America, presented by Mrs. Dade; two Brown Mud Frogs (*Pelobates fuscus*) from Italy, presented by Count M. Peracea; an Indian Elephant (*Elephas indicus*, ♀) from India, a Rose-crested Cockatoo (*Cacatua moluccensis*) from Moluccas, deposited; a Chimachima Milvago (*Milvago chimachima*), two Violaceous Night Herons (*Nycticorax violaceus*) from South America, a Common Quail (*Coturnix communis*) captured at sea, a Common Rhea (*Rhea americana*) from South America, a Bornean Gibbon (*Hylobates muelleri*, ♀) from Borneo, purchased.

OUR ASTRONOMICAL COLUMN.

THREE BRILLIANT STELLAR SYSTEMS.—Prof. T. J. J. See, with the aid of the 24-inch refractor of the Lowell Observatory, in Mexico, has recently discovered (*Astr. Journal*, No. 396) three objects which "may be regarded as amongst the most splendid systems in the heavens." The first, discovered in January last, is α Phœnicis, its position for 1900 being R.A. 0h. 21m. 19·5s., decl. −42° 50′ 48″·1. The primary of this double has a magnitude of 2·4, the companion being as faint as a thirteenth mag. star. This inequality, combined with the deep orange or reddish colour of α Phœnicis, renders the system both striking and difficult. The mean of some measures made for determination of the position of the components was 1897·041, pos. angle 272°·7, dist. 9″·73. The second of these objects, also a very southern star, is μ Velorum with a magnitude of nearly 3, the companion being 11, of a purplish colour and very near the large star. [R.A. 10h. 42m. 28s., decl. −48° 53′ 31″ (1900)]. This system is described as one of the most extraordinary in the heavens, and likely to have a very large orbital motion. Measurements of position gave for 1897·059, pos. angle 62°·7, dist. 2″·54. The third and last of these objects, η Centauri, situated at R.A. 14h. 29m. 10s., and decl. −41° 42′ 59″ (1900). The components are of magnitude 2·5 and 13·5, being yellow and purple in colour. The system is described as extremely difficult, requiring a powerful telescope to see it. The relative positions of the components is given for 1897·051, as pos. angle 270°·1, dist. 5″·65.

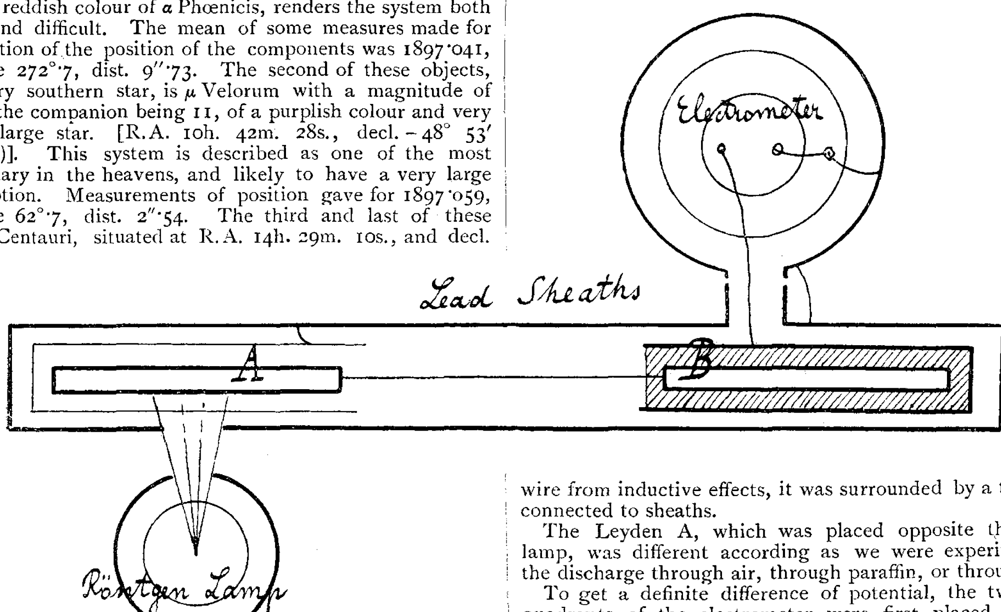
THE COMPANION TO PROCYON.—To those who wish to seek for the companion to Procyon, Prof. Schaerberle's description of the method he adopts (*Astr. Nachr.*, No. 3410) in observing this faint companion will prove of service. Owing to its very close proximity to Procyon, the companion can only be seen when the observing conditions are at their best. If a good objective be employed the aperture should not be reduced, but a cap fitted over the eyepiece is found most serviceable. For Prof. Schaeberle's measures an eyepiece magnifying 500 diameters was employed, the aperture of the cap over the eyepiece being about 1·6 millimetres. The magnitude of this companion is estimated as fully equal to a twelfth-magnitude star, and when the seeing is good it is "as easily and accurately measured as the satellite Phobos when Mars is in opposition." Sirius' companion is estimated as being two or three magnitudes brighter than that of Procyon, and is also being regularly observed at the Lick Observatory, the same means—namely, cap over the eyepiece—being employed.

ON THE INFLUENCE OF RÖNTGEN RAYS IN RESPECT TO ELECTRIC CONDUCTION THROUGH AIR, PARAFFIN, AND GLASS.[1]

WE have in previous papers described experiments respecting electric conduction when Röntgen rays fall on metals, positively or negatively electrified to potentials of two or three volts. We found that although air is rendered conductive, paraffin and glass are not rendered sensibly conductive when the differences of potential concerned are not more than two or three volts per centimetre of air, or per centimetre of paraffin, or per half-millimetre of glass.

We have now to describe an extension of the investigation to much higher voltages, in which we use an arrangement of two (quasi) Leyden jars, A and B, with their inside coatings connected together. The outside coating of A was connected to sheaths, the outside of B to the insulated terminal of the electrometer. In all the experiments to be described, B remained the same.

It consisted of a cylindrical lead can, 25 cms. long, 4 cms. diameter. A metal bar about 1 cm. diameter, 25 cms. long, was supported centrally on paraffin filling the whole space between it and the containing lead. This metal bar was connected by a wire to the internal coating of A. To protect this



wire from inductive effects, it was surrounded by a tube of lea connected to sheaths.

The Leyden A, which was placed opposite the Röntgen lamp, was different according as we were experimenting on the discharge through air, through paraffin, or through glass

To get a definite difference of potential, the two pairs of quadrants of the electrometer were first placed in metallic connection. Then one terminal of a battery or of an electrostatic inductive machine was connected to the internal coatings of the jars, and the other terminal to sheaths. The difference of potential produced was measured by a multicellular voltmeter in the case of differences under 500 volts, and on a vertical single vane voltmeter for higher differences.

When the desired difference of potential had been established, the metallic connection of the battery or electric machine with the internal coatings of A and B was broken, and this charged body left to itself. To find the loss due to imperfect insulation, the pair of quadrants in metallic connection with the outside coating of B was insulated in the ordinary way, and the deviation of the electrometer reading from the metallic zero per half-minute was observed. To find the loss when the rays were acting, the two pairs of quadrants were again placed in metallic connection, the Röntgen lamp set a-going, then the pair of quadrants connected to the outside coating of B was insulated from the other pair, and the deviation from metallic zero again observed per half-minute.

In the experiments with air, the Leyden A consisted of an aluminium cylinder, 16 cms. long, 3 cms. in diameter. This cylinder projected beyond the lead tube, and was connected to sheaths. The insulated metal inside it, which was a flat strip

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

of aluminium, about 10 cms. long and $1\frac{1}{2}$ cms. wide, cut from the same sheet as the surrounding aluminium tube, was supported at one end by a small piece of paraffin so placed as to be out of reach of the action of the Röntgen lamp. The rays from the lamp were allowed to pass from a lead cylinder surrounding it by a small hole about ·3 of a square cm. in area. They fell on the aluminium sheath transparent to them, and rendered the air between it and the insulated aluminium within conductive.

We tried various differences of potential, ranging from a few volts to 2200 volts. In one series of experiments we charged the insulated metal to $-97 \cdot 5$ volts, and then disconnected the battery electrodes. The lamp was then set a-going, and the electrometer deviation taken each half-minute for a minute and a half with one pair of quadrants insulated. The rays were then stopped, the quadrants metallically connected, and metallic zero again found. Then the reading during another period of one and a half minutes, with the rays acting, was observed, and so on until no deviation from the metallic zero of the electrometer was found with one pair of quadrants insulated, and the rays falling on the aluminium outside coating of the Leyden A. The sensibly complete discharge thus observed took place in about a quarter of an hour. We found that the rate of deviation from the metallic zero was the same as the difference of potential fell from $-97 \cdot 5$ volts to about -4 volts. With differences of potential of -930, -1750, and -2000 volts the rate of deviation was not appreciably greater than with ± 20 volts.

This confirms and extends, through a very wide range of voltage, the interesting and important discovery announced by J. J. Thomson and McClelland, in their paper in the Cambridge Philosophical Society *Proceedings* of March 1896, to the effect that the conduction of electricity through air under influence of the Röntgen rays is almost independent of the electric pressure when it exceeds a few volts per centimetre.

In the experiments on paraffin, the outside coating of the Leyden A consisted of an aluminium cylinder 27 cms. long, 4 cms. diameter, connected to sheaths. A metal bar about $1 \cdot 75$ cms. in diameter, and 30 cms. long, supported centrally on paraffin filling the whole space between it and the aluminium sheath, constituted the inside coating. With this arrangement we made experiments with differences of potential of ± 94, ± 119, ± 238, -2000, $+2500$, and -2400 volts. At none of these potentials did we find any perceptible increase of conductance produced by the Röntgen rays above the natural conductance of the paraffin when undisturbed by them.

In the experiments with glass, the Leyden A consisted of a glass tube silvered on the inside. The inside silvering was placed in metallic connection with the inside coating of B. That part of the glass tube which projected beyond the lead sheath was covered with wet blotting-paper connected to the sheaths. We observed the behaviour of glass under the Röntgen rays at differences of potential of $+800$, $+1500$, $+2000$ volts. We found no indication of increased conductance due to the rays at these voltages.

We are forced to conclude that the experiments described by J. J. Thomson and McClelland do not prove any conductance to be induced in paraffin or glass by the Röntgen rays. It seems to us probable that the results described in their paper —pages 7 and 8—are to be explained by electrifications induced on surfaces of glass or of paraffin in contact with air rendered temporarily conductive by the Röntgen rays.

THE INTRODUCTION OF BENEFICIAL INSECTS INTO THE HAWAIIAN ISLANDS.[1]

FEW countries have been more plagued by the importation of insect pests than the Hawaiian Islands; in none have such extraordinary results followed the introduction of beneficial species to destroy them. By far the most conspicuous of the former class, and hitherto the most injurious, have been the scale-insects. The number of species of this group, which have spread throughout the islands, is remarkable, and not less so the enormous multiplication of individuals of many or most of these species.

The first importation of *Coccinellidæ* to destroy these hordes was made in 1890, when *Vedalia cardinalis*, Muls., a native of Australia, was sent over by Mr. Albert Koebele. At that time many trees were in a deplorable condition from the attacks of *Icerya*, monkey-pod trees being particularly badly infested—so much so that they were being largely cut down, as the only resource. The *Vedalia* was a complete success; it became perfectly naturalised, increased prodigiously for a time, practically cleared the trees, and then, as the *Icerya* became comparatively scarce, decreased in numbers; while at the present time it is evident that the number of the scale and its destroyer has arrived at a fixed proportion. Previously to its introduction here the same ladybird had done excellent service in the fruit orchards of Lower California.

The complete success of this first experiment was followed by the engagement of Mr. Koebele by the Hawaiian Government and planters for a term of years, to contend against other plagues no less serious than the *Icerya*. The wisdom of this course cannot be too highly commended, when compared with the indifference shown by the countries similarly circumstanced, and is a set-off against the reckless importation of infected plants which had been allowed in former years. Mr. Koebele, after seeing the wants of the country, with his unrivalled knowledge of the habits of *Coccinellidæ*, introduced numbers of other species in 1894, many of which, no doubt, failed to establish themselves, while a considerable number (how many is yet uncertain) have become completely naturalised, and done splendid service.

Before mentioning these, it may be said that the two chief products of the islands are sugar (which until lately has been far the most important export) and coffee, the cultivation of which has lately enormously increased. There is also a considerable amount of fruit grown; and this, too, is lately increasing. All these industries have been continually threatened with destruction from imported insects. The Rev. T. Blackburn, who studied the insects of the islands during six years—now nearly twenty years ago—wrote that the fruit trees were afflicted with incurable blight. Coffee plants were introduced in 1825. Its cultivation formed quite an industry in the middle of the century on Kauai, where only it was systematically cultivated; its growth was finally abandoned there in 1856, owing to the ravages of blight, said to have been imported in 1850. The sugar-cane has been, and is, attacked not only by scale-insects and *Aphides*, but by several other creatures of quite different orders.

To return now to the ladybirds: one of the most useful has been *Coccinella repanda*, Thun. (from Ceylon, Australia, China, &c.) which feeds on *Aphides*. The services of this species cannot be over-estimated. On Kauai recently the cane was so much attacked by an *Aphis* as to cause considerable alarm. On visiting the locality the *Coccinella* was found to be already present, breeding in such numbers as to leave little doubt that the plants would be soon cleared. On the same island, on another occasion, I saw the fruit trees (especially orange and lime) in a beautiful garden in a most deplorable condition from the attacks of *Aphis* and scales. Very few ladybirds could be found after a careful search. The owner was for spraying the trees, but, seeing their condition could not be much worse, I advised him to wait and give the beetles a chance. In a few weeks these were swarming; and when I returned, after six months, the infested trees were all in perfect condition, full of fruit and flower. Not less numerous than the preceding is a *Cryptolæmus* (*C. montrouzieri*) introduced from Australia, and thoroughly naturalised. It attacks the highly injurious species of *Pulvinaria*. When I visited the Kona district of Hawaii in 1892, many of the trees were literally festooned with the masses of this pest, and appeared on the point of being totally destroyed. In 1894 the ladybirds were sent there, and very soon had entirely changed the condition of things, and the affected trees speedily recovered. To show the vast increase of this species of ladybird, I may state that in June of the present year, many large trees in the city of Honolulu had several square feet of their bark entirely hidden by the larvæ, which formed great white masses, presenting such an extraordinary appearance that I much regret not having obtained photographs of some of the trees. At the present time this species and *Coccinella repanda* are far the most conspicuous and abundant of the introduced *Coccinellidæ*, either of them far outnumbering even the most abundant native insects. Their wide distribution is remarkable, for not only are they all over the lowlands, but throughout the mountain forests as high as four or five thousand feet above sea-level; indeed, the *Coccinella* is still higher up beyond the limits of

[1] Notes on the result of introducing predatory and parasitic insects into the Hawaiian Islands for beneficial purposes. Communicated by the Secretary of the Committee, appointed by the Royal Society and British Association, for investigating the Fauna of the Sandwich Islands.