THE ELECTRICAL CAUSES OF CHANGES IN THE WEATHER.

BY FREDERICK A. TALBOT.

Prof. Elmer Gates, of Chevy Chase, Md., has conducted a series of experiments which has led him to conclude that our varying conditions of weather are due to electricity. According to the professor, this subtle force produces rain and drought, the changes of air pressure, and the various meteorological disturbances, such as tornadoes and waterspouts, which visit us from time to time.

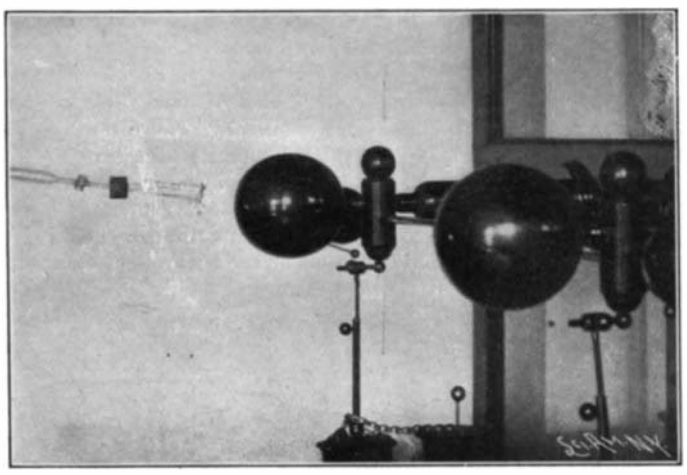
That electricity exerts a powerful influence upon the air pressure is proved by means of a simple experiment. A large fluffy ball of cotton suspended from the ceiling by means of a silken cord and charged with electricity immediately increases in size very appreciably. This expansion Prof. Gates explains as indicative of a low barometer, arguing that the expanding of the ball by charging it with electricity proves that the fibers of the cotton are repelling one another, so that the ball possesses less density. The same result attends the charging of the atmosphere with electricity. The density of the air is diminished, with the result that the pressure is decreased, and the barometer consequently falls.

The presence of electricity, however, in the atmosphere, produces not only low pressure, but high pressure as well. When two opposite masses of air charged with electricity—positive and negative respectively—approach one another, they become denser, with the result that the barometer rises. To prove this, Prof. Gates uses another ball of cotton, suspending it from the ceiling also by means of a silken cord about 2 feet distant from the first ball. In a few minutes the two balls approach each other, both decreasing in size. From this experiment Prof. Gates infers that when one mass of air becomes charged with electricity, a neighboring mass of air becomes electrified with an opposite charge by induction. Thereupon the masses of air gradually approach one another slowly, and decrease the density of the air.

One outcome of these investigations has been the construction of an appliance which Prof. Gates intends to use in forecasting the weather. It is impossible, with the present appliances employed, to predict the barometric pressure until a change has actually occurred; that is to say, until the barometer has either risen or fallen, meteorologists cannot tell us what weather to expect. If the variations of the barometer are the result of electrical influences, Prof. Gates suggests that the electric conditions of the atmosphere should be observed, and by this means foretell at what places and at what time the barometer will be either high or low. The primary object of his contrivance is to measure and to record the amount of electricity in different regions of the atmosphere. The device is to be attached to a small aerial apparatus which soars to the upper strata of air, makes automatic records at various heights, and then returns to the earth. By means of the appliance the professor hopes to glean information of those regions of air about which little at present is known.

That rain is produced by the mingling together of masses of air oppositely charged with electricity, Prof. Gates explains by another simple operation. Two windows on either side of his laboratory were opened. An electrical fan was placed in one window and set in motion for the purpose of withdrawing the air from the apartment. Thus the only air within the room was that which entered through the two windows. The weather outside was clear and bright, though the air was charged with a certain amount of humidity. The two currents of air entered the apartment by either window and mingled together in the usual way, without causing any untoward circumstance. A current of negative electricity was induced into the air entering through one window, and a similar current of positive electricity induced into the stream of air proceeding through the other window. A most remarkable phenomenon instantly occurred. The two oppositely electrified currents of air came into contact, formed a slight mist, and in a few seconds the floor of the laboratory was quite wet. Directly the electricity was switched off the air cleared, only to become misty again whenever the currents were switched on. This experiment was intended to prove that the electrified masses of moisture-laden air, generally termed clouds, when they meet, produce showers. When they are abnormally laden with electricity, lightning and thunderstorms result. If, for example, reverting, the two cotton balls are charged very highly with electricity they jump together with a spark and a snap, then spring apart and come together again with another spark and snap, separate once more, while the charge is maintained. This is practically an illustration of thunder and lightning upon a miniature scale. The spark represents the lightning and the snap the thunder.

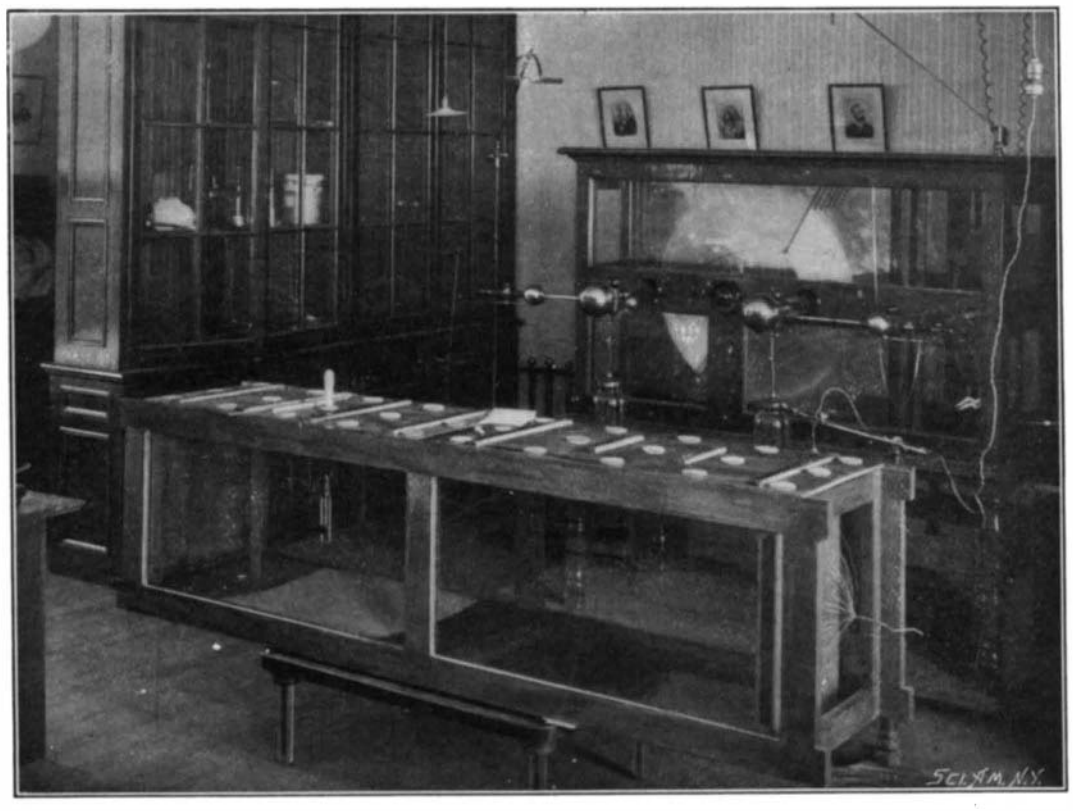
Prof. Gates, in the course of his experiments, also discovered another curious fact. This is the transportation of moisture from one point to another by means of electricity. During a shower of rain it has often been observed that a far greater quantity of



ELECTRICAL ATTRACTION SHOWING HOW CLOUDS MAY BE INFLUENCED BY ELECTRICITY.

rain has fallen in one place than could be possibly contained in the air covering that area. This peculiar fact is explained as follows: While it is raining in a certain spot, moisture from various directions is being conveyed to this special region by electrical energy. To illustrate this transportation possibility of electricity, Prof. Gates has constructed a large glass case about eight feet in length, divided into two compartments by means of a section of thin porous paper. One division is filled with very dry air and the other with air containing a heavy percentage of humidity. A wire leading from the negative pole of a static electrical machine is attached to the compartment containing the dry air, while another wire led from the positive pole is connected to the chamber containing the moist air. When the current is switched on, the moist air is transported from one end of the box to the other in a much shorter time than it would be conveyed by ordinary diffusion.

In addition to producing artificial miniature showers, mists, and thunderstorms, Prof. Gates contrives on a similar scale the more violent eruptions of nature, such as cyclones and waterspouts, with equal facility. To the bottom of an ordinary saucer filled with water a wire is attached, connected with the positive pole of the machine. A small rod connected with the other pole of the machine is held a short distance above the surface of the water. When the current is switched on, the water is agitated, the disturbance increasing in violence as the potential of the current is raised, until presently a cone is formed, rising higher and higher, until it ultimately touches the rod above.



ELECTRICAL APPARATUS BY WHICH EXPERIMENTS ON WEATHER CONDITIONS WERE MADE.

The British Antarctic Expedition.

The present year will be a red letter one in the annals of Antarctic exploration, inasmuch as determined efforts are to be made by the British Geographical Society and the German Government in concert, to unravel a little of the *terra incognita* of that remote region. Owing to its remote distance from the great centers of civilization, the South Pole has not received that attention from explorers which has been bestowed upon the North Pole, for whereas we are only 238 miles from the latter goal, we are yet about 770 miles distant from the South Pole. Yet it is imperative that our knowledge of these southern regions should be extended, in the interests of navigation, since owing to our meager information of the magnetic pole, ships sailing in these southern waters often stray miles out of their course and thus consequently protract their voyages unnecessarily.

The vessel in which the British expedition will set sail was recently launched at Dundee (Scotland), where she was constructed by the Dundee Shipbuilders Company, which makes a specialty of building whalers and other vessels for plying among the Arctic ice. As with the "Fram," in which Nansen set out for the North Pole, the "Discovery" has been specially built for the forthcoming task. In appearance she is a small, ungainly looking vessel, 178 feet in length, though she possesses fine lines. She is built of timber throughout and special attention has been devoted to the strengthening of her sides to enable her to resist the enormous ice pressure she will encounter. Her framing is constructed of Scottish oak, and where she will be subjected to the maximum pressure, heavy transverse bulkheads are supplied. There is a solid mass of wood 9 feet in thickness in her stem, while her sides amidships are 2½ feet thick. Her outside planking is of hard wood sheathed with greenheart and iron bark. Owing to the peculiarity of her form, when the ice exerts heavy pressure, instead of crushing the vessel, it will gradually lift her up.

She belongs to the auxiliary class of steam vessels, her engines developing only 450 horse power, and she will thus depend mainly upon her sails for progress. She is driven by three propellers fitted with new pattern withdrawing shafts and lifting screws, by which means, whenever an exigency arises, the screw shaft can be withdrawn inboard out of the way of the ice. Her boilers are the best return tube Scotch type. Her coal capacity is only 280 tons, but this is sufficient to carry her 8,000 knots at an average speed of 6½ to 7 knots per hour. She covered the 480 miles between Dundee and London with the consumption of only 14 tons of coal. She carries a steam dynamo and also a windmill dynamo to economize coal.

The internal arrangements of the vessel are as comfortable as possible. There is the usual range of laboratories and workshops incidental to such expeditions, and roomy quarters for the officers and crew. One prominent feature of the interior equipment is a kind of atmospheric lock by which means the raw Antarctic air is prevented from entering the interior of the vessel, when a person enters from the deck. It is a double-door arrangement, and when entering the person first closes the outer door before he opens the one leading into the apartment. To preserve the warmth in the rooms the walls are lined with asbestos. The stoves are provided with talc doors with funnel-like fittings over them, through which the air from the outside enters and is carried over glowing coals to be heated prior to its delivery into the rooms.

All the available space on the deck is occupied with winches, anchors, cables, sounding apparatus, spare propellers, masts, etc. For deep-sea soundings 10,000 fathoms of wire are being carried upon drums. The ship is lighted throughout with electric light. The magnetic instruments carried are of the most delicate description, and to prevent their being deranged no steel or iron

is located within a radius of 30 feet of them. All the rigging forward has in fact been specially made of hemp to prevent any disturbance in this direction. Kites are also being carried for the purpose of conducting the meteorological observations, and there is a possibility of Marconi's wireless telegraph system being installed.

The total cost of the expedition is $500,000. Sir Clement Markham, President of the Royal Geographical Society of Great Britain, who is himself an experienced Arctic explorer, was mainly responsible for the inauguration of the expedition. When he first promulgated the scheme he advocated its being carried out entirely by the Government, but this was found to be impossible. The latter, however, finally agreed to subsidize it to the extent of $225,000, the balance of the sum being defrayed by public subscription. A large amount of this has already been forthcoming. The expedition will be absent for three years, and the annual cost of maintaining it will be $100,000.

The leader of the expedition is Capt. R. F. Scott, of the Royal Naval Reserve. The officers and crew will in all number forty-five, an excess of fifteen over the strength of the German expedition.

The South Polar regions have been divided into four quarters or quadrants, named respectively, Victoria, 90 deg. to 180 deg. east; Ross, 180 deg. to 90 deg. west; Weddel, 90 deg. west to 0 deg., Greenwich Meridian, and Enderby, 0 deg. to 90 deg. east. The British expedition will explore the Victoria and Ross quadrants and the Germans will explore the Weddel and Enderby sections. Both expeditions will start simultaneously from Melbourne in the latter part of this year.

COKE MAKING IN THE CONNELLSVILLE REGION.

Of the coke industry it may be truly said that it has revolutionized the iron and steel trade of the world. To-day this great fuel industry ranks with the great industrial enterprises in which fame and fortune have been won. Coke-making, as now carried on in many States and Territories, had its birth in the Connellsville region of southwestern Pennsylvania. The originator of this industry never dreamed of the far-reaching effect it would eventually have on the iron and steel industries. To-day its effects are universal. Less than half a century ago the successful manufacture of coke in western Pennsylvania shifted the pig-iron industry to Pittsburg, and thus laid the foundation for that city's present industrial greatness.

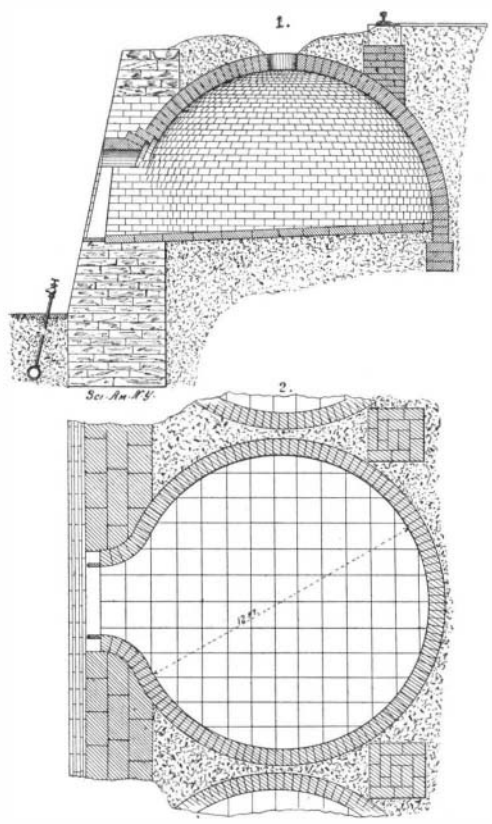
The Connellsville coking-coal seam embodies some peculiar geological conditions. It is a detached portion of the Pittsburg coal basin, and extends along the western slope of Chestnut Ridge, the westernmost range of the Alleghanies, from Latrobe, Pa., on the main line of the Pennsylvania Railroad fifty miles east of Pittsburg, southward into Maryland and West Virginia. Its average width is not more than four or five miles, and the region contains something over 100,000 acres, its borders having been somewhat extended during the past year or two through the introduction of improvements in the coking processes, whereby the production of a good quality of coke is made possible from the coal lying on the borders of the main coking field.

In the Connellsville region the standard bee-hive oven, the type now in general use, has a diameter of from 10 to 12 feet, and a height of from 6 to 8 feet, and is built of fire-brick or stone. It is arched in the interior, and has an opening in the top for charging and for the escape of the gases during the coking process, and a door in the lower front side through which the finished product is "drawn," this door being closed during the coking process. The average charge of coal per oven is from three and one-half to four tons, the heavier charge requiring more time for the coking process. When the charge is leveled it has a depth of from two and one-half to three feet in the oven, thus leaving sufficient room for the accumulating gas and for the expansion and rising of the coke during the processes of its manufacture. It is the practice to charge every other oven each day, and the charge is ignited by the heat retained in the walls of the ovens. The ignition is indicated by a puff something like a powder explosion. For twenty-four hours the gas is allowed to escape, and then the oven is closed up. Furnace coke in general use requires forty-eight hours for the coking process, while foundry coke is a seventy-two hour coke. The last twelve hours of the coking process are usually consumed in cooling. Pure water is essential for coke cooling. The object is to expel the water, hydrocarbons and the sulphur, and leave a fixed residuum of ash, carbon and such of the sulphur as cannot be driven off during the coking process. Should the water used in cooling the coke contain sulphur or other deleterious substances, these would be readily absorbed by the coke, and would injure the iron or steel manufactured with such coke.

The operation of the bee-hive oven is extremely simple. Nevertheless there have been numerous improvements in the ovens erected during the past two years, and especially is this the case in the coking fields adjacent to the Connellsville region, but not strictly in the main coking district. These new ovens are larger in size, have improvements in the way of draft, and electricity enters largely into their operation. The mines which supply these new ovens are lighted with electricity, electric mining machines are used, and electric haulage shaft and tipple operations have been largely introduced. Electricity has supplanted the old "Larry" for the purpose of charging the ovens, and electric and automatic coke-drawers and car-loaders have supplanted hand labor. One great trouble with the bee-hive oven is the impossibility of obtaining by it an absolute uniformity of the product.

To improve the process of manufacture, larger charges and increased natural air drafts have been employed, but with no decided results. The bee-hive ovens erected during the past two years are somewhat larger in size than the old ovens. There have also been various minor changes. In the bee-hive oven the mass of coal, as it fuses into coke, swells and rises. If, on quenching, it falls back to its original bulk, it makes a hard coke; if not, a soft coke is the result. There is also a lack of uniformity of porosity which is necessary to give toughness and hardness to a furnace or foundry fuel.

The general reduction of the coking industry to a science awaits the introduction of the by-product coke oven wherein the coal is coked in an airtight chamber and an absolute uniformity of the product is assured.



SECTION AND PLAN OF BANK OVEN.

In Number 1108 of the Scientific American Supplement the writer gave something of the progress of these ideas up to that time, together with a comparison of the economy which would result from the introduction of this coking system. So here it will suffice to say that the coke yield under the by-product system would be 73 per cent of the coal charge against 66 per cent by the bee-hive system. The resultant economy through the utilization of the by-product would amount to at least sixty cents for each ton of coal coked, and for the 20,000,000 tons coked in the Connellsville region during 1900 the by-products which are now a total waste would represent $12,000,000. However, during these days, when there is such a great demand for coke, there is not likely to be any great progress by these new coking ideas.

One of the features introduced into the coke business by the H. C. Frick Coke Company is coke crushing. This company has now in operation three great crushers, each having a daily capacity of 2,000 tons. The coke is crushed into sizes corresponding to anthracite coal and is shipped all over the country for various manufacturing and domestic purposes. This and other firms manufacture a special seventy-two-hour foundry coke which combines to the highest degree the requisites of a foundry fuel.

During the past twenty years there has been a wonderful railway development in the region, and to-day the numerous roads in this district are the most profitable in the country. The coke shipments by the Pennsylvania, the Baltimore and Ohio, and the Pittsburg and Lake Erie lines of the Vanderbilt system at present exceed 200,000 tons weekly. The past year has been the most prosperous in the history of the coking industry, the output of this region having exceeded 15,000,000 tons. Over 8,000 new ovens have either been completed or were in the course of construction during the year and many million dollars have been expended in the further development of the region. Since the birth of the coke industry here in the Connellsville region the industry has been established in twenty-six States and Territories, but this region still retains its pre-eminence.

Traveling Beehives.

California is an ideal home for apiculturists, and one of the most progressive bee-keepers, noticing that the activity of the insects depended upon the coming of spring flowers, conceived the idea of assisting them to set out earlier on their yearly campaigns. The orchards of the Sacramento and San Joachim valleys burst into bloom some months before the southern sage brush, and to them Mr. Graham drove a wagon-load of bee colonies late in January, 1896, says The New York Tribune, to which we are indebted for our information. The journey was an easy one, as the bees had not really aroused themselves. In February the fragrance of the trees stimulated them, and they set to work. As the blossoms faded in April, Mr. Graham turned southward again. He traveled by night only, and reached home with practically full colonies, a honey crop of one hundred pounds to each hive, and the sage brush was still open before him. The following two years he moved two wagon-loads of colonies, and he was able to obtain three distinct crops of honey, keeping the bees active during nine months of the year. Since 1899 Mr. Graham has shipped the bees by car-loads from one feeding ground to another. He has had built from his own designs a wagon the size of a common flat-car and a crate that exactly fits this wagon. At night he loads the colonies in the crate, about 300 in each, and at the railroad station slips the crate upon the flat-car. Then the wagon is taken apart and all are shipped to their destination. On their arrival, again under cover of darkness, the crate is slipped from the car to the readjusted wagon, and the colonies are wheeled off and established in their new feeding ground. Mr. Graham scatters the bees around the fruit region in the proportion of about a hundred colonies in an area of five square miles, and pays a certain ground rental for the season. As the bees help pollenize the flowers and thus produce a superior fruit, the owner of the orchard is reaping an equal benefit with the apiculturist, if not a greater one. One raiser of alfalfa in Southern California estimates so highly the help of the bees that he invited the bee-keeper to locate permanently on his farm, sharing the profits of his hay. The partnership was continued for several years and both are well satisfied with the results.

In addition to outfits for transferring the bees Mr. Graham takes with him a regular camping wagon and all the apparatus for extracting honey from the comb. When the combs are full the equipments for straining are placed in the camping wagon. The honey is strained, and shipped to the market from the nearest railroad station. Among the fruit blossoms and the spring wild flowers the bees take about fifteen days to fill their combs, and during that season they produce about one hundred pounds of strained honey to a colony. In the sage brush the combs are filled within ten days, and each colony gives about two hundred pounds in the season.

Meteorology of London.

The annual report of the Greenwich Observatory, published the 1st of June, contains the following figures relating to the meteorology of London. The mean temperature for the year has been 10.3 deg. C., or 0.6 deg. above the normal (9.7 deg.) of the period of 50 years from 1840 to 1890. From May 1, 1900, to April 30, 1901, the absolute maximum observed at London has been 34.4, 33.2 and 34.1 deg., measured on the same day (July 16) at three different stations. This maximum has not been reached in the month of July since 1881, and since 1841 it has only been exceeded twice, namely, the 15th of July, 1881 (36.2 deg.), and the 22d of July, 1868 (35.9 deg.). During the last 60 years the mean temperature for the month of July, 19.2 deg., has only been exceeded four times; in 1852 (19.4 deg.), in 1859 (20.1 deg.), in 1868 (20.1 deg.) and in 1876 (19.3 deg.). December has been exceptionally warm, having a mean temperature of 7.6 deg., which is 3.3 deg. more than the average of the 60 years preceding. It has, however, been exceeded three times during this period; 8.7 deg. in 1852, 7.8 deg. in 1868 and 7.7 deg. in 1898. The minimum, —6.5 deg., was observed on the 14th of February. The thermometer fell below 0 deg. C. during only 47 days, which is much below the average number. Mean speed of the wind has been 20.4 feet per second, slightly above the average for the 33 years preceding. The sunshine record, measured by the Campbell-Stokes heliograph, is 1,513 hours for 4,457 hours during which the sun was above the horizon, or 34 per cent. The total rainfall is the lowest since 1894; or 20.1 inches in 151 days, this being less than the average for 50 years by 4.3 inches.