nose gently against his arm, after which he walked off with a great sigh of relief.

A story somewhat analogous to the foregoing was told me by a friend, whose uncle, an old country squire in one of our western counties, had a favourite hunter in a loose box in the stable. One warm summer day he was "athirst," and could get no water. He tried to draw the groom's attention to the fact, but without success. The horse was not to be discouraged; he evidently gave the matter consideration. The thirst was pressing. All at once he remembered that he always had a certain halter put upon his head when led to the water. He knew where it hung. He managed to unhook it from its peg, and *carried it to the groom!* who at once, in great admiration of the knowledgable brute, rewarded him in the manner he desired.

M. CAREY-HOBSON

Colour-Blindness

DR. PRIOR's letter is almost entirely philological, and therefore does not come within my province. I have alluded to the colour-blind impression of white in my paper in the *Phil. Trans.*

I should like to know more about the eyesight of the person who says he cannot distinguish snow.

The latter part of the first paragraph of my letter on p. 120 should run, "In pigments, neutral green appears to me gray."

December 14 W. POLE

Magnetic Storm, May 14, 1878

REFERRING to a letter from the Rev. S. J. Perry in NATURE, vol. xviii. p. 617, reporting the magnetic disturbances observed at Stonyhurst, Melbourne, and Shanghai, on May 14, it may interest your readers to learn that earth-current disturbances were also noted on the Persian Gulf cables from 4 P.M. (Kurrachee time) on the 15th up to 5 A.M. on the following day.

Unusually strong earth-currents were also observed on June 3 and 4, on the cables between Bushire and Kurrachee; the current-strength at 2.40 P.M. on the 3rd, and 12.20 A.M. on the 4th, being reported as equal to fourteen Daniell's cells.

Kurrachee, November 8 HENRY C. MANCE

"Measuring the Height of Clouds"

THE electric light promising to be of great intensity at a small cost, the thought occurred to me that it might be used with advantage for the purpose of ascertaining the height of clouds. For, supposing an electric lamp sending a beam of light to the clouds, the spot where the light meets the latter, will be more or less visible, and we are obviously able to determine trigonometrically the height of the cloud.

By using two lamps, or a lamp and two reflectors, we may easily find also the rate at which clouds travel, by bringing the plane, passing through the axes of the beams of light, parallel to the direction in which the clouds move, and by noting the time it takes a cloud to travel from one beam of light to the other, having, of course, determined also the actual distance between the two spots of light on the clouds.

The above refers to observations during the night only, but by making use of coloured light, or by bringing a substance in the carbons of the lamp, the spectrum of which is easily recognisable, we might probably be able to work also during day-time.

Kew J. F. WILKE

The Weather

AFTER a week of unusually cold weather, the mean temperature having been 28°·5, and the wind constant from a northerly point, a thaw set in yesterday, and the wind became westerly, when immediately after sunset a rather unusual condition of weather occurred: viz., the rapid formation of a complete sheet of ice on the roads, though at the time, and till eleven P.M., the thermometer was 2° or 3° above the freezing-point.

As the sky was overcast at the time radiation cannot well account for it. Owing to the penetration of the cold, the surface must have retained a temperature considerably below 32° for some time after the air had become warmer and damper, so that the moisture was at once congealed.

Clifton, December 16 G. S. THOMSON

THE LAST EXPERIMENTS WITH THE 80-TON GUN

THE last experiments with the 80-ton gun at Woolwich deserve to be recorded, if only for the sake of showing that our scientific artillerists appear to be working in the proper channel. The last shot fired from the monster piece of ordnance was with the unprecedented charge of 460 lbs. of powder, and yet there was not so much strain upon the gun as that formerly exerted by charges one hundred lbs. less. The reason of this is in the main due to a change having been made in the character of the gunpowder employed; for whenever the former powder was used, even in lesser quantity, the pressure of the gas inside the gun rose at once. This would not so much matter if it could be shown that with the increase of strain, the work of the shot increased also. But such is not the case. For instance, in the case of two shots fired last week, one was sent on its way by 460 lbs. of prismatic powder, recording a velocity, we are told, of 1,626 per second, and a strain inside the gun of 19½ tons, while the other, with but 425 lbs. of cube powder, had a speed of only 1,600 feet, while it exerted a strain upon the weapon of 21 tons per square inch. The gun has been chambered—or in other words the cartridge cavity enlarged—to permit the introduction of heavier charges, as also to allow of a certain amount of air-space in the cartridge; but this modification in the weapon, beneficial as it may be, does not account, as we have shown, for the decrease upon the strain of the gun. This is due to the change in the powder.

In most of the former experiments a gunpowder of solid cubes, irregular in shape and measuring about an inch and a half, were employed; the recent results have been secured by thick six-sided prisms, about an inch across, and so accurately shaped that they may be packed together very closely. There is a single perforation in the middle of this prismatic powder, which, by the way, is of German origin, and when the cartridge has been securely packed so as to represent one solid mass, the perforations running through the whole length of the charge permit of the same being rapidly kindled. If the perforations were not there, half the charge would probably be expelled the gun before it was kindled; so that a packed cartridge of prismatic powder represents as nearly as possible a solid charge with tubes running its entire length, through which the kindling flames pass.

It has, of late, grown to be an axiom that the larger the gun the larger must be the grains of powder. A large grain of gunpowder burns slow because the fire is some time reaching the centre, and a slow-burning powder is what artillerists require for rifled guns. In a smooth-bore weapon the cannon ball fits loosely, and may be expelled at a bound; but in rifled cannon the shot, so to speak, moves upon a sort of railway, and it would never do to get the shot into motion too suddenly. An undue strain would be exerted upon the gun, while the velocity of the shot would not be increased. For a rifled gun, therefore, a slow-burning charge is absolutely necessary, and this is to be secured only by reducing the surface to be kindled. In the case of the prismatic powder, the grains, if they may be called by that name, are so closely packed that no fire can get between them, and hence the action of kindling is still further reduced.

Not only is the shape and density of powder grains now attracting particular attention, but the percentage of moisture contained in the material has also lately been under study. The amount of water in gunpowder to the minute extent existing in ordinary samples is found to influence combustion in a very marked degree, and nothing but an exhaustive series of trials can give sufficient data for practical application of so important an element in the science of explosives. In the meantime chemists are pointing out yet another source of uncertainty in the combustion of gunpowder, to which, notwithstanding

their repeated warnings, but little attention has hitherto been given. We mean the composition of the charcoal. According to the manner of preparing this, the method adopted for charring and the material employed, so does the chemical composition of the charcoal differ. Some samples, for instance, prove on analysis to contain 85 per cent. of carbon, while others have 20 per cent. less; it is scarcely to be expected that gunpowder made from the two kinds will have the same burning qualities, and yet with gunpowder manufactures charcoal is charcoal, no matter how much its component parts of carbon, hydrogen, oxygen, and ash may differ. It is of little use, therefore, paying any particular attention to the physical qualities of gunpowder so long as its chemical composition is almost entirely ignored.

The manner in which the strain upon the gun and the velocity of the shot are measured at Woolwich are worthy of explanation. The means employed are of the simplest kind. The maximum pressure of the gases inside the gun as the shot is being expelled is recorded by what is termed a "crusher gauge." This is no more than a tiny pillar of copper. The pillar is placed loosely in a tube, the end of which, made of steel, stands firm and fast no matter what the pressure. So that the soft copper pillar, when subjected to the action of the gas, gets compressed, or crushed, and assumes something of a barrel shape. The pillar and its case, being affixed to the base of the shot, gets the full pressure of the gunpowder gases, and its length afterwards denotes how much this pressure has been. To secure more trustworthy pillars of the metal it is the practice to compress them first of all to a certain degree, to remove any honeycomb or imperfection, and, thus uniformly compressed, they may be relied upon to record the strain with accuracy. Comparison of the fired pillar, with other pillars which have been subjected to known pressures, at once reveals the degree of force to which the former has been subjected in the gun. The maximum pressure, or strain, to which the 80-ton gun should be subjected, is set down as 25 tons on the square inch, and it is with the aid of this "crusher-gauge" that the strain exerted in the various experiments has been ascertained.

The initial velocity of a shot, or, in other words, the rapidity with which a projectile flies at the outset of its career, is now measured by an electrical instrument, the invention of Major le Boulengé, a Belgian officer. As in the case of other instruments of a like nature, the shot is made to break through two wire screens, placed at some distance from one another. The interval is usually about 100 feet. The screen is simply a wooden framework with fine wires zigzagging across, and it is these fine wires which the shot cuts. One screen is near the muzzle of the gun, and the other at the distance we have mentioned. No. 1 screen is in connection with an electro-magnet in the instrument-house, and No. 2 screen with a second, the two magnets hanging close together. While the wires in front of the screen are perfect, an electric current passes without interruption, and the electro-magnets in connection with them are endowed with power, but this power ceases as soon as the shot cuts the wires of the screen. Before the gun is fired there is suspended to the magnets two rods of iron, which remain, however, only so long as the magnets are magnets. When the shot is fired, No. 1 screen is torn, and down falls the rod suspended to No. 1 magnet; an instant afterwards, when the shot has reached No. 2 screen, No. 2 magnet also loses it virtue, and down falls the second rod. The time between the falling of the two rods is so small, that ere the first has fallen half its length the second has dropped upon a trigger, which trigger darts out and strikes the side of No. 1 rod. When the latter is picked up, the first thing is to examine the surface for the mark of the trigger, for the position of this mark, whether high or low, tells the operator what he wants to know. The rod being of a given weight, always takes the same time to fall, and according whether it has fallen half or quarter its length, so the time taken by the shot to travel between the screens has been long or short. In a word, the rod has only to be compared with a prepared scale in order to read off the number of feet per second at which the shot has gone on its way.

THE REGISTRARSHIP OF LONDON UNIVERSITY

LAST week we referred to Dr. Carpenter's intended resignation of the Registrarship of the University of London. We have before us his letter intimating his desire to resign his post on May 31 next, and the resolution of the Senate in connection therewith. By the date mentioned Dr. Carpenter will have completed his twenty-third year as Registrar, and, including his previous nine years as Examiner, his connection with the University has extended over four-fifths of its term of existence, and over a corresponding proportion of his own professional life. There is no doubt that the success of this great institution is to a great extent owing to the energy and faithfulness with which Dr. Carpenter has discharged the duties of his post. It has been fortunate for the University as well as for science that a man of so eminent a scientific position has been so long and so intimately connected with it, and it will be extremely difficult to find one capable of taking up adequately Dr. Carpenter's work. We have pleasure in publishing the resolution of the Senate, to which we have referred.

"In accepting the Registrar's resignation of the important office he has held since 1856, the Senate desire to record their sense not only of the ability, judgment, and fidelity with which he has uniformly discharged its duties, but also of the zeal and efficiency with which he has on all occasions exerted himself both within and beyond the limits of his official obligation, for the promotion of the best interests of the University.

"The Senate would further record their conviction that it has been of special advantage to the University, during the twenty years of its most rapid development, to have had the services of a Registrar who, besides being an excellent administrator of its affairs, has attained, by his scientific labours, a position which has given him a just weight and influence over those with whom he has been brought officially into contact.

"The Senate strongly recommend the Registrar to the favourable consideration of the Lords of Her Majesty's Treasury as having acquired, by 'special services,' a claim to a larger superannuation allowance than that to which he is entitled by mere length of service."

ABOUT FISHES' HEADS

IN a former number (vol. xvii., p. 286), in a note "About Fishes' Tails," we called attention to some recent observations of Alexander Agassiz on the young stages of some fishes, in which he showed the wonderful changes that, as development went on, took place in their caudal fins; yet strange though these changes are, they seem as nothing to those that take place in some fishes' heads, and the facts first noticed by Steenstrup, and the theory which, by a marvellous power of intuition, he built up thereon, as to the eye in a flounder passing from the right side of its head to its left, have been in a great measure confirmed, and perhaps in a greater measure added to, by the painstaking observations quite recently published, of Alexander Agassiz,[1] from which it would now seem very certain that even the most shapeless adult fishes begin their life as quite symmetrical young creatures. No more

[1] *Proceedings* of the American Academy of Arts and Sciences, vol. xiv., July 1878.