EPHEMERIDES OF COMETS AND PLANETS.—Many readers of this column will be very glad to know that from the beginning of next year it will not be necessary to turn up back numbers of the *Astr. Nach.* to find the ephemerides of comets and planets for observational purposes. Prof. H. Kreutz tells us (*Astr. Nach.*, No. 3527) that he has been asked from several sides to supply this information separately; that is, in addition to that published in the numbers of that journal, and he has made the following arrangements. Those who are subscribers to that journal may, by paying an additional sum of ten marks yearly, obtain such information, provided that notice of such requirement is given directly, and applications are sufficient in number to indicate a decided want in this respect. We hope that many of our readers will think fit to take advantage of this very useful change.

We may mention that it would be a good opportunity for keeping to one system of publication, and that the Right Ascensions, for instance, might always be given in time, and not in degrees, as is often the case.

THE NEBULOUS REGION ROUND 37 CYGNI.—Although there may be countless nebulae in the heavens symmetrical in form, there are others which seem to have absolutely no sense of regularity. Such a nebulous region is that comprised between 20h. 51m. 24s. and 21h. 0m. 43s. in Right Ascension, and in Declination between +42° 56′·5 and +44° 51′ (epoch 1900). An excellent reproduction of the greater part of this region appears in *Knowledge* for November, and is taken from a fine negative obtained by Dr. Isaac Roberts in October 1896. A careful study of the photographic appearance of this large cosmical mass shows, as Dr. Roberts remarks, several indications of fission, as well as evidence of *loci* of vortical disturbance in different regions; but, for the main part, irregularity is the striking feature. In his description of this nebulous region, Dr. Roberts brings up the question of the connection between the stars apparently immersed in the nebulous mass and the nebula itself. In regular, such as spiral, nebulae, Dr. Roberts had previously come to the conclusion that many of the stars immersed are not stars, as we are generally acquainted with, but star-like condensations, the result of condensations in the nebula itself. In the irregular nebula in question, in which the whole surface area of this cloud of nebulosity is covered with stars, ranging from the ninth to the seventeenth magnitude, very few of the stars can be pronounced "as being actually involved in, and forming part of, the nebulosity." Dr. Roberts' evidence for assuming that those what he terms "apparently finished stars" are between us and the nebulosity is, in his own words, as follows:—"If the stars were beyond the nebulosity their photo-discs would on the negative appear less bright, and their margins be more or less nebulous; whereas only those stars which appear involved in the nebulosity present these appearances. Of course, it is a fair subject for argument that those nebulous stars which appear to be involved in the nebulosity are not so in reality, but seem thus because they are beyond it in our line of sight. But this argument is much weakened, if not entirely destroyed, when we find on examination of the negative that those faint, star-like condensations are not only nebulous themselves, but they follow the curvatures found in various parts of the nebulosity; thus we are driven to infer that the stars are the nearer bodies to us, and that the nebulosity lies beyond the stars."

WOLSINGHAM OBSERVATORY CIRCULAR, No. 48.—Mr. T. E. Espin in this circular informs us that a star, magnitude 8·4, Type IV., not in B.D. was found on November 13 in Right Ascension 4h. 19m. 49s., Declination + 39° 32′ (55). The star in the Andromeda Nebula was seen on November 10, closely following the nucleus. The one found in 1886 was preceding.

THE EXTRACTION OF NICKEL FROM ITS ORES BY THE MOND PROCESS.[1]

THE Mond process marked an entirely new departure in metallurgical practice and in the principles which had hitherto guided it. It depended on the remarkable property possessed by nickel of forming a volatile compound with carbon-monoxide, from which metallic nickel might be released if the gaseous compound was heated to 180° C.

The methods hitherto employed for extracting the metal from its ores involved concentrating the nickel either as a sulphide (matte or regulus), or as arsenide (speise), followed by either dry or wet treatment; and the metal had to be refined, mainly with a view to separate it from associated carbon.

In 1889 Dr. Ludwig Mond, in collaboration with Dr. Carl Langer, had been engaged upon a method for eliminating the carbon-monoxide from gases containing hydrogen. They had been guided by the observation that finely-divided nickel removed carbon from carbon-monoxide at a temperature of 350° C., converting it into carbon-dioxide, whereas the dissociation of carbon-monoxide by heat alone, according to Victor Meyer and Carl Langer, remained incomplete at the high temperature of 1690° C. The experiments were carried out in conjunction with Dr. Friedrich Quincke; finely-divided nickel, formed by reducing nickel oxide at 350° C. by hydrogen, being treated with pure carbon-monoxide in a glass tube at varying temperatures. The gas escaping from the apparatus was ignited, and while the tube containing the nickel was cooling, the flame became luminous, and increased in luminosity as the temperature sank below 100° C. Metallic spots were deposited on a cold plate of porcelain held in this luminous flame, and on heating the tube through which the gas was escaping a metallic mirror was obtained, while the luminosity of the flame disappeared. These metallic deposits were found to be pure nickel. Nickel carbonyl was then isolated in a liquid state, and it was possible to produce it with facility in any desired quantity. It could be readily distilled without decomposition, but on being heated to 150° C., the vapour was completely dissociated, pure carbon-monoxide being obtained and the nickel being deposited in a dense metallic film upon the sides of the vessel.

No other metals which were submitted to investigation showed indications of combining directly with carbon-monoxide except iron. The discovery that in a mixture of metals only nickel and iron would form volatile compounds with carbon-monoxide, and that they could, therefore, be separated from the other metals, induced Dr. Mond to arrange experiments with ores containing nickel, cobalt, iron and copper, such as "kupfer-nickel" and "pyrrhotine." The experiments afforded such promising results that apparatus of considerable size, though still within the limits of the resources of a laboratory, was set up, and in it several pounds of ore could be treated with carbon-monoxide. The principal nickel ores which were metallurgically treated contained the nickel in combination with arsenic and sulphur, besides other metals and gangue. These ores had first to be submitted to calcination, in order that the nickel might be present in the form of oxide, and to drive off, as far as practicable, the arsenic, sulphur, and other volatile bodies. The resulting oxide of nickel was treated with reducing gases, such as water-gas or producer-gas, in order to convert the oxide of nickel into finely divided metallic nickel, and the material containing it was cooled to about 50° C., and was treated with carbon-monoxide.

In 1892 an experimental plant on a large scale had been erected at Smethwick, near Birminghan. The process began with "Bessemerised" matte; it ended with the market product, commercial nickel. The Bessemerised matte proceeded to the first operation of dead roasting, after which the matte contained 35 per cent. of nickel, 42 per cent. of copper, and about 2 per cent. of iron. It then passed to the second operation for the extraction of part of the copper (about two-fifths) by sulphuric acid, the copper being sold as crystallised sulphate of copper. The residue from this process contained about 51 per cent. of nickel, and it passed to the third operation for reducing the nickel. Incidentally, the remaining copper was reduced to the metallic state, care being taken to avoid reducing the iron. This was effected in a tower provided with shelves, over which mechanical rabbles passed, the reducing agent being the hydrogen contained in water-gas. The temperature did not exceed 300° C., and should be kept lower when much iron was present. From this tower the ore was conveyed continuously to the fourth operation of volatilisation, in which part of the nickel was taken off by carbon-monoxide and formed the compound nickel carbonyl. The formation of this volatile compound was effected in a tower similar to the reducing tower, but the temperature was much lower, and did not exceed 100° C. From the volatiliser, the ore was returned

[1] Abstract of paper read at the Institution of Civil Engineers, on November 8, by Prof. W. C. Roberts-Austen, C.B., F.R.S.

to the reducer, and it continued to circulate between the reducing and the volatilising stages for a period which varied between seven days and fifteen days, until about 60 per cent. of the amount of nickel had been removed as nickel carbonyl. The residue from this operation, amounting to about one-third of the original calcined matte, and not differing much from it in composition, was returned to the first operation and naturally followed the same course as before. The nickel carbonyl produced in the fourth operation passed to a decomposer, which consisted either of a tower or a horizontal retort heated to a temperature of 180° C., so as to decompose the nickel carbonyl and release the nickel in the metallic form, either on thin sheets of iron or, preferably, on granules of ordinary commercial nickel. Carbon-monoxide was in turn also released, and was returned to the volatiliser for taking up a fresh charge of nickel. When the operation was in progress, the gaseous carbon-monoxide and the partially reduced oxide of nickel and copper continuously revolved in two separate circuits, which joined and crossed each other in the volatiliser. The commercial product contained 99·8 per cent. of nickel.

The author proceeded to a description of the working as he saw it in full operation in Smethwick a few months ago. The plant had been working for some time, and about 80 tons of nickel had already been extracted from different kinds of matte. The results were quite satisfactory, and pointed to the conclusion that the process was well able to compete with any other process in use for the production of metallic nickel.

The process would always occupy a prominent position in chemical history, and there appeared to be no reason why it should not play an important part in metallurgical practice. Its application in Canada to the great nickeliferous district of Sudbury would probably contribute to the development of the resources of the great Dominion.

NATURAL HISTORY NOTES FROM YUNNAN.[1]

I LEFT Mengtze in the end of January with a caravan of mules, some forty, carrying stores, &c. I had three mule-loads, *e.g.*, of silver. The journey here took eighteen days, rather easy stages. The country passed through was very varied. I was in good spirits, rode nearly all the way, and enjoyed the trip very much. I crossed three large rivers *en route* by pontoon and suspension bridges; the latter very well made, of iron rods joined by rings at the ends, the best specimens I have seen of Chinese blacksmith's work. At these river crossings we reached low levels, about 1800 feet above the sea, and came into tropical vegetation, which I never find at all interesting. At Yuenchiang, on the Red River, the ugly-looking shrub *Calotropis gigantea* was in flower, and there was a great display of the tree-cotton, *Bombax*, in flower, without any leaves, looking like an artificial candelabrum affair more than a living tree. These and some *Areca* palms were the only things of note. At the higher levels vegetation was at a dead point and I collected very little, one or two species of *Clematis*, two Rhododendrons: the very curious *Scolopendrium Delavayi*, which I had never seen before, I found one day on a shady bank where I stopped for tiffin. I also found, at the same place, two plants of *Abutilon sinense*, which had been sent by me from Ichang, and an *Antrophyum*, which may be new. I also came across *Lonicera Bournei* in flower; it is of no value as an ornamental plant. There was very little forest until after Talang, when we passed one or two days through almost continuous pine forest, varied here and there by little woods of evergreen oaks. Here, rather to my surprise, I learned that the peacock exists in the wild state, and it is quite common in the forest south of Szemao. These pine forests had not a plant in flower amongst them. I noticed, however, two little woods made up of an *Abies*, new to me, but I only found one cone. However, I am not pretending now to give any account of the trip botanically, as it would require too much time to get my notes in order at the moment. On the eighteen days I may have collected about thirty plants in flower. At one or two places I might have done a lot of collecting if I could have stayed for a day or two, but I was travelling on official business, and could not tarry.

The main interest of the route was the aborigines, or non-Chinese races. Chinese here and there dwell on the little tracts of good land which are found in the high-lying valleys and plains of the plateau, and I passed through five or six largish towns mainly peopled by Chinese. But the larger part of the population was made up of aborigines. Whether the ethnology of this part of the world will ever be satisfactorily explained is doubtful. There seems to be the same variety in the human being as exists in the vegetable world in the same region, and there is a strange blending of races of Chinese, Malay, Negrito, perhaps even Caucasian here.

The greatly increased interest in China at home will, I hope, give a stimulus to the study of the history of the social evolution of the Chinese, which is calculated to bring out many important lessons for ourselves. There have been, as it were, two parallel developments of the human race, one on the west of Europe-Asia, the other on the east side, very little dependent on each other. At the start, the Chinese seem to have been fairly equal to the Westerners; and even in the middle ages, judging from the way in which mediaeval travellers wrote, Chinese civilisation was quite as good as that of Europe. The decay of manly spirit, brought about by the idea that war is immoral, the low position of woman, the absence of an hereditary aristocracy holding up ideas of honour and probity and constantly acting as a check on philistinism, the government by officials selected by competitive examination in ancient classics and trivialities akin to Latin verse, all these causes must have been acting disastrously to have brought an intelligent race into such a low position.

There is a good deal of wooded country at no great distance from Szemao, and the mountains run up to nearly 6000 feet, but there is an absence of the sharp and precipitous kind of mountain and valley, and the flora in consequence is very uniform and not nearly so interesting as Mengtze nor so rich in species. Hills clad with pine and oak are almost barren in interesting plants, and I haven't come on any of those dark ravines and steep wooded cliffs which are the joy of the botanical collector. There is a great absence (perhaps the autumn will make a better show) so far of ferns and herbaceous plants. What one collects is mainly trees and shrubs and climbers. There is a fair number of epiphytic orchids. The common plants are not the common plants of Mengtze, in fact the two floras are very different. Szemao will possibly turn out very like the Shan country where Sir Henry Collett collected, and Indian forms not hitherto recorded from China are frequent enough. One curious thing occurs here as well as at Mengtze, *i.e.* the occurrence of two or three species of the same genus in precisely the same locality and often flowering at the same time.

The woods near Szemao are full of birds, and the notes are exquisite, and to be heard in perfection in these days of showery weather, for the rainy season has begun. When the sun gets out the cicadas start such a racket that one can hear nothing else. I have not told you of the jungle-fowl; this is, I believe, *Gallus bankiva*, the original form of the farmyard fowl. They are very common in the forests and woods here, and are simply gorgeous. They are glorified bantams, the colours having a brilliancy that seems abated in the domesticated kind. They crow and cackle and behave in the woods just as a farmyard fowl would do, only they are a little shyer of man. Occasionally one sees a flying-squirrel, a big black one, sailing in the air from tree to tree, and I saw the other day what I thought was a calf; it turned out to be a red-coloured deer, which speedily bolted with an upturned tail, white beneath like a rabbit's. It is very hard to believe that this particular deer, which only occurs, so far as I know, one or two together, never a herd, derives much advantage in life from this white-signal tail.

In many of the Mengtze and Szemao trees and shrubs the flowers occur on the branches below the leaves, and not on the peripheral surface of the tree, as in ordinary cases. Many lianas have this peculiarity. These are all forest plants, and I think the explanation is that in forests there are two surfaces open to insect-visitors, the top of the forest and the bottom. Some trees and shrubs and climbers cannot get to the top, so they have their flowers at the bottom. But of course this explanation is only a guess. There is no time for me to make any observations of the kind necessary; if one could spend six months on end in a forest, one could observe, measure, &c. The *Mucuna sempervirens* of Ichang was a splendid example of this peculiarity. There was in one specimen a dense wall of foliage climbing over trees, interlaced with them, &c., nearly 200 feet by 100 feet, while the main trunk of the climber close to the ground was covered with

[1] Abridged from a letter to Mr. Thiselton-Dyer, from Dr. Augustus Henry, published in the Kew *Bulletin* for November (No. 143).