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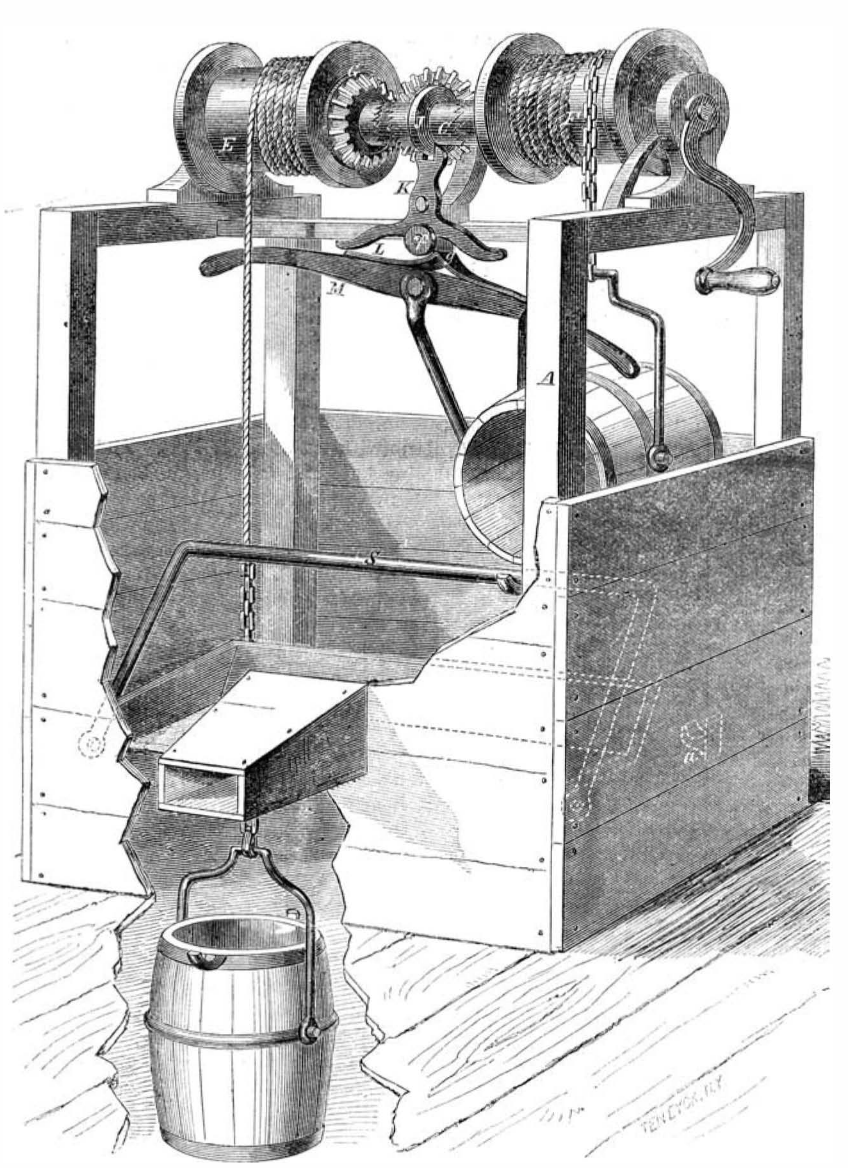
Improved Water Elevator.

The paintings in the tombs and temples of Egypt, which have preserved in so wonderful a manner the minute records of the life of that singular people, show that the efforts of mankind were directed in very early times to contriving plans for raising water. These efforts have been continued in all ages. The old treadmill has been superseded by the windmill, the waterwheel, the steam engine and the air motor. In this, as in every other department, the activity of the present century asserts its superiority over all those which have preceded it. We have no doubt that more devices for raising water have been invented in this country in the last 40 years than had been produced before in all the world since the beginning of time. We have had rotary pumps, centrifugal pumps, cylinder pumps, single and double acting, with movable valves, with stationary valves, with solid pistons, with hollow pistons; water wheels, buckets, and elevators in almost endless variety of combination. After so thorough an investigation of the subject by so many active and fertile minds, it is surprising to find an invention in this department entirely original and novel; perhaps no more striking proof could be furnished of the absolutely boundless extent of the field which is open for inventors.

By this contrivance water is drawn from an open well by turning a shaft or crank constantly in one direction; two buckets alternately rising and falling, being filled and emptied, and the direction of their motions being changed, all by automatic devices. The mode of accomplishing this is very simple, as will be seen by examining the engraving.

A curb, A, is placed over the well, with shaft, C, across it. Upon this shaft are loosely placed the two drums, E and F, around which the ropes for raising the buckets are wound. Around the middle of the shaft, C, is the sleeve, J, sliding freely horizontally, but caused to rotate with the shaft by a feather and groove. To the inner ends of the drums, E and F, are secured the beveled gears, G, which mesh into the gear wheel, H, so that when one drum is rotated, it will carry the other drum in the opposite direction, and *vice versa*. The sleeve, J, has ratchet teeth which lock into similar teeth upon the end of either of the hollow axles of the drums, E and F. Thus it will be seen that, when the sleeve, J, is locked to the drum, E, so as to cause it to rotat with the shaft, C, the drum, F, is turned in the opposite direction. As one of the buckets is drawn to the upper part of the curb by the drum, E, it strikes one arm of the lever, M, which carries up the arm of the lever, K, and thus slides the sleeve, J, into connection with the drum, F, thus of of course reversing the motion of the buckets, carrying the upper one down and bringing the lower one up. A friction roller, *f*, upon the lower part of lever, K, and a spring, L, with an inverted V-shaped projection, *g*, upon lever, M, render this movement quick and positive, and prevent it from occurring casually without the action of the buckets.

The buckets are caused to be tilted and emptied by a simple device, which acts with great certainty. A hook, *l*, upon the upper edge of the bucket, catches into a bail-shaped bar of iron, S, which is connected to the curb by hinges, and rests in a support, *a*. As the bucket is liable to turn by the twisting of the rope, a flat chain is introduced at the end of the rope, and this chain, by winding upon the drum, always turns one of two sides of the bucket to the spout side of the curb, hooks being placed upon both of these sides of the bucket.



ANDERSON'S IMPROVED WATER ELEVATOR.

The buckets may be made with valves in the bottom opening upward, so that they will be filled without being inverted.

The advantages secured by this apparatus are: 1st, The weight of the descending bucket aids in bringing up the one that is ascending; 2d, As one bucket is being filled while the other is being emptied, there is no delay in waiting for the former operation; 3d, The rotating of the crankshaft continually in the same direction saves all time and trouble in reversing its motion, and adapts the apparatus to be worked by steam or other power; 4th, The ease with which it can be adjusted, so that the buckets will descend precisely to the depth required and no further, thus allowing the water to be drawn from very near the bottom of the well without rendering it turbid.

The patent for this ingenious and novel invention was granted, through the Scientific American Patent Agency, February 12, 1861, and further information in relation to it may be obtained by addressing the inventor, Philander Anderson, at Norwich, N. Y.

The Color of Water.

Dr. Tyndall has shown, by a series of beautiful and conclusive experiments, that water has a decided color—that even in small thicknesses it is not the colorless substance it is usually imagined to be. When seen through a glass full of the liquid, of course it appears without color, but if looked at through a stratum of fifteen feet its color is very evident. The following is Dr. Tyndall's arrangement of the experiment for showing this to a large audience. A tin tube, fifteen feet long and about three inches in diameter, is placed horizontally on a stand, and half filled with water. The tube is closed by plate glass at each end, and a beam of electric light is thrown through it from the further end. By this means an image of the contents of the tube is projected on a white screen. The tube being about half filled with water, and the image upon the screen being inverted by the lens, the upper air space in the tube is seen in the lower part of the image, which is quite colorless; whilst the upper portion, illuminated by the rays which pass through the stratum of water, is of a greenish blue color. The color varies from a pure green up to a blue, according to the purity or otherwise of the water. Thus it is evident that the color of water is very appreciable; for, in a stratum of fifteen feet, a very considerable amount is exhibited, and thus there is no difficulty in comprehending the fact that, in looking through a deeper stratum, such as is seen in the Swiss lakes and in the waters which we have around our own shores, this color of water makes itself very perceptible.

KEHL is the name of a small town on the German side of the Rhine, nearly opposite to the ancient city of Strasburg, France. We remember crossing the river at this point a few years ago upon a pontoon bridge, a structure quite common on the Rhine. Near to this bridge is a red sandstone monument, erected upon a small island in the river, to the memory of the gallant Desaix, one of Napoleon's trusty and brave generals. A great railway bridge over the Rhine, at Kehl, is now completed. It is provided with draws to admit the passage of boats which are easily turned. They were recently subjected to an enormous pressure of two heavy trains, and the flexion was found to be very trifling.

THE CHEMICAL HISTORY OF A CANDLE.

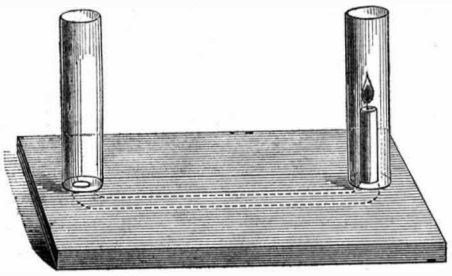
By Professor Faraday.

A Course of Six Lectures (adapted to a Juvenile Audience) Delivered before the Royal Institution of Great Britain.

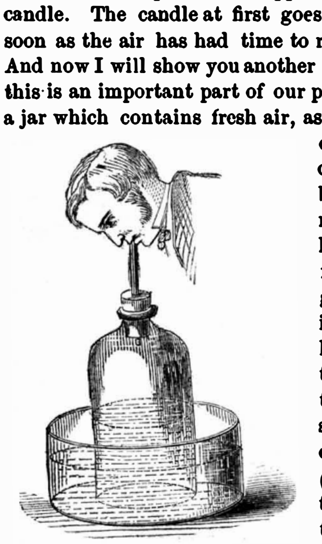
LECTURE VI.—(Concluded).

Carbon or Charcoal—Coal Gas—Respiration and its Analogy to the Burning of a Candle—Conclusion.

Now, I must take you to a most interesting part of our subject—to the relation between the combustion of a candle and that living kind of combustion which goes on within us. In every one of us there is a living kind of combustion going on exactly like that of a candle, and I must try to make that plain to you. For that is not merely true in a poetical sense—the relation of the life of man to a taper, and if you will follow, I think I can make this clear. In order to make the relation very plain, I have devised a little apparatus which we can soon build up before you. Here is a board and a groove cut in it, and I can close the groove at the top part by a little cover;



I can then continue the groove as a channel by a glass tube at each end, there being a free passage through the whole. Suppose I take a taper or candle (we can now be liberal in our use of the word "candle" since we understand what it means) and place it in one of the tubes; it will go on, you see, burning very well. You observe that the air which feeds the flame passes down the tube at one end, then goes along the horizontal tube, and ascends the tube at the other end, in which the taper is placed. If I stop the aperture through which the air enters, I stop combustion, as you perceive. I stop the supply of air, and consequently the candle goes out. But now what will you think of this fact? In a former experiment I showed you the air going from one burning candle to a second candle. If I took the air proceeding from another candle, and sent it down by a complicated arrangement into this tube, I should put this burning candle out. But what will you say when I tell you that my breath will put out that candle? I do not mean by blowing at all, but simply that the nature of my breath is such that a candle cannot burn in it. I will now hold my mouth over the aperture, and without blowing the flame in any way, let no air enter the tube but what comes from my mouth. You see the result. I did not blow the candle out. I merely let the air which I expired pass into the aperture, and the result was that the light went out for want of oxygen, and for no other reason. Something or other—namely, my lungs—had taken away the oxygen from the air, and there was no more to supply the combustion of the candle. It is, I think, very pretty to see the time it takes before the bad air which I throw into this part of the apparatus has reached the candle. The candle at first goes on burning, but so soon as the air has had time to reach it it goes out. And now I will show you another experiment, because this is an important part of our philosophy. Here is a jar which contains fresh air, as you can see by the circumstance of a candle or gas light burning in it. I make it close for a little time, and, by means of a pipe, I get my mouth over it so that I can inhale the air. By putting it over water, in the way that you see, I am able to draw up this air (supposing the cork to be quite tight) take it into my lungs and throw it back into the jar; we can then examine it and see the result. You observe I first take up the air, and then throw it back, as is evident from the ascent and descent of the water, and now, by putting a taper into the air you will see the state in which it is by the light being extinguished. Even one inspiration, you see, has completely spoiled this air, so that it is no use my trying to breathe it a second time. Now you understand the ground of the impropriety of the arrangements among the houses of the poorer classes, by which the air is breathed over and over again, for the want of a supply, by means of proper ventilation, sufficient to produce a good result. You see how bad the air becomes by a single breathing, so that you can easily understand how essential fresh air is to us.



To pursue this a little further, let us see what will happen with lime water. Here is a globe which contains a little lime water, and it is so arranged as regards the pipes, as to give access to the air within, so that we can ascertain the effect of the respired or unrespired air upon it. Of course, I can either draw in air (through A) and so make the air that feeds my lungs go through the lime water, or I can force the air out of my lungs through the tube B, which goes to the bottom, and so show its effect upon the lime water. You will observe that however long I draw the external air into the lime water, and then through it to my lungs, I shall produce no effect upon the water—it will not make the lime water turbid; but if I throw the air *from* my lungs through the lime water several times in succession, you see how white and milky the water is getting, showing the effect which expired air has had upon it; and now you begin to know that the atmosphere which we have spoiled by respiration is spoiled by carbonic acid, for you see it here in contact with the lime water.

I have here two bottles, one containing lime water and the other common water, and tubes which pass into the bottles and connect them. The apparatus is very rough, but it is useful notwithstanding. If I take these two bottles, inhaling here and exhaling there, the arrangement of tubes will prevent the air

going backward. The air coming in will go to my mouth and lungs, and in going out will pass through the lime water, so that I can go on breathing and making an experiment, very refined in its nature and very good in its results. You will observe that the good air has done nothing to the lime water; in the other case nothing has come to the lime water but my respiration, and you see the difference in the two cases.

Let us now go a little further. What is all this process going on within us which we cannot do without, either day or night, which is so provided for by the Author of all things, that He has arranged that it shall be independent of all will? If we restrain our respiration, as we can do to a certain extent, we should destroy ourselves. When we are asleep, the organs of respiration and the parts that are associated with them still go on with their action, so necessary is this process of respiration to us, this contact of the air with the lungs. I must tell you, in the briefest possible manner, what this process is. We consume food: the food goes through that strange set of vessels and organs within us, and is brought into various parts of the system, into the digestive parts especially; and alternately the portion which is so changed is carried through our lungs by one set of vessels, while the air that we inhale and exhale is drawn into and thrown out of the lungs by another set of vessels, so that the air and the food come close together, separated only by an exceedingly thin surface; the air can thus act upon the blood by this process, producing precisely the same results in kind as we have seen in the case of the candle. The candle combines with parts of the air, forming carbonic acid, and evolves heat; so in the lungs there is this curious, wonderful change taking place. The air entering combines with the carbon (not carbon in a free state, but, as in this case, placed ready for action at the moment), and makes carbonic acid, and is so thrown out into the atmosphere, and thus this singular result takes place; we may thus look upon the food as fuel. Let me take that piece of sugar, which will serve my purpose. It is a compound of carbon, hydrogen and oxygen, similar to a candle, as containing the same elements, though not in the same proportion; the proportions being as shown in this table:—

SUGAR.

Carbon	72	
Hydrogen	11	99
Oxygen	88	

This is, indeed, a most curious thing, which you can well remember, for the oxygen and hydrogen are in exactly the proportions which form water, so that sugar is compounded of 72 parts of carbon and 99 parts of water; and it is the carbon in the sugar that combines with the oxygen carried in by the air in the process of respiration, so making us like candles; producing these actions, warmth, and far more wonderful results besides, for the sustenance of the system, by a most beautiful and simple process. To make this still more striking, I will take a little sugar, or to make the experiment shorter, I will use some sirup, which contains about three-fourths of sugar and a little water. If I put a little oil of vitriol on it, it takes away the water, and leaves the carbon in a black mass. [The lecturer mixed the two together.] You see how the carbon is coming out, and before long we shall have a solid mass of charcoal, all of which has come out of sugar. Sugar, as you know, is food, and here we have absolutely a solid lump of carbon where you would not have expected it. And if I make arrangements so as to oxydize the carbon of sugar, we shall have a much more striking result. Here is sugar, and I have here an oxydizer—a quicker one than the atmosphere; and so we shall oxydize this fuel by a process different from respiration in its form, though not different in its kind. It is the combustion of the carbon by the contact of oxygen which the body has supplied to it. If I set this into action at once, you will see combustion produced. Just what takes place in my lungs—taking in oxygen from another source, namely, the atmosphere, takes place here by a more rapid process.

You will be astonished when I tell you what this curious play of carbon amounts to. A candle will burn some four or five, or six, or seven hours. What, then, must be the daily amount of carbon going up into the air in the way of carbonic acid! What a quantity of carbon must go from each of us in respiration! What a wonderful change of carbon must take place under these circumstances of combustion or respiration! A man, in twenty-four hours, converts as much as seven ounces of carbon into carbonic acid; a milch cow will convert seventy ounces, and a horse seventy-nine ounces, solely by the act of respiration. That is, the horse in twenty-four hours burns seventy-nine ounces of charcoal or carbon, in his organs of respiration, to supply his natural warmth in that time. All the warm-blooded animals get their warmth in this way, by the conversion of carbon, not in a free state, but in a state of combination. And what an extraordinary notion this gives us of the alterations going on in our atmosphere. As much as 5,000,000 pounds, or 548 tuns of carbonic acid is formed by respiration in London alone, in twenty-four hours. And where does all this go? Up into the air. If the carbon had been like the lead which I showed you, or the iron, which, in burning, produces a solid substance, what would happen? Combustion could not go on. As charcoal burns it becomes a vapor, and passes off into the atmosphere, which is the great vehicle, the great carrier for conveying it away to other places. Then what becomes of it? Wonderful is it to find that the change produced by respiration, which seems so injurious to us (for we cannot breathe air twice over) is the very life and support of plants and vegetables that grow upon the surface of the earth. It is the same, also, under the surface, in the great bodies of water, for fish and other animals respire upon the same principle, though not exactly by contact with the open air. Such fish as I have here [pointing to a globe of goldfish] respire by the oxygen in the air, which is dissolved by the water and forms carbonic acid, and they all move about to produce the one great work of making the animal and vegetable kingdoms subservient to each other. And all the plants growing upon the surface of the earth, like that which I have brought here to serve as an illustration, absorb carbon: these leaves are taking up their carbon from the atmosphere to which we have given it in the form of carbonic acid, and they are growing and prospering. Give them a pure air like ours, and they could not live in it; give them carbon with other matters, and they live and rejoice. This piece of wood gets all its carbon, as the trees and plants get theirs, from the atmosphere, which, as we have seen, carries away what is bad for us and, at the same time, good for them—what is disease to the one being health to the other. So are we made dependent not merely upon our fellow creatures but upon our fellow existers, all Nature being tied together by the laws which make one part conduce to the good of another.

There is another little point which I must mention before we draw to a close—a point which concerns the whole of these operations, and most curious and beautiful it is to see it clustering upon and associated with the bodies that concern us—oxygen, hydrogen and carbon, in different states of their existence. I showed you just now some powdered lead, which I set burning; and you saw that the moment the fuel was brought to the air it acted, even before it got out of the bottle—the moment the air crept in, it acted. Now, there is a case of chemical affinity by which all our operations proceed. When we breathe the same operation is going on within us. When we burn a candle the attraction of the different parts one to the other is going on. Here it is going on in this case of the lead, and it is a beautiful instance of chemical affinity. If the products of combustion rose off from the surface, the lead would take fire, and go on burning to the end; but you remember that we have this difference between charcoal and lead—that while the lead can start into action at once if there be access of air to it, the carbon will remain days, weeks, months, or years. The manuscripts of Herculaneum were written with carbonaceous ink, and there they have been for 1,800 years, or more, not having been at all changed by the atmosphere, though coming under various circumstances in contact with it. Now, what is the circumstance which makes the lead and carbon different in this respect? It is a striking thing to see that the matter which is appointed to serve the purpose of fuel *waits* in its action: it does not start off burning, like the lead, and many other things I could show you, but which I have not encumbered the table with; but it waits for action. This waiting is a curious and wonderful thing. Candles—those Japanese candles, for instance—do not start into action at once like the lead or iron (for iron, finely divided, does the same thing as lead), but there they wait for years, perhaps for ages, without undergoing any alteration. I have here a supply of coal gas. The jet is giving forth the gas, but you see it does not take fire—it comes out into the air, but it waits till it is hot enough before it burns. If I make it hot enough it takes fire. If I blow it out, the gas that is issuing forth waits till the light is applied to it again. It is curious to see how different substances wait—how some will wait till the temperature is raised a little, and others till it is raised a good deal. I have here a little gunpowder and some gun cotton; even these things differ in the conditions under which they will burn. The gunpowder is composed of carbon and other substances, making it highly combustible; and the gun cotton is another combustible preparation. They are both waiting, but they will start into activity at different degrees of heat, or under different conditions. By applying a heated wire to them, we shall see which will start first [touching the gun cotton with the hot iron]. You see the gun cotton has gone off, but not even the hottest part of the wire is now hot enough to fire the gunpowder. How beautifully that shows you the difference in the degree in which bodies act in this way. In the one case the substance will wait any time until the associated bodies are made active by heat; but in the other, as in the process of respiration, it waits no time. In the lungs, as soon as the air enters, it unites with the carbon, even in the lowest temperature which the body can bear short of being frozen, the action begins at once, producing the carbonic acid of respiration; and so all things go on fitly and properly. Thus you see the analogy between respiration and combustion is rendered still more beautiful and striking. Indeed, all I can say to you at the end of these lectures (for we must come to an end at one time or other) is to express the wish that you may, in your generation, be fit to compare to a candle, and that you may, like it, shine as lights to those about you; that, in all your actions, you may justify the beauty of the taper by making your deeds honorable and effectual in the discharge of your duty to your fellow men.

Guano.

Peruvian Guano is the most concentrated manure with which we are acquainted; and, under certain circumstances, it exceeds all other substances in its fertilizing influences. A manure is valuable in proportion to the amount which it contains of three substances—*ammonia*, *phosphate of lime*, and *alkaline salts* (compounds of potash and soda with acids). The proportions of these ingredients present in farmyard manure are shown in the following figures, and are the average results of several analysis made by ourselves:—

100 PARTS OF FARMYARD MANURE CONTAIN:—

Ammonia	0.450
Phosphate of lime	1.750
Alkaline salts	1.300

The great superiority of guano over farmyard manure will be seen from the following statement, which gives the average results of several hundred analysis of this substance, made by us during the last six years:—

100 PARTS OF PERUVIAN GUANO CONTAIN:—

Ammonia	16
Phosphate of lime	22
Alkaline salts	9

The use of guano, as a manure, was long known to the Peruvians, and so highly was the article valued, that the *Incas*, the ancient rulers of Peru, at one time attached the penalty of death to the offence of killing the "manufacturers" of the article—the sea fowl that haunted the coast.

Sir Humphrey Davy was the first who suggested the employment of guano in British husbandry. This was in the year 1810; but the distinguished chemist's advice was not acted upon till thirty years afterwards. In 1840, a small quantity of the article was imported by Mr. Myers, of Liverpool, which, on being applied as a fertilizer, produced such wonderful results that in the following year the large quantity which was imported was readily bought up, and ever since, the annual demand for guano in Britain has only been satisfied by the enormous supply of from 200,000 to 300,000 tuns. The great demand for this curious substance inducing enterprising merchants to explore other regions than Peru in search of a similar commodity, and with considerable success, as guano is now imported in large quantities from various countries. With scarcely an exception, the guano found in every locality, except on the Chinchas islands, the other places along the coast of Peru, contains but a small proportion of ammonia in relation to the amount of lime; and, as it is an established fact that certain crops require more than others do, an abundant supply of phosphate of lime, it is very desirable that the farmer should know the composition of the various kinds of guano, in order that he may apply the most suitable kind to his crops, as the time for purchasing artificial manures is rapidly approaching.—*Irish Country Gentleman.*

[Guano should never be brought into contact with seeds. It should always be mixed with about six times its weight of finely sifted soil—loam, we think, is best. Guano requires considerable moisture to give out its fertilizing properties; in dry seasons its effects are inconsiderable. Peruvian guano is a monopoly; the government of Peru fix the price of it, and farm it out to a great company, who charge $40 per tun for it.—EDS.

Artificial Guano.

A desire to obtain an artificial guano, equal to that of Peru, and at a moderate cost, has long been manifested. The following has been furnished us by Dr. Abraham Gesner, F.G.S., on this subject:—

Guano, so valuable a fertilizer, is chiefly composed of the excrements of sea fowls. Frequently it contains feathers, bones of fishes, humus, &c. It is very variable in composition, a circumstance that has been ascribed to the different kinds of food upon which the birds subsisted. Some guanos contain upwards of 25 per cent of uric acid, in others that acid is almost entirely absent, and it is the same in regard to other acids, salts and alkalies. Ammonia usually enters largely into the best qualities of this fertilizer, and the presence of its carbonate is known by its odor. The oxalate, urare and phosphate of ammonia and magnesia are almost always present with the phosphates of soda and lime, the phosphates having been derived from the bones of the fish upon which the birds fed. In the supply of ammonia and of earthly and alkaline salts, guano is of the greatest value for plants cultivated for food. The food of the birds, from which the guano had been deposited has been certain fish that fed upon other fish, the food of which was marine plants, or animalcula. The origin of this fertilizer is therefore found in marine plants and animals.

The writer has obtained a product analogous to the true guano, and one nearly, if not quite, equal in its value for fertilizing purposes. Chemical and mechanical means have been applied to the marine *fuci* and fishes and fish offal until an artificial guano has been obtained. The sources of the alkaline carbonate, chloride of sodium and organic matter have been found in marine plants, the phosphates and carbonates of lime and ammonia in the bones and flesh of fishes, and after many experiments carefully performed, they have been combined so as to form a cheap and portable manure. At Long Island, in the State of New York, *menhaden* are manufactured into manure: the oil, which is very offensive, being extracted from the fish and employed for common purposes.

Having visited a great number of the fishing establishments of the Provinces of New Brunswick, Nova Scotia, New Foundland and the islands and coasts of the Gulf of St. Lawrence and Labrador, the writer obtained a knowledge of the vast quantity of fish and flesh offal annually thrown into the sea, or otherwise lost to every useful purpose. The garbage thrown overboard yearly from vessels fishing on the Banks of Newfoundland, if properly preserved and manufactured, with the annual growth of sea weeds upon the shore, would fertilize the entire cultivated surface of the Eastern States and British Provinces; still the amount of animal matter thus referred to is far less than that produced by the inshore fisheries.

To the foregoing may be added the enormous quantities of mytili and other shellfish growing upon the shore, and which are not less applicable for the manufacture of artificial guano, than the offal of the finny tribes. At many places on the shores, fish are met with in such abundance that they are employed by the fishermen to manure the small patches of ground some of them cultivate. At the principal fishing stations, the refuse garbage and bones alone would supply a manufactory, and with good management and the use of kelp, the offal may be transported from place to place without inconvenience. Like the bones of terrestrial animals, the inorganic matter or ash of the bones of fishes consists in the greater part of the phosphates of lime, or bone phosphate, with carbonate of lime, the fertilizing properties of which are well understood. Fewsoils preserve their fertility for any length of time. Every crop removes from the earth certain elements, which it is the business of the farmer to restore, and for that purpose no manure is better adapted than guano, either natural or artificial.

MODELS UNDER THE NEW LAW.—A number of newspapers, in attempting to enlighten their readers in the new patent law, have erroneously stated that hereafter models would not be required to accompany applications for patents. So far as applying for patents in ornamental designs, trade marks, paintings, busts, &c., their information is correct, but applications for patents in all mechanical inventions are required to be accompanied with models as formerly.