in seventy-nine cases of cholera examined in Calcutta. 2. He demonstrated pure cultures of the comma bacillus from France, Italy, and Germany, all exactly alike. 3. He considers it proven that this comma bacillus occurs only in cholera, may be differentiated from others similar to it, and is diagnostic of the disease. 4. He demonstrated inoculation experiments upon animals, as follows: —

Five cubic centimetres of a five-per-cent solution of sodic carbonate, and in twenty minutes ten cubic centimetres of meat-broth containing a pure culture of the comma bacillus, were injected into the stomach of each guinea-pig. Immediately afterwards laudanum (one centimetre for each two hundred grams weight) was injected into the abdominal cavity. This served to narcotize the animals for one-half an hour to one hour. The next day they were ill, with bristling hair, great weakness of the hind-legs and muscles of the back, and died in from one to three days. Section showed swelling of the intestinal glands, and the stomach and coecum full of an alkaline, colorless, flocculent fluid, containing almost a pure culture of the comma bacillus. This experiment was made upon eighty-five guinea-pigs.

Similar experiments were made with Finkler and Prior, and Denecke's bacillus, but in much smaller number. The results were very different, Finkler's bacillus producing putrefaction in the intestinal contents, as shown by their smell.

Therapeutic experiments upon the inoculated animals showed merely that large doses of calomel, or the use of naphthaline, would prolong the life of the animal for a day at most. The comma bacillus is easily destroyed by drying and other disinfectants, as by a one-half-per-cent solution of carbolic acid.

The observations upon man, considered by Klein and Macnamara to be of the nature of infection experiments, Koch took up again, and showed, that, of the one hundred and fifty physicians who took the 'cholera course' in Berlin, but one had cholerine, and comma bacilli were found in his dejections.

He has also found that the comma bacillus will live in well-water thirty days, in dirty canal-water seven days, twenty-four hours in the contents of a privy, three to four days in moist linen, eighty-one days in the harbor-water of Marseilles (Nicati and Rietsch), and more than one hundred and forty-four days on agar-agar. Koch has never found any *resting* form at all like the spore stage of some other bacteria.

Pettenkofer confessed himself not convinced. He said the inoculation experiments were unsatisfactory. Those made with Emmerich's short staffs at Naples and at Munich were much more so. The manner in which Koch inoculated his animals threw no light upon the subject, for only man had the disease. He cannot agree that the comma bacillus is more than a usual accompaniment of cholera. The epidemiological knowledge of cholera is to be completed by considering the comma bacillus its cause, — a difficult thing to prove, since drying kills this organism; and yet in lower Bengal a dry year is notoriously a favorable one for the disease.

The comma bacilli are found only in the intestines, not in the organs; and yet the intestinal glands are highly absorptive. Cholera is not a combination of infection and intoxication, but an infectious disease, pure and simple. It is possible that in the future Emmerich's staffs may be found to be the cause of the disease. These are found in the organs of the inoculated animals, and produce cholera-like vomiting and diarrhoea. Before fully accepting the bacillus, more must be known of the epidemiology of the disease. Since cholera is not communicated directly, so the cholera-germ is not; and, since cholera depends upon place and time, the cholera-germ must be governed in the same way.

ROLLESTON'S LIFE AND WORK.

Rolleston's worthiest memorials are the growing school of biology at Oxford, and the important zoölogical and anthropological collections of its university museum. His remarkable energy, however, enabled him not only to do his work as a teacher, and take the part of a leader in university politics, but to add to knowledge by investigations in many subjects. His original papers, dealing with topics pertaining to anatomy, physiology, zoölogy, archeology, and anthropology, are scattered over the pages of different journals, and the reports and transactions of various societies. It is well that some of his friends have collected these scattered writings, and secured their republication in the volumes before us. Professor Turner of Edinburgh has edited them; and Prof. E. B. Tylor of Oxford has added a brief biography, which is full of interest as giving a clew to the source of the remarkable influence which Rolleston was able to exert in favor of natural science, at a time when the traditions, and the preponderance of the sentiment of his university, were against such studies.

Rolleston's father, vicar and chief land-owner of a small Yorkshire parish, was a good classical scholar, and undertook the primary education of his son, who, it is said, was able to translate Homer at sight when only ten years of age. The lad had, from the first, something of the tastes and instincts of the naturalist: he read Izaak Walton, and Gilbert White's ever-charming 'Selborne,' and in his play-hours mounted the skeletons of mice and weasels, and stuffed the skins of birds and beasts of the neighborhood. After subsequent years at school, he won a classical scholarship at Pembroke college, Oxford, and began residence in

Scientific addresses and papers. By George Rolleston, M.D., F.R.S., Linacre professor of anatomy and physiology, and fellow of Merton college. 2 vols. Oxford, *Clarendon press*, 1884. 76+947 p., portr., illustr., 5 pl. 8°.

his eighteenth year. He seems to have been unusually boyish for his age. A contemporary records "how young he was in every way, beginning at first sight to tell with schoolboy frankness all about his study at Sheffield, how he furnished it, how the boy next him had died, and how he had read all his Greek plays." The master of Pembroke did not trouble himself concerning the unsophistication of his new scholar. He said, "He is a clever Yorkshireman; and, when a Yorkshire-man is clever, he *is* clever."

In 1850 Rolleston graduated with a first class in classics, and next year he was elected a fellow of his college. His fellowship was only tenable on the condition that he should graduate in medicine within a certain period. Oxford affording at that time even less opportunity than now for medical studies, he went to St. Bartholomew's hospital in London. After completing his professional course he worked with notable success for a time in the English hospital at Smyrna, towards the close of the Crimean war. In 1857 we find him settled in London, and assistant physician to the hospital for sick children. Extracts from letters written at this period show him entirely devoted to his work, and interested not merely in his little patients, but endeavoring to promote the welfare of their parents. "I see a good deal of the London poor by this means, and, though I find among them much stupidity and brutishness, I nevertheless see more of qualities which are estimable. Love and self-denial I see constantly, and I make it my business to encourage these qualities."

Rolleston's career was not, however, to be that of a successful London physician. His character, his talents, and his learning were not forgotten at Oxford; nor had he lost his love for his university. Before he had practised a year in London, the Lee's readership in anatomy, and the post of assistant physician to the Radcliffe infirmary, fell vacant, and Rolleston was elected to both. For some time after returning to his *alma mater*, he was hampered in the performance of his teaching duties by the necessity of practising medicine to make a sufficient income; but in 1860, being then in his thirty-first year, he was elected to the Linacre professorship of anatomy and physiology, just endowed by Merton college. This position he held for the rest of his life. Once freed from the cares and distractions of a physician's life, Rolleston's future career was that of an earnest teacher and investigator, and protagonist in the weary war which biology had to wage in Oxford, year after year, before it could obtain any standing in the university less galling than a begrudged and contemptuous tolerance.

When Rolleston was appointed Linacre professor, the Oxford museum was being organized against much opposition, partly on financial grounds, but mainly because a powerful group of university leaders had aroused the sentiment that natural phenomena should only be studied from an artistic or emotional standpoint. The beliefs of this group were, that there was something degrading, if not absolutely obscene, in the study of the bare facts of anatomy and physiology; that skulls of early races of mankind were disagreeable objects, which no well-bred person would ever look at but through the semi-translucent atmosphere of history and poetry; that organic nature could never interest any one possessing refined feelings, except when a hazy glamour had been thrown around it by the discoloration and distortion of naked facts by mental spectacles of 'sweetness and light;' that the objective study of the question, how man came to live, and move, and have his being, was not only irreligious (which might be pardoned), but ungentlemanly, and therefore inexcusable. The forces and feelings against which Rolleston had to contend, are hard to picture in imagination now, but they were then very real and vigorous. Ten years after the foundation of the Linacre professorship, an Oxford man told us that all the natural-science students in Oxford called themselves mathematicians; and even mathematicians were regarded with contempt by the average undergraduate, whose boyish aestheticism led him to gently coo that 'culture' was all in all, and literature its only road. Against this sentiment Rolleston had to work. He had personally experienced that a student who intended to adopt the profession of medicine was heavily handicapped if he gave up three or four years of his life, after leaving school, to the sole study of Greek and Latin. As one excelling in classical scholarship, and skilled 'in all the learning of the Egyptians,' he could command a respectful hearing, even from the most conservative supporters of the eighteenth century Oxford curriculum. His indisputable excellence as a scholar, his eloquence, his energy, his executive ability, his genial nature, his universally recognized honesty of purpose, and hatred of all sham or subterfuge, enabled him to do what, perhaps, no other man of his time could have done; namely, obtain at Oxford a tolerably fair recognition of the value and importance of biological study.

No one can bring about a great reform, unless in a social medium already somewhat prepared for it. It was Rolleston's good fortune to work at a time when his efforts were not mere hopeless assaults on a fortress rendered impregnable by prejudice. He battled at an epoch when many sympathized with him, and were ready to help. But it is his glory to have been the leader, exceptionally fitted by natural gifts and academic career, to conduct to victory those who desired to widen the range of Oxford studies. To him, more than to any other one man, is it due that in biological teaching the university on the Isis is now pressing close on the heels of her sister on the Cam.

PROFESSOR MARSH ON THE DINOCERATA.

Of late years Professor Marsh has been following the plan of selecting a certain group of extinct vertebrates, and thoroughly elucidating its structure in an exhaustive monograph. Where practicable, this plan is by far the most satisfactory method of dealing with the subject; but it seldom falls to the lot of a paleontologist to obtain his materials in the necessary abundance. The volume before us is a magnificent one, surpassing in many respects all other paleontological works. Never before has such a remarkably perfect series of mammalian fossils, illustrating a single group, been brought together. Only in the tertiary lake-deposits of western America could such a collection have been formed; but few can realize what an expenditure of time, labor, skill, and money, even under the most favorable circumstances, is represented by the raw material of this work. Had Professor Marsh done nothing beyond collecting, he would still be entitled to the lasting gratitude of all biologists.

The introduction gives a short but sufficient account of the geology of south-western Wyoming, the only region where remains of the Dinocerata have been found. The section illustrating this part is open to serious criticism, in that it substitutes for the long-established names of formations given by Hayden, King, and Powell, new terms derived from some characteristic fossil. Such arbitrary changing of accepted names can only result in 'confusion worse confounded.' This section refers the Laramie to the cretaceous, whereas it is almost certainly tertiary. The Puerco is altogether omitted.

The Dinocerata: a monograph of an extinct order of gigantic mammals. By Othniel Charles Marsh. U. S. geological survey. Monogr. Vol. x. *Washington*, 1884. 237 p., 56 pl.

The descriptive part of the book opens with a chapter on the skull, in which the most curious part of these most curious animals is illustrated with much care. A remarkable and novel feature of this chapter is the series of sections of the skull which it presents. These sections are made in all directions, — transverse, vertical, and horizontal, — and thoroughly display the internal structure of the skull, the sinuses, cranial cavity, olfactory chambers, as well as the characters of those bones which cannot be seen from the surface. Professor Marsh has here indicated a new method of investigation, which is certain to yield valuable results in the future, as it already has in his hands. Strange to say, the description of the skull ignores almost entirely the basi-occipital, sphenoidal, and periotic regions, as well as the foramina at the base of the cranium. These are most important features, and their omission detracts materially from the value of the chapter. The lower jaw receives very thorough description and illustration: its chief peculiarities are the backward projecting condyles, and, in the males, the anterior flanges, for the protection of the great upper tusks. Professor Marsh shows that in the females these tusks were very small, and that in consequence the flanges of the mandible are absent or rudimentary; thus correcting the very natural error into which Speir and Osborn had fallen in regarding the flange as a generic instead of a sexual character.

The chapter on the teeth need not detain us except to notice the lower incisors and canines. Osborn and Speir first showed that these teeth differed from those of all other ungulates in having bilobed crowns. In his restoration of 'Tinoceras' and elsewhere, Professor Marsh represents these teeth as having a very different shape, though the only actual specimen he figures (woodcut 38, p. 37) is an evidently much-worn canine; of 'Dinoceras,' he gives figures of three isolated incisors. We must believe that the restoration of these teeth in 'Tinoceras' is erroneous.

Certainly one of the most striking and valuable chapters in the book is that on the brain. The brain in the Dinocerata "was proportionately smaller than in any other known mammal, recent or fossil, and even less than in some reptiles. It was indeed the most reptilian brain in any known mammal." This is a most remarkable and unexpected fact. This chapter is enriched by an extended and valuable series of cranial casts of mammals from nearly all the tertiary formations. Lartet first pointed out the comparatively small size of the brain in the