OUR ASTRONOMICAL COLUMN.

COMET 1916*b* (WOLF).—The following is a continuation of Messrs. Crawfurd and Alter's ephemeris of this comet, for Greenwich midnight:—

1917	R.A. h. m. s.	Decl. ° ′ ″	Log Δ	Brightness
Aug. 31	23 40 22	+12 24 23	9·9998	
Sept. 2	40 22	11 34 5	0·0020	2·29
4	40 18	10 43 12	0·0045	
6	40 12	9 51 55	0·0074	2·17
8	40 4	9 0 25	0·0108	
10	39 53	8 8 54	0·0146	2·05
12	39 42	7 17 34	0·0188	
14	39 29	6 26 35	0·0234	1·91
16	39 16	5 36 9	0·0284	
18	39 4	4 46 27	0·0338	1·77
20	38 52	3 57 38	0·0396	
22	38 41	3 9 52	0·0457	1·63
24	38 31	2 23 17	0·0522	
26	38 24	1 38 1	0·0590	1·49
28	38 18	0 54 11	0·0661	
30	38 15	0 11 50	0·0735	1·35

The unit of brightness is that on April 21, 1917. The comet will be at opposition on September 17.

RADIAL VELOCITIES OF SPIRAL NEBULÆ.—In view of the faintness of spiral nebulæ, and the small dispersion necessarily employed in photographing their spectra, some doubt may have been felt as to the reality of the extraordinarily high radial velocities which have been derived for these objects. A recent statement by Dr. V. M. Slipher, however, appears to place the main results beyond question (the *Observatory,* August). The average velocity which he has found for thirty spirals is 570 km. per second, and he points out that this is more than twenty-five times the velocity of an average star. Thus, although the spectrograph employed for nebulæ at the Lowell Observatory has a linear scale only about one-fifteenth that of a powerful three- or four-prism spectrograph, it is at no disadvantage as regards the relative accuracy of the results obtainable in the two cases, when similar precautions have been taken. Further confidence is given by the agreement in the results obtained for the Great Andromeda nebula at four different observatories, namely, velocities of approach of 300, 304, 300–400, and 329 km. per second. These compare very favourably with the values which have been found for stellar velocities by different observers, those for Canopus, for example, ranging from 18·5 to 21·0 km. per second.

THE HISTORY OF ORBIT DEDUCTION.—In an address on "The Derivation of Orbits: Theory and Practice," delivered to the American Mathematical and Astronomical Societies, and published in *Science* of June 8, Prof. A. O. Leuschner deals in an interesting and illuminative manner with the history of orbit deduction from Newton downwards. Prof. Leuschner himself introduced some very useful modifications a few years ago, and his method is now generally acknowledged to be the most rapid and convenient for obtaining preliminary orbits of newly discovered planets or comets. It is based on that of Laplace, using three observed right ascensions and declinations, and their first and second differences. This method fell into discredit owing to some over-hasty strictures of Lagrange; it had the undoubted disadvantage that the first and third observed positions were not exactly satisfied by the resulting orbit. Harzer showed how differential corrections might be applied, and Leuschner introduced further improvements, which are best summarised in his own words. "Criteria have been introduced . . . regarding the eccentricity. Provision has been made for passing from parabola to ellipse without repeating the solution. Numerical criteria have been set up to distinguish the physical from the mathematical solutions. A method has been provided for eliminating the parallax. The various approximations for the distances are avoided; these are taken from a table; the accuracy attainable in each case can be ascertained, and the range of solution determined." These claims are well justified in the numerous orbits that have been published by Prof. Leuschner and his students. The case of planet MT (Albert) was particularly striking. Dr. Haynes obtained an orbit from three observations, at very short intervals, by the aid of which several other places were found on later plates; they were so faint that an approximate knowledge of the position was required before they were detected.

PROGRESS OF APPLIED CHEMISTRY.

THE annual general meeting of the Society of Chemical Industry was held in Birmingham on July 18–20. At the opening meeting the chair was taken by the Lord Mayor of Birmingham, Ald. A. D. Brooks, who, in an address, said the society had two chief objects at present: first, to assist in the prosecution of the war, and, secondly, to do its best to help the country after the war. The war was being carried on largely by scientific methods, and the chemist was devoting his attention chiefly to destroying human life, whereas formerly his efforts had been directed to the elimination of things dangerous to life. Before the war Englishmen had allowed important improvements to pass into other hands, but they must see to it that this did not happen again. Suspended industries must be rebuilt, and all conducted on sound economical lines, using to the full all scientific and technical help. Alluding to Birmingham industries, the Lord Mayor emphasised the need for recovery of waste products and conserving mineral resources.

Dr. Carpenter replied suitably, and proceeded to read his presidential address. He indicated the basis of modern industry in the sciences of mechanics and chemistry, and insisted on the absolute necessity for the engineer and the chemist to "get into double harness as quickly as possible" and work sympathetically together for the progress of the chemical industry.

Each paper given during the congress might be cited as an exemplar of the president's remarks. Each was a record of an effort or efforts of the chemist to co-operate with the engineer, and in this way to further the interests of some industry. For example, Messrs. Hancock and King, in their paper on "The Texture of Fireclays," described methods of comparing the unfired fireclay with the finished material, and the paper by Mr. Henry Watkin on chemical porcelain was a record of many persistent attempts to convert the various clays found in different parts of the world into the finished materials satisfying many practical requirements. The latest and, according to Mr. Watkin, a completely successful attempt has been made in this country since the outbreak of war to produce in England a chemical procelain similar to that which was monopolised by Germany before the war.

Prof. Boswell instanced the fact that the war had greatly increased the output of glass and all kinds of metals and alloys, and he gave a record of work directed to the furnishing of British sand for the glass and metallurgical industries. Here the preliminary analytical work, which is of fundamental importance, forms a basis for all the far-reaching consequences which will follow for these industries in this country.

No finer example could be given than that of the modern gas industry illustrating the joint and successful co-operation of the chemist and the engineer, and the paper given by Mr. E. W. Smith, emphasising the merits of gas as an industrial fuel as against coal, etc., and that by Mr. C. M. Walter, exemplifying the use of gas in such operations as metal melting, annealing, hardening, etc., indicated the rapid progress made in recent years in the chemistry and the mechanics of this industry.

Perhaps no development of chemistry is fraught with greater consequences to mankind than the "Fixation of the Nitrogen of the Air." The success of rival processes designed to accomplish this result must in times of peace be determined mainly by practical considerations *e.g.* cost, etc. The rival methods at the present time are the direct method of oxidation of the nitrogen to nitric acid, and the production of ammonia by the combination of nitrogen and hydrogen. Various means of bringing about direct oxidation of nitrogen were shown by Mr. Kilburn Scott, including the Kilburn Scott furnace. Mr. Scott's furnace is intended to increase the efficiency of the process by bringing the whole of the air under the action of the electric spark.

Dr. Edward B. Maxted, in describing the synthesis of ammonia, showed how enormously important the very latest refinements of chemistry and physics are, in this very complicated process, for practical success. The nitrogen is actually separated from the air in the first case by passing through a column cooled by liquid nitrogen, the oxygen being liquefied and the nitrogen passing forward, whilst the residual mixture of oxygen and nitrogen undergoes fractionation in the lower part of the apparatus The hydrogen is produced by the interaction of carbon monoxide from water-gas with steam, and many refinements and devices are needed to get pure hydrogen free from carbon monoxide at a workable cost.

The actual combination of the nitrogen and the hydrogen is brought about by catalysts consisting of various metals or combinations of metals. Here, again, a whole series of complications ensue from which the chemist has to make his choice, and iron containing traces of other bodies as promoters is preferred as catalyst. The reaction is carried out at pressures of 150–200 atmospheres and at temperatures approaching a red-heat, followed by cooling out of the combined product from the residual nitrogen and hydrogen.

Under such conditions the ammonia vapour is exceedingly corrosive, and presents a problem of considerable difficulty to the chemist and to the manufacturer; and, indeed, at every stage of this long process the problems to be solved by the joint ingenuity of the chemist and the engineer, and the manner in which they have been successfully solved, are astonishing. Finally, the ammonia is fixed as ammonium nitrate, or more usually as ammonium sulphate, as this can be more easily handled.

The sewage problem is of world-wide importance, and the stereotyped methods in vogue amongst engineers during the latter half of last century proved quite unequal to its proper solution. Since the chemist came to the rescue conditions have greatly improved, and great progress has been made towards a satisfactory solution. The activated sludge process described by Mr. Ardern illustrates very forcibly that a proper understanding of biological chemistry is essential to the correct solution of this problem, and that the engineer must accommodate his plant and his operations to the conditions established for him by the chemist and biologist.

The alleged value possessed by sewage sludge has long been a lure to engineers and others, and Mr. Ardern and his colleagues have demonstrated that activated sludge possesses considerable manurial properties. This question is a relative one, however, and the activities of the chemist in producing cheap fixed nitrogen will profoundly influence the engineering and commercial aspects of the sludge problem.

The overwhelming need in industry for research, and yet more research, was emphasised by almost every speaker, and in a notable speech dealing with this question Dr. C. A. Keane indicated that not in one way, but in many various ways, could science best be made to serve the needs of industry by means of research.

Twenty-five papers were read during the congress.

F. R. O'SHAUGHNESSY.

TECHNICAL EDUCATION IN SOUTH WALES.[1]

PRINCIPAL E. H. GRIFFITHS has published three lectures which important representatives of commerce and education in South Wales were invited to attend. The first two set out very clearly and at considerable length views in regard to the dependence of industry on science and with reference to science as an essential element in education; with these views the readers of NATURE are well acquainted and, for the most part, in cordial accord. In the third lecture the author deals with the existing provision for scientific and technological education in his district and with the lack of proper co-ordination.

In regard to the relations between the University of Wales and its constituent colleges, Principal Griffiths appeals for wider discretion for the colleges, either as parts of the existing federal University, or, if this be found impossible, as separate entities. He refers favourably to the inclusion of the Swansea Technical College in the reformed University, and there can be little doubt that this is desirable. Effective co-ordination of technological work between Cardiff and Swansea would be for the good of both; the former city should be willing to give up some branch of technology to Swansea, so that for advanced study in that branch Cardiff should send its students to Swansea, while the rest of the advanced work should be concentrated at Cardiff. Work up to the standard of the intermediate examinations for the B.Sc. degree might, of course, be taken in both towns.

In England, also, we have suffered from lack of co-ordination of this kind. Really advanced work needs very large expenditure on teachers, apparatus, and material; to duplicate it unnecessarily means a number of weak departments instead of one strong one. It would be well if the English provincial universities should come to some concordat such as is advocated for Cardiff and Swansea.

Allusion is made to the young and thriving School of Mines already attached to the Cardiff University College. The coalowners of the Principality have readily taxed themselves to provide this institution; it is fortunately free from excessive academic control, and can, therefore, render more readily useful service to the greatest industry of South Wales.

There are in the district flourishing technical institutions at Cardiff and Newport, and Principal Griffiths would like to see these take their proper places in a general scheme. One difficulty in carrying into effect all such proposals is that local education authorities are not always willing to take a broad view of what they can most effectively do. Many of them want to provide every kind of technical education within the walls of the institution which they control; but some of them are by no means equally ready to provide the very large funds needed to do this with real efficiency. So we find too often quantity preferred to quality; for only the wiser authorities seem to realise that ten highly trained technologists will be of far more value to an industry and to the State than a hundred persons with but a smattering of knowledge.

J. WERTHEIMER.

1 "Industry, Science, and Education." By Principal E. H. Griffiths. Pp. 70. (Cardiff: Roberts and Co., 1917.) Price 1s.