SIMPLE EXPERIMENTS IN PHYSICS.

BY GEO. M. HOPKINS.

As a means of illustration, nothing can excel projection by means of a good optical lantern. Not only can pictures and diagrams be shown clearly to a large assemblage, but apparatus of various kinds may be pro-

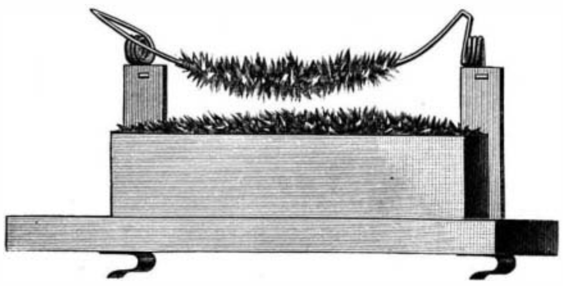

Fig. 1.—ARAGO EXPERIMENT.

jected on a mammoth scale, many chemical actions may be exhibited, the phenomena of light, heat, electricity, and magnetism may be shown in various ways. In fact, there is scarcely a branch of physics that may not be illustrated in this way. The lantern is becoming deservedly popular in colleges and schools and for private use. Besides being of great use for general instruction, it affords a means of rational amusement and entertainment.

A poor lantern, like any other inferior piece of apparatus, is undesirable. An instrument for scientific work should have a triple condenser, a rectilinear objective, a swinging front for the vertical attachment, a calcium or electric light, polariscopic and microscopic attachments, an erecting prism, and an alum or water tank. Such an instrument may now be purchased for a reasonable price, so that there is no economy in making one's own instrument. It will, however, be found advantageous to make the attachments.

A simple way of illustrating Arago's experiment showing the magnetizing effect of an electric current

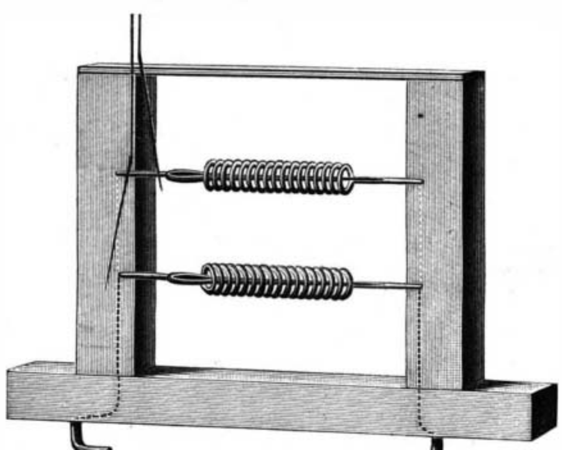

Fig. 2.—MAGNETIZATION BY MEANS OF SPIRALS.

on soft iron, is represented in Fig. 1. The lantern to which this and other pieces of apparatus are adapted is provided with two rods projecting from the front of the instrument and connected with binding posts, which in turn are connected with a battery or dynamo. The base of this apparatus is furnished with spring clips for engaging the conducting rods of the lantern. To the upper ends of two posts rising from the base are attached the extremities of a copper wire, which is bent into spirals at its fixed ends. The wire is bent twice at right angles, and is curved downwardly between the arms extending from the spirals. The ends of this wire are connected with the clips. On the base below the curved part of the wire is placed a box well filled with iron filings. The box and the wire are projected on the screen, an erecting prism being used. The wire is pressed downward into the filings and withdrawn before the current passes, to show that the wire, uninfluenced by the current, is not able to lift the filings. The current is sent through the wire, when it is again dipped into the filings. This time it will take up a quantity of the filings, as shown in the engraving, each fragment of iron becoming a magnet, which tends to place itself at right angles to the current. When the current is interrupted, the filings fall.

In Fig. 2 is represented a device for showing the magnetizing effect of a helix, also the different results secured by helices wound in opposite directions. The frame is provided with metal clips for attachment to the rods of the lantern, and two helices, which are oppositely wound with respect to each other, are stretched across the frame.

The ends of the helices are connected with the clips, so that the current passes from one clip through both helices, as indicated by dotted lines, to the other clip. The helices are provided with a coating of insulating varnish. A darning needle is placed in each helix, and when no current is passing, a magnetized cambric

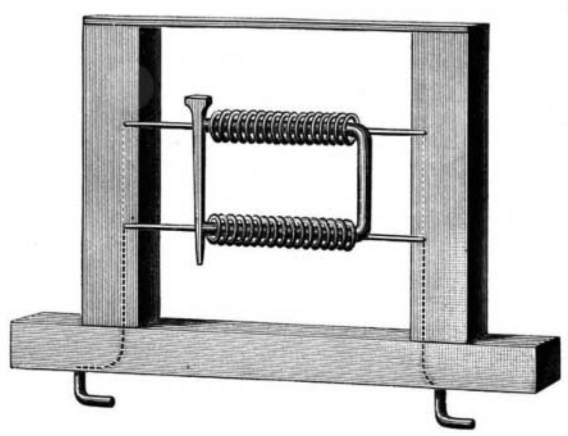

Fig. 3.—STURGEON'S MAGNET.

needle, suspended by a fine thread, is held near the ends of the needles in alternation. It is drawn toward both alike.

After a current has been sent through the helices it will be found that the darning needles are magnetic, but, owing to the opposite winding of the helices, corresponding ends will have opposite polarity, as will be shown by again presenting the suspended cambric needle to the ends of the darning needles. It will be attracted by one and repelled by the other. By placing a U-shaped piece of soft iron wire in the helices, as shown in Fig. 3, the construction of the first electro-magnet (Sturgeon's) is clearly illustrated. In Fig. 4 is shown a device for projecting the incandescent lamp. It is suspended from two conductors, and its image is thrown upon the screen with a dull light which is just sufficient to clearly show the outline of the lamp and the black carbon filament. A current is then sent through the lamp, when the filament becomes incandescent and shows as a brilliant arch on the screen, while all of the parts of the lamp are distinctly visible.

In Fig. 5 is shown a method of projecting the electric arc which has the advantage of showing the carbons before the arc is formed, and also of rendering them visible during the experiment. The lamp consists of two wire carbon holders attached to a wooden standard and connected with the rods of the lantern, as in the cases before described. The carbons are projected with a dim light, showing the crater of the positive carbon and the point of the negative carbon. Then the current is turned on, the carbons are brought into contact and separated, forming the arc, the points soon become incandescent, and the arc light, in full operation, is seen on a large scale on the screen.

These experiments are very striking when seen upon a large screen, the projection of the arc and incandescent lights being particularly interesting.

Our First Imported Locomotive.

In our sketch, in September last, of the venerable octogenarian, Eli Cooper, engineer on the first railway train from Boston to Lowell, it was inadvertently stated that the locomotive, the Stephenson, brought from England in 1834, was the first locomotive im-

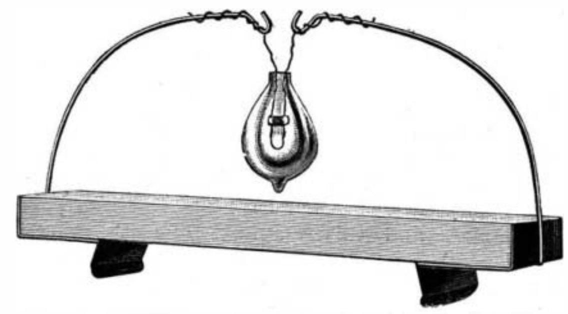

Fig. 4.—INCANDESCENT LAMP ARRANGED FOR PROJECTION.

ported. The Stourbridge Lion, which is reported as having made but one trip, had, however, the precedence of the Stephenson by some five years. It was built at Stourbridge, England, and imported by the Delaware & Hudson Canal Company. Horatio Allen, of Orange, N. J., then chief engineer of that company, thus speaks of the trial trip, in a note under date of January 18 last, addressed to Mr. J. E. Watkins, Curator of the National Museum, Smithsonian Institution:

"The locomotive known as the Stourbridge Lion was the first locomotive run on this continent. The occurrence took place at Honesdale, Pa., August 9, 1829, on the mine railroad of the Delaware & Hudson Canal Company. The locomotive was one of three built for that company in England, in 1828, under my direction as to plans, which were received in the city of New York early in the year 1829. Through circumstances not necessary to state, I ran the locomotive myself—a responsibility I had never undertaken before and have

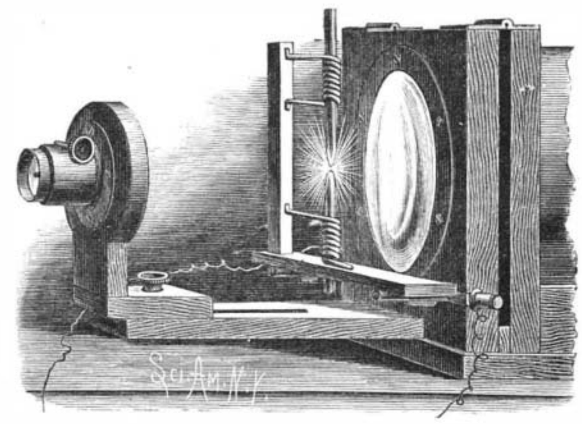

Fig. 5.—PROJECTION OF THE ARC.

never repeated since. Thus on this first movement by steam on railroads on this continent I was engineer, fireman, brakeman, conductor, and passenger."

EXPLOSION OF A PETROLEUM STEAMER AT CALAIS, FRANCE.

On October 16, a few minutes after nine o'clock in the evening, the usually quiet seaport of Calais was startled by a tremendous explosion. The inhabitants were terribly startled, the shock to the houses being terrific, and many people took to the streets, believing that an earthquake had occurred, windows being broken in all directions, and the gas being suddenly extinguished. It was soon ascertained that the explosion had taken place on board the Ville de Calais, a new vessel of some thousand tons register, which had been built for carrying petroleum between Calais

EXPLOSION OF A PETROLEUM STEAMER AT CALAIS, FRANCE.

and New York, from which place she had lately arrived. For this purpose she had been fitted with various tanks and tubes. She had completed the discharge of her cargo the previous day, and at the time of the explosion water was being pumped into her ballast tanks. It is supposed that the disaster was caused by one of the engineers taking a naked light into the hold in order to examine these tanks, thus igniting the gas which had generated from the petroleum. The wreck of the vessel, the *Times* correspondent states, presented a remarkable appearance. The crew numbered twenty-six hands, but at the time only ten persons were on board. The captain, with his wife and another lady, were in their cabin in the after part of the steamer, and this remained almost intact, as though nothing had happened—the captain never imagining that the accident was so serious until he came on deck. The rest of the ship, with the exception of a small part of the forecastle, was blown into the air, and scattered in all directions, while the sides of the vessel were blown clean away. Some heavy pieces of machinery were hurled three-quarters of a mile or more. Almost simultaneously with the explosion, a huge cloud of black smoke and debris rose into the air, and burst into a column of flame of great height—the hull becoming a mass of flame, which was not extinguished until the next morning. Three persons lost their lives, one of the engineers, one of the ship's officers, and a seaman. Considering that the dock was full of timber-laden shipping, and that the quays were laden with logs, it is marvelous that the disaster was not far greater. Our illustration is from a sketch forwarded by Mr. Frank Merridew, of the British and Foreign Library, Boulogne.—*The Graphic.*

Type Writer Ribbons.

BY ISIDOR FURST.

The ever recurring query as to reinking type writer ribbons has been kindly referred to me by the editors of this journal.

In treating of this question the second time, I shall endeavor to put whatever knowledge I possess regarding it into such form as will enable any person of average skill to make an ink suitable for any particular style of ribbon and apply it. I mean to illustrate the principles involved and how to meet the various requirements. My reason for doing this, rather than to give a specific formula to be followed in every instance, is that often an experimenter has already produced an ink which lacks only some correction to make it entirely suitable; for "there are many ways leading to Rome." Besides, an ink which may have been suitable at one time may fail at another, because used under different conditions, and once a person knows how to correct a defect, the ink may be made to answer all purposes.

The constituents of an ink for type writer ribbons may be broadly divided into four elements: 1, the pigment; 2, the vehicle; 3, the corrigent; 4, the solvent. The elements will differ with the kind of ink desired, whether permanent or copying.

Permanent (Record) Ink.—Any finely divided, non-fading color may be used as the pigment, vaseline is the best vehicle, and wax the corrigent. In order to make the ribbon last a long time with one inking, as much pigment as feasible should be used. Suppose we wish to make black record ink. Take some vaseline, melt it on a slow fire or water bath, and incorporate by constant stirring as much lampblack as it will take up without becoming granular. Take from the fire and allow it to cool. The ink is now practically finished, except, if not entirely suitable on trial, it may be improved by adding the corrigent wax in small quantity. The ribbon should be charged with a very thin, evenly divided amount of ink. Hence the necessity of a solvent, in this instance a mixture of equal parts of petroleum benzine and rectified spirit of turpentine. In this mixture dissolve a sufficient amount of the solid ink by vigorous agitation to make a thin paint. Try your ink on one extremity of the ribbon; if too soft, add a little wax to make it harder; if too pale, add more coloring matter; if too hard, add more vaseline. If carefully applied to the ribbon, and the excess brushed off, the result will be satisfactory.

On the same principle, other colors may be made into ink; but for delicate colors, albolene and bleached wax should be the vehicle and corrigent, respectively.

The various printing inks may be used if properly corrected. They require the addition of vaseline to make them non-drying on the ribbon, and of some wax if found too soft. Where printing inks are available, they will be found to give excellent results if thus modified, as the pigment is well milled and finely divided. Even black cosmetic may be made to answer, by the addition of some lampblack to the solution in the mixture of benzine and turpentine.

After thus having explained the principles underlying the manufacture of permanent inks, I can pass more rapidly over the subject of copying inks, which is governed by the same general rules. Personally I am not in favor of the use of copying ink: first, because the print is liable to fade, smear, and become invisible; second, because it is unsuitable for legal and other documents of value; third, because it is easier to write two or more copies at one operation with manifold (carbon) paper than to make a second press copy after the writing is done.

For copying inks, aniline colors form the pigment; a mixture of about three parts of water and one part of glycerine, the vehicle; transparent soap (about one-fourth part), the corrigent; stronger alcohol (U. S. P.) (about six parts), the solvent. The desired aniline color will easily dissolve in the hot vehicle, soap will give the ink the necessary body and counteract the hygroscopic tendency of the glycerine, and in the stronger alcohol the ink will readily dissolve so that it can be applied in a finely divided state to the ribbon, where the evaporation of the alcohol will leave it in a thin film. There is little more to add. After your ink is made and tried—if too soft, add a little more soap; if too hard, a little more glycerine; if too pale, a little more pigment. Probably printer's *copying* ink can be utilized here likewise, because every one now has the means to modify and correct it to make it answer the purpose. I have not tried it, because I am opposed to copying inks.

Users of the type writer should so set a fresh ribbon as to start at the edge nearest the operator, allowing it to run back and forth with the same adjustment until exhausted along that strip; then shift the ribbon forward the width of one letter, running until exhausted, and so on. Finally, when the whole ribbon is exhausted, the color will have been equably used up, and on reinking, the work will appear even in color, while it will look patchy if some of the old ink has been left here and there, and fresh ink applied over it.

According to the directions here given, I have done nearly all the reinking of my ribbons for more than seven years, and I am sure, if the reader should fail, it will be due to inattention on his part to some of the principles laid down.—*American Druggist.*

The White Ant of the Bahamas.

Charles J. Maynard, Newtonville, Mass., in the last number of *Psyche*, a publication issued under the auspices of the Cambridge (Mass.) Entomological Club, says that among the many objects of interest that engage the attention of the naturalist on the Bahamas, perhaps the most striking are the nests of the white ants. The first that I saw was in the vicinity of Nassau in a cultivated field. It is the custom among the natives upon clearing away any portion of the low growth of trees that occupy the land before it is tilled, to leave certain ones, which serve for bean poles, or as a support for the stem of the yam, which climbs to a considerable height. The tree usually selected is the gumbo limbo, that has long naked branches, the twigs of which are only scantily supplied with leaves. These trees are so very often chosen by the ants as a support that it is not infrequent to see two or three nests in one field placed on them. The color of these domiciles is nearly black, and as they are often of a large size, they form conspicuous objects, even when seen from a distance.

The nest of which I have spoken was placed upon a limb some three feet from the ground, was about four feet high by some two feet in diameter, and was very nearly of the form of an old-fashioned beehive. This object in the midst of the field presented such a singular appearance that it was only upon close observation that I convinced myself that it was not something made by the owner of the field, and placed there by him for some purpose.

Subsequent observation showed that the ants prefer to build in openings, and that the gumbo limbo is a favorite tree on which to place their nests. This may be explained by the fact that the trunks of these trees are covered with a smooth bark, thus rendering the covered passages that the insects build between the ground and nests more easy of construction than on rougher material. There are two reasons that appear plausible why the ants prefer open fields to less exposed and more shady locations, the first of which is that they like the hot sunshine and free circulation to dry the moist material which is used in the construction of the nests, second the materials from which they gather their building supplies, and which consist of dead wood, palm leaves, boards, shingles, etc., are much more abundant in the fields than elsewhere. In fact, so universally are these situations chosen that I do not now remember ever having seen a nest in any other place.

The nests, as related, are most often placed in trees, generally low and near the trunk, but I have occasionally seen them among the branches. I have also seen them on stumps and even on rocks, although this support is rarely used.

In form, the nests are, as remarked, hive-shaped whenever the basal support is large, but if it be small the ants will then build around it, producing another hive-shaped structure with its base upward, which, resting against the base above, results in an oval-shaped nest. Sometimes, owing to the situation, irregularly formed nests are seen, but there is always a tendency to assume the hive shape. The nests are composed of various galleries, about 0·20 of an inch high and about the same width, of varying length, opening into others in many directions. Thus the whole system forms an exceedingly complicated labyrinth, the clew of which is difficult to find, but which appears to be perfectly understood by the insects. From the nests to the ground, and wherever the passages cross rocks the surfaces of which are exposed (and this frequently occurs even at a considerable distance from the nests), the roadways by which the ants travel are always covered. These thoroughfares are of sufficient width to allow the insects to pass freely at all points, and upon breaking down any portion of a gallery they may be seen hurrying in both directions.

Whenever their passageways are broken open, some of the ants at once begin to repair it, and this brings me to the material used in building, and the method of depositing it. Fibers, gathered from dead wood, leaves, etc., and mixed with enough earth to give it a dark color, form the principal portion of their building material. How this is applied was for a long time a mystery to me, for, although I had seen many hundred nests, it was not until December 19 of last year that I chanced upon one of them upon which visible labor was being performed. I was passing a nest that stood on the margin of a field on Andros, when, attracted by its size, it being the largest that I had ever seen, measuring six feet in height by four and a half in diameter, I turned aside to examine it, and perceived that a circular piece some six inches in diameter was being built on one side. Something over two inches of the outer margin of this portion had been completed, leaving a circular hole in the center. On this portion the ants were at work, standing around the unfinished margin as close together as possible without interfering with one another's movements. The workers are constantly changing. As one disappeared another took its place. Upon appearing, each ant had its jaws filled with building material, and as it reached the wall it turned and exuded a drop of mucilaginous fluid from the abdomen, then whirled instantly about and deposited its fibers upon it as it lay on the wall, mixing and moulding the mass with its jaws. This pulp had about the consistency of papier mache, and was readily manipulated, forming a wall of about the thickness of heavy writing paper. This hardens rapidly, but remains pliable for some time; thus the walls on the extreme outer edge of the newly erected portion could be bent without breaking, whereas the older portions are quite brittle.

As the orifice on which the ants were employed grew smaller, fewer and fewer could find room, yet there was no crowding, each keeping his accustomed distance from his fellows. So one after another they disappeared, as I watched, until but one was left to complete the minute hole remaining.

These ants are very destructive to buildings, especially to the small houses of the negroes, and when they have once obtained a foothold the house is doomed. I knew of a small house in the neighborhood of Nassau that had not been occupied for a year or two, that was two-thirds devoured by them. There was a nest on the roof, supported by the rafters, around which all the shingles had disappeared, while others were much eaten, and all the posts were thickly perforated with their galleries. Such was the speed with which the ants worked, through industry and numbers, that the eroded surfaces appeared quite fresh, being of nearly the color of newly cut wood. The owner of this house informed me that he had destroyed every trace of the nest many times, only to see it rebuilt as fast as the ants could construct it.

How to Thaw Frozen Gas Pipes.

Mr. F. H. Shelton says: I took off from over the pipe some 4 inches or 5 inches, just a crust of earth, and then put a couple of bushels of lime in the space, poured water over it, and slaked it, and then put canvas over that, and rocks on the canvas, so as to keep the wind from getting underneath. Next morning, on returning there, I found that the frost had been drawn out from the ground for nearly 3 feet. You can appreciate what an advantage that was, for picking through frozen ground, with the thermometer below zero, is no joke. Since then we have tried it several times. It is an excellent plan if you have time enough to let the lime work. In the daytime you cannot afford to waste the time, but if you have a spare night in which to work, it is worth while to try it.

A Great Irrigation Project in Texas.

The director of the geological survey is of the opinion that the recently conceived plan of constructing an immense dam across the Rio Grande at or near El Paso is perfectly practicable, but he thinks the question of conflicting water rights must first be settled by the enactment of a general law by Congress. The purpose of the dam would be to irrigate the valley for fifty miles and furnish motive power, to prevent destructive floods below here, and to settle the Mexican boundary question by keeping the river in its proper channel. It is proposed to make the dam an international affair.