ON SOUND.

BY PROFESSOR TYNDALL.

Last week, Professor Tyndall delivered the first of a series of lectures on sound to a large auditory at the Royal Institution.

Dr. Tyndall began by saying that sound makes itself known to human consciousness by means of objective and subjective phenomena. The objective phenomena exist entirely outside of ourselves, and are altogether independent of us; so sound, objectively considered, is not sensation at all; it is but a kind of motion given to the air. That motion reaches the brain by some process not yet unveiled, and perhaps it will never be given to man to unveil how the motion produces sensation. A very little observation will show that sound consists of some kind of mechanical motion. For instance when a gun is fired, say at Shoeburyness, the observers near the gun feel a shock which disturbs them from head to foot, and sometimes the shock is so great that it will flutter an umbrella. Everybody also knows that glass windows may be broken by loud noises. Sound also is evidently a kind of wave motion, and not something projected from the sounding body; for instance when a gun is fired, and a person is placed near it so as to be perfectly protected from all projected portions should it burst, he still hears the noise.

All the foregoing facts about sound might be learnt in very early times, but before the knowledge of the nature of sound could progress to any great extent, it was necessary that other sciences should grow and give their aid. The air pump and other things had to be invented before the philosophical mind could trace its way from facts to causes. By means of the air pump it can be proved that it is the air which conveys waves of sound. The speaker then set a small bell, driven by clock work, in motion in a very perfect vacuum under the receiver of an air pump, but not a sound was heard. The objection might be made, he said, that the glass sides of the receiver cut off the sound, but he would prove this not to be the case by letting the air in gradually. He did so and as the air entered, the tinkling of the bell made itself perceptible, grew louder, and finally was clearly heard all over the theatre of the Royal Institution.

The foregoing experiment, said Dr. Tyndall, might lead to the impression that the loudness of the sound depends upon the destiny of the atmosphere. He then proved this to be not necessarily the case by a very remarkable experiment. He admitted air into the exhausted receiver, till a pressure of only 2 in. of mercury was exerted inside, and in this partial vacuum he set the bell to work. A faint tinkle could be heard. He then let hydrogen gas into the receiver, so as to greatly increase the pressure and density of the atmosphere inside, yet instead of the sound growing louder, it gradually became fainter. Thus increasing the density of the atmosphere diminished the sound. He then explained that air has to be struck violently and sharply to produce a sound. Waving the hand in the air, for instance, does not set up sound waves, because the disturbed air has time to flow round to the other side of the hand, instead of being set in that kind of wave motion which produces sound. Hydrogen gas, he believed to have the power of flowing round a vibrating tongue more rapidly than air, so that it is less easily beaten into sound waves; and this surmise, which was first mooted by Professor Stokes, he believed explained the true philosophy of the experiment he had just shown.

In some other experiments he took some long polished wooden rods, and rubbed them with resined flannel, whereby each rod in turn was made to give a musical note. In this way he proved that deal conveyed sound more rapidly than oak, although oak is the denser wood of the two, so it is an error to ascribe this power to density.

Professor Tyndall then called attention to the top of a thin wooden rod projecting 2ft. into the air through the floor of the theatre. He said that the rod went down through two floors of the building, and rested at its lower end upon a musical box. That box was then playing, and throwing the rod into musical vibratory motion, which music, however, could not be heard in the theatre because the top of the rod presented too small a surface to the air to set up good loud sound waves. He then placed a guitar, on the top of the rod to act as a sounding board, and instantly the playing of the musical box could be heard distinctly by everybody. A piece of board instead of the guitar, answered the same purpose when it was placed on the top of the rod. Next, one of his assistants played a fiddle, which was placed in contact with the lower end of the rod, and every time the lecturer placed a board on the top of the rod the music could be heard.

The lecturer next explained that sound travels more rapidly through warm than through cold air, and whenever the elasticity of the air is augmented, the velocity of sound is augmented likewise. A themtemperature of 0° C. the velocity of sound is 1,090ft. per second, and it augments about 2ft. for every degree C. added to the pressure. The velocity of sound in air depends upon elasticity of the air in proportion to its density; the greater the elasticity the swifter is the propagation, the greater the density the slower is the propagation. The velocity is directly proportional to the square root of the elasticity, it is inversely proportional to the square root of the density; hence, where elasticity and density vary in the same proportion, the one will neutralise the other as regards the volocity of sound. But that this law shall hold good, it is necessary that the dense air and the rare air shall have the same temperature. From the foregoing it follows that given the velocity of sound in air, the temperature of the air may be readily calculated. If the molecules of air be supposed to be balls held together by springs, then heating the air is tantamount to increasing the rigidity of the springs. The very motion of waves of sound through air raises the temperature of the air; thus a sound wave raises in its own path things which augment its rate of propagation.

The distance of a fired cannon or of a discharge of lightning may be determined by observing the interval which elapses between the flash and the sound. Hence, it is easy to see that if a row of soldiers form a circle, and discharge their pieces all at the same time, the sound will be heard as a single discharge by a person occupying the centre of the circle. But if the men form a straight row, the simultaneous discharge of men's pieces will be a continuous kind of roar. A discharge of lightning along a lengthy cloud may in this way produce a long roll of thunder; the roll of thunder must, however, be in part, at least, due to echoes from the clouds.

The following was the most beautiful of the experiments exhibited in the course of the lecture. A thin thread of light from the electric lamp was thrown upon a small mirror, about the size of a sixpence, mounted on the top of one of the legs of a large tuning fork. This mirror reflected the line of light back, behind the lamp, upon a looking glass which Professor Tyndall held in his hand; this large mirror reflected the light as a bright spot upon a large white screen facing the observers. The vibrating fork gave a slight up-and-down motion to the line of light, and the lecturer by by moving the large mirror on its vertical axis, gave a horizontal motion to the light. The result of these was that a series of very beautiful waves of light was seen upon the screen, and thus gave optical expression to the sound of the fork.

PAPIER MACHE AND CARTON PIERRE.

The use of paper for various constructional purposes has occupied the attention of the *savans*, in many forms. We have seen boots, shoes, panelling for coaches and other purposes, coffins, and even guns, made of this material; but with these exceptional and speculative adaptations of the material we have not now to deal, the subject of the present notice being simply the use of paper in its various forms for architectural decorative purposes. It probably does not strike the unpractical or unprofessional mind, when assisting at the opening of some new theater, and admiring the decorations of the house, and the enrichments of the front of the stalls, the proscenium and the ceiling, that these are for the most part hollow, and made of that most homely of all materials, brown paper. Such, however, is, in the great majority of cases, the simple fact; and we propose to give a short account of the manipulation of the material, and the method of its adaptation.

The sweepings and waste of the factories are the materials used, moistened with water with a little glue, and pressed in a brass mold—this is *papier maché* (pressed paper); while the cuttings of cardboard stewed to a pulp and ground to an even consistency by steam rollers and cast in a plaster mold, are the constituents of *carton pierre* (stone made of card); and we quote Her Majesty's Theatre, the Gaiety, most of the new theatres in the provinces, and private mansions in numbers throughout both town and country, as instances of its use. The brown paper for the *papier maché* is softened in water sufficiently to allow it to be forced into the sharpest angles of a brass mold previously coated with a light skin of paper pulp which has been cast for the purpose, and has the inside carefully chased. The sharpest curves and angles of delicate foliage are thus reproduced; and for all the lighter portions of the work, enriched moldings, beads, and foliage, this is the material adopted, light strips of wood glued to the back keeping the work in its place, and being available for its fixing, which is simply a matter of nails and screws. For the heavier portions of work, such as sofa or table legs, large coffers for ceilings, trusses, figures, and the more solid features, *carton pierre* is used. A mold is prepared in plaster, which takes to pieces in the ordinary way. This is, in the majority of cases, not filled up solid, but only carefully lined by hand pressure with a thickness varying from one fourth inch to one half inch, or perhaps a little more, with the *carton pierre* in a state of pulp. It is allowed to dry for a certain time; aud when sufficiently consolidated for the mold to be removed, it is heated in a drying room until hard, and the process is then complete. A similar process of drying is applied to the *papier maché*; in fact, they are dried in the same room. As compared with ordinary plaster, upon the question of cost, plane surfaces, or work involving a large amount of repetition, can be more cheaply executed in plaster; while the most elaborate and expensive enrichments can be executed to better advantage in *papier mache* which has the great advantage of being much more manageable in fixing. It can be prepared to any pattern, and put together in the workshop; and its fixing is either by glue, nails, or screws. The mess invariably attending the working of plaster is also avoided—a most important element in buildings finished, as is now so much the fashion, with the wood stained in its native color, and not painted; and the use of water is avoided—a great advantage in new buildings, where it is of importance that the seasoned joiner's work should be kept as dry as possible.

Before dismissing the subject, we may just allude to a material which, though neither *papier mache* nor *carton pierre* is used for some of the same purposes. This is Desachy's patent fibrous plaster. There is nothing new in the materials employed; it is a combination of ordinary fine or common plaster, and canvas. The plaster is cast very thin, less than one-fourth inch, in a mould, and then upon the back of it is laid the canvas, which becomes incorporated as it sets; the shape is supported by light strips of wood, laid on at the same time; and for the plain moldings and large panelling, this system gives all the usual effect, combined with extreme lightness and facility for fixing. As an instance, we saw a large circular molding, more than seven feet in diameter, for surrounding a light, made in one piece, ready for fixing, no portion of the face of which was more than a quarter of an inch in thickness. We may mention the ceiling of the library of the new Record Office as an instance of its use, the apparently massive Gothic ribs, forming the groins between the skylight, being of this material, screwed to wrought iron girders inside, which really do the work. The method combines great lightness with absolute security from fire; and its cost is not such as to preclude its being adopted in any case where it is desirable to attain a similar result. In addition to the advantages alluded to above, as gained by the introduction of these various materials, the demand for which is increasing, we may notice the question of rapidity of completion as most important. Time, especially in connection with theatrical matters, is of the first importance; the delay of a few months in the completion of a building makes a difference of a whole season; and it would have been impossible to complete any of the theatre recently opened within some months of the time actually occupied, had it not been for the facility afforded for their decoration by the use of *carton pierre* and *papier maché*.—*London Architect.*

Profits on Patent Sewing Machines.

The organization of a large sewing machine company—capital, five hundred thousand dollars—is being agitated at Chicago, for the manufacture of the Secor machine. The following statements in regard to the past and present progress of the sewing machine business are furnished by the projectors of the new enterprise:

Up to 1860 there had been manufactured and sold in the United States only about 104,000 machines of all kinds. In that year, the total number made was less than 55,000 machines, of which Wheeler & Wilson made 21,000; Grover & Baker, 10,000; Singer & Co, 11,000; Willcox & Gibbs, 7,500; all others, about 5,000.

The business was then in its infancy, still $5,000,000 were invested in the manufacture; and these leading manufacturers have, since that date, so increased their great establishments that in the year 1870 there were turned out more than 500,000 machines, a half million in a single year, and yet the demand could not be supplied. It is stated as a fact, that orders came in upon these factories much faster than, even with all their facilities, they can turn out the machines.

In 1870 Singer & Co., made and sold the enormous aggregate of 140,000 sewing machines, and the others kept up their proper proportion.

These companies have their own factories and their own own machinery, and do all of their own manufacturing, and the cost at which a complete machine can be put upon the market, in working order, ready for sale, would be surprising to the uninitiated. But if Singer & Co. only realized $10 profit upon each machine, (which is less than half the real profit on the cost) then the dividends in 1870 must have been 1,400,000, or ten per cent on a capital of $14,000,000, all of which has been accumulated within ten years. At the same rate, the profits on all the machines sold reached the great sum of $5,000,000. But it is probable that the sum of $10 does not amount to more than a third of the profit on a single machine.

These machines have not only become a necessity in every family, but they are largely used in all the factories of boots and shoes, clothing, hats and caps, etc., so that the merely domestic demand does not amount to one fourth part of the entire trade; some of the large factories of New York and New England have in constant use from 200 to 1000 machines each. In the State of Massachusetts, in the manufacture of boots and shoes alone, $15,000,000 are annually saved by the use of the sewing machine, and in New York city, the clothing manufacturers save yearly more than $12,000,000 in the same manner, and this applies with equal force to all of the various branches of trade where the use of the needle is required.

There is no limit to the demand for all first class machines, and it has been estimated that before the expiration of the next ten years, 1,000,000 sewing machines per annum will be required.

It is generally understood by the public, that sewing machine companies have made large fortunes; but we doubt if the facts are not sufficient to show that the dividends declared by the companies making the most popular machines, have been much larger than the most extravagant oues outside of the ring have supposed.

The old companies accumulated their vast capital of millions out of the profits of the business, and the principal companies have declared and paid dividends for years, of from 75 to 400 per cent upon their capital stock, besides accumulating a reserved fund of an equal or larger amount, for the extension of their works and the general business of stocking their branch offices throughout the country.

Of the value of the stock in the principal companies, we would illustrate by stating the fact, that the par stock in some of the best companies five years old cannot be bought for 2,500 per cent premium, and the value is entirely unknown to the outside public.

SEXES OF THE LOBSTER.—A correspondent of *Land and Water*, makes an announcement, which is endorsed by the editor of that paper, to the effect that the sexes of lobsters can be readily determined by the character of their claws, since, in nearly fourteen hundred specimens examined, it was ascertained that in the male, the blunt, tufted claw is always on the left side, and the sharpest serrate claw on the right, a condition of things exactly reversed in the female. This, however, has been subsequently denied, and the question, of determining the sex by means easily understood by the laity, yet remains open.