and photographs. Vice-President Ryerson and Mr. C. L. Hutchinson, on their trip around the world, procured and presented to the Museum a large and unique amount of material, including Etruscan and Stone Age remains from Italy, Roman terra-cottas, metal and stone work from the Indies, and butterflies from the Himalayas. Mr. Owen F. Aldis invited Mr. O. P. Hay, Assistant Curator of Ichthyology, to accompany him on an excursion to the waters of Southern Florida. Nearly one hundred fine specimens were thus obtained. By sending collectors to all parts of the world in this way, the Field Columbian Museum gives evidence of very great activity. The specimens obtained by its officers will not only serve to enrich the Museum directly, but a large number of them can do so indirectly by exchange.

THE additions to the Zoological Society's Gardens during the past week include two Secretary Vultures (*Serpentarius reptivorus*) from South Africa, presented by Mr. P. Myburgh; two Sacred Ibises (*Ibis æthiopicus*) from South Africa, presented by Mr. Almeda; a Herring Gull (*Larus argentatus*), a Lesser Black-backed Gull (*Larus fuscus*) from Nova Zemlya, presented by Mr. C. L. Rothera; a Rose-crested Cockatoo (*Cacatua moluccensis*) from Moluccas, presented by Mrs. Anderson; two Crested Porcupines (*Hystorix cristata*), a Griffon Vulture (*Gyps fulvus*) from North Africa, presented by Mr. R. S. Hunter; four Common Rat-Kangaroos (*Potorous tridactylus*, 2 ♂, 2 ♀), seventeen Lesueur's Water Lizards (*Physignathus lesueuri*) from Australia, deposited; two —— Parrakeets (*Psephotus chrysopterygius*) from Australia, four Brent Geese (*Bernicla brenta*, 2 ♂, 2 ♀), European; a Bengalese Cat (*Felis bengalensis*) from the East Indies; four Red-crested Pochards (*Fuligula rufina*, 2 ♂, 2 ♀) from India, three Mandarin Ducks (*Æx galericulata*, ♀) from China; three Summer Ducks (*Æx sponsas*, ♀) from North America; two Rosy-billed Ducks (*Metopiana peposaca*, ♂) from South America; a Japanese Teal (*Querquedula formosa*, ♀) from North-east Asia; five Chiloe Widgeon (*Mareca sibilatrix*, 3 ♂, 2 ♀) from Chili, a Spur-winged Goose (*Plectropterus gambensis*, ♂) from West Africa, purchased.

OUR ASTRONOMICAL COLUMN.

COUDÉ MOUNTINGS FOR REFLECTING TELESCOPES.—For spectroscopic work the reflector is, without doubt, the most ideal form of telescope. Not only does the visual light-grasping power increase very rapidly the larger the aperture, but for the purposes of photography the same is also true. The refractor has, however, as yet the most convenient and comfortable arrangement for observation from the observer's point of view, while with the reflector the observer is not so conveniently situated. That some kind of coudé arrangement can be adopted is, therefore, an important step in bringing these instruments more into use; for not only are reflectors cheap when compared with objectives, but their mountings and the accompanying housing are much less expensive. Prof. Wadsworth, in the February number of the *Astrophysical Journal* (vol. v. No. 2), describes several ways in which the reflector may be coudé mounted, one of which was suggested by the late Mr. Cowper Ranyard, but was not completely worked out owing to his sudden death. Perhaps the two most promising arrangements are (1) when the reflector is of the Newtonian type, and the primary flat is placed at right angles to the axis of the tube reflecting the cone of rays back again on to two small mirrors, one placed just in front of the mirror, and the other in the polar axis; and (2) when the reflector is of the Cassegrain type, and a single small additional mirror is necessary to reflect the rays directly down the polar axis. The latter appears, however, the more simple of the two, but the method of mounting seems somewhat too weak for mirrors of large size. Prof. Hale, in the same number of that journal, discusses the comparative value of refracting and reflecting telescopes for astrophysical investigations, pointing out the superiority of the latter from many points of view, while Mr. Ritchey describes a new method of a support system for large specula.

ON APPARENT AND REAL DISELECTRIFICATION OF SOLID DIELECTRICS PRODUCED BY RÖNTGEN RAYS AND BY FLAME.[1]

THE fact that air is made conductive by flame, by ultra-violet light, by Röntgen rays, and by the presence of bodies at a white heat has been shown experimentally by many experiments. We propose in this communication to give some results bearing on this conductivity of air, based chiefly on experiments of our own.

We have examined more particularly the behaviour of paraffin and of glass.

In our first experiments with paraffin we used a brass ball of about an inch diameter, connected to the insulated terminal of an electrometer by a thin copper wire soldered to the ball. The ball and the wire were both coated to the depth of about one-eighth of an inch with paraffin. The ball was then laid on a block of paraffin in a lead box with an aluminium window, both of which were in metallic connection with the case of the electrometer. By this means we avoided all inductive effects.

The electrometer was so arranged as to read 140 scale divisions per volt.

After testing the insulation the paraffined ball was charged positively and the rays played on it. After two minutes the electrometer reading was steady at 0·5 of the initial reading. The electrometer was then discharged by metallic connection, and again charged positively. Its reading remained steady after three minutes at 0·63 of the initial charge. In the third and fourth experiments the readings after three minutes were ·81 and ·90 of the initial charges respectively.

The ball was next charged negatively. When the rays were played on it a steady reading was obtained after four minutes at ·18 of the initial charge. In the second, third, and fourth experiments the steady readings after four minutes were ·45, ·70, and ·78 of the initial charges respectively.

The paraffin was then removed and the brass ball polished with emery paper; whether the charge was positive or negative, it fell in about five seconds to one definite position, 50 scale divisions on the positive side of the metallic zero, when the Röntgen rays were played on the charged ball.

These experimental results demonstrate that the Röntgen rays *did not produce sensible conductance* between the brass ball, when it was coated with paraffin, and the surrounding metal sheath: and that *they did produce it* when there was only air and no paraffin between them. From experiments by J. J. Thomson, Righi, Minchin, Benoist and Hurmuzescu, Borgmann and Gerchun, and Röntgen,[2] we know that air is rendered temporarily conductive by Röntgen rays, and Röntgen's comparison of the effect of the rays with that of a flame shows that our experimental results are explained by the augmentation of the electrostatic capacity (quasi-condenser) of the brass ball by the outside surface of its coat of paraffin being put into conductive communication with the surrounding lead sheath and the connected metals.

In our second experiments we have endeavoured to eliminate the influence of the varying capacity of this quasi-condenser. For this purpose, we placed a strip of metal connected to the insulated terminal of the electrometer inside an aluminium cylinder; the space between the metal and the cylinder was first filled with air, afterwards with paraffin. The aluminium was connected to the case of the electrometer, and inductive disturbances were avoided by surrounding the copper wire connecting the metal to the isulated terminal with a lead sheath in metallic connection with the electrometer sheath (see diagram).

In our first experiments with this apparatus we had air, instead of the main mass of paraffin, separating the insulated metal from the surrounding aluminium tube, as shown in the diagram, and we had only small discs of paraffin serving as insulating supports for the ends of the metal, and not played on by the Röntgen rays. When the metal thus supported was charged, whether positively or negatively, the Röntgen rays

[1] By Lord Kelvin, Dr. M. Smoluchowski de Smolan, and Dr. J. Carruthers Beattie. Read before the Royal Society of Edinburgh, February 15, 1897.

[2] J. J. Thomson, *Proceedings* R.S.L., February 13, 1896; Righi, *Comptes Rendus*, February 17, 1896; Benoist and Hurmuzescu, *Comptes Rendus*, February 3, March 17, April 27, 1896; Borgmann and Gerchun, *Electrician*, February 14, 1896; Röntgen, Würzburger. Phys. Med. Gesellschaft, March 9, 1896; Minchin, *The Electrician*, March 27, 1896.

diselectrified it in about five seconds; not, however, to the metallic zero of the electrometer, but to a "rays-zero" depending on the nature of the insulated metal and of the metal surrounding it.

With paraffin between the aluminium cylinder and the insulated metal within, as shown in the diagram, the following results were obtained:—

December 30, 1896. 5.30 p.m.—Interior metal charged negatively. Total charge 356.

Röntgen lamp in action and no screen	39 scale divisions discharged in	5	mins.
R. L. not acting	25 ,, ,,	5	,,
R. L. again acting and no screen	17 ,, ,,	5	,,

5.45.—Interior metal charged positively. Total charge 244.

R. L. in action and lead screen	1 scale division discharged in	3	mins.
R. L. in action and no screen	6 ,, ,,	3	,,
R. L. not acting	0 ,, ,,	3	,,

Dec. 31, 1896. 10.54 a.m.—Interior metal charged positively. Total charge 163.

R. L. not acting... ...	2 scale divisions discharged in	3	mins.
R. L. acting & no screen	1 ,, ,,	3	,,
11.0—R. L. stopped ...	1·5 ,, ,,	2	,,
R. L. again acting, no screen	3 ,, ,,	2	,,
R. L. stopped	2·5 ,, ,,	3	,,

11.12.—Interior metal charged negatively. Total charge 342.

R. L. not acting... ...	10 scale divisions discharged in	3	mins.
R. L. acting, no screen	21 ,, ,,	3	,,
11.18—R. L. stopped	11·5 ,, ,,	3	,,
R. L. acting, no screen	16·5 ,, ,,	3	,,

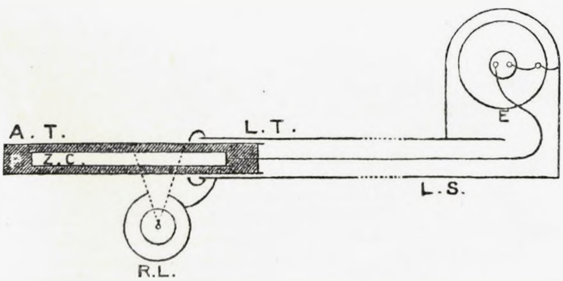

FIG. 1.—A. T., Aluminium tube; L. T., Lead tube; R. L., Röntgen lamp; L. S., Lead sheaths; E., Electrometer; P., Paraffin; Z. C., Zinc cylinder.

These results are quite in accordance with those found in similar experiments by Röntgen; and they show that if paraffin is made conductive, it is only to so small an extent that it is scarcely perceptible by the method we have used.

To make a similar series of experiments with glass, we used a piece of glass tubing 9·5 mm. thick, length 70 cm., and 1 cm. external diameter. The inside of this tube was coated with a deposit of silver, which was placed in metallic connection with the insulated terminal of the electrometer. The outside of the glass was covered with wet blotting-paper connected to sheaths. With this arrangement we obtained the following results:—

Feb. 8, 1897.

Insulated terminal of electrometer charged to − 333 scale divisions from the metallic zero.

4.23.—Röntgen lamp,	acting ...	0·5 sc. div. lost in	3	mins.
,, ,,	not acting ...	1·0 ,, ,,	5	,,

Charged to + 164 scale divisions from the metallic zero.

4.36.—Röntgen lamp,	not acting ...	13 sc. divs. lost in	7	mins.
,, ,,	acting ...	8·5 ,, ,,	5	,,
,, ,,	not acting ...	6·0 ,, ,,	6	,,
,, ,,	acting ...	3·5 ,, ,,	5	,,
,, ,,	not acting ...	3·5 ,, ,,	5	,,

[Sensibility of electrometer, 140 scale divisions per volt.]

We next removed a part of the wet blotting-paper from the outside of the glass, and, after having charged the insulated interior metal deposited on the inside of the glass, we heated the exposed part with a spirit flame, in this way making the glass a conductor. Thus with a charge of + 280 scale divisions from the metallic zero, the loss in 30 seconds, during which time the glass was heated in the spirit flame, was 90 scale divisions; in the next minute, with no further heating, the loss was 20 scale divisions. Re-application of heat gave complete discharge in 2½ minutes. Thus we see that our method is amply sensitive to the conductance produced in glass by heating.

We conclude that the Röntgen rays do not produce any conductance perceptible in the mode of experimenting which we have hitherto followed.

A similarity in effects produced by flame and by Röntgen rays is brought out by the following experiments.

Two similar sticks of paraffin, which we shall call A and B respectively, each of about four sq. cm. cross section, were coated throughout half their lengths with tinfoil. These tinfoils ought to be each metallically connected to sheaths.

To obtain a sufficiently delicate test for their electric state, a metal disc of three cm. diameter was fixed horizontally to the insulated terminal of the electrometer.

The two pieces of paraffin were first diselectrified by being held separately in the flame of a spirit-lamp. Their non-tinfoiled ends were then pressed together, and their electric state again tested after separation. It was found that they were still free from electric charge. After this B was charged by being held over the pointed electrode of an inductive electric machine. The quantity of electricity given to it in this way was roughly measured by noting the electrometer reading when the paraffin was held at a distance of 4 cm. above the metal disc connected to the insulated terminal of the electrometer.

The free ends of A and B were again held together, and, after separation, both pieces were tested separately. The charged one, B, had suffered no appreciable loss, and the other, A, induced an electrometer reading of a few scale divisions in the same direction, when held as near as possible to the metal disc without touching it. This showed that an exceedingly minute quantity of electricity had passed from B to A when they were in contact.

A was then diselectrified by being held alone in the flame. The ends of A and B were again put together, and in this position were passed through the flame. They were tested with their ends still pressed together, and it was found that when held as near as possible to the metal disc without touching it, no reading was produced on the electrometer. After this they were separated and tested separately; and it was found that B, when held over the disc, gave a large reading in the same direction as before it had been passed through the flame, and A (which was previously non-electrified) gave a reading of about the same amount in the opposite direction.

The same results were obtained when Röntgen rays were substituted for the flame.

The explanation clearly is this: the flame or the Röntgen rays put the outer paraffin surfaces of A and B temporarily in conductive communication with the tinfoils; but left the end of B, pressed as it was against the end of A, with its charge undisturbed. This charge induced an equal quantity of the opposite electricity on the outer surfaces of the paraffin of A and B between the tinfoils; half on A, half on B.

When the application of flame or rays was stopped, this electrification of the outer paraffin surfaces became fixed. B, presented to the electrometer, showed the effect of the charge initially given to its end, and an induced opposite charge of half its amount on the sides between the end and the tinfoil. A showed on the electrometer only the effect of its half of the whole opposite charge induced on the sides by the charge on B's end.

We have here another proof that paraffin is not rendered largely conductive by the Röntgen rays. Had it been made so, then the charge given to the end would have leaked through the body of the paraffin to the outside, and have been carried away either by the tinfoil or by the conductive air surrounding the non-tinfoiled parts.

To show that the induced charges were fixed on the sides, the two sticks, A and B, were next coated with tinfoil throughout their whole length, only one end of each being uncovered. The uncoated end of B was then charged and pressed against that of A, and the two were held either in the flame of a spirit-lamp or in the Röntgen rays. When taken out of the flame or the Röntgen rays, and then separated and tested separately, it was found that B had retained its charge practically undiminished, and that A had acquired a very slight charge of the opposite kind.

Instead of placing the two ends of the paraffin in immediate contact, four pieces of metal of 1/10 of a mm. thickness were placed one at each corner of one of the ends, so that when the sticks of paraffin were placed end to end there was now an air space of 1/10 of a mm. between the paraffin ends. When B was charged and A not charged, and the two put end to end, and then exposed to flame or to Röntgen rays, it was found that B's end still retained its charge, and A's end acquired a very slight opposite charge.

With an air space of 1/5 of a mm. the same results were obtained.

With the air space increased to 1 mm. the charge on B was less after the two had been passed through the flame or the rays.

Similar experiments were made with rods of glass and of ebonite, with similar results.

FORTHCOMING BOOKS OF SCIENCE.

MR. EDWARD ARNOLD has in preparation:—Practical Science Manuals; Agricultural Chemistry, by T. S. Dymond; Steam Boilers, by George Halliday, illustrated; The Chemistry of the Raw Materials of the Coal-Tar Colours, by R. J. Friswell; A Manual of Physiology, by W. Snodgrass, arranged to meet the requirements of the syllabus of the Science and Art Department; The Calculus for Engineers, by Prof. John Perry; A New Elementary Geography, based on Frye's Complete Geography, and revised and largely re-written from the British standpoint, by Andrew J. Herbertson, illustrated.

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