Selwyniana*, and *Rhineastes rhœas* Cope.

Fossil Turtles. — Then come the remains of a species of *Stylemys*, an extinct turtle belonging to the family of the *Testudinidæ*, one of the *Chelonia.*

Chalicotherium and *Hempisalodon.* — The latter form (described under the name of *H. grandis* Cope) affords another example of an extinct type of hyena, much larger than any of the modern living ones. It belongs to the family of the *Hyœnodontidæ*, and forms a part of a sub-order of that family with very large representatives. The genus *Chalicotherium*, one of the family of the *Chalicotheriidæ* Lydekker, has certain affinities to the rhinoceros, whose size and proportions it greatly resembled.

Thus it will be seen that from the miocene tertiary strata of the Swift Current River, not far from the line of the Canadian Pacific Railway, along the treeless prairie region of Canada, a large fauna existed, some of whose remains now adorn the cases of the National Museum at Ottawa.

HENRY M. AMI.

Ottawa, Ont., July 6.

Osteological Notes.

AMONG the primates, the *Anthropomorpha* (higher apes) have strong jugal arches, longer than in man, and presenting marked horizontal and vertical curvature. Although properly composed of only two bones, viz., the zygomatic process of the squamosal, and the jugal, this last rests upon a process of the maxilla so much developed that in many cases it might be rightfully considered as entering into the formation of the arch. The suture which joins the squamosal and the jugal is long and serrated, its great inclination downwards and backwards vastly increasing the strength of the parts as well as the power of resistance.

In the gorilla the jugal arch is relatively broader and more developed than in the other higher apes. The process of the squamosal presents a sudden vertical convexity upon its upper border, at a point corresponding to the junction of the anterior transverse root, the remaining portion of the arch being nearly of the same width. The breadth of the channel for the play of the temporal muscle is proportionally large. The entire structure of the arch, especially in its horizontal and vertical curvatures, exhibits enormous strength. In the adult male all the cranial ridges attain their maximum size, thus presenting a largely increased surface for the origin of the temporal muscle, while the relative greater breadth of the ascending ramus of the mandible, and the increased width of the pterygoid fossæ are correlated with a corresponding development of the masseter and pterygoid. The long and massive canines so characteristic of the higher apes, especially of the gorilla and orang, have reference to the powerful action of the last-named muscles. Their use has also a sexual relation. The glenoid cavity is transversely broader than in man, and