OUR ASTRONOMICAL COLUMN

VARIABLE STARS.—Minima of the short-period variable S Cancri may be expected about November 8, 9h. 5m. ; November 27, 8h. 21m. ; and December 16, 7h. 36m. The latest observations upon record were made by Schmidt in 1883 : he found the star faint on March 12 at 7·2h. and March 31 at 12·8h. mean time at Athens. The star does not appear to have been much observed of late years, and further observations are needed as a check upon the period An abstract of Prof. Schönfeld's discussion on the fluctuations of this variable will be found in vol. ix. of the *Vierteljahrsschrift der Astronomischen Gesellschaft*, p. 226 ; he there gives as elements

Minimum = 1867 August 31, 14h. 12·24m. Paris M.T. + (9d. 11h. 37·75m.) E.

The diminution of light appears to commence about 8½ hours before the minimum ; about 13 hours after minimum the star attains its usual brightness. It is therefore a variable of the Algol type. The abstract of Prof. Schönfeld's memoir referred to above is a pretty full one : the memoir itself is not to be found in the libraries either of the Royal or Royal Astronomical Societies.

Considering the great loss which this branch of observational astronomy sustained in the death of Prof. Schmidt, it is very satisfactory to find that observations of variable stars are systematically made at several Continental observatories, including the important physical establishment at Potsdam, where Dr. Wilsing is giving much attention to the subject. In the year 1883 he made upwards of 380 series of observations on 38 stars, including 24 of R Coronæ, a star which has been too much neglected. Prof. Safarik, Director of the Observatory at Prague, made numerous determinations of the brightness of some fifty stars during the same year : he mentions two *maxima* of U Geminorum, which we take to be a clerical error for *minima*. He further states that the companion of S Orionis 10·11 m., was invisible at the beginning of 1883, and continued so until April ; in August it was again visible, and slowly attained 10·9 m., so that it is variable to the extent of several magnitudes, and Prof. Safarik adds, "möglicherweise alterniren seine Erscheinungen mit jenen von S Orionis." If there is reason to suspect this, the star will obviously deserve close attention. The companion precedes 2·5s., and is south 0''·4.

The positions of S Cancri and S Orionis for 1885·0 are :—

	R.A.	N.P.D.
	h. m. s.	° ′
S Cancri	8 37 22	70 33·1
S Orionis ...	5 23 20	94 46·9

Reference was made in a former column to the approaching maximum of χ Cygni about the middle of November.

WOLF'S COMET.—A circular of the Vienna Academy contains elliptical elements of this comet by Dr. Zelbr, which confirm generally the calculations of Prof. Krueger and Mr. S. C. Chandler ; the period of revolution is found to be 6·76 years, the perihelion passage November 17·6739 Greenwich M.T. At midnight on that date the comet will be in R.A. 341° 50′, N.P.D. 92° 8, distant from the earth 0·979.

THE SOLAR ECLIPSE OF MARCH 16, 1885.—The commencement of this eclipse will be visible just before sunset on the west coast of Ireland. So far as we are aware, the only astronomical observatory at which it will be observable is that of Col. Cooper at Markree, which is in charge of Mr. Marth. The first contact takes place there at 5h. 43m. 58s. Markree M.T. at 86° from north point towards west, for direct image. At Valentia the eclipse begins at 5h. 40m. 22s. local mean time, at 82° from north towards west. Particulars of the track of the annular eclipse across the United States and Canada have already appeared in this column.

GEOGRAPHICAL NOTES

AN interesting pamphlet, on the systems of writing used by the various races which inhabited or still inhabit the Philippine Islands, has just been published by Señor Pardo de Tavera under the title "Contribucion para el estudio de los Antiguos Alfabetos Filipinos." It is illustrated with plates containing the alphabets discussed, which include those of the Tagals, Visayas or Bisayas, and the Battas. This archipelago offers a comparatively virgin field to students in almost every branch of inquiry. Prof. Blumentritt of Leitmeritz has devoted much study and research to the early history of the Spanish occupation of Luzon, and to the settlements of the Chinese and Japanese there during the sixteenth and seventeenth centuries, but since the publication of Jagor's work nearly thirty years ago little that is generally known in Europe has been done to solve the various problems which the languages, races, and geography of the islands present. In Spain there exists an important literature, chiefly of the last century, on the subject, and the works of Fray Gaspar, Argensola, Bravo, and others should be a mine for the modern student. The ethnology of the Negritos of the Philippines has been discussed in Germany by Dr. Mundt-Lauf ; but of the wild mountain tribes of the interior, and of those who are in a state of chronic war with the Spaniards to the south of Iloilo, hardly anything is known. There is a vague surmise that some of them (the Igorrotes of Luzon, for example) are descendants of Chinese pirates of the latter end of the sixteenth century, who having attacked the Spanish settlements were defeated, and fled to the mountains, where they took themselves wives of the natives and became the progenitors of a new race.

THE last number of the *Zeitschrift der Gesellschaft für Erdkunde zu Berlin* contains a long paper by Prof. Blumentritt on the Island of Mindanao, the second largest of the Philippine Islands, accompanied by an excellent map, based on numerous Spanish maps. The writer enters at length into the geography and ethnology of the island, dealing in successive sections with the mountains, hydrography, political divisions, population, and the eighteen tribes which inhabit it. With regard to the last section of his subject, Prof. Blumentritt says that if we omit the few Europeans, Creoles, Mestizos, and Chinese, the natives of Mindanao may be divided into Negritos and Malays. The former are subdivided into Mamanuás and Atas, while the latter are composed of a series of tribes which may be approximately placed according to their religion under three heads : (1) the Visayas, or "Old Christians" ; (2) the mountain tribes, who are either Pagans or Conquistas ; (3) the Moros (Moors), who are Mohammedans. The Visayas and Moors are late-comers ; the former arrived within the period of Spanish rule in the island from the archipelago lying to the north, which at present bears the name of the Visaya Islands ; the Moros also came recently from Borneo and Ternate. Our knowledge of the mountain tribes, says Prof. Blumentritt, is not sufficient to enable us to state definitely what relation they bear to the Visayas, or to the head-hunters of Borneo and Luzon. In the following sections of his paper the writer gives all the information available respecting these tribes, his sources being chiefly the reports of Spanish missionaries. In many cases this information is of the vaguest possible description. In addition to the eighteen tribes here mentioned, there are no fewer than fourteen States with independent Sultans amongst the Moros of Mindanao.

THE same number of the *Zeitschrift* also contains a paper (with a map) on the Loochoo Islands, by Herr Müller-Beeck. It appears to be wholly taken from reports furnished to the Japanese Government by an official who visited the archipelago several times for the purpose of investigation. The paper adds little to our knowledge of the islands, because there is probably not a great deal to know about them geographically. By the way, Herr Müller-Beeck is in error in attributing the name Linschoten, as applied to the seven islands of the northern group called Shichi-to, to the English. This corruption is due to the Dutch, and like many similar corruptions still retains its place in our Admiralty charts as the name by which the islands are known to European navigators.

M. BRAU DE SAINT-POL LIAS, who, as recently mentioned in NATURE, has been commissioned by the French Minister of Public Instruction to make a natural history collection in Sumatra and Java, is an experienced traveller in those regions. Not long since he published a work on Perak, in the Malay Peninsula, and the tribes inhabiting it. He has now issued another small volume on the Acheenese, under the title of "Chez les Atchés-Lohong" (Paris, Plon). Having made friends with the headman of Lohong, he was able to travel freely in that portion of Sumatra, and to observe the customs of the natives. Not long before, two of his countrymen were murdered in neighbouring territory, through which, however, M. Lias was allowed to pass. He appears also to have travelled near the now notorious Tenom, where the unfortunate crew of the *Nisero* were so long confined, and on the whole to have enjoyed advantages for obtaining information about this little-known region—although

it lies within a few miles of the path of the greater part of the trade of Europe with the Far East—than any previous traveller. The apparently interminable war between the Dutch and the natives of Sumatra renders travelling or investigation in that marvellous island all but impossible to Europeans.

AT a meeting of the Society for Commercial Geography of Paris, held on the 21st inst. under the presidency of M. Meurand, Dr. Neis, of the Naval Medical Service, recounted the incidents of a recent journey from Saigon to the frontiers of Tonquin, and thence to Bangkok. He travelled from the basin of the Meikong to that of the Meinam, and referred in his paper to the various tribes met on the frontiers of Tonquin and Cambodia, and to the progress of England in Siam and Burmah. The Society, we observe, now numbers 1000 members.

THE following is a list of the papers arranged to be read before the Society for Commercial Geography of Oporto during the ensuing winter session:—Useful animals of Portugal and its possessions, by M. Torgo, jun.; crime from climatological and ethnological points of view, by M. Veloso; the geography of the Azores, by M. Silva; the exportation of national products to Brazil and the Portuguese colonies, by M. Gonsalvez; the climatological geography of the Portuguese colonies, by M. Monteira; recent colonial treaties with England, by M. de Sonza.

Petermann's Mittheilungen for October contains an article on the south-western portion of the province of Ciudad-Real, in Spain, with a map, by Herr Otto Neussel; one by Dr. Roukis, on the ethnography and statistics of Albania, based on a series of articles contributed to the Athens journal *Akropolis*, under the title of "The Present and the Future of Albania," by the late Greek Consul-General in that country; a third paper on Terek is a translation of one read before the Caucasian section of the Russian Geographical Society by Herr Dinnik. The "Recent Information from Corea" is that published in English Blue-books as reports from various consular officials who have lately visited the peninsula.

NOTES ON NITRIFICATION[1]

IN the following brief notes I propose to consider in the first place the present position of the theory of nitrification, and next to give a short account of the results of some recent experiments conducted in the Rothamsted Laboratory.

The Theory of Nitrification.—The production of nitrates in soils, and in waters contaminated with sewage, are facts thoroughly familiar to chemists. It is also well known that ammonia, and various nitrogenous organic matters, are the materials from which the nitric acid is produced. Till the commencement of 1877 it was generally supposed that this formation of nitrates from ammonia or nitrogenous organic matter was the result of simple oxidation by the atmosphere. In the case of soil it was imagined that the action of the atmosphere was intensified by the condensation of oxygen in the pores of the soil; in the case of waters no such assumption was possible. This theory was most unsatisfactory, as neither solutions of pure ammonia, or of any of its salts, could be nitrified in the laboratory by simple exposure to air. The assumed condensation of oxygen in the pores of the soil also proved to be a fiction as soon as it was put by Schlœsing to the test of experiment.

Early in 1877, two French chemists, Messrs. Schlœsing and Müntz, published preliminary experiments showing that nitrification in sewage and in soils is the result of the action of an organised ferment, which occurs abundantly in soils and in most impure waters. This entirely new view of the process of nitrification has been amply confirmed both by the later experiments of Schlœsing and Müntz, and by the investigations of other chemists, amongst which are those by myself conducted in the Rothamsted Laboratory.

The evidence for the ferment theory of nitrification is now very complete. Nitrification in soils and waters is found to be strictly limited to the range of temperature within which the vital activity of living ferments is confined. Thus nitrification proceeds with extreme slowness near the freezing-point, and increases in activity with a rise in temperature till 37° are reached; the action then diminishes, and ceases altogether at 55°. Nitrification is also dependent on the presence of plant-food suitable for organisms of low character. Recent experiments at Rothamsted show that in the absence of phosphates no nitrification will occur. Further proof of the ferment theory is afforded by the fact that antiseptics are fatal to nitrification. In the presence of a small quantity of chloroform, carbon bisulphide, salicylic acid, and apparently also phenol, nitrification entirely ceases. The action of heat is equally confirmatory. Raising sewage to the boiling-point entirely prevents its undergoing nitrification. The heating of soil to the same temperature effectually destroys its nitrifying power. Finally, nitrification can be started in boiled sewage, or in other sterilised liquid of suitable composition, by the addition of a few particles of fresh surface soil, or a few drops of a solution which has already nitrified; though without such addition these liquids may be freely exposed to filtered air without nitrification taking place.

The nitrifying organism has been submitted as yet to but little microscopical study: it is apparently a micrococcus.

It is difficult to conceive how the evidence for the ferment theory of nitrification could be further strengthened; it is apparently complete in every part. Although, however, nearly the whole of this evidence has been before the scientific public for more than seven years, the ferment theory of nitrification can hardly be said to have obtained any general acceptance; it has not indeed been seriously controverted, but neither has it been embraced. In hardly a single manual of chemistry is the production of saltpetre attributed to the action of a living ferment existing in the soil. Still more striking is the absence of any recognition of the evidence just mentioned when we turn to the literature and to the public discussions on the subjects of sewage, the pollution of river water, and other sanitary questions. The oxidation of the nitrogenous organic matter of river water is still spoken of by some as determined by mere contact with atmospheric oxygen, and the agitation of the water with air as a certain means of effecting oxidation; while by others the oxidation of nitrogenous organic matter in a river is denied, simply because free contact with air is not alone sufficient to produce oxidation. How much light would immediately be thrown on such questions if it were recognised that the oxidation of organic matter in our rivers is determined solely by the agency of *life*, is strictly limited to those conditions within which life is possible, and is most active in those circumstances in which life is most vigorous. It is surely most important that scientific men should make up their minds as to the real nature of those processes of oxidation of which nitrification is an example. If the ferment theory he doubted, let further experiments be made to test it, but let chemists no longer go on ignoring the weighty evidence which has been laid before them. It is partly with the view of calling the attention of English and American chemists to the importance of a decision on this question that I have been induced to bring this subject before them on the present occasion. I need hardly add that such results as the nitrification of sewage by passing it through sand, or the nitrification of dilute solutions of blood prepared without special precaution, are no evidence whatever against the ferment theory of nitrification. If it is to be shown that nitrification will occur in the absence of any ferment, it is clear that all ferments must be rigidly excluded during the experiments; the solutions must be sterilised by heat, the apparatus purified in a similar manner, and all subsequent access of organisms carefully guarded against. It is only experiments made in this way that can have any weight in deciding the question.

Leaving now the theory of nitrification, I will proceed to say a few words, firstly, as to the distribution of the nitrifying organism in the soil; secondly, as to the substances which are susceptible of nitrification; thirdly, upon certain conditions having great influence on the process.

The Distribution of the Nitrifying Organism in the Soil.—Three series of experiments have been made on the distribution of the nitrifying organism in the clay soil and subsoil at Rothamsted. Advantage was taken of the fact that deep pits had been dug in one of the experimental fields for the purpose of obtaining samples of the soil and subsoil. Small quantities of soil were taken from freshly-cut surfaces on the sides of these pits at depths varying from 2 inches to 8 feet. The soil removed was at once transferred to a sterilised solution of diluted urine, which was afterwards examined from time to time to ascertain if nitrification took place. These experiments are hardly yet completed; the two earlier series of solutions have, however, been examined for eight and seven months respectively. In both these series the soil taken from 2 inches, 9 inches, and

[1] A Paper by R. Warington, read before the Chemical Section of the British Association at Montreal.