OUR ASTRONOMICAL COLUMN.

"BUREAU DES LONGITUDES."—The *Annual* for the year 1897 is still as complete as ever, and is a necessary *vade mecum* to the astronomer, physicist, and chemist. Our readers are so familiar with the usual contents of this compact little volume, that we limit ourselves to summing up the chief alterations and additions. The table of minor planets has been completed up to September 7, 1896, the number of these bodies now amounting to 431. Cometary notices have been brought up to the year 1895, while several new values for double-star elements have been inserted. Among the articles, which are always of great interest, are three from the pen of M. F. Tisserand. The first is a masterly summary of our knowledge of the proper movement of the solar system; the second, on the fourth meeting of the International Committee for the completion of the photographic map of the heavens; and the third, on the labours of the International Commission on fundamental-stars. M. H. Poincaré writes on the kathode and Röntgen rays. M. J. Janssen discusses some epochs in the astronomical history of planets, and the work done at the Mont Blanc Observatory during the present year. Several discourses are also included, namely, that delivered by M. A. Cornu at the funeral of M. Fizeau, and those delivered by M.M. Janssen, Lœwy, and Poincaré at the funeral of the late Director of the Paris Observatory.

"THE SYSTEM OF THE WORLD."—In a small pamphlet entitled "Unser Weltsystem" (Gustav Fock, Leipzig), Herrn A. F. Barth presents us with an essay on the movements of the bodies contained therein. Without going at all into mathematical reasonings, complicated by numbers, he limits himself to discuss in words the questions that arise. In this way a clear idea of the movements of the earth round the sun, and also those further movements due to perturbations, can be obtained. Not only are the earth's motions discussed, but those of the moon are also taken in hand. One may here, among other things, learn what are the causes which give us different lengths of days, months and years, and how these may be converted into one another. These and several other points are touched upon, and the author concludes with a few general remarks on the extent of space.

Another pamphlet (Gauthier-Villars et Fils, Paris) contains an exposition of the mechanical formation of a "Système du Monde," after a new theory by Lieut.-Colonel du Ligondès. M. L'Abbé Th. Moreux is the writer of the essay, and he introduces this new idea to us after a short summary of previous hypotheses, such as those of Laplace and Faye. Assuming that motions in space can take place in all directions, then if there exist spots around which these movements are to a certain extent symmetrical, and if such a region be more or less homogeneous, then disturbances will be equally symmetrical in every direction, and a nearly round mass will be formed. The next stage in the development of this mass is its change of shape from circular to lenticular. This is brought about by the particles circulating towards the interior of the mass, and therefore coming into collision with one another. With condensation the mass becomes less homogeneous, and the law of gravity becomes modified. A general deformation of all the orbits of the particles commences, and finally a lens-shaped mass is the result. A ring now begins to be formed, having its point of greatest density some distance from its centre. The values of gravity vary along a radius, being small at the centre, reaching a maximum some distance away, and finally vanishing. The point of maximum velocity coincides with the maximum value of gravity. The ring becomes now the centre of attraction of bodies lying near it. Stresses are set up and a rupture takes place, this ring being split into three parts. At a later epoch the conditions are such that another ring of small dimensions is formed; this forms a second maximum point of density on the flat disc, which eventually is ruptured. These rings finally condense and form the several planets. The theory accounts for the different densities, sizes, rotations, and velocities of the planets, and also for the cases of the satellites. Space forbids us, however, from going into this theory more in detail, but there are several good points about it which make it interesting.

"COMPANION TO THE OBSERVATORY."—This annual for the year 1897 contains the usual amount of useful information, and the arrangement remains as formerly. Mr. Denning gives the list of principal meteor showers for the year, but we are surprised to see that no additional information is given of those swarms which will be of special interest during the next year or two. Data for the total solar eclipse which will occur on January 21, 1898, in addition to the two annular eclipses in 1897, are given. An ephemeris for Jupiter's fifth satellite up to the middle of May also receives a place, but its accuracy is doubted, for, as Mr. Marth says, no recent measures have been made, so that the adopted daily rate of motion is based on measures made in 1892 and 1893. The variable star information is very full and complete; but, if we may venture to make a suggestion, the table giving the mean places for the year 1897 would be made more useful if the approximate periods were to be placed against each star.

BACTERIAL WATER PURIFICATION.

THE twenty-seventh annual report of the State Board of Health of Massachusetts for 1895 has just been issued. This is the eighth year that the valuable experimental work of the now famous Lawrence Experiment Station has been continued. Although no very remarkable novel features have been recorded in the practice of bacterial water purification, it is highly satisfactory to find that the previous important work of the station is fully confirmed by the investigations conducted during the past year. An interesting point to which attention is called is the tendency exhibited by sand-filters to increase in bacterial efficiency in proportion to their period of service. In support of this the working of the oldest experimental filter at the station, and one of those with the greatest effective size of sand grain, is cited. This filter in 1893, filtering at an average rate of 2,000,000 gallons per acre daily, had a bacterial efficiency equal to 96·75 per cent.; during 1894 its rate of filtration was 4,500,000 gallons per acre daily, and its bacterial efficiency reached 98·97 per cent., whilst in 1895, although working at approximately the same rate as in the previous year, its bacterial efficiency rose to 99·57 per cent. This increased bacterial efficiency, caused by greater length of service period, was considerably more marked in the case of filters constructed of medium coarse or coarse sands than with those in which medium fine sand was employed. It would be out of place in these columns to discuss the various technical questions dealt with in the report, but there is one point which is very clearly brought out, and which is of particular interest in connection with the controversy which has recently arisen over the bacterial examinations of the London water-supply. An attempt has been made more than once to discount the value attaching to early bacterial examinations of the London waters, which first exhibited the efficiency of the purification processes employed, on the ground that the samples for investigation were not collected direct from the filters but from the delivery pipes. It has been contended that the numerical results obtained from samples drawn from the mains do not represent the bacterial efficiency of the purification processes in operation at the works, and this contention is based upon the hypothesis that the bacteria present in the effluent multiply in the pipes before delivery. The examinations made at the Lawrence Experiment Station show that there is no foundation whatever for this supposition. Thus in the monthly averages of daily bacterial examinations made of the Lawrence water conducted over six months, we find the raw river water contained 7533 bacteria per cubic centimetre, the effluent taken direct from the filter 134, the reservoir outlet 119, and the samples taken from the City Hall tap 86 bacteria per cubic centimetre. These results are sufficiently striking and instructive, and require no further comment. Another point to which considerable interest attaches is the effect upon the total number of bacteria which appear upon a gelatine plate, produced by the time during which the latter is kept and the colonies counted. Thus a water-plate poured from raw river-water exhibited 913 colonies per cubic centimetre on the first day, after two days the number rose to 8613, after three days to 12,317, whilst after four days they numbered 15,017 per cubic centimetre. Similarly in a sample of the same water filtered, whilst only three colonies could be counted on the first day, 48 made their appearance after two days, 72 after three days, and 87 per cubic centimetre after four days. The bacteriological examination of water, it cannot be too frequently insisted upon, is surrounded with subtle pitfalls into which the unwary may very easily be decoyed, and if the method is to take its position as a scientific process, too much attention to the details upon which its accuracy depends cannot be expended. In conclusion, in the section devoted to bacteriological technique, we note the

introduction of a new word. Hitherto we have spoken of plate-cultivating a given water, but this expression we find cut down to "plating" a water; as, however, the general practice is now to substitute dishes for plates, we shall probably be reduced to the ugly phraseology of "dishing" a water.

G. C. FRANKLAND.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—At the Junior Scientific Club, on December 9, Mr. E. S. Goodrich read a paper on the "Evolution of the Ungulata," and Mr. E. C. Atkinson gave an account of some further experiments on rowing, exhibiting and describing also the improved form of his rowing indicator.

CAMBRIDGE.—All the graces which were non-placeted on December 10, were carried by considerable majorities. The professorship of Surgery has accordingly been suspended for one year, the professorship of Logic and Mental Philosophy is established, and the Sedgwick Memorial Museum of Geology will be built on the ground lately belonging to Downing College. At the same Congregation it was agreed to present to the Lord President of the Privy Council a memorial urging the necessity of legislation bearing upon secondary education.

Mr. Ernest Clarke, Hon. M.A., of St. John's College, Secretary of the Royal Agricultural Society, has been appointed the first Gilbey Lecturer in the History and Economics of Agriculture.

Mr. J. J. H. Teall, of St. John's, has been appointed an elector to the Professorship of Geology; and Dr. A. S. Lea an elector to the Professorship of Physiology.

THE Hamilton Court Building Company, consisting of friends of Columbia University, have purchased land in New York City, at a cost of two hundred thousand dollars, and will erect upon it, at a cost of one million dollars, a dormitory to accommodate 900 students of the University.

THE following are among recent announcements:—Dr. W. Valentiner, associate professor of astronomy at Heidelberg, to be full professor, and Dr. Knövenagel to be associate professor; Dr. P. Freiherr von Lichtenfels to be professor of mathematics in the Technical High School at Graz; Dr. W. Rothert to be associate professor of botany in the University of Kasan; Dr. Seitaro Goto to be professor of botany in the First High School at Tōkyō, Japan; Dr. Kepinsky to be associate professor of mathematics at the University of Krakau.

THE William Gossage Laboratories, just added to the Chemical Section of Liverpool University College, were formally opened on Saturday by Lord Derby, President of the College, in the presence of a large and representative gathering. The laboratories have been built and equipped at a cost of 7000*l.* by Mr. F. H. Gossage and his partner Mr. T. Sutton Timmis, as a memorial of the father of the former, the late Mr. Wm. Gossage, distinguished as a chemical investigator and inventor of chemical processes. An address was delivered by Prof. Ramsay on chemical education and the equipment of laboratories. A full report of the address and other speeches made upon the same occasion is given in the *Liverpool Courier* of Monday, December 14.

SIR P. MAGNUS, in the course of some remarks at the Norwood Technical Institute, on Wednesday of last week, reviewed the history of the polytechnic institutes in London and the provinces. He estimated the amount spent on evening teaching, exclusive of interest on capital outlay for buildings, at over 175,000*l.* a year. It was pointed out that the London institutes give facilities not only for technical but also for literary and general education, which are not obtainable on the same scale and on similar lines in any other capital in the world. The reason why in some other countries, especially in Germany and Switzerland, lads are better able to profit by the technical instruction of evening classes than they are in this country, is because the lads leave school at a later age and more generally attend continuation classes.

IT is very satisfactory to note that our political leaders have lately devoted themselves to expounding the connection of science with industry. Mr. A. J. Mundella, M.P., speaking at the Birmingham Municipal Technical School, on Friday last, on the subject of German competition, said he quite admitted that we had suffered loss from our past neglect, particularly in regard to the development of the new sciences and new discoveries, which Germany had adopted and developed in a marvellous manner. He instanced the growth of the colour trade in Germany. That industry was an English discovery, founded by a Birmingham man, and worked in Manchester. Yet English manufacturers, not for the want of money or want of enterprise, but from the want of knowledge, had allowed it to be exploited by Germany, and the trade, amounting to many millions a year, had almost entirely left this country.

IN the course of an address at the Battersea Polytechnic, on Wednesday in last week, the occasion being the distribution of prizes and certificates to evening students, Mr. John Morley, M.P., referred to a few points of importance to science and education. He remarked that those who had studied the education question seriously were aware that a London polytechnic was not the same thing as a German polytechnic. In German polytechnic institutions the students learned the highest, most important, and profoundest principles in connection with the scientific subject which they there studied. The main object in the London polytechnic institutes was a different one; it was that the craftsman, the man who made things and did things with the labour and skill of his hand, should have opportunities brought within his reach of training not merely in the mechanical details but in the principles and the basis of his work. It was difficult, however, it was impossible, to put scientific methods and spirit into the habits of people who had not already undergone a preliminary training. There was a direct connection between technical education and an improvement in their national system of secondary education which did not yet exist. He hoped that the Government before many weeks were over would lay before the House of Commons a scheme for the improvement of secondary education. Every one saw that a higher appreciation of science, of the technical arts, of the improvement of scientific research and investigation on the part of the great English manufacturers was of the very utmost importance. One very often heard of the workmen being complained of; but it was now being seen that the leaders and captains of industry, especially the employers and the heads of great manufacturing enterprises, must open their minds to the improving of scientific investigation and research and training, both for the heads of the enterprises as well as for those who had the actual conduct and the carrying of them out. When the sources of the successful competition against this country in certain branches of industry were investigated, he believed that competent men in trade who had examined the matter would say that one great source of the success of foreign competition, and especially of German competition, had been the existence in Germany for some years of an organised and systematic plan for technical education, technical education connected with the other branches of education; and he hoped that this country would speedily amend and reform its system. . . . A scheme was being framed for a Teaching University for London—a most important scheme. It was most desirable that this body, when it was established, should not be so constituted as to discourage the evening teaching and evening learning of such places as the Battersea Polytechnic. They should allow students from such institutions as this to be admitted by their examinations.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, December 11.—Prof. Ayrton, Vice-President, in the chair.—A paper on the applications of physics and mathematics to seismology was read by Dr. C. Chree. Prof. J. Milne has attempted to account for certain changes in the indications of spirit-levels and delicately suspended pendulums by the supposition that they are due to meteorological agencies, such as rainfall or evaporation. Thus he considers that a relative excess of moisture—say, on the west of an observatory—is equivalent to a surface load on that side tending to make the ground, on which the observatory rests, slope downwards from east to west. The author, by making the assumptions as to the physical state of the substance of the earth that it is a homogeneous, isotropic, elastic solid, has examined in as general a manner as possible the amounts of flexure which would be produced by different systems of loading. He points out that the alteration in the reading of such an instrument as