Helmand River flows, and which is occupied, according to season, by a large lake or by a series of lakes of variable area. Owing to the fact that in flood-time the Hamun overflows, by the Shelagh River, into the Gaud-i-Zirreh, "the Dead Sea of the Helmand system," its waters do not reach a high degree of salinity, and it sustains a fauna, impoverished indeed, but rich in comparison with that of true salt lakes. Dr. Annandale points out that although the Hamun occupies part of an ancient lake-bed, "there has been no biological continuity between the old lake and the recent one." The present lake may even have originated within historic times by a shifting of the course of the Helmand River. Dr. Annandale describes the Cyprinid fishes of the genus Discognathus found in the region and, in collaboration with Dr. B. Prashad, the Mollusca. In the case of the latter it is pointed out that the fauna shows a mingling of Palæarctic and Oriental types and a noteworthy absence of Western Asiatic elements. The fauna, however, "is a starved one, in which only species of great adaptability can survive."

## *PHYSICS AT THE BRITISH ASSOCIATION.*

ONE day of Section A was devoted almost entirely to matters relating to wireless telegraphy. Prof. Eccles opened a discussion on thermionic valves, giving a general description of the history and development of the three-electrode valve, explaining its rectifying property, the method of heterodyne reception, and the arrangements necessary to produce continuous waves. Experiments were shown illustrating these uses of the valve, and the way was thus prepared for the discussion of special points by subsequent speakers. Prof. Fortescue directed attention to the functions and properties of the various parts of the valve in some detail. The hot filament is the source of the electrons upon which the action of the valve fundamentally depends; with tungsten filaments as at present used only $4\frac{1}{2}$ per cent. of the energy heating the filament is usefully employed as electron emission. This efficiency might be improved by using oxide-coated filaments or higher temperatures, but at present neither of these methods has been entirely successful in practice. The construction of the grid and the question of freeing the anode and containing vessel from occluded gas during pumping were also discussed, and the importance of investigating the methods of removing the last traces of gas and examining their nature was emphasised. Dr. Whiddington directed attention to the possibility of using valves and oscillating circuits for making many standard physical measurements. Thus, for example, the coefficient of mutual induction can be determined by observing the degree of coupling at which oscillations are just started and maintained. He also alluded to Prof. Eccles's example of the extreme sensitiveness of heterodyne reception as illustrated by the effect of passing coal-gas between the plates of a condenser in an oscillating circuit. The temperature coefficient of resistance, the conductivity of flames, the permeability of liquids, and other quantities could also be measured by this delicate method.

In a paper entitled "A Wireless Method of Measuring $e/m$" Dr. Whiddington showed how oscillations may be set up in valve-circuits, not including capacities and inductances. The oscillations are produced by bursts of electrons from hot spots on the filament of a soft valve and the periodic return of positive ions from the space between the grid and anode. In the special experiments described it was shown from the value of $e/m$ obtained that the ions consisted of mercury.

The report of the committee on wireless telegraphy was of special interest on account of the observations made on the strength of signals during the recent solar eclipse. It was, however, too early to give any very definite conclusions, although it was stated that Malta and Paris had received signals of increased intensity during the eclipse. Bearing on the same point, Prof. G. N. Watson gave a *résumé* of his recent work on the diffraction of electric waves, in which, starting from the Heaviside-Eccles hypothesis of conduction in the upper regions of the atmosphere, Austin's formula can be obtained as a result of certain simple assumptions.

Papers were read by Prof. Horton and Miss A. G. Davies and by Prof. Horton and Miss D. Bailey respectively on the ionisation by electron collisions in argon and helium and on the luminosity produced in the latter gas. It appears that there are two critical velocities of the electrons at which radiation from the atoms and ionisation occur respectively. In argon these two phenomena occur at 11·5 and 15·1 volts, and in helium at 20·4 and 25·6 volts. The results are of great interest, but, as Dr. Goucher pointed out, their interpretation seems still open to question.

The phenomena of novæ were dealt with in two papers by Mr. Stratton and Father Cortie. In the former paper the types of spectra occurring in the course of the history of Nova Geminorum were described. The observed displacements of the spectral lines correspond with velocities reaching $2\times10^8$ cm./sec., which are so large that electrical causes are suggested to explain them. Similar velocities were deduced from the observations on Nova Aquilæ, and, after sketching the sequence of progressive changes occurring in the star, Father Cortie concluded that a solar eruption in a giant star situated in a dark nebula would square with the observed spectral changes.

In an interesting communication on the theory of vision Sir Oliver Lodge put forward the suggestion that the retina may be found to contain atoms in such a condition of instability that impulses of the correct luminous frequency can excite them and cause the expulsion of electrons. A difficult but highly interesting experiment was suggested of trying to find in the retina chemical substances capable of emitting high-speed electrons when subjected to light.

Prof. Eddington gave an account of the observations which had been made at Principe during the solar eclipse. The main object in view was to observe the displacement (if any) of stars the light from which passed through the gravitational field of the sun. To establish the existence of such an effect and the determination of its magnitude gives, as is well known, a crucial test of the theory of gravitation enunciated by Einstein. Prof. Eddington explained that the observations had been partially vitiated by the presence of clouds, but the plates already measured indicated the existence of a deflection intermediate between the two theoretically possible values 0·87″ and 1·75″. He hoped that when the measurements were completed the latter figure would prove to be verified. Incidentally, Prof. Eddington pointed out that the presence of clouds had resulted in a solar prominence being photographed and its history followed in some detail. Some very striking photographs were shown.

Following on this account Prof. Eddington opened the discussion on relativity, and referred again to the bending of the wave-front of light to be expected from Einstein's new law when the light passes near a heavy body. It should be possible to test experimentally this law, which demands that the speed of light varies as $1-2\Omega$, where $\Omega$ is the gravitational potential. He showed that, whether Einstein's solution of the problem be correct or not, it has, at any rate, given a new orientation to our ideas of space and time. Sir Oliver Lodge regarded the relativity theory of 1905 as a supplement to Newtonian dynamics by the adoption of the factor $(1-v^2/c^2)$ and its powers necessitated by experimental results; but he did not consider this dependence of mass and length on velocity as entailing any revolutionary changes of our ideas of space and time, or as rendering necessary the further complexities of 1915. He compared the difficulties involved with the case of measuring temperature, defined in terms of a perfect gas, and made with gases which only approximate to this ideal state. Dr. Silberstein pointed out that Einstein's theory of gravitation predicts three verifiable phenomena, *i.e.* a shift of spectral lines, the bending of light round the sun, and the secular motion of the perihelion of a planet. In the neighbourhood of a radially symmetric mass such as our sun, the line-element $ds$ is given by

$$ds^2=(1-2M/c^2r)c^2dt^2-(1-2M/c^2r)(dx^2+dy^2+dz^2).$$

The coefficient $c^2dt^2$ gives by itself a lengthening of the period of oscillation for a terrestrial observer in the ratio $(1+M/c^2r):1$, demanding a shift of spectral lines of about 0·01 Å.U. Secondly, the path of rays of light is obtained by putting $ds=0$, and the first and second coefficients give jointly a bending which for rays almost grazing the sun is 1·75″. Thirdly, Keplerian motion is predicted with a progressively moving perihelion, which in the case of Mercury turns out to be 43″ per century. He directed attention to the fact that St. John's results in 1917 showed no shift of the spectral lines, which in itself would overthrow the theory in question. Father Cortie pointed out that Campbell's photographs taken in 1918 and measured by Curtis gave no trace of any displacement of the images of forty-three stars distributed irregularly round the sun.

Amongst other papers read at the meeting may be mentioned an account by Sir Frederick Stupart of weather conditions in Alberta and a paper by Prof. Forsyth on Gauss's theorem.

## CHEMISTRY AT THE BRITISH ASSOCIATION.

IT was perhaps only to be expected that the programme of the Chemical Section should be coloured by the four years of war through which we had just passed, but, though war chemistry took a prominent place, more academic subjects were not entirely relegated to the background.

Some excellent summaries of work in different branches of chemistry during the war were given by various speakers.

Sir William Pope spoke on the general subject of the position of chemistry in Germany and this country as a result of the war, and pointed out that while German chemical industries emerged from the war in a strengthened position, ours remained much as they were, and that we were faced with a great, immediate danger in a strong propagandist movement to rehabilitate the German chemist in the eyes of the world.

Brig.-Gen. Hartley described the development of chemical warfare and the measures taken to counteract its destructive effects by means of gas-masks, etc. This particular form of warfare is, perhaps, not so inhuman as it is often regarded to be; for if it be granted that human lives must be sacrificed and suffering endured to achieve military objectives, then such objectives can often be attained by the use of gas attacks, lachrymatory shells, etc., with less loss of life and permanent injury than by the employment of high explosives.

Col. C. D. Crozier reviewed the output and methods of manufacture of high explosives during the war, directing attention to the improvements in method and quality which took place as the exigencies of the military situation called for an ever-increasing output, and claimed that this result was due in no small part to the activities of the Inspection Department.

Prof. Desch gave an excellent *résumé* of the metallurgical position in this country and the Central Empires, and showed how metallurgical considerations entered into the Franco-German Peace of 1871, and largely influenced the war and the territorial readjustments of the Peace Treaties. The necessities of war, if without any striking metallurgical developments, have at any rate, so far as this Empire is concerned, done much to stimulate the working within the Empire of locally produced ores, while fresh industries have arisen to smelt ores of metals hitherto imported from enemy countries. In Germany, as might have been expected, the study and use of substitutes for such metals as copper, nickel, and manganese have received close attention.

A paper by Dr. M. W. Travers described the position of the glass trade after the war. Though much has been done to supply the demand for various kinds of glass in this country, Dr. Travers must undoubtedly be written down as an optimist when he declares we can now supply from home-made stock all requirements of laboratory glass and glass for scientific purposes. We fancy few universities and schools would endorse his view, as most of them have great difficulty in supplying the requirements of their students.

Prof. Boswell contributed a paper on some recent problems in geo-chemistry. The border-line of chemistry and geology presents problems of the greatest interest and value as regards the sources and supply of raw materials for chemical manufactures, and the necessity of finding fresh material or substitutes during the war has greatly stimulated geochemical research. Prof. Boswell reviewed the different problems created by war demands, and showed how geo-chemistry has developed our home supplies of materials formerly obtained from enemy countries.

A short but interesting paper by Major E. R. Thomas on the work of an ammunition chemist in the field concluded the papers directly dealing with the war. Major Thomas, with improvised appliances and some Chinese coolies for labour, recovered upwards of a ton daily of $KNO_3$ and pitch from condemned ammunition. Major Thomas deserves the warmest praise for setting an example of economy and showing that so-called waste is really valuable material.

Though not directly dealing with war chemistry, a paper by Drs. Lowry and Perman on the equilibrium in the system ammonium nitrate—sodium chloride—sodium nitrate—ammonium chloride gave the results of much work conducted for war purposes.

Several papers were contributed from H.M. Naval Cordite Factory at Holton Heath, dealing mainly with industrial bacteriological problems such as the preparation of acetone and industrial alcohol, though a few of them dealt with pure organic chemistry. Special mention must be made of the paper by Dr. A. C. Thaysen, which gave a capital review of different aspects of bacteriology outside medicine, and showed how large a field of investigation is open to