ELECTRO-MAGNETS FOR LIFTING PURPOSES.

THE following particulars and photographs of some electro-magnetic lifting devices, which have been in everyday use at the Proof Butts, Royal Arsenal, Woolwich, for the last four years, were published by permission of the Inspector-General of Ordnance in the Electrical Review.

The magnets in question were designed by Major H. C. L. Holden, R.A., F.R.S., for the special purpose of lifting the shot that are used for proving guns and for ballistic experiments generally. These shot, it will be seen from the photographs, are of special form, having a flat instead of a pointed head, in order that their motion may be arrested as quickly as possible in the sand of the butt into which they are fired. The shot weigh from 1,800 lb., the weight of the projectile fired from the 110-ton gun, downward to the smallest bores; they are piled one upon another in the stores, and it used to be somewhat laborious work moving them when required, not only on account of their weight, but also on account of the difficulty of getting slings round them. The introduction of the electro-magnet in the place of the slings has made the task easy, and one which is, moreover, quickly performed. The figures require but little explanation, as they show clearly the construction and method of employment.

The body or core of the magnet is Ω -shaped and in one forging. The winding is mechanically protected by stout brass flanges and is covered with thick brass strip. The ends of the winding are led to duplicate terminals. Duplication wires, to prevent accidents in the case of the wire fouling and breaking, being taken over pulleys to the switch box on the counterweight at the back of the crane.

A single pole switch is placed in this box and is used, in conjunction with a water resistance, to shunt the

bone of an inquiry like this ought necessarily to be found in a careful discussion as to how far an accidental combination of figures could account for the apparent effect. The magnetic declination is subject to so many changes which to us seem accidental, that if we take a certain number out of the whole series of daily averages, they must necessarily show deviations. The whole question then turns on the discussion whether the effects found by Mr. Leyst are sufficiently large and regular to be considered as real. This part of the subject is, unfortunately, treated in an insufficient manner, and, for this reason, the author has not in my opinion made out his case.

We may, however, from Mr. Leyst's numbers, draw the conclusion that even if the effect is a real one, it cannot, as the author considers, be due to an ordinary magnetic force depending in its magnitude on the distance of the planets. Within a few days of conjunction that distance does not vary appreciably, and Mr. Leyst should therefore get more trustworthy results by taking account not only of the days of conjunction but of a group of days immediately surrounding the configurations. The necessary data are supplied by Mr. Leyst, and it appears that, taking Mercury, for instance, the diminution of declination is reduced from $0^{\circ}29$ to $0^{\circ}20$ when the preceding and following days are taken into account; while when five days altogether are considered, there is a further reduction of the effect to $0^{\circ}15$, and when a month is taken, in the middle of which the inferior conjunction lies, there is only a deviation of $0^{\circ}08$ from the average declination. The other planets show the same fact. The average effect of all the planets amounts to $0^{\circ}33$, which is reduced to $0^{\circ}26$, $0^{\circ}17$, and $0^{\circ}08$ when the

his case. Among the many improbabilities of magnetic influences which are hanging over us, that of a planetary effect may for the present be set aside.

ON THE RAYS OF ROENTGEN.

By Prof. E. SALVIONI.*

I HAVE the pleasure of briefly communicating to the academy the results of some studies which I have undertaken on the rays of Roentgen.

The theoretical portion of these studies had for its object to examine if Roentgen's agency could be considered as a form of light in the sense that this agent consists in vibrations of the ether. It is known that Roentgen, in his memoir, emphasizes the probability that we have to do with longitudinal waves of the ether. Now the totality of the facts established by him, and especially the fact that the agent is propagated with the same rapidity in different transparent media, and that a substance is so much the more transparent to these rays the smaller is its density, have caused a doubt to spring up in my mind that the power may be due to highly subtile matter projected from the Crookes tube, a matter to which bodies are permeable so much the more as they are less compact. Bodies will be traversed by the subtile particles of this matter more or less easily as a net more or less close would be by a discharge of small shot. I communicated this idea in private conversation, and have since found that, without my knowledge, it had appeared in a correspondence in a daily paper.

From a very summary account of a lecture delivered at Pisa by Prof. Garbasso, I learned that this idea is

Bronze shackles.

Struck to 8 1/2 in. radius.

Sheet brass covering.

Winding 230 turns 0.004 in. wire.

T, terminals. B C, brass cheeks.

ELECTRO-MAGNETS FOR LIFTING PURPOSES.

extra current produced on breaking the circuit, to close or open the circuit. The current varies from 3 to 4 amperes at 20 to 30 volts. The maximum weight that can be lifted has not been ascertained exactly, but it exceeds 3,000 lb. as two 1,800 lb. shot can be lifted, one slung below the other in the manner shown in the photograph of an 1,800 lb., and 1,250 lb. shot being thus lifted. The shot are of hard cast iron or cast steel, their surface is rough and thickly covered with paint. The weight of the electro-magnet complete is about 45 lb.

MAGNETIC INFLUENCE OF THE PLANETS.

By ARTHUR SCHUSTER, in Nature.

AN attempt to discover a direct magnetic influence emanating from the planets is described in "Magnetismus der Planeten" by Ernst Leyst. For this purpose the author makes use of the observations taken at St. Petersburg and Pawlowsk during the years 1873-1889, and calculates the average magnetic declination for the days at which the planets are at their greatest and least distance from the earth; also for those days at which the planets are at their greatest eastern and western elongation. The numbers so obtained show certain regularities, which are considered sufficiently marked to indicate a true effect of the planetary configurations. According to the tables given, the declination is increased by $0^{\circ}2$ of arc when Venus is nearest, and is diminished by $0^{\circ}32$ when it is furthest away. Mercury acts in the opposite direction, diminishing the declination by $0^{\circ}29$ when it is nearest and increasing it by $0^{\circ}20$ when it is furthest. The back-

three days, five days, and the month nearest to conjunction are taken into calculation. If the effect is a real one, it must be due to some other cause than an ordinary magnetic action, for it practically vanishes two days before or after conjunctions, when there is very little change in the relative positions of sun, planet, and earth. Mr. Leyst himself draws attention to the rapid diminution of the supposed planetary influence within a few days of conjunction, but considers it to be an argument in favor of his view.

The amplitude of the diurnal variation is discussed; and here, of course, also a planetary effect is found, which, curiously enough, is greater for Neptune and Uranus than for Venus and Mercury. The "probable error" of the result is considered, and is calculated to exceed the supposed effect in the case of Mercury, Mars and Saturn, and to amount to about two-thirds of the effect in the case of Venus, Uranus and Neptune. The author draws the conclusion that the planetary influence is "certain" for the three latter planets and Jupiter.

It is hardly necessary to follow the author further in the complicated results he deduces, by separating what he calls the "primary" and "secondary" extremes, the primary and secondary amplitudes, and the irregular and periodic part of the diurnal variation; the primary and secondary quantities being affected in opposite directions by the mischievous Mercury. In fairness to the author, it must be stated that some of the effects of that planet are found to be in the same direction when the whole period of fifty synodic revolutions is divided into two, which are separately considered. Nevertheless, a careful perusal of Mr. Leyst's work leads to the conclusions that he has not proved

shared by him and Battelli, and is confirmed by their researches. But what is the subtile matter? It must either be common matter projected from the Crookes tube or imponderable matter, such as the cosmic ether.

Let us pass to that portion of my studies which renders the application of Roentgen's discovery more easy. I submit to the academy photographs taken by Roentgen's method.

The photographs of several metals (magnesium, aluminum, iron, lead, zinc, copper, palladium, silver, gold, platinum) confirm the relation between transparency and density discovered by Roentgen.

I give a photograph of my hand showing the bones. The cartilages are not transparent, but the spongy parts of the joints are more transparent. Two of the photographs show a frog paralyzed with curare taken with different times of exposure. One of these proofs, besides the bones, shows the two lungs; in the other there are seen, besides the lungs, also the heart and another viscus.

I then turned my attention to the eye. Roentgen has found that bodies fluorescent by common light fluoresce also in his rays. I instituted experiments on a retina taken from a living animal—a rabbit. The observations made with the living retina showed that the retina is somewhat fluorescent to the light emanating directly from a Crookes tube, but with the Roentgen's rays there was no appearance of fluorescence. I studied in the sequel by the photographic method the transparency of Roentgen's rays in the dioptric apparatus of

* A communication made to the Medico-chirurgical Academy of Perugia, on February 6, 1896. In the Electrical Review

† Radiant matter.

the eye, and I obtained the result that the totality of the various media which constitute it intercept the rays of Roentgen almost like a small plate of common glass, of the size of one millimeter, and hence very little transparent. It seemed possible to see in an indirect manner through wood, aluminum, flesh, etc., by an indirect method transforming Roentgen's rays into common luminous rays before they arrive at the eye. I have constructed a simple apparatus by means of which I can see distinctly the outline of objects inclosed within boxes of card, aluminum, etc. This cryptoscope, which I have the pleasure of submitting to the academy, is a small tube of cardboard of about 8 centimeters in height. Its bottom is completely closed with black cardboard on which is laid a stratum of fish glue and calcium sulphide, a substance which I have found very phosphorescent in Roentgen's rays. Within the tube of cardboard at the other extremity to which the eye is applied is fixed a lens which enables us to see clearly the phosphorescent cardboard, keeping the eye in a state of repose. With this cryptoscope applied to the eye, it is possible to see, even in a lighted space, the

THE POLARIZING PHOTO-CHRONOGRAPH APPLIED TO THE MEASUREMENT OF THE VELOCITY OF PROJECTILES.*

THIS new instrument for the reliable measurement of very minute intervals of time was developed in some preliminary experiments at the United States Artillery School, Fortress Monroe, Va., in measuring the velocity of projectiles from the new 3.2 inch B. L. field rifle adopted by the army.

In the course of these experiments, which were necessarily limited to two weeks' time, observations were taken at intervals as small as 5 feet, and as many as ten consecutive observations at 5 foot intervals, beginning at the muzzle of the gun and extending to 45 feet distance, were easily obtained from a single shot. This instrument being admirably adapted for recording the passage of the projectile at a number of points of its trajectory, it was made an object to study the law of variation of the velocity of a projectile near the muzzle of a gun. From measurements on the negatives it is clearly evident from each that the velocity

"crossed," the light is totally extinguished, as though the beam had been interrupted by an opaque body. By turning the analyzer ever so little from the "crossed" position, light will pass through it, and its intensity increases until the planes of the prisms are parallel, when it again diminishes, and if one of the prisms is rotated, there will be darkness twice every revolution.

To accomplish the end that is obtained by rotating the analyzer without actually doing so, a transparent medium which can rotate the plane of polarization is placed between the polarizer and analyzer, and made subject to the control of an electric current. The medium used in these experiments was liquid carbon bisulphide, contained in a glass tube with plane glass ends. This was selected because it is very clear and colorless and possesses the necessary rotary property to a considerable extent when situated in a magnetic field of force, the rotary power being in proportion to the intensity of the magnetic field.

To produce a magnetic field in the carbon bisulphide a coil of wire is wound around the glass tube, and an

FIG. 1.—ARRANGEMENT OF LABORATORY APPARATUS.

FIG. 2.—COMPLETE ARRANGEMENT OF ELECTRICAL CIRCUITS.

form and position of metallic bodies inclosed within boxes of cardboard, of wood, of aluminum, and within flesh.

This apparatus, when suitably improved, will be found convenient for surgical and medical applications, not less in the scientific study of phenomena substituting direct vision for photography. For calcium sulphide there may be substituted with advantage platinum and barium cyanide.

If your granite has rust on from rubbing, grease or any stain, wet thoroughly with water; then mix plaster of Paris with muriatic acid about the consistency of thick paste, and apply it on parts about one-fourth of an inch thick, leaving it on for fifteen minutes; after taking off wash parts clean; repeat application if necessary. This must be done in the shade, and if the piece to be cleaned is in the cemetery, take a cloudy day to do the work. If the sun shines on it discoloration sets in. Always use care in washing off the acid.—Stone.

actually increases after leaving the gun, a fact which has long been suspected, but which, so far as we know, has not previously been demonstrated experimentally.

The particular form of transmitter used in these experiments depends for its action upon the use of polarized light. A sensitive photographic plate is made to rotate at a known speed in a light-tight box, and light is admitted to the plate through a narrow slit by means of a "massless" shutter, as the inventor terms it. Any material shutter would possess a certain amount of inertia, and would not admit of a practical result. By the use of a polarizer the light is admitted or shut off without the movement of any material thing.

As is well known, the most efficient polariscope consists of a pair of Nicol prisms. When the prisms are

electric current passes through the coil. The prisms being crossed, so that no light emerges from the analyzer, a current is sent through the coil on the tube, causing the rotation of the plane of polarization.

This is equivalent to rotating the polarizer; hence a light now emerges from the analyzer. When the current is broken the medium loses its rotary power and there is again complete darkness. This arrangement makes an effectual shutter for the beam without moving any mass of matter.

A view of the laboratory apparatus is shown in Fig. 1. Fig. 2 shows diagrammatically a complete arrangement of the electrical circuits and apparatus, and Fig. 3 shows the apparatus on the proving ground. Corresponding letters represent like parts in the figures.

The arc lamps, L and L', are used as sources of light. P is the polarizer; T, the transmitter tube containing carbon bisulphide and wound with magnet wire; A is the analyzer, in front of which is a lens to condense a beam of light upon the camera, C. The motor, M, revolves the sensitive plate in the camera.

* An abstract from an interesting paper by Dr. Albert O. Crehore, Assistant Professor of Physics at Dartmouth College, and Dr. George O. Squier, First Lieutenant, Instructor United States Artillery School. For a full account of these experiments see Journal of the United States Artillery, July, 1895.—Fortress Monroe Press.