THE SCIENTIFIC USE OF THE PHONOGRAPH.

BY GEO. M. HOPKINS.

Many of the experiments in sound commonly performed by the vocal organs, in connection with some mechanical device, may be carried on to advantage by the aid of the phonograph. When the mouth is used it is difficult to secure continuous or variable sounds without producing puffs of air, which are fatal to the experiment, whereas in the case of the phonograph these puffs are absent. Take for example the beautiful experiment of the vibrating soap film. It is almost impossible to produce continued vibrations by means of the vocal organs; but it is a simple matter to secure uniform results when the vibrations are produced by the phonograph.

To carry out this experiment in connection with the phonograph, it is necessary to first produce a record of the required sounds. A thistle tube, made in the form shown in Fig. 1, is used for holding the soap film. A beam of sunlight, or a parallel beam from an optical lantern, is thrown upon the film, and the reflected beam is passed through a lens of 6 or 8 inch focus, and received upon a white screen. As the phonograph imparts vibrations to the air in the thistle tube the soap film is vibrated, and gorgeous color effects in various figures are seen upon the screen.

Fig. 1.–PROJECTION OF VIBRATING SOAP FILM.

A similar experiment is illustrated by Fig. 2. This is a modification of the opeidoscope. A thin membrane of goldbeater's skin or rubber is stretched over a wooden or metallic cell and secured by a winding of thread. To the center of the membrane is cemented a small thin mirror. The light is received and reflected, as in the other case. When the membrane is vibrated, intricate bright figures appear on the screen, the figures varying with the character of the vibration.

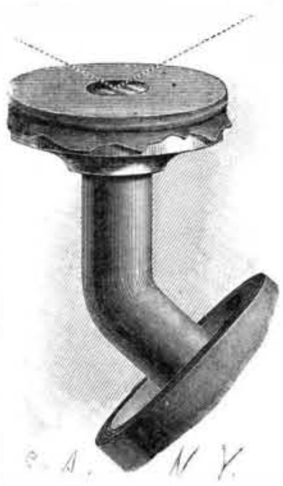

Fig. 2.–THE OPEIDOSCOPE APPLIED TO THE PHONOGRAPH.

Precious Stones in Arizona.

One day recently, upon falling in with Colonel Manuel Gomez, of Parita, a Mexican mining engineer, who has lately been traveling extensively in Arizona and Old Mexico, investigating the mineral resources of that part of the country in the interest of some Eastern and European capitalists, I asked him, says a writer in the *Star* newspaper, what truth there was in the report that precious stones in paying quantities could be found in Arizona. He said:

"I was not looking for precious stones, but I picked up some information about them, for I go on the principle that no sort of general information can do a man harm. My experience in Brazil, however, taught me that wherever there were precious stones to be found there was a much larger number of fairy stories afloat as to the value of the 'finds.' You know that precious stones are simply crystallizations, and, with the exception of the diamond, which is pure carbon, they are water formations, colored with some mineral or vegetable impregnations. Those found in Arizona are spinal rubies, sapphires, emeralds, turquoises, an excellent garnet, amethysts, and small pearls. The ruby has been found in large sizes up to fourteen carats, but much inferior to the Burman rubies. The sapphires, emeralds, and pearls are very small, and the amethyst crystals very large. They are often found in ants' nests in the deserts, as those industrious insects have a habit of carrying shining stones to their nests. Larger turquoises are found there than anywhere else, but very light in color. The majority of them are greenish, but many are light blue. The rubies, sapphires, and emeralds are corundums, and are generally found in a granite country. The pearls are found along with petrified clams and oysters, showing that the country has been, at some remote period, under water. I have been told by geologists that Arizona was the first land appearing above the waters in prehistoric ages.

"The turquoise is found in seams of an eighth of an inch to four inches in width. The Spaniards mined them at a depth of about thirty feet. There are turquoise mines in both New Mexico and Arizona, which have been long abandoned, and in which are found Indian hammers, made of stone, showing that the Indians worked them. The large turquoise set in the Spanish crown, and which is as large as a pigeon's egg, is supposed to have come from Arizona. Turquoises are very popular among the Indians, and a good sized perfect stone can generally be traded for a pony to some of the chiefs. About twelve years ago some unscrupulous Eastern man, finding that corundums are in the desert, got up a diamond excitement, scattered some small rough diamonds at certain points, and on the strength of the 'finds' organized a diamond mining company. He is said to have made money out of it, but the company didn't. The emeralds found in Arizona are of very good quality and very clear, but they are small.

"In the eastern part of the Territory, near where most of the gems are found, there is a petrified forest some eighteen hundred acres in extent, the major part of which seems to have been California redwood. There are a number of petrified trees lying about that locality that are a hundred feet long, and some are four feet thick at the butt. Where these trees are hollow, the inside is often coated with crystals—amethysts and topazes. Some of these are very large. The trees take a very high polish, and have been used for table tops and other ornamental purposes, but on account of their hardness, and the necessarily great expense of transportation and working, they are not used so much as their beauty would warrant."

Armor Plates.

In December last the Navy Department issued an advertisement and circular inviting steel manufacturers to submit armor plates for a competitive test to be held at the naval ordnance proving ground at Annapolis. Having failed to secure, in response to this advertisement, any armor plates of American manufacture, the department has decided to test the relative merits of three varieties of foreign armor plates, and accordingly three plates 10½ inches thick have been purchased abroad and will be tested by a board of naval officers some time next month. The first of these plates is a compound plate of the kind used in England, made by Cammell & Co. The second is a steel plate made by the Creusot Co., and of the kind adopted in certain Continental countries. The third is of an alloy of steel and nickel, which is reported to have shown remarkable resisting qualities on the proving ground at Creusot and in England. These plates will be attacked with forged steel shell of 6 and 8 caliber, fired with velocities of 2,075 and 1,850 f. s. respectively.

A WRINKLE IN SAWING.

A try square is not always at hand when it is desired to saw a stick, and when it is handy some mechanics prefer to work by "guess" than otherwise. When a bright straight saw is placed upon a stick or on the edge of a board, the reflection of the stick or board in the saw is sufficiently well defined to permit of placing the saw so that the reflected image coincides with the object reflected, forming a continuous straight line. If the sawing is done while the image and the stick are in line, the stick will be cut at right angles.

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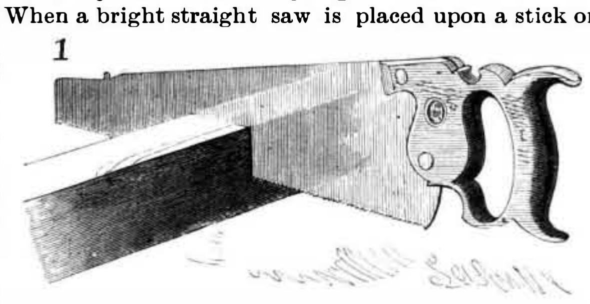

Fig. 1.–REFLECTION SUBSTITUTED FOR THE TRY SQUARE.

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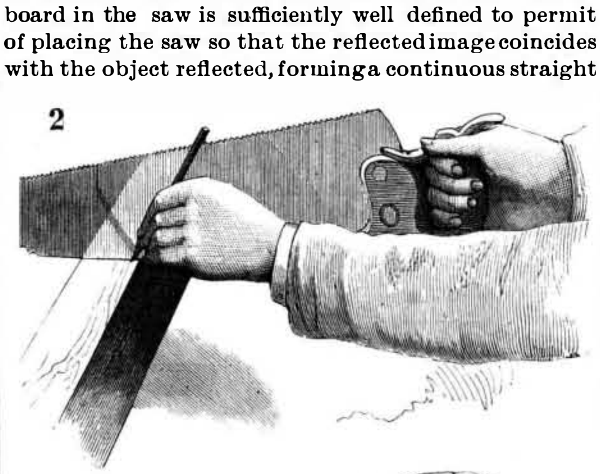

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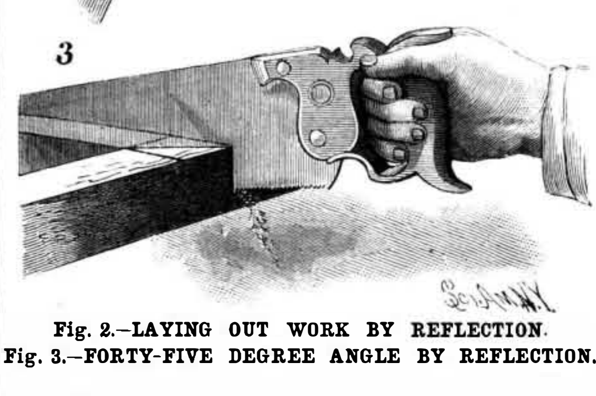

Fig. 2.–LAYING OUT WORK BY REFLECTION.
Fig. 3.–FORTY-FIVE DEGREE ANGLE BY REFLECTION.

It is obvious that a line may be drawn at right angles to the stick by arranging the saw as shown in Fig. 2. If, after forming this line, the saw be placed across the stick so that the line and its reflected image and the stick and its reflected image form a square, with the reflected image and the stick lying in the same plane, as shown in Fig. 3, the stick may be sawed at an angle of forty-five degrees, provided the saw is held in the same position relative to the stick.

Effect of Contraction and Expansion on Steam Boilers.

One of the severest tests of the strength of a steam boiler is due to the unequal expansion and contraction of its different parts, owing to the effects of changes in its temperature. In the case of flue or tubular boilers, in which the flues or tubes are more directly exposed to the influence of heat than the shell, the strain thus developed is tremendous, the tubes or flues, or their material, expanding lengthwise with a force calculated to tear the heads out of the boiler. Where the flues are placed very near the bottom of a boiler, in which case the pressure is all on the lower side of the heads and the plates that keep them together, it is not unusual for these plates to be ruptured or the seams sprung underneath, causing troublesome and often dangerous leaks.

The smaller the proportion of the surface of a boiler that is exposed to the heat, the more active will be the effect of the expanding and contracting forces, and in the case of some boilers, set more than half exposed to the influence of the atmosphere, the tremendous power exercised by the expansive heat of the fire below and the contraction due to the low temperature above are almost enough to tear the boiler to pieces.

It is the unequal expansion of shell and tubes, of the upper and lower shell, that really does more injury to a steam boiler than the expansion and contraction due to changes in pressure of steam; the leakage and cases of rupture that so often occur in the lower seams and along the bottom of horizontally fired boilers are unquestionably due to these causes, and in very many instances forced firing in getting up steam on first starting the boiler is to blame.

To avoid the injuries so often caused to boilers in this manner, it is necessary, a writer in the *Boston Journal of Commerce* wisely asserts, to exercise great care in raising steam in new boilers or those that have been blown out and allowed to cool down.

The fire should be raised moderately and gradually and the boiler moderately filled with water, so that the increase in the temperature may be gradual. In cooling off a boiler the same care must be exercised. The plan adopted by some engineers of turning a stream of cold water into the boiler as soon as it is emptied cannot be too severely condemned, nor should the furnace doors be too suddenly thrown open or any other proceeding taken that will result in suddenly lowering the boiler temperature, a rapid decrease in the heat being quite as bad for the safety and durability of the boiler as the immoderate and unequal increase above referred to.

The Growth of the Alternating System.

It was practically not until the spring of 1887 that the alternating current incandescent lighting system came into commercial operation in this country. At the February meeting of the National Electric Light Association in Philadelphia it was described and discussed as a thing quite rare and novel and of dubious value. Looking over the list of central stations on their alternating system just issued by the Westinghouse Electric Company, we find a detail of no fewer than 301 central stations, of a total generating capacity of 554,350 lamps of 16 c. p. or 886,960 lamps of 10 c. p. This is an enormous growth, and, of course, does not by any means represent all the alternating plants in the country. But even if it stood by itself, this list would be evidence of amazing development and would show beyond cavil that the alternating system had found a vast territory awaiting occupancy by it, and had already made a respectable start in filling that territory up. On a basis of about $30 per 16 c. p. light, this growth represents the handsome investment of not far short of $17,000,000 in these 301 central stations, for lamps, wiring, dynamos, and steam or water plant. —*Electrical Engineer.*

Eighty Miles an Hour.

A special train bearing 150 Pennsylvania editors was run on the 15th July from Baltimore to Washington at an extraordinarily fast gait. It left Baltimore at noon, and thirty-five minutes later had traveled forty-two miles and was in the Pennsylvania railroad station here.

The speed averaged 72 miles an hour, or allowing for starting and stopping, at least 80 miles for the greater part of the run.