

supplement the device with oral instruction. Thus it has come about that in the vicissitudes of savage existence all those who possessed the knowledge of how to use these world charts in the southeastern voyage to the Gilberts have vanished without communicating to others their knowledge. The old construction is repeated on all modern charts, even though it is no longer of use.

In the other direction the additional information has been handed down unimpaired, and the Caroline voyage is frequently made. This has been particularly the case in recent years since the Marshall Islanders have acquired various sloops and schooners from white men and are able to make such a long voyage with greater profit and comfort than in their aboriginal canoes.

Of the group charts there is an abundant supply for the home archipelago in its two chains, as of course is only to be expected. There are also charts of the Caroline Islands designed to be used after the landfall has been made on the world chart. Probably there no longer exist in the archipelago itself any specimens of the chart for the Gilbert Islands. After the knowledge of the Gilbert voyage had perished, the detailed chart of that group became useless. Traders and naval officers visiting the islands and seeking to buy charts as curios would be accommodated from those which had outlived their usefulness. Most of such purchases brought back from the land of savage peoples become rubbish at home and are destroyed. But some of these charts have found their way into museums in Europe. Neither in the Gilberts nor in the Carolines have the people the slightest knowledge of the art of navigating by means of these charts, whether general or of their own group.

According to the method of the Marshall Island pilots, the use of these stick charts lies in comparison with the sea, for each corner of intersecting sticks represents a corner in the sea. In practical operation the pilot takes his place in the bow of the vessel. The chart is laid out flat in some place where he can conveniently refer to it, and is lashed or weighted down in such a way that the stick along which the vessel is sailing is brought into alignment with the course. The pilot devotes his whole attention to the sea, and when some important point is about due or expected all aboard who have the wisdom of the charts give him the benefit of their assistance in identifying the particular point in the empty water. In doing this they aid the sight by tasting the water. When the corner in the sea has been reached the pilot refers to his chart, and in accordance with what he sees there gives directions whether to continue along the same course or go on another one, and the position of the chart is adjusted to conform to the new direction.

Now, what is this corner in the sea that the islander can see, and even taste? Frankly, it is impossible to tell. It is certain that the islander sees something there. There is no medicine or magic in it. He is ready and anxious to point it out to his white fellow voyager, and is disgusted because you cannot see what is so plain to him. When asked to give an explanation, his stock reply is a comparison with two paths on the beach. You are on one path and you come to another which intersects it. If the new path is your road to destination you turn and follow it in the proper direction. So at sea you watch until you come to the intersection of the paths, which is perfectly clear to him to see; and dependent on your ultimate destination you keep on your own path or turn off to the new one. Others make reference to two streams of water which come together and form one; if you are going up the stream you have no difficulty in seeing where the two forks come into one.

This certainly sounds absurd. No one familiar with the sea can imagine any such system of paths and rivulets recognizable within it. Absurd, irrational, impossible, this may be argued to be all of these. Yet the fact remains, none the less, that by watching these corners in the sea, this race of hardy navigators has been able to find its way over thousands of miles of sea without the use of any instruments besides the network of sticks, with its shells and beads. That such is the case does not rest on the word of mere beach-combers of the South Sea, but has been proved by naval officers who have been piqued to confess the existence of something in navigation which with all their scientific training they could not explain. That there is no humbug on the part of these native pilots, appears very plainly in their conduct when it happens that they have lost a corner. They waste no time in a search which they know would be vain. They stand away westward until some land is sighted. This gives them a new departure; they are once more on their chart and may proceed on the interrupted voyage.—Forest and Stream.

CONTEMPORARY ELECTRICAL SCIENCE.*

ATMOSPHERIC ELECTRICITY.—The general result of atmospheric observations to date shows that the earth has a permanent negative charge, and the atmosphere a permanent positive charge, which probably balance each other and make the earth act outwardly as a neutral body. The positive charge is greatest in the case of fog, which probably prevents a great number of the heavier positive ions from reaching the surface of the earth. The source of the ionization may be the ultra-violet light of the sun, but H. Geitel prefers to seek it in the spontaneous ionization of the air. The negative ions, many of which are, no doubt, free electrons, reach the earth's surface sooner on account of their superior mobility, and the negative charge thus imparted to the earth is kept from growing indefinitely by the repelling action exerted by it upon the negative ions. But when the negative ions are formed below the surface, as, for instance, in a forest or a landscape covered with vegetation, the earth's field is unable to exert this repelling action, and hence the ionization of the atmosphere is encouraged by vegetation. The conductivity of the air is greatest where the air is purest, i. e., on mountains or in high latitudes, on account of the superior mobility of the ions in pure air.—H. Geitel, Hamburg Scientific Congress, 1901.

TREATMENT OF TUBERCULOSIS.—G. Kaiser has attained some remarkable results by treating pulmonary consumption and other diseases with pure blue light. He finds that the bacilli of tuberculosis are killed off in about 30 min. by the light of an arc lamp concentrated through a lens containing methylene blue or through glasses giving blue light of equal purity. The liquid lens is preferable, as it absorbs all the heat rays, but then a constant circulation of liquid must be maintained through the lens. These rays are capable of penetrating the human body, as was proved by taking a print of a negative tied to the back of a patient who was illuminated with blue light in front. It is, therefore, possible to reach the bacilli in the lungs and to kill them all with blue light. Two patients treated at an advanced stage by this method showed a great improvement after six days, and the author is about to carry out further experiments on a large scale. Incidentally, he mentions that blue light diminishes pain, and acts as a mild anæsthetic, but it must contain none of the rays of the red end of the spectrum.—G. Kaiser, Wiener Klinische Wochenschr., No. 7, 1902.

IONIC INDUCTION.—Mrs. Ayrton describes some experiments which may, perhaps, be fitly designated by the above title. They consist in the discharge or charge of an electroscope by means of a charged body placed at a distance. The most striking experiment of the series was performed as follows: A positively charged glass rod was brought to within 200 cm. of an uncharged electroscope. A candle, also positively charged, was placed between the rod and the electroscope, but nearer to the rod. The leaves then diverged, and the electroscope was found to have acquired a positive charge. In another experiment the candle and the electroscope were placed 150 cm. apart and a negative charge given to the electroscope. Result—no leakage. A glass rod was then rubbed, brought up to the candle on the side remote from the electroscope, and then withdrawn. When this had been done several times the leaves began to collapse, and collapsed in jerks, each time the rod was excited, brought near the candle, and withdrawn. The collapse appeared to take place at the withdrawal of the rod. The same results were obtained by charging the electroscope positively and bringing rubbed sealing wax up to the candle. The further the distance of the two apart, the longer was it before the leaves began to collapse and the slower was the collapse when it began. The authoress also found that a red-hot platinum wire is capable of discharging an electroscope at a distance of 300 cm. The candle in the above experiments could also be replaced by an insulated saucer of cotton wool, saturated in turns with ether, methylated spirit and dilute sulphuric acid placed at a distance from the electroscope, but not by dry carbon dust.—H. Ayrton, Nature, February 27, 1902.

RADIO-ACTIVE LEAD.—From a large quantity of the mother-liquor of barium-radium bromide, resulting from the technical working of about 2,000 kg. of uranium ore, F. Geisel separated (by means of ammonia and consequent purifying with sulphuric acid) about 3 milligrammes of an intensely radio-active substance which behaved like lead, and resembled preparations of radium in its action (compared on the phosphorescent screen). After a year had elapsed it still exhibited strong radiation. The author therefore asked M. Demargay to undertake an exact spectroscopic examination of the residue after treatment with concentrated hydrochloric acid. The examination showed that the spectrum was principally that of lead. Iron, magnesium, and the few other metals were also present, but lines of radium were absolutely wanting. Two new lines were found at 4116.8 and at 3659.6 respectively, both extremely weak. The latter may also be a line belonging to either iron or air. The author inclines to the belief that the lead owed its radio-activity to the quantities of radium with which it was associated in the original ore. He maintains that the "radio-lead" described by Hofman and Strauss is different from the substances now described, as it shows a different spectrum and has not as great a radio-activity.—F. Giesel, Chem. News, February 21, 1902.

ELECTRICITY IN DENTAL SURGERY.—The employment of anæsthetics in dental operations is open to the objection that the risks or inconveniences incurred by the patient are out of proportion to the gravity and pain of the operation. Even local anæsthetics, such as cocaine or ethyl chloride, introduce undesirable elements into the circulation, and ice as a local anæsthetic is usually insufficient. L. R. Regnier and Henry Didsbury therefore advocate the use of D'Arsonval's high-frequency electric currents for purposes of painless dentistry. The current is applied through a molding of the part to be rendered insensate. The interior of the molding is covered with metallic powder and a layer of tinfoil. To absorb the heat produced by the current the tinfoil is further covered with a layer of asbestos paste. The statistics of cases dealt with are very encouraging. In 15 cases of extraction of teeth with one root there were 13 cases of complete anæsthesia. The patient is enabled to follow the whole operation of removing the teeth in a waking condition, and a nervous patient will sometimes make some gesture of defense, but will admit afterward that he felt no pain. The authors have also successfully applied the method to other dental operations.—Regnier and Didsbury, Arch. d'Elect. Médicale, February 15, 1902.

IONIZATION OF LIQUIDS BY RADIATION.—P. Curie has made the important discovery that radium rays and Roentgen rays are capable of imparting a conductivity to a liquid dielectric. The liquid is placed in a metallic vessel into which a tube of thin copper is plunged. These two metallic pieces serve as electrodes. The vessel is maintained at a positive potential by means of a battery of small accumulators, one pole of which is put to earth, while the tube is connected with an electrometer. This tube is also surrounded by a guard tube to prevent any current traversing the air. A small vessel containing a radium preparation can be placed at the bottom of the inner tube. The rays act upon the liquid after traversing the glass wall and the wall of the copper tube. When working with Roentgen rays, the latter are made to enter through the bottom of the copper vessel con-

taining the liquid. All liquid dielectrics show an increase of conductivity by the action of both kinds of rays, but to prove this increase it is necessary that the original conductivity of the liquid should be small. Both classes of rays give effects of the same order of magnitude. As in the case of gases, the current remains proportional to the tension up to a certain limit, but this limit is much higher in the case of liquids than in the case of gases. It is, in fact, difficult to prove the existence of the saturation phenomena observed in the case of gases, as there is no sign of saturation below 450 volts. But if the ionization is lowered by employing much more feeble rays it is found that the proportionality between difference of potential and current is no longer maintained, and that some kind of saturation is indicated, as in the case of gases. Vaseline oil is much less sensible to the action of the rays than petroleum ether. Liquid air which has boiled for some time in the vessel is more sensitive to the rays than liquid air which has just been poured in. The conductivity due to the radiation is reduced by only 10 per cent in passing from a temperature of 10 deg. to -17 deg., and no effect whatever is produced by lowering the temperature of the radium preparation, even down to the temperature of liquid air.—P. Curie, Comptes Rendus, February 17, 1902.

A NEW ELECTRIC THERMOMETER.—If the temperature of any region cannot be directly determined with an ordinary thermometer it is usual to employ a thermoelectric couple or a platinum thermometer. These instruments have the advantage of following all the changes of temperature very rapidly. When that is not required, and when for other reasons the instruments mentioned are not advantageous, G. Meslin proposes the novel expedient of employing a Clark cell for determining temperatures. The temperature coefficient of the E. M. F. of the Clark cell is pretty high, being about 0.5 per cent per degree, and the circuit may be so arranged that the observations are made by a null method, and that the temperatures are measured in terms of resistance. In the author's arrangement the principal circuit contains two resistance boxes of about 30,000 ohms, an accumulator, and a double key, which enables the observer to close, first, the principal circuit, and then the derived circuit containing the galvanometer and the Clark cell. The resistances may be so arranged that 1 ohm corresponds to one-tenth of a degree, and fractions of degrees may be accurately measured.—G. Meslin, Comptes Rendus, February 17, 1902.

ELECTRIC DISPERSION IN THE ATMOSPHERE.—A. Gockel has made observations of the dispersion of electric charges in the atmosphere of Southern Algiers and on the coast of Tunis. In general he found a higher coefficient of dispersion in those countries than in Germany, amounting, indeed, to as much as 10 per cent per minute. But the potential gradient was less marked, being only about 35 instead of 100 volts per meter. There was a marked daily variation of the dispersion. Starting at about 3 per cent per minute at sunrise, it increased to 10 per cent in the early afternoon. A minimum of 1 per cent per minute occurred about half an hour before sunset owing to the prevalence of dust and vapor. This was specially marked in the desert, but not at the seaside. A minimum of dispersion coincided as usual with the maximum potential gradient, which rose as high as 150 volts per meter. During a sirocco storm the dispersion on the coast of Tunis reached a very high value. The author does not agree with Elster in thinking that the dispersion in the interior of the continent is less than at the coasts.—A. Gockel, Physik. Zeitschr., February 15, 1902.

INDUCTANCES MEASURED BY THE SPEAKING ARC.—Duddell's experiments have shown that if a continuous-current arc is provided with a derived circuit comprising a condenser of capacity, C , and inductance, L , the arc under certain conditions gives a very pure note, having the period

$$T = 2\pi\sqrt{LC}$$

For capacities of 7 microfarads and feeble inductances, due to the coils of the circuit, the sound obtained is very shrill, and the intensity of the alternating current may attain 20 or 25 effective amperes in the condenser circuit. Under these conditions, P. Janet measures with a thermal ammeter the current intensity, I , in the derived circuit, and with a thermal voltmeter the difference of potential, e , at the ends of the coil. Then, neglecting the resistance of the coil and the inductance of the rest of the circuit, we have

$$I = \frac{e}{L\omega}$$

And further, $\omega = \frac{2\pi}{T}$; and hence $L = \frac{e^2 C}{I^2 T^2}$

The last formula permits the calculation of L by purely electrical methods, and without any acoustic measurements.—P. Janet, Comptes Rendus, February 24, 1902.

SOME ELECTRICAL DEVELOPMENTS.

IN the fourth of his course of lectures at the Royal Institution, Lord Rayleigh began by explaining how Weber's hypothesis that the molecules of a piece of iron are already magnetized, but are lying about in all directions indifferently, and so do not produce any magnetic effect as a whole, is in close agreement with all the observed phenomena. Prof. Ewing has illustrated this by a model which shows clearly why magnetism is not proportional to the magnetizing force, and how the friction of the molecules causes magnetic hysteresis. Some pretty experiments, due to Prof. Elihu Thomson, were shown to illustrate electro-magnetic induction through space. When a coil of wire with its ends attached to a miniature lamp was brought near an electro-magnet, the lamp lit up. Inserting a plate of glass between the magnet and the coil had no effect, but a thick sheet of copper screened off most of the magnetism and caused the lamp to burn dimly. When a ring of aluminium was placed over the magnet and the current turned on, the ring was repelled several feet high by the magnetic repulsion. The lecturer next considered the mechanical

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