SIMPLE EXPERIMENTS IN PHYSICS.

BY GEO. M. HOPKINS.

The experiment illustrated in Fig. 1 shows the great elasticity of certain solid bodies, and the almost total want of elasticity in other solid bodies. This experiment is introduced here mainly on account of its adaptability to projection with a lantern. A thick plate of glass, a small slab of marble, or better a bar of tempered steel, is supported so that its upper surface appears in the field of the lantern. A small glass ball, or a ⅜ or ½ inch hardened, ground, and polished steel ball, such as is made by the Simonds Manufacturing Company for ball bearings, is dropped upon the glass or steel from a measured height within the field of the lantern. The impact compresses the ball and the plate. At the instant following the stopping of the ball, the ball and the plate, by their own elasticity, return to their normal condition, and the force stored by the impact is given out instantaneously, forcing the ball back toward the point of starting. If undisturbed, the ball will fall and rebound again and again, losing a little of its force each time until it finally comes to rest.

By substituting a lead plate for the glass or steel plate, or by substituting a lead ball for the glass or steel one, it is found that the force acquired by the ball in its descent is expended mainly in changing the form of the plate or ball, and that as the inelastic nature of the material prevents it regaining its former shape, there can be no rebound, as in the other case.

The property of elasticity is also shown by the collision balls illustrated in Fig. 2. This well known experiment is adapted to the lantern and shows well on the screen. Six of the steel balls already referred to or six small glass balls or marbles are required. Each ball is provided with a small metallic eye, which is attached by means of cement or fusible metal used as a solder. Five of the balls are suspended from the two wire supports by fine silk threads, so that they all hang in line and touch each other very lightly. The sixth ball is suspended by a wire, which is bent down between the supports to receive a thread which extends through an eye attached to the supports and serves to draw back the sixth ball. The thread by which the ball is moved is not noticeable, as it is partly or wholly concealed by the supports. By drawing back this ball in the manner indicated, and then allowing it to fall, its impact will slightly flatten the ball with which it comes into contact, and each ball in turn transmits its momentum to the next, and so on through the entire series. The last of the series is thrown out as indicated in dotted lines, and upon its return its impact produces the same result as that already described, but the effects are in a reverse order.

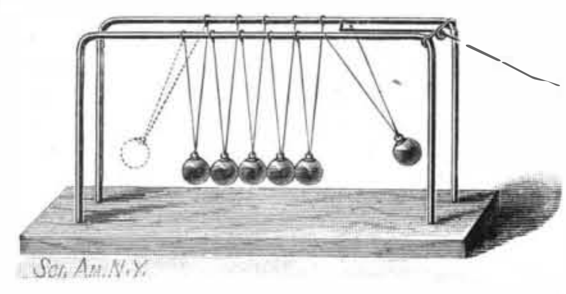

Fig. 2.—COLLISION BALLS.

In Fig. 3 is shown a method of forming magnetic curves for projection, in which the iron particles slowly arrange themselves under the influence of the magnet, giving the appearance of crystallization. In a closed cell is placed a quantity of glycerine, into which is introduced a quantity of fine iron filings. In the top of the cell are inserted two soft iron pole pieces, arranged to receive the poles of a permanent magnet. The glycerine is thoroughly agitated, so as to distribute the filings as evenly as possible throughout the cell. The cell is then placed in the lantern, and the magnet applied to the pole pieces. The iron particles will be drawn slowly toward the pole pieces, arranging themselves in symmetric curves.

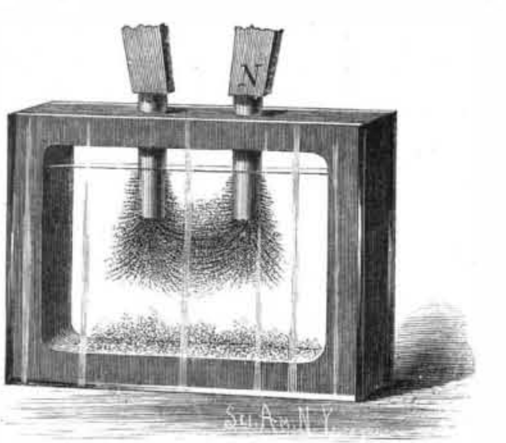

Fig. 3.—MAGNETIC FIELD.

In Fig. 4 is shown apparatus for the projection of the static discharge. It consists of a stand having two vulcanite columns, in the upper ends of which are inserted adjustable brass rods, provided with brass balls at opposite ends. The adjacent balls are adjusted to the striking distance and focused on the screen. The light for projection should be only strong enough to show an image of the balls. When the conductors of a static machine or induction coil are connected with the brass rods, the path of the spark will appear as a brilliant white line on the screen. The discharge of a Leyden jar is still more brilliant.

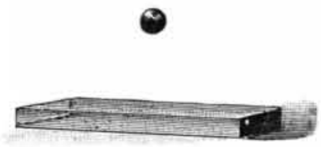

Fig. 1.—ELASTICITY OF SOLID BODIES.

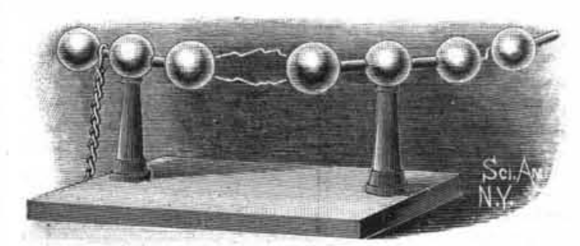

Fig. 4.—PROJECTION OF ELECTRIC SPARK.

The apparatus shown in Fig. 5 is designed to show upon the screen the experiment known as the electric fountain. A small glass vessel provided with a capillary tubulure at the bottom is supported above a tumbler. The vessel is filled with water and the capillary aperture allows the water to drop slowly when acted upon by gravity only, but when the water is electrified by connection with a static machine or induction coil, it issues in a fine stream, the change in the character of the discharge being caused by the mutual repulsion of the particles of water.

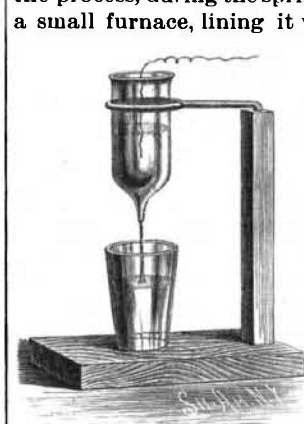

Fig. 5. ELECTRICAL REPULSION.

In all these experiments an erecting prism is required.

Changes in the English Patent Law.

The total number of applications for patents in England was larger in the year just completed than ever before, being 19,070, as compared with 18,051 in 1887, or more than three times as numerous as in any year before the passing of the patent act in 1883. That this upward tendency indicates a real amount of industrial progress it would be impossible to deny, though there is, combined with the rise in numbers, a slight fall in the average value of the inventions, as indicated by the smaller proportion which pass beyond the earliest stage. Very little more than half the applications become completed patents, and the percentage has been gradually though slowly declining as the total numbers have increased. Judging from the experience of the previous law, not a quarter of these completed patents will outlast the first period of four years. Under the old system about 30 per cent were not completed, and of those that were completed about 70 per cent dropped at the end of the first stage (then three years).

The principal event during the past year of importance to patentees has been the passing of the patents, designs, and trade marks act, 1888. This is an amending act on the principal act of 1883, and is the result of the recommendations of the Board of Trade Committee on the Patent Office, which, after sitting for two years, reported in January, 1888. This act, which has just been printed, and came into force with the year, establishes for the first time a register of patent agents. The rules by which the practice of patent agents will in future be regulated are to be made and issued by the Board of Trade, the act only providing that from next July no unregistered person shall be allowed to describe himself as a patent agent. The proposal, when it was before the House, met with a certain amount of criticism from the technical papers, but was accepted.

Another provision of importance is the abolition of what are known as "notices of interference." It has hitherto (since the passing of the 1883 act) been the practice for the office to send notice to an applicant of any subsequent application received at the office which appeared to interfere with his, in order to give him an opportunity of opposing the granting of a patent. This provision has never worked satisfactorily, the officials not having been able to make up their minds as to what constituted a "similar invention," and has therefore probably been of little practical value to patentees. The idea of informing inventors that others were on the same track was an excellent one, and the exercise of a little judgment on the part of the officials would have made it useful, and enabled it to have been carried out to the great benefit of the public. As, however, they were incapable of turning the rule to the advantage of inventors, it was perhaps as well that it should be dropped.

The remainder of the act refers principally to designs and trade marks. There is a new definition of a trade mark which does not appear much easier to construe than the old, and there are other modifications of procedure, the result of experience in the working of the act of 1883.—*London Times.*

Coasting without Snow.

Many of the streets of Astoria, Oregon, are as precipitous as those of our rugged New England towns, and furnish ample grades for the prosecution of that old pastime, sliding down hill.

Snow seldom if ever falls, but the climate is so moist that, at the freezing point, nights and mornings, a thick coat of white frost covers the planked roadways, which are turned into extempore toboggan slides. The amusement is so enjoyable that it is kept up into the small hours of the morning by old and young, the speed attained frequently exceeding that of the ordinary railway train.

The Compressibility of Sea Water.

An important contribution was made to the discussion of the subject of the compressibility of sea water, at a recent meeting of the Royal Society of Edinburgh, by Professor Tait, a scientist, says *Engineering,* well entitled to speak on the question by virtue of his experiments to ascertain the effects of the sea pressure on the Challenger deep-sea thermometers. The address, which was given at the request of the council, dealt with the historical as well as experimental phase of the subject. Until about ten years ago little that was positive and complete was known of the properties of water as regards compressibility. Lord Bacon and others had in vain attempted to compress water, but in this case the water was in a metal shell, completely filled, sealed, and exposed to blows with a hammer. Professor Tait said he encountered difficulties in his experiments, and the principal of these was that water got heated by compression much more rapidly when vulcanite was immersed in it than when there was no vulcanite. By means of a galvanometer he showed to what extent the heating was observable. In trying to overcome the difficulty he ascertained the remarkable fact that the heat evolved increased in a greater proportion than the pressure. This, then, established the fact that water is more expansible when the pressure is greater. A practical test with the thermometer at a depth of a mile and a half of sea confirms this fact. Difference in the results attained from those got in the laboratory was due to the differences in the temperatures in which the tests were made. He had therefore confirmed the contentions of Perkins in 1823 that the more water was compressed, the less compressible it became. He also showed theoretically that by the application of infinite pressure water would be compressed to about three-quarters of its natural bulk, but no further. The compressibility of sea water was 0·92 of that of fresh water. The maximum density point of water went down three degrees for every additional ton of pressure applied. Regarding the effect of pressure on the ocean, Canton, 120 years ago, showed that in a depth of two miles of sea the increasing compression of water under the above condition would be diminished by 69 ft.—a statement which Professor Tait had verified. In a depth of six miles the decrease in depth would be 620 ft. If the water of the ocean were to suddenly cease being compressible, the result would be that 4 per cent of the habitable land on the globe would be submerged, because the mean depth of water would be raised by 116 ft.

Henderson Steel.

The experiment of making steel from the pig iron of Alabama at a very reasonable cost has at last been practically solved by the Henderson process. To test the process, during the spring of 1888 a company erected a small furnace, lining it with the best ordinary fire-brick. The result of the iron made was, first, that steel of the finest quality as well as soft steel could be made, but the test demonstrated also that the fire-brick used could not withstand the heat. The company was not discouraged, but doubled its capital to $40,000. With this it imported magnesia brick from Germany, and made a furnace of about 14 tons capacity a day. This new furnace was put into blast on November 26, 1888, and has since been running continuously and without any injury to the magnesia brick. The cost of making the finest steel by this process and by this company, limited as its plant is, will not exceed $22 per ton. Heretofore steel could not be made out of the low grade iron of the Birmingham and St. Louis districts by any process known which did not cost too much; but it looks now as if there would be a great revolution in Southern iron, and also in the steel business of Pennsylvania, as its iron will have energetic competition from Alabama. There is ore and coal enough, however, in the latter State to absorb all the Pennsylvania manufactories which desire to change their base of operation.