

OUR ASTRONOMICAL COLUMN.

SCHORR'S COMET.—The following observations are reported from Hamburg. Positions are for equinox of 1918.0:—

d.	G.M.T.			R.A.			N. Decl.	
	h.	m.	s.	h.	m.	s.	°	'
Dec. 21	7	48	4	3	56	56.8	13	8 14
24	8	57	8	3	56	21.2	13	24 19
26	6	42	8	3	56	8.3	13	34 20
31	11	10	4	3	56	8.2	14	4 2

The magnitude was 15.0.

Continuation of ephemeris:—

Feb.	d.	R.A.			N. Decl.	Log r	Log Δ
		h.	m.	s.			
4	4	16	50	17	51	0.3370	0.2106
	8	4	21	8	18		
	12	4	25	44	18	0.3435	0.2408
	16	4	30	36	19		
	20	4	35	44	19	0.3500	0.2699
	24	4	41	7	19		
	28	4	46	43	20	0.3566	0.2980

On December 26 the ephemeris needed the corrections +1s., 0.0'

A CURIOUS FEATURE ON JUPITER.—On the night of January 16, at about 9 p.m., Mr. Frank Sargent, of Bristol, observed a luminous protuberance on the eastern edge of Jupiter. It was situated on the equatorial side of the north equatorial belt. He watched it for some time, and it was visible as a white spot well within the limb of Jupiter, but grew fainter as it advanced further on the disc. Clouds interfered and prevented a transit being taken, but on the following night Mr. Sargent re-detected the object, and it was on the central meridian at about 6.46, though so faint as to be scarcely perceptible. He saw it projecting from the western limb at about 9.5 p.m., when it was quite bright and very easily distinguishable. Luminous projections of this kind are often visible on Mars, and are effects of irradiation, but, in the case of Jupiter, where the atmosphere is considerably denser, the conditions are very different, and it seems probable that the feature observed on Jupiter may have been a real prominence, or it would have been obliterated amid the dense vapours on the limb of the planet.

THE PARIS-WASHINGTON LONGITUDE.—Vol. ix. of the Publications of U.S. Naval Observatory contains the details of the determination of this longitude by wireless telegraphy in 1913 and 1914. The transit instruments used were of 3-in. aperture, with travelling wires driven by electric motors. Every transit was observed with the telescope in both positions, thus eliminating collimation and pivot errors. There were two transit instruments at each station—one for a French, the other for an American observer. The observers interchanged stations when half the observations were obtained. The level error was ascertained by striding levels, the azimuth by meridian marks combined with polar stars. High stars, on both sides of the zenith, were used for clock error, thus minimising the effect of an erroneous azimuth.

The wireless signals were sent from Radio (Virginia) and the Eiffel Tower. The power at Radio was 70 kilowatts, and the wave-length 2500 metres. A rhythmic series of signals was sent, controlled by a pendulum, the period of which was 0.99s. M.T. Coincidences of beats between the Radio signals and the ticks of a mean-time chronometer were noted, a similar comparison being made for the signals of the sidereal clocks, the errors of which were obtained from the transit observations.

The double-transmission time over the distance of 3840 miles is 0.0429s. by the American observers, and

0.0424s. by the French. The deduced speed is $180,000 \pm 12,000$ miles p.s., practically that of light.

The final result for Washington-Paris is 5h. 17m. 36.653s. ± 0.0031 s. The result for period ii. is, however, 0.06s. greater than that for period i.

The seconds of the longitude as given by cable exchanges in 1866, 1870, 1872, and 1892 were 36.56s., 36.73s., 36.69s., and 36.70s. respectively. The mean is 36.67s., very near the new determination. The longitudes of several other American observatories were deduced by the same wireless signals. The results are appended to the report.

THE ELECTROLYTIC DISSOCIATION THEORY.

AMONG scientific gatherings the general discussions of the Faraday Society have come to occupy a very high place on account of their representative character and practical value. The latest of these discussions, on the present position of the theory of ionisation, held on January 21, was favoured by an interesting contribution from Prof. Arrhenius himself, the last sentence of which is as follows:—"On the whole, it may be said that the dissociation theory corresponds as well with experience as may be expected in the present state of our knowledge." Nowadays few will quarrel with this dictum.

Although the discussion reflected the general opinion that the dissociation theory of solution is the only one worth serious consideration, it also showed that there are still many unsolved problems in connection with solutions. Among these the following deserve special mention:—(1) The question of hydration or, more generally, "solvation" of the ions; (2) the problem of strong electrolytes—that is, the fact that the ionic equilibrium in strong electrolytes does not follow the law of mass-action, which applies so accurately to weak electrolytes (e.g. organic acids); and (3) the question of the chemical activity of ions and non-ionised molecules.

Most chemists now consider that ions in solution are associated with the solvent to a greater or less extent. Some go further, and adopt the view first put forward tentatively by van der Waals in 1891 that association with the solvent is the determining cause of ionisation and that the required energy comes from the heat of hydration of the ions. Although this suggestion is at first sight a plausible one, it is still unsupported by any convincing evidence, and, in any case, is not likely to furnish a full explanation of the mechanism of ionisation.

Further, the many attempts made to determine the degree of hydration of the ions have so far not been very successful. Mr. W. R. Bousfield, who contributed two papers to the discussion, has calculated the degree of hydration of certain ions on the assumption that an ion (with associated water molecules) can be treated as a small sphere moving through the solvent, and that the radius of the complex can be calculated by means of the well-known formula of Stokes. Dr. H. Sand now finds that the application of Stokes's formula in the manner adopted by Mr. Bousfield gives a value for the volume of the hydroxyl ion about one-thirtieth of that obtained by other methods, and he draws the important conclusion that Stokes's formula cannot be applied to particles of molecular magnitude.

The discussion of the problem of strong electrolytes proved of special interest on account of the recent work of Messrs. Washburn and Weiland in America on the dissociation of potassium chloride in very dilute solution (0.0001–0.001 molar). This was rendered

possible by the use as solvent of "ultra-pure" water with a specific conductivity of $0.05-0.07 \times 10^{-8}$ reciprocal ohm. The uncertainty attached to measurements in high dilution owing to impurities in the solvent is thus practically eliminated, as the water correction for 0.00007 and 0.00002 molar solutions is only 0.7 per cent. and 2.5 per cent, respectively. From their results Washburn and Weiland draw the important conclusion that the law of mass-action applies between the concentrations 0.00002 and 0.00007 molar, the constant, k , of the dilution formula, $\alpha^2 c / (1-\alpha) = k$, having the value 0.02 at 18°; between 0.00007 molar and 0.001 molar k increases regularly up to a value of 0.052 at the latter concentration. Although it is true that the concentration of the undissociated part, $1-\alpha$, is very small in these high dilutions, yet the accuracy of the measurements is such that the applicability of the dilution law up to 0.00007 molar may be regarded as established. Prof. Arrhenius and others had previously expressed the opinion that the law of mass-action is valid for strong electrolytes in sufficiently dilute solution, but this conclusion was open to doubt on account of the uncertainty in the correction for the conductivity of the solvent. At the meeting considerable difference of opinion was expressed on the question as to whether the validity of the mass law for strong electrolytes in sufficiently dilute solution can be proved by thermo-dynamical reasoning.

The results just described would appear to throw some light on the cause of the deviation of strong electrolytes from the mass law. The fact that the deviation appears in such high dilutions is difficult to reconcile with any explanation based on association between solvent and solute, as this would involve hydration values so great as to be in the highest degree improbable.

Walden and others ascribe the deviation to increased ionising power of the solvent owing to the presence of the electrolyte, and also to the effect of the electrolyte in increasing the ionisation of the solvent. Dr. J. W. McBain and Mr. F. C. Coleman showed in a paper published some years ago that there is no definite evidence of the supposed effect of salts in increasing the ionising power of water, and they show in a contribution to the present discussion, on the basis of migration experiments, that salts do not increase the ionisation of water. The latter conclusion is supported by the fact that the same value is obtained for the dissociation constant of water as determined by different methods, salts being present in some cases, but not in others.

The consideration of the above and other suggested explanations shows that the problem of strong electrolytes is not yet solved, but much may be hoped from the continuation of investigations, such as those of Washburn, with highly purified solvents. The question of inter-ionic forces also deserves careful study, and in this connection a theoretical contribution to the discussion by Dr. S. R. Milner will be read with interest.

Mr. Ghosh (Trans. Chem. Soc., 1918) has recently put forward the view that salts are completely ionised in solution, and that the apparent increase of the molecular conductivity with dilution is due to the operation of electrical forces. On this basis he obtains a formula which permits of the calculation, from known data and a knowledge of the dielectric constant of the solvent, of the ionisation of a salt at a particular dilution and temperature. Dr. J. R. Partington, in an interesting contribution to the discussion, has critically examined Mr. Ghosh's theory, and draws the conclusion that his fundamental assumption, that only electrical forces are operative in the solution, is disproved.

The view formerly held by many supporters of the

ionisation theory that only the ions of an electrolyte can react has now been abandoned, since it has been shown independently by Dr. Senter and by Prof. Acree that both ions and undissociated molecules are chemically active. Another aspect of the same subject which has received much attention in recent years is the suggestion that the catalytic activity of strong acids is due partly to H⁺ ions and partly to the undissociated molecules of the acid. If it be accepted that the catalytic effect of acids is a chemical action, this is simply a special case of the chemical activity of non-ionised molecules and their ions. A plausible explanation is thus afforded of the well-known fact that neutral salts accelerate the catalytic activity of strong acids.

Prof. Arrhenius considers the latter question in his contribution to the discussion, but favours an explanation of the accelerating effect of foreign substances based on the assumption that these substances increase the osmotic pressure of the reacting substances, and that the chemical reactivity of the latter is proportional to their respective osmotic pressures. The available experimental data do not allow this interesting suggestion to be tested adequately.

G. S.

THE INHERITANCE OF MILK AND FAT PRODUCTION IN CATTLE.

AT the Maine Agricultural Experiment Station Mr. John W. Gowen has made a genetic study of the first-generation crosses of prominent dairy breeds of cattle and beef-bred Aberdeen-Angus. This work, the results of which are published in the *Journal of Agricultural Research* (vol. xv., October, 1918, pp. 1-57, 6 plates), was undertaken as a link in the chain of evidence necessary to the final solution of the problems which are connected with the inheritance of milk production and butter-fat production. A cross-bred herd is being formed at the experiment station so as to provide as much material as possible for the analysis of the laws of heredity concerned with the productivity referred to, and this herd has now gone into its second generation.

An indication may be given of some of the important results already reached by Mr. Gowen:—

(1) Black body colour is dominant to the other colour in the first generation. In the second generation an orange-coated bull and a dark Jersey dun-coated heifer were segregated out.

(2) White marking of the body, taken as a whole, appears as a dominant. Study of individual white areas, however, indicates that this is due to white in the inguinal region only, for this alone appears as such a dominant. White spots on the face, neck, shoulders, rump, flanks, and legs are generally suppressed in the offspring when the white-spotted individuals are mated to solid colour.

(3) Pigmented muzzle is dominant to one not so pigmented.

(4) A pigmented tongue is dominant to a non-pigmented one—a confirmation of a previous result.

(5) A black switch appears to cause the suppression of the other switch colours in the offspring.

(6) Some exceptions were found to the previously accepted hypothesis of simple dominance of polledness over the horned condition, and it is suggested that a hormone secreted by the testes may have some influence on the presence or absence of horns. Should this prove true, it would establish an interesting parallel between cattle and sheep, for in the latter a sex hormone is known to affect the development of the horns.

(7) The qualities of beef production are shown to be divisible into four general regions of the body: