NEPTUNE'S FAINT EQUATORIAL BELTS.—Dr. T. J. J. See publishes in the *Astronomische Nachrichten*, No. 4656, a paper describing some observations he made on the planet Neptune in 1899 and 1900, with the 26-in. refractor of the Naval Observatory at Washington. On some days in those years the air was particularly steady and the mottled appearance of the disc of the planet accidentally attracted his attention. This led him more closely to scrutinise the disc, and he noticed that beaded bands or belts were faintly visible against the brighter body of the planet. The seeing on these occasions was such that 95 Ceti, the most difficult of known double stars, was resolved, and other difficult pairs, such as 85 Pegasi and T Cygni, measured. The bands, he says, were found to be extremely faint, but on a few occasions they came out with more distinctness, and he attaches drawings from which their general character can be inferred. Dr. See refers to Prof. Asaph Hall's observations with the same instrument, which gave the suggestion of suspected mottlings on the planet's surface, and to Prof. S. J. Brown, who noticed an unsymmetrical appearance on the disc. As Dr. See points out, the chief interest attaching to the discovery of these equatorial belts arises from the circumstance that phenomena depending on planetary rotation first noticed on Jupiter, and then on Saturn, and finally on Uranus, are now seen to be common to the most remote member of the solar system. The paper concludes with a brief notice of the discovery of belts on the other major planets.

VARIABLE STARS.—Numerous recent papers deal with the subject of variable stars. Prof. A. A. Nijland, of Utrecht, sends a pamphlet on the light curves of twenty-three Algol stars, and the classification of variables. Two papers in the *Astronomische Nachrichten* (No. 4653, vol. cxciv.) deal respectively with the ellipsoidal variables SI Tauri and S Antliæ, by Harlow Shapley, and the variability of the pole star by Ant. Pannekoek.

Photometric observations of variables is the subject of Padova's communication to the *Mem. della Soc. dei Spettroscopisti Italiani* (April, disp 4*a*, vol. ii., ser. 2*a*), and he deals with two Algol variables, U Ophiuchi and RZ Cassiopeiæ; two variables of short period, Y Ophiuchi and β Lyræ; five long-period variables, and two irregular variables, RS Cygni and R Scuti. Light curves accompany the observations in most cases. Harlow Shapley contributes a paper on the visual and photographic ranges and the provisional orbits of Y Piscium and RR Draconis to the April number of *The Astrophysical Journal*, while the same journal also contains a second paper by Frederick H. Seares on the Algol variable RR Draconis. Prof. E. C. Pickering refers in Circular 177 of the Harvard College Observatory to the maximum brightness of Algol variables.

KODAIKANAL SOLAR PROMINENCES DURING 1912.—Bulletins Nos. 29 and 30 of the Kodaikanal Observatory contain a summary of prominence observations made at that observatory during the past year. Previously it was customary to publish detailed lists of prominences, such as those which appeared in the series of bulletins ending with No. 28, but these will now be discontinued and replaced by a *résumé* of the observations issued half-yearly. This *résumé* will include full descriptions of any remarkable phenomena observed or photographed, and, in addition to the summary of the observations at the sun's limb, there will be given the results of a study of the prominences projected on the disc as hydrogen absorption markings. The present two bulletins are written on these lines, and they contain the summarised material for 1912.

THE ALLOTROPY OF IRON.

TWO papers read before the recent meeting of the Iron and Steel Institute, one by Dr. Carpenter on the critical ranges of pure iron, and the other by Dr. Rosenhain and Mr. Humfrey on the tenacity, deformation, and fracture of soft steel at high temperatures, were responsible for a renewal of the discussion upon the allotropic modifications of iron. The present discussion may be regarded as a further contribution to an old controversy, and in order to appreciate its true significance it is necessary to review, somewhat in the manner of a serial story, the incidents of the preceding chapters.

In 1890 Osmond showed that when a piece of steel was allowed to cool from a bright red heat the rate of cooling was not uniform, but that at three points there was an evolution of heat in the steel itself which had the effect of retarding the fall in temperature of the mass. These three arrests Osmond designated as A1, A2, and A3, A1 representing the change taking place at the lowest temperature. In order to distinguish between the evolutions of heat during cooling and the corresponding absorptions of heat during heating, the letters *r* (*refroidissement*) and *c* (*chauffage*) were added, and this nomenclature has been retained, the irregularities in the cooling curve being described as Ar1, Ar2, and Ar3, and those in the heating curve Ac1, Ac2, and Ac3.

It was clearly shown by Osmond that the A1 change was dependent upon the carbon in the steel, whereas the points A2 and A3 were independent of the carbon and equally prominent in the purest steel obtainable. Osmond therefore argued that the thermal changes at A2 and A3 must be due to molecular rearrangement or allotropy in the iron. Iron above the A3 point he described as γ iron, that between the A3 and A2 points β iron, and below the A2 point α iron.

Roberts Austen repeated and confirmed Osmond's experimental work, and accepted his theory of allotropy as being the most probable explanation of the facts. Prof. Arnold, on the other hand, rejected the allotropic theory on the ground that "steel research was, in his opinion, a field of too national an importance to be used lightly as a cantering ground for the hobbies of periodicity and allotropy." After repeating and confirming the work of Osmond and Roberts Austen, Prof. Arnold suggested that the A3 point was due to the influence of hydrogen, and the A2 point to a change from a plastic to a crystalline condition. He contended that these changes had little connection with the phenomena underlying the hardening of steel, but that these were due solely to the carbon, and at a later date he developed a subcarbide theory to explain the changes brought about by hardening, &c. Further investigations, however, by independent metallurgists, tended to confirm Osmond's original views, and within the last few years little has been heard of the controversy between the "carbonists" and the "allotropists."

The two papers which have been responsible for the reopening of the discussion may be briefly summarised as follows:—Prof. Carpenter, following a hypothesis of Benedicks, endeavours to prove that the change at Ar2 is not an independent change, but merely the tail end, or limit of supercooling due to impurities, of Ar3. It may be mentioned that this was Osmond's original explanation, which he abandoned when it was proved that the appearance of magnetism coincided exactly with the point Ar2. Prof. Carpenter argues that if Benedicks's theory is correct pure iron should show the Ar2 change but not the Ac2 change, and he gives a number of heating and cooling curves of the purest iron obtainable in

©1913 Nature Publishing Group

support of his view. Unfortunately, as Prof. Arnold has pointed out, the heating curves actually show the Ac2 change. It is true that they are less strongly marked than the Ar2 changes, but this is only what would be expected.

The changes during heating, as shown by inverse rate curves, extend over a greater range and are therefore less strongly marked than in the cooling curves. This is well shown in the A3 change shown in the curves, and in view of the fact that the Ar2 change is itself very small, it was scarcely to be expected that the Ac2 change would be very easily detected. Moreover, Prof. Carpenter has shown that if the iron, after cooling just below Ar3, is held at that temperature for two and a half hours in order to allow the change from γ to α iron to become complete, and then slowly cooled, the Ar2 change is shown as decidedly as before. He attempts to explain this by assuming that the impurities present are sufficient to prevent actual contact of the γ and α molecules, but the explanation is unsatisfactory, and his results must be regarded rather as proving than disproving the independence of the A2 critical point.

The paper by Dr. Rosenhain and Mr. Humfrey describes a series of experiments admirably conducted with the aid of an ingeniously constructed testing machine, in order to investigate the physical properties of mild steel at high temperatures. It is impossible to describe the experiments in detail, but the results show that the curve representing the tenacity at high temperatures consists of three branches corresponding to the γ, β, and α ranges of iron. Starting at 1100° C., the tenacity increases as the temperature falls, until the Ar3 point is reached, when there is a rapid decrease in tenacity. This is followed by a further increase until Ar2 is reached, when there is another falling off in tenacity. The influence of the rate of strain is discussed, also the influence of varying size of crystals; and photographs are given to illustrate the types of fracture at different temperatures. The authors conclude that they find it difficult to reconcile their results with Benedicks's theory by which β iron is regarded as a solution of γ iron and α iron.

Prof. Arnold's contribution to the discussion when separated from side issues resolves itself into little more than a reassertion of his own theories, which he claims are supported by the two papers in question. The one useful criticism which Prof. Arnold makes has already been referred to, in which he points out that the Ac2 change is observable in Prof. Carpenter's curves.

The criticism of Dr. Rosenhain and Mr. Humfrey's paper is even less helpful. It is claimed that the authors' conclusions are of no value owing to their "erroneously presupposing that they are discussing results obtained from chemically pure iron rather than from their dead mild commercial steel." It is possible that the authors have underestimated the importance of the impurities in their steel and have pushed their conclusions a little too far, but they give full details of the material upon which their experiments have been carried out. and they make no claim that their conclusions are final. Nevertheless, the authors have laid themselves open to some criticism inasmuch as they have chosen for their experiments a steel which, even from a commercial point of view, is of very poor quality.

As a matter of fact, the importance of the discussion has been exaggerated, and the two papers leave the β iron theory very much where it was before. The somewhat ill-defined A2 change and its relation to the physical properties of steel will still attract the attention of men of science who are anxious to discover the truth. Other papers will be read and further discussions will take place, but in the meantime, and until further evidence is forthcoming, those who are wise will refrain from a too dogmatic insistence upon their own particular views.

THE ROYAL SOCIETY CONVERSAZIONE.

THE annual June conversazione of the Royal Society was held in the rooms of the society at Burlington House on June 11. As is usual upon such an occasion, various instruments and objects of scientific interest were exhibited. Most of these have been described already in the account of the May conversazione given in NATURE of May 15 (p. 273). Other exhibits are mentioned below:—

Dr. E. C. Pickering: Colour-blindness, if any, of eminent astronomers. The sensitiveness of the eye to rays of different colours has been tested for numerous astronomers by grouping their estimates of the light of the stars according to their colour, as shown by the class of spectrum. The earliest estimates, those of Ptolemy and Sûfi, show results agreeing closely with those of recent times. Peirce shows a marked sensitiveness to the red, and Seidel to the blue, rays. The latter effect is still more marked in photographic plates.

Prof. Silvanus P. Thompson: Poulsen's telegraphon. The telegraphon of Dr. V. Poulsen, of Copenhagen, is an apparatus which records speech or sound transmitted by telephone, and reproduces it, at any subsequent time, in another telephone. The recording is effected magnetically. In this newest pattern, a thin wire of tungsten steel is caused to run rapidly between the poles of a small electromagnet in the receiving circuit of the telephone; and this electromagnet impresses the corresponding vibrations on the wire by magnetising it in an immense series of minute local spots. The record on the wire is absolutely invisible. On passing the wire again between the poles of a small electromagnet in the circuit of a receiving telephone, the series of minute magnetic spots on the wire sets up, by magneto-electric induction, a corresponding series of electric undulations, causing the telephone to emit a corresponding sound. The sounds so reproduced are faint unless a Brown telephone relay is employed to magnify them.

Mr. R. Inwards: Spiraloid curve apparatus. This is an instrument consisting of a revolving table carrying the paper, and over which a pen is caused by gear-wheels and adjustable cranks to describe an undulating line, and to produce figures resembling the structure of the Diatomaceæ, Radiolaria, and other natural forms.

Mr. C. R. Darling: Experiments with liquid drops and skins. (1) Large drops of liquids may be formed in media of slightly less density, *e.g.* orthotoluidine in water at 18° C. The formation is gradual, and all the stages may be observed by the unaided eye. If two drops of different diameters be made to communicate through a tube, the lesser passes into the greater when both are at the same level; if, however, the lesser drop be lowered, the movement is reversed. A position of equilibrium may be found in which both drops are stationary. (2) Skins of aniline may be formed on suitable frames under water, and made into bubbles filled with water. (3) Skins of various liquids on the surface of water exhibit characteristic movements, depending upon the liquid used.

Dr. T. K. Rose: Recrystallisation of gold on annealing. The specimens exhibited of incompletely annealed gold show that the new crystals make their appearance singly when annealing begins, and that as the temperature is raised or the time prolonged, other

©1913 Nature Publishing Group