mais on le chercha en vain. La terreur était d'autant plus grande dans la ville que le peuple, à cette époque même, multipliait les superstitions, et les sacrifices en l'honneur des divinités protectrices contre les incendies. Aussi le grand mandarin de Tchong-kin avait prohibé la vente et l'usage des allumettes chimiques importées par les étrangers (yang ha) et celui du pétrole (yang leon) qui avaient naguère occasionné une terrible conflagration.

Voici une note de Mr. Harding, l'ingénieur chargé d'élever un phare à la pointe sud de l'île Formose.—Le 11 Décembre 1881, vers 4h du matin, trois chocs distincts de tremblement de terre furent ressentis. The first, of which the motion was oscillating, and which was the most severe, lasted about 3 to 4 seconds; then an interval of about 10 seconds followed by the second shock—an interval of 1 or 2 seconds, followed by the third shock—direction from S.S.W. to N.N.E. These shocks, which were of great severity, were also felt in Tai-wan-foo and Takow (environ 75 et 52 milles au nord nord-ouest du cap sud). The water at South Cape rose 16 feet, causing great destruction to the cargo boats moored near the beach, and was accompanied by a heavy southerly swell. The water which at spring tides only rises 3 feet 8 inches, had resumed its ordinary level at 7 a.m.

On March 19, 1882, at about 5 p.m., a slight shock of earthquake (toujours au cap sud), with a gentle oscillating motion from south to north. Duration of shock about 3 seconds."

J'ai pensé que ces curieux faits intéresseraient les lecteurs de NATURE.

Le Directeur de l'Observatoire,
MARC DECHEVRENS, S.J.

Observatoire de Zi-ka-wei, près Shanghai, Chine, Avril 25

P.S.—Une grave perturbation magnétique a été enregistrée à Zi-ka-wei le 17 Avril dernier. Elle débuta brusquement à 7h. 36m. du matin (temps moyen de Zi-ka-wei, longitude 8h. 5m. 50s. de Gr.) par une augmentation de la composante horizontale de l'intensité et une diminution de la déclinaison. Vers 8h. un mouvement inverse commença pour se continuer avec de larges ondulations mêlées de saccades brusques et nombreuses jusqu'à 2h. 22m. de l'après midi, moment où la déclinaison atteignit son maximum. Entre le minimum, qui fut enregistré quelques minutes après le début de la perturbation, et ce maximum de 2h. 22m. la déclinaison a varié de 21'1", valeur considérable à Zi-ka-wei. La composante horizontale eut son minimum d'intensité (apparent à cause de la variation de température) d'abord à 4h. 20m. du soir, puis encore à 7h. 20m. du soir. On peut se rendre compte de l'énorme baisse enregistrée en cette occasion, en sachant que le 19, par exemple, où la variation de la composante fut normale, la courbe photographiée à une amplitude totale de 15 millim. tandis que le 17 pendant la perturbation la variation totale s'éleva à 76 millim. entre 7h. 36m. du matin et 4h. 20m. du soir. Les grandes ondulations se dessinèrent pendant le minimum d'intensité entre 2h. du soir et 10h. du soir. Vers 11h. 30m. du soir la composante se releva très-brusquement, oscilla encore 3 ou 4 fois ce vers 3h. du matin la perturbation était finie. A cette augmentation brusque d'intensité correspondit une diminution non moins rapide de la déclinaison, suivie aussitôt après d'une forte augmentation qui mit aussi fin à la perturbation de cette boussole.

Pendant tout ce temps l'aimant de la composante verticale oscilla constamment mais dans de très-petites limites; il n'y eut que deux ondulations qui se dessinèrent assez nettement, l'une entre 8½ et 8½ du soir l'autre à 11. 30.

Le 20 Avril, nouvelle perturbation aussi intéressante commençant avec une soudaineté et une violence extraordinaire à 11h. 40m. du matin par une énorme diminution de la composante horizontale, suivie de sauts ou d'ondulations amples et assez rapides. Inutile de dire que la déclinaison a varié proportionnellement et en sens inverse. Le maximum de déclinaison fut enregistré à 3h. 43m. de l'après-midi; entre le minimum normal de 9h. et ce maximum de l'après-midi la variation a été de 13'2 seulement. La perturbation prit fin à 2h. 20m. du matin le 21, quoique la déclinaison continuât à être irrégulière dans la journée.

A cette double perturbation magnétique ont correspondu des troubles profonds dans toutes les lignes télégraphiques, marines ou terrestres, de l'extrême Orient, de Singapore et Manille jusqu'à Tientsin. Les moments où les courants perturbateurs furent observés furent surtout, le 17, entre 10h. et midi (Nagasaki-Shanghai Shanghai-Hongkong), à midi 50m. (Hongkong-Amoy-

Shanghai), à ce moment la correspondance entre Hongkong, Manille, et Singapore entièrement interrompue; entre 2h. 5m. et 2h. 20m. Shanghai-Amoy). Le 20, à midi (Shanghai-Nagasaki).

Tout cela indique pour l'Europe de belles aurores boréales. Ici rien.

Non-Electric Incandescent Lamps

It is I believe well known that a method of obtaining light by means of incandescent platinum was patented by A. Cruickshanks in 1839. The following extracts from his specification (No. 8141) will, I think, show that there is no essential difference between the lamp devised by Prof. Regnard (NATURE, vol. xxvi, p. 108) and the invention of the patentee, which is described as follows:—

"In order to increase the light obtained from substances that are rich in carbon and to obtain light from gases and vapours that do not contain the proportions of carbon necessary to produce a bright flame, I construct a cage of fine platina wire gauze or network of the form of the flame and just so much smaller than the flame, that it may be entirely immersed in the outer portion of it, where it will soon become intensely ignited."

Further on it is stated that the platinum (covered with lime) may be heated by jets of the "vapour of inflammable liquids mixed with atmospheric air," and the patentee says that "the most advantageous method in practice" of obtaining the mixture "is to pass a current of air through such liquid."

The use of incandescent platinum as a source of light was again patented in 1849 by Gillard, and put in practice at Narbonne and some other small towns in France, but after a fair trial the experiment was abandoned (see King's "Coal Gas," vol. i. p. 53).

F. M. SEXTON

61, Barrington Road, S. W., June 12

Conservation of Solar Energy

THE views of Dr. C. William Siemens suggest a consideration of the influence of solar rotation upon the æthereal atmosphere, at various distances from sun's centre.

Laplace's limit of equal rotary and planetary velocity is at 36°35', r_0 , being sun's semidiameter. The centrifugal force of rotation at that limit would be 1321·3 times as great as at sun's surface, while the centripetal force of gravitation is only $\frac{1}{1321·3}$

as great. The lately-published photographs of the solar eclipse indicate an atmospheric oblateness which may be due to the equilibrating tendencies of the two opposing forces.

If the æthereal disturbances from this source are not sufficient to account for luminous and thermal vibrations, we may look next to the velocity which the subsiding particles would acquire in falling from the equatorial limit to the solar poles. If there were no resistance, this velocity would be

$$\left(\frac{35'35''}{36'35''} \times 2gr \right)^{\frac{1}{2}} = 376·8 \text{ miles per second.}$$

Any diminution of this velocity by resistance would be converted into heat.

If we apply Coulomb's formula of torsional elasticity, $f = \frac{\pi a^2 W}{2 g t}$, to solar rotation, W may represent sun's mass, a the coefficient of the radius of torsion, f the coefficient of torsion, g gravitating acceleration at sun's equatorial surface, t time of oscillation when the force of torsion is removed, or time of a solar half-rotation. Then

$$f = \frac{m}{2} = \frac{W}{2} \cdot \frac{\pi a^2 r_0}{g t^2}; \therefore \pi a^2 r_0 = g t^2 = \pi^2 l.$$

But g' , or the projectile velocity that is represented by sun's rotary oscillation, is the velocity of light; $g t^2$ is the modulus of light at sun's equatorial surface; $a^2 r_0$ is the theoretical length of a pendulum, at sun's surface, which would oscillate once in each half rotation; $a r_0$ is the length of an equatorial radius rotating with sun, and having the superficial orbital velocity, $\sqrt{g r_0}$, at its remote extremity.

PLINY EARLE CHASE

May 27

The Function of the Ears in the Perception of Direction

UNFORTUNATELY, through the bungling of my late agents, I am unable to refer to NATURE, vol. xxiv. p. 499, as quoted by

Mr. S. E. Peal, I may, therefore, be communicating stale information; but as it is the result of personal experience, what I have to relate may be of some use as confirmatory of statements of others. Mr. Peal would not be able accurately to estimate direction, unless the sense of hearing—the capacity to receive sound—was precisely equal and similar in each ear. A greater sensibility in one than in the other, would incline him to the right, or the left, as the case might be.

Few people know that they may be partially deaf on one side, and yet not perceive it, just as some are right- or left-eyed, without knowing it. A good test is a watch slid along a two-foot rule, the end of which touches the cheek. The watch is moved away, inch by inch, till the ticking is no longer audible—if the distance is the same on both sides, the sensibility of each ear is of course equal.

I shall not forget my horror when my medical man, applying this test, showed that while with my right ear I could distinguish the ticks far beyond the 2 feet, my left ear was impervious to the sound until within an inch or two of the watch. Hearing on that side has now totally ceased, and the result is *I have not the slightest idea of the direction of sound*. I can hear certain sounds (for I am becoming deaf on the right side also), but to whichever side I incline my right ear, from thence do I fancy the sound to come.

To me, with my passion for ornithology, it is a terrible deprivation. In my youth my senses were intensely acute. I could instantly detect and proceed to the faintest note uttered by a bird in the forest. Now the loudest call only puzzles me the more. But I was a long time before I found this out. I fancied more than once that the bird I was pursuing had powers of ventriloquism; then that there were two or more, calling from different directions. As soon, however, as I found, as before stated, that I was deaf on one side, I began experimenting on myself, and quickly arrived at the conclusion that in order to estimate direction, both ears needed to be equally sensitive.

A curious instance of correct judgment as to direction and distance of sound is given by one of the South African explorers, Green, I think. He had been much annoyed by a lion which roared round his camp. Taking his rifle and some of his native followers, he went outside in the direction of the sound. Halting, they listened intently, and at the next roar caught the exact direction, and judged the animal to be at (I think) about 300 yards. Carefully levelling his rifle, he fired, and had the satisfaction of hearing the well-known "thud" of the bullet, and a change of note from the midnight serenader. Next morning showed traces of blood, and following up the track they found, and despatched the wounded beast.

Colour-blindness is represented in the other sense, by an inability to distinguish certain sounds. That this is caused by partial deafness, I am now pretty well certain. My father-in-law, who never knew he was deaf, never heard the chirrup of the cricket, and I now find I cannot do so. Only last night my wife observed "what a noise the crickets are making," to me there was unbroken silence as regarded outward sounds. I only heard the continuous "buzzing" that sounds in my head, augmented by the regular "thud thud" of my pulse.

I have a clock, the hours of which strike on a sweet-toned, metallic bell. If my right ear is turned towards it, at a moderate distance, I hear the ringing note; if turned away, I am only conscious of the "burr" of the works, and a dull "thud, thud," denoting the stroke. Why do I hear the "burr," which is not so loud, or clear, as the metallic "ting"? That wave of sound seems to pass by and not affect me; it is like the sharp note of the cricket.

The cause why certain sounds are inaudible to certain ears is a subject well worthy of investigation, as bearing on the placing of sentries or outposts at night, in time of war; also for sportsmen hunting large dangerous game. E. L. LAYARD

British Consulate, Noumea, New Caledonia, April 7

Jamaica Petrel

MR. D. MORRIS asks (NATURE, vol. xxv. p. 151) for some clue to the locality and general character of the nesting-places of petrels. As I fail to find any reply in your pages up to January 19, I venture to send my mite by way of response to Mr. Morris.

Most of the petrels (*Æstrelata*), the Storm Petrels (*Thalassidroma*) and the Shearwaters (*Puffinus*) breed in holes in the ground, excavated by themselves; sometimes on small

islands, at other times on high mountains, at considerable distances from the sea. Their movements to and fro are almost always performed at night, and as they are capable of a very rapid flight, a distance of fifteen or twenty miles is quickly traversed.

Here, in New Caledonia, the well-known *Æstrelata mollis* breeds on the summit of Mont Mou (about 4000 feet) in January-March, in great numbers, laying one white egg, as usual. I am informed that in some places the ground is honeycombed with their burrows. I am also told that during the non-breeding season numbers come to roost in their old holes.

The larger, *Æ. rostrata*, Peall, nests in similar places, but at a much less elevation, on the Island of Uen, the most southern portion of New Caledonia, and hardly divided from it by the celebrated Wodin passage.

Other species are said to frequent other mountains in the interior, but I have no personal knowledge of them.

In Fiji I obtained *Puffinus ungar*, which bred far away in the mountainous interior, and there are other true petrels which do the same.

Vast numbers of various petrels and shearwaters are found in these seas, and I fancy all burrow, more or less, in the earth, to lay their eggs. Of the "Great Grey Petrel" (*Adamastor cinerea*) Capt. Hutton says, that it "burrows horizontally into the wet, peaty earth" (of Kerguelen's land) "from two to eighteen feet."

That the "Jamaica Petrel" resorts to the Blue Mountain range of Jamaica, for the purposes of breeding, I have not the smallest doubt, and if the holes are examined at the right time of year, I feel sure eggs will be found. The birds probably do use the holes as resting places, during certain periods of the year. They do not, however, *lay their eggs at sea!* and sooner or later Mr. Morris may be sure of finding eggs, though he may not find much of a nest.

The breeding of the Mutton Bird (*Puffinus brevicaudus*) on many of the Australian islands has been often described. Its burrows render walking positively dangerous. If Mr. Morris can refer to Gould's "Birds of Australia," he will find much information on this head. E. L. LAYARD

British Consulate, Noumea, April 10

THE REGNARD INCANDESCENT LAMP.—In reply to several correspondents who find a difficulty in the use of petroleum for this lamp, we think they may be more successful with benzoline.

DOUBLE STARS¹

II.

WE are in possession of numerous methods of computing double star orbits. Sir John Herschel gave one of the first solutions of this problem, and his method has been used more than any other up to this, and so far from becoming obsolete, it is yearly gaining ground at the cost of the methods that have been proposed elsewhere. It starts with the construction of the orbit, which the companion appears to describe round the main star. It is clear that as the planes of the orbits may be inclined in every direction in space, we see only the projection of the real orbits on the heavens, but this, as well as every other projection of an ellipse on a plane surface, is another ellipse, though the main star does no longer appear situated in the focus. Five points determine an ellipse, if we therefore possess five complete observations, we can determine the apparent ellipse. Now the observations are not perfectly accurate, but the calculus of probabilities furnishes us with means to ascertain the most probable ellipse from a great number of observations, to which different weight may be attributed, according to their reliability, as far as known. But at Herschel's time, though the angles had been fairly observed, the measurement of these minute distances was still in its infancy. He, in consequence, threw them away, and computed distances by aid of the Keplerian law referred to above, from the angular velocities, concluded from a comparison of observations separated by moderate intervals. He improved the angles in the following way:—On a paper neatly divided into squares, he lays down a

¹ Continued from p. 155.