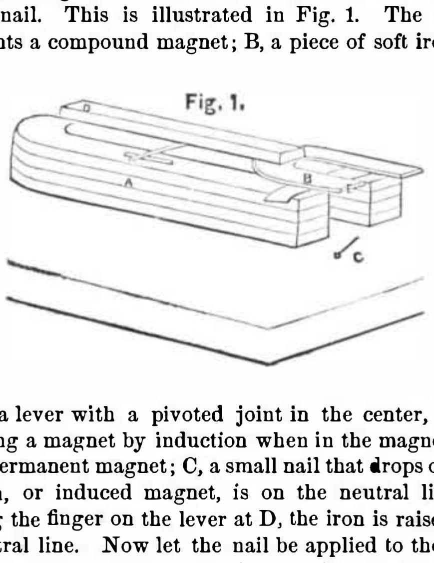
[From *Harper's Magazine* for March, 1879.]

GARY'S MAGNETIC MOTOR.

With an ordinary horseshoe magnet, a bit of soft iron, and a common shingle-nail, a practical inventor, who for years has been pondering over the power lying dormant in the magnet, now demonstrates as his discovery a fact of the utmost importance in magnetic science, which has hitherto escaped the observation of both scientists and practical electricians, namely, the existence of a neutral line in the magnetic field—a line where the polarity of an induced magnet ceases, and beyond which it changes. With equally simple appliances he shows the practical utilization of his discovery in such a way as to produce a magnetic motor, thus opening up a bewildering prospect of the possibilities before us in revolutionizing the present methods of motive power through the substitution of a wonderfully cheap and safe agent. By his achievement Mr. Wesley W. Gary has quite upset the theories of magnetic philosophy hitherto prevailing, and lifted magnetism out from among the static forces where science has placed it to the position of a dynamic power. The Gary Magnetic Motor, the result of Mr. Gary's long years of study, is, in a word, a simple contrivance which furnishes its own power, and will run until worn out by the force of friction, coming dangerously near to that awful bugbear, perpetual motion.

The old way of looking at magnetism has been to regard it as a force like that of gravitation, the expenditure of an amount of energy equal to its attraction being required to overcome it; consequently its power could not be availed of. Accepting this theory, it would be as idle to attempt to make use of the permanent magnet as a motive power as to try to lift one's self by one's boot straps. But Mr. Gary, ignoring theories, toiled away at his experiments with extraordinary patience and perseverance, and at last made the discovery which seems to necessitate the reconstruction of the accepted philosophy.

To obtain a clear idea of the Gary Magnetic Motor, it is necessary first to comprehend thoroughly the principle underlying it—the existence of the neutral line and the change in polarity, which Mr. Gary demonstrates by his horseshoe magnet, his bit of soft iron, and his common shingle-nail. This is illustrated in Fig. 1. The letter A represents a compound magnet; B, a piece of soft iron made

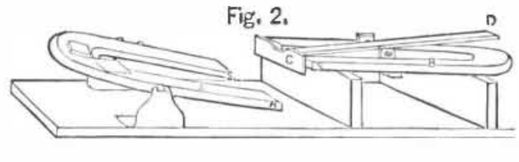


fast to a lever with a pivoted joint in the center, the iron becoming a magnet by induction when in the magnetic field of the permanent magnet; C, a small nail that drops off when the iron, or induced magnet, is on the neutral line. By pressing the finger on the lever at D, the iron is raised above the neutral line. Now let the nail be applied to the end of the induced magnet at E; it clings to it, and the point is turned inward toward the pole of the magnet directly below, thus indicating that the induced magnet is of opposite polarity from the permanent one. Now let the iron be gradually lowered toward the magnet; the nail drops off at the neutral line, but it clings again when the iron is lowered below the line, and now its point is turned outward, or away from the magnetic pole below. In this way Mr. Gary proves that the polarity of an induced magnet is changed by passing over the neutral line without coming in contact. In the experiment strips of paper are placed under the soft iron, or induced magnet, as shown in the figure, to prevent contact.

The neutral line is shown to extend completely around the magnet; and a piece of soft iron placed upon this line will entirely cut off the attraction of the magnet from anything beyond. The action of this cut-off is illustrated in Fig. 2. The letters A and B represent the one a balanced magnet and the other a stationary magnet. The magnet, A, is balanced on a joint, and the two magnets are placed with opposite poles facing each other. The letter C is a piece of thin or sheet iron, as the case may be, made fast to a lever with a joint in the center, and so adjusted that the iron will move on the neutral line in front of the poles of the stationary magnet. By pressing the finger on the lever at D the iron is raised, thus withdrawing the cut-off so that the magnet, A, is attracted and drawn upward by the magnet, B. Remove the finger, and the cut-off drops between the poles, and, in consequence, the magnet, A, drops again. The same movement of magnets can be obtained by placing a piece of iron across the poles of the magnet, B, after the magnet, A, has been drawn near to it. The magnet, A, will thereupon immediately fall away; but the iron can only be balanced, and the balance not disturbed, by the action of the magnets upon each other when the iron is on the neutral line, and does not move nearer or farther away from the magnet, B.

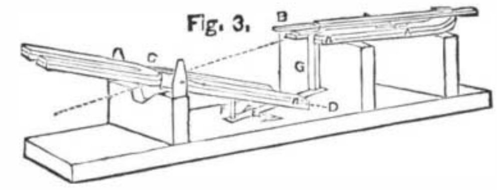
It may not be found easy to demonstrate these principles at the first trials. But it should be borne in mind that it took the inventor himself four years after he had discovered the principle to adjust the delicate balance so as to get a machine which would go. Now, however, that he has thought out the entire problem, and frankly tells the world how he has solved it, any person at all skillful and patient, and with a little knowledge of mechanics, may soon succeed in demonstrating it for himself.

The principle underlying the motor and the method by which a motion is obtained now being explained, let us examine the inventor's working models. The beam movement is the simplest, and by it, it is claimed, the most power can be obtained from the magnets. This is illustrated in Fig. 3. The letter A represents a stationary magnet, and B the soft iron, or induced magnet, fastened to a lever with a joint in the center, and so balanced that the stationary magnet will not quite draw it over the neutral line. The letter C represents a beam constructed of a double magnet, clamped together in the center and balanced on a joint. One end is set opposite the stationary magnet, with like poles facing each



other. The beam is so balanced that, when the soft iron, B, on the magnet, A, is below the neutral line, it (the beam) is repelled down to the lower dotted line indicated by the letter D. The beam strikes the lever, E, with the pin, F, attached, and drives it (the lever) against the pin, G, which is attached to the soft iron, B, which is thus driven above the neutral line, where its polarity changes. The soft iron now attracts the beam magnet, C, to the upper dotted line, whereupon it (the soft iron) is again drawn down over the neutral line, and its polarity again changing, the beam magnet, C, is again repelled to the lower line, continuing so to move until it is stopped or worn out. This simply illustrates the beam movement. To gain a large amount of power the inventor would place groups of compound stationary magnets above and below the beam at each side, and the soft iron induced magnets, in this case four in number, connected by rods passing down between the poles of the stationary magnets. A "pitman" connecting the beam with a fly-wheel to change the reciprocating into a rotary motion would be the means of transmitting the power. With magnets of great size an enormous power, he claims, could be obtained in this way.

One of the daintiest and prettiest of Mr. Gary's models is that illustrating the action of a rotary motor. There is a peculiar fascination in watching the action of this neat little contrivance. It is shown in Fig. 4. The letter A represents an upright magnet hung on a perpendicular shaft; B, the horizontal magnet; C, the soft iron which is fastened to the lever, D; E, the pivoted joint on which the lever is balanced; and F, the thumbscrew for adjusting the movement of the soft iron. This soft iron is so balanced that as the north pole of the upright magnet, A, swings around opposite and above the south pole of the horizontal magnets, B, it drops below the neutral line and changes its polarity. As the magnet, A, turns around until its north pole is opposite and above the north pole of the magnets, B, the soft iron is drawn upward and over the neutral line, so that its polarity is changed again. At this point the polarity in the soft iron, C, is like that of the permanent magnets, A and B. To start the engine the magnet, A, is turned around to the last-named position, the poles opposite like poles of the magnets, B; then one pole of the magnet, A, is pushed a little forward and over the soft iron. This rotary magnet is repelled by the magnets, B, and also by the soft iron; it turns around until the unlike poles of the permanent magnets become opposite; as they attract each other the soft iron drops below the neutral line, the polarity changes and becomes opposite to that of the magnets, B, and like that of the magnet, A; the momentum gained carries the pole of A a little forward of B and over the soft iron, which, now being of like polarity, repels it around to the starting point, completing the revolution. The magnets, A and B, now compound or unite their forces,

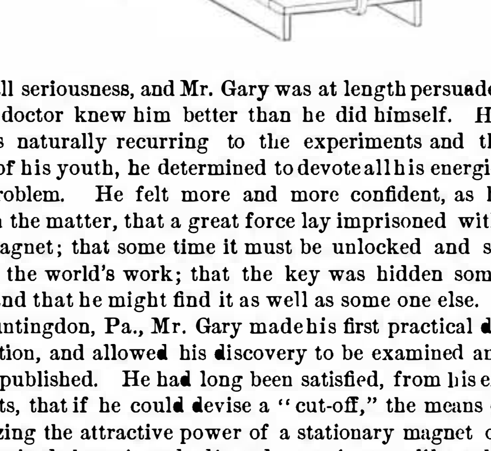


and the soft iron is again drawn up over the neutral line; its polarity is changed, and another revolution, is made without any other force applied than the force of the magnets. The motion will continue until some outside force is applied to stop it, or until the machine is worn out.

The result is the same as would be obtained were the magnets, B, removed and the soft iron coiled with wire, and battery force applied sufficient to give it the same power that it gets from the magnets, B, and a current changer applied to change the polarity. The power required to work the current changer in this case would be in excess of the power demanded to move the soft iron over the neutral line, since no power is required from the revolving magnet under these circumstances, it being moved by the magnets compounding when like poles are opposite each other, three magnets thus attracting the iron. When opposite poles are near together, they attract each other and let the iron drop below the line. The soft iron, with its lever, is finely balanced at the joint, and has small springs applied and adjusted so as to balance it against the power of the magnets. In this working model the soft iron vibrates less than a fiftieth of an inch.

The rotary motion is intended for use in small engines where light power is required, such as propelling sewing machines, for dental work, show windows, etc.

When Wesley Gary was a boy of nine years, the electric telegraph was in its infancy and the marvel of the day; and his father, who was a clergyman in Cortland county, New York, used to take up matters of general interest and make them the subject of an occasional lecture, among other things, giving much attention to the explanation of this new invention. To illustrate his remarks on the subject he employed an electro magnetic machine. This and his father's talk naturally excited the boy's curiosity, and he used to ponder much on the relations of electricity and magnetism, until he formed a shadowy idea that somehow they must become a great power in the world. He never lost his interest in the subject, though his rude experiments were interrupted for a while by the work of his young manhood. When the choice of a calling was demanded, he at first had a vague feeling that he would like to be an artist. "But," he says, "my friends would have thought that almost as useless and unpractical as to seek for perpetual motion." At last he went into the woods a-lumbering, and took contracts to clear large tracks of woodland in Western and Central New York, floating the timber down the canals to Troy. He followed this business for several years, when he was forced to abandon it by a serious attack of inflammatory rheumatism, brought about through exposure in the woods. And this, unfortunate as it must have seemed at the time, proved the turning point in his life. His family physician insisted that he must look for some other means of livelihood than lumbering. To the query, "What shall I do?" it was suggested that he might take to preaching, following in the footsteps of his father, and of a brother who had adopted the profession. But this, he said, he could never do; he would do his best to practice, but he couldn't preach. "Invent something, then," said the doctor. "There is no doubt in my mind that you were meant for an inventor." This was really



said in all seriousness, and Mr. Gary was at length persuaded that the doctor knew him better than he did himself. His thoughts naturally recurring to the experiments and the dreams of his youth, he determined to devote all his energies to the problem. He felt more and more confident, as he dwelt on the matter, that a great force lay imprisoned within the magnet; that some time it must be unlocked and set to doing the world's work; that the key was hidden somewhere, and that he might find it as well as some one else.

At Huntingdon, Pa., Mr. Gary made his first practical demonstration, and allowed his discovery to be examined and the fact published. He had long been satisfied, from his experiments, that if he could devise a "cut-off," the means of neutralizing the attractive power of a stationary magnet on another raised above it and adjusted on a pivot, unlike poles opposite, and so arrange this cut-off as to work automatically, he could produce motion in a balanced magnet. To this end he persistently experimented, and it was only about four years ago that he made the discovery, the key to his problem, which is the basis of his present motor, and upsets our philosophy. In experimenting one day with a piece of soft iron upon a magnet he made the discovery of the neutral line and the change of polarity. At first he gave little attention to the discovery of the change of polarity, not then recognizing its significance, being absorbed entirely by the possibilities the discovery of the neutral line opened up to him.

Here was the point for his cut-off. For a while he experimented entirely with batteries, but in September, 1874, he succeeded in obtaining a movement independent of the battery. This was done on the principle illustrated in Fig. 2. The balanced magnet, with opposite poles to the stationary magnet, was weighted so that the poles would fall down when not attracted by the stationary magnet. When it was attracted up to the stationary magnet, a spring was touched by the movement, and thus the lever with the soft iron was made to descend between the two magnets on the neutral line, and so cutting off the mutual attraction. Then the balanced magnet, responding to the force of gravitation, descended, and, when down, struck another spring, by means of which the cut-off was lifted back to its original position, and consequently the force of attraction between the magnets was again brought into play.

In June, the following year, Mr. Gary exhibited this continuous movement to a number of gentlemen, protecting himself by covering the cut-off with copper, so as to disguise the real material used, and prevent any one from robbing him of his discovery. The publication in the local newspapers of the performance of the little machine, which was copied far and wide, excited much interest. But the inventor was by no means satisfied. He had succeeded in securing a continuous motion, but not a practical motor. He had invented a unique plaything, but not a machine that would do man's work. So he made further experiments in one direction and another, using for a long time the battery; and it was not until some time after he moved to Boston (which was about two years ago) that he was convinced that the points in the change of polarity, with which he was so little impressed when he first hit upon them along with his discovery of the neutral line, were the true ones to work upon. Thereafter his progress was most rapid, and in a little while he had constructed working models, not only to his own satisfaction, but to that of those experts who had the fairness to give them a critical and thorough examination, clearly demonstrating his ability to secure motion and power, as they had never before been secured from self-feeding and self-acting machines. His claim, as he formally puts it, is this: "I have discovered that a straight piece of iron placed across the poles of a magnet, and near to their end, changes its polarity while in the magnetic field and before it comes in contact with the magnet, the fact being, however, that actual contact is guarded against. The conditions are that the thickness of the iron must be proportioned to the power of the magnet, and that the neutral line, or line of change in the polarity of the iron, is nearer or more distant from the magnet according to the power of the latter and the thickness of the former. My whole discovery is based upon this change of polarity in the iron, with or without a battery." Power can be increased to any extent, or diminished by the addition or withdrawal of magnets.

Mr. Gary is forty-one years old, having been born in 1837. During the years devoted to working out his problem he has sustained himself by the proceeds from the sale of a few useful inventions made from time to time when he was forced to turn aside from his experiments to raise funds. From the sale of one of these inventions—a simple little thing—he realized something like ten thousand dollars.

The announcement of the invention of the magnetic motor came at a moment when the electric light excitement was at it height. The holders of gas stocks were in a state of anxiety, and those who had given attention to the study of the principle of the new light expressed the belief that it was only the question of the cost of power used to generate the electricity for the light that stood in the way of its general introduction and substitution for gas. A prominent electrician, who was one day examining Mr. Gary's principle, asked if in the change of polarity he had obtained electric sparks. He said that he had, and the former then suggested that the principle be used in the construction of a magneto-electric machine, and that it might turn out to be superior to anything then in use. Acting on this suggestion, Mr. Gary set to work, and within a week had perfected a machine which apparently proved a marvel of efficiency and simplicity. In all previous machines electricity is generated by revolving a piece of soft iron in front of the poles of a permanent magnet. But to do this at a rate of speed high enough to produce sparks in such rapid succession as to keep up a steady current of electricity suitable for the light, considerable power is required. In Mr. Gary's machine, however, the piece of soft iron, or armature, coiled with wire, has only to be moved across the neutral line to secure the same result. Every time it crosses the line it changes its polarity, and every time the polarity changes, a spark is produced. The slightest vibration is enough to secure this, and with each vibration two sparks are produced, just as with each revolution in the other method. An enormous volume can be secured with an expenditure of force so diminutive that a caged squirrel might furnish it. With the employment of one of the smallest of the magnetic motors power may be supplied and electricity generated at no expense beyond the cost of the machine.

The announcement of the invention of the magnetic motor was naturally received with incredulity, although the recent achievements in mechanical science had prepared the public for almost anything, and it could not be very much astonished at whatever might come next. Some admitted that there might be something in it; others shrugged their shoulders and said, "Wait and see;" while the scientific referred all questioners to the laws of magnetic science; and all believers in book authority responded, "It can't be so, because the law says it can't." A few scientists, however, came forward, curious to see, and examined Mr. Gary's models; and when reports went out of the conversion of two or three of the most eminent among them, interest generally was awakened, and professors from Harvard and from the Massachusetts Institute of Technology called, examined, and were impressed. More promptly than the scientists, capitalists moved; and before science had openly acknowledged the discovery and the principle of the invention, men of money were after Mr. Gary for the right to use the motor for various purposes; one wished to use it for clocks, another for sewing-machines, others for dental engines, and so on.

It is as yet too soon to speculate upon what may result from the discovery; but since it produces power in two ways, both directly by magnets and indirectly by the generation of unlimited electricity, it would seem that it really might become available in time for all purposes to which electricity might long ago have been devoted except for the great expense involved. Within one year after the invention of the telephone it was in practical use all over the world, from the United States to Japan. And it is not incredible that in 1880 one may be holding a magnetic motor in his pocket, running the watch which requires no winding up, and, seated in a railway car, be whirling across the continent behind a locomotive impelled by the same agency.

Astronomical Notes.

OBSERVATORY OF VASSAR COLLEGE.

The computations in the following notes are by students of Vassar College. Although only approximate, they will enable the ordinary observer to find the planets.

M. M.

POSITIONS OF PLANETS FOR MARCH, 1879.

Mercury.

On March 1 Mercury rises a little before seven in the morning, and sets at 5h. 30m. P.M. Its course is so nearly that of the sun, that it probably will not be seen before the middle of the month. After the middle of the month it should be looked for, in the twilight, some degrees north of the point of sunset.

Mercury is in its best position on March 29. It sets on the 31st at 8 P.M., about a degree south of the point at which Venus sets.

Venus.

Venus will be more and more conspicuous, in the west, during the whole month of March. It sets on March 1 at 7h. 28m. P.M., and on the 31st at 8h. 41m. P.M.

Venus and Saturn will have nearly the same apparent position on the evening of March 2, and with a small telescope, can probably be seen in the field of view at the same time.

Mars.

Mars is not likely to be seen, as it is visible only in the early morning hours. Mars rises on March 1 at 4h. 9m. A.M. far south of east, and sets at 1h. 12m. P.M.

On March 31 Mars rises at 3h. 26m. A.M., and sets at 1h. 3m. P.M.

Jupiter.

Jupiter's path is so nearly that of the sun, that it cannot be seen until the latter part of the month, and at that time for only a short interval before sunrise. On March 31 Jupiter rises at 4h. 23m. A.M., far south of east.

Saturn.

Saturn is now so far from us, and sets so soon after the sun, that only its larger satellites can be seen, even with a powerful telescope.

On March 1 Saturn rises at 7h. 40m. A.M., and sets at 7h. 33m. P.M. On March 31 Saturn rises at 5h. 50m. A.M., and sets at 5h. 54m. P.M. On March 2 Saturn and Venus approach; Saturn will be south of Venus.

Uranus.

Although Uranus has passed its point of opposition, it is still in good position for evening observers.

On March 1 Uranus rises at 4h. 56m. P.M., and sets at 6h. 20m. A.M. of the next day. On March 31 Uranus rises at 2h. 52m. A.M., and sets at 4h. 19m. P.M.

Uranus comes to the meridian at 10 P.M. on March 25, at an altitude (in lat. 42°) of 60°. It is then nearly between Regulus and Rho Leonis, 3° east of Regulus. A telescope of two inches aperture will show the planet with a disk, and it is sometimes seen with the eye. With a powerful glass Uranus appears as a small bluish-white planet, unmarked by spots. Its satellites are not easily found; very rarely are more than two seen.

The Zodiacal Light.

The zodiacal light is a column of soft white light seen after sunset and before sunrise. It has been unusually bright during February, its cone-shaped figure resting upon the horizon; its apex has been seen near the Pleiades. On February 12, at 7 P.M., it was so brilliant that the rest of the sky seemed to be thrown into darkness. The southern boundary was decidedly brighter than the northern. It can probably be seen on any moonless night in March. It is most easily traced by looking a little north of west, and therefore seeing it by oblique vision.

Electro-plating with Zinc.

The so-called galvanized iron is covered with zinc, not by galvanic action, but mechanically, the object being to protect it by galvanic action at the expense of the zinc. If it is desired to deposit a uniform layer of zinc upon iron or other metal by means of a battery the following bath is employed: 10 parts of alum and 1 part of freshly precipitated hydrated oxide of zinc (still moist) are dissolved in 100 parts of water. This bath can only be used cold. The article to be plated is cleaned in an acid bath, attached to the negative pole of a battery, and immersed in the above bath. A large plate of cast zinc is connected with the positive pole. The current need not be very strong, and the zinc is deposited equally well upon all metals. If copper which has been zinc plated in this way is heated, a beautiful and thin layer of brass is produced on the surface. When iron is coated in this way the strength of the coating increases upon warming the article, and the iron is completely protected from rust. The thickness of the coating, of course, is proportional to the time it is left in the bath. It must be borne in mind, however, that the zinc is poisonous, and such vessels should never be used either for culinary purposes or to hold drinking water, which objection does not hold in regard to the more expensive, but likewise more durable, nickel plating. For ornamental and architectural work and some parts of machinery zinc will prove a cheap and useful substitute.

Wise Industrial Legislation not Impossible.

Discussing the memorial with reference to the establishment of a national industrial bureau, lately presented to Congress by Senator Davis, of Illinois, a writer in the Newark *Advertiser* says:

Confessedly the greatest difficulty environing this subject lies in our inability to mobilize labor, so that when any special industry becomes overcrowded, its muscle and brain may be speedily transferred to other employments. If a part of the sad toilers of the coal mines could have been suddenly moved off and transformed into agriculturists at the time of the decline of the iron trade, a long story of privation would have remained untold. But they were miners and miners only, and, mostly of foreign origin, they lacked that transmutability which is peculiar to the American mechanic and laborer, who is usually enough of a jack of all trades to try his hand at something new whenever his present resource has failed him. It is from this latter class that the agriculture of the West has been so amazingly recruited within the last five years, so that Kansas and other trans-Mississippi States have grown in wealth and population while all was idle and retrograde at the East. Still another difficulty is that the trades are now so subdivided that few mechanics know more than some one specialty of their avocation, and the intrusion of a pegging machine breaks up a whole "gang" of shoemakers. The first influence of the introduction of machinery is always to depreciate the value of handiwork. It takes some time to adapt the two so that they can work in harmony, as they always do at last.

That it is not altogether Utopian to look to legislation for some remedy of this evil, is plain in the one fact we have referred to of the vast growth of agriculture during our recent period of depression of trade and commerce. Had it not been for homestead legislation almost thirty years ago this exodus of labor from the East to the West and from the shop to the field would have been impossible. Had it not been for a system of legislation far older than the Homestead act, as it is also more recent because it has been continuous, the new settlers at the West would not have found a School Fund already provided and waiting for them. Given good lands and good schools as a free gift, poverty is inexcusable, and that at least legislation has done for labor. It has done far more. It has given to the emigrant the shelter of established order, the protection of the law, an organized government based on the experience of older States, and put them all at work in waiting for the oncoming flood tide of population. So much then is already proved to be within the easy scope of statesmanship to accomplish.

This achievement suggests that more is possible in the same direction, and not only those who suffer in idleness, not only those who are sentimental philanthropists, but careful and cautious social scientists, who reason calmly and from facts, believe that there is enough of a possible Providence, even in a Congress, to afford cheer and encouragement in the further work of adapting our labor to civilization.

Advice to Young Physicians.

At the thirty-eighth annual Commencement of University Medical College, held at the Academy of Music in this city a few evenings since, Chancellor Howard Crosby performed the duty of conferring the degree of M.D. upon 205 young men, composing the largest medical class ever graduated in America.

The Chancellor afterward delivered an address to the graduating class, which contained much good advice, and was received with great applause.

Among other good things, which we have not room to give, the Chancellor said: The same Faculty who have counted you worthy to receive the Degree of Doctor of Medicine have counted me worthy to address you with words of counsel on this occasion, and if I respect their decision in the one case I am obliged as a reasoning mortal to respect it in the other. Whenever I enter the medical college a new sense of my ignorance bursts painfully upon me, accompanied by a profound feeling of awe, to conceal both of which I have to summon all of my powers of hypocrisy and to appear very knowing and perfectly at my ease. So I walk around the museum and delightedly examine the bottled diseases that ornament that instructive department, and if Dr. Darling is near I drop a Latin phrase of admiration; then I mount to the microscopic apparatus and put histological questions, whose answers, wholly indigestible, I nevertheless swallow with apparent gusto, after which I am thoroughly prepared to visit the Styx, Acheron, and Pyriphlegethon, the region of *monstra horrenda quibus lumina adempta*, a region which, strange to say, in that wonderful edifice occupies the highest story. I descend to the Faculty Chamber, and there serenely talk with men who, I know, look right through me, and see my liver and my diaphragm as plainly as they see my nose. Nor does my presence of mind leave me here; my faith is encouraged to rise to a sublime height, and so when Dr. Thomson tells me that the heat of the healthy body never rises above 98°, I believe him, although I have been baked under an Arabian sun with the mercury about 150°; and when Dr. Arnold tells me that the teeth are not bones, I believe him, while I inwardly wonder what they are if they are *not* bone.

"A rolling stone gathers no moss," which I suppose may be also read, "An itinerant doctor gets no practice." There are some men in this world so impatient that they dodge their opportunities. Their opportunities come along and find them gone. If they had waited the tide would have turned or the wind would have blown from a different quarter. A professional man starting in life will be sorely tempted to this recklessness, wearily. Waiting for clients or patients, it is so very natural to think, "This cannot be the spot: I ought to be in another part of the city, or in another town;" but it *is* the spot, only he isn't the *man* quite. He will be when he has become longer known in the neighborhood, when acquaintance has ripened into confidence, and confidence into experience of his professional ability. Great names, gentlemen, were once very small names, and large fortunes began with a dollar. Identify yourself with one place, and in due time you'll become as well known and well used as the penitentiary.

"The early bird catches the worm." I know malevolent wit has from this wholesome saw drawn an unhealthy conclusion about the stupidity of early worms, but you will not, I'm sure, be misled by those triflers. The adage means promptness, and promptness means self-denial, and self-denial is ugly. For it means getting out of a warm bed in the middle of a cold night to breast the storm for a mile or two; it means letting that smoking dinner go untouched; it means giving up that ride with your sweetheart just as you were going to be so comfortable in the buggy; it means, in short, everything, however disagreeable, when duty calls. If you are ever ready on call, people will be ready with their calls. They always count the prompt doctor the best doctor. Your skill will be of small avail without promptness to use it.

"Pleasant words are health to the bones," which may be also read, "A doctor's cheerfulness is often as good as his physic." I wish some one of you gentlemen would take the leisure of the next year—while you are waiting for patients—in studying the curative properties of cheerful manners in the sick room, and then publish your discoveries in a manual for Dr. Thomson to use with his classes. I don't suppose you could do much with scarlet fever or smallpox; but what a vast array there is of nervous diseases to which pleasant words would be like the breath of spring and the oxygen of the mountain top! Cheer up your patient, and you'll rectify the circulation; cheer up your patient, and you'll augment his nerve power; cheer up your patient, and all the tissues will revive. Medicine must sometimes be disagreeable, but doctors never. A physician's face should be like sunshine and his voice like wedding bells.

"Take care of the pennies, and the pounds will take care of themselves." Now, don't think I am going to preach pecuniary carefulness to you. No. I have quoted the proverb for quite another purpose. It is of time, not money, I would use it. Your whole life is to be given to science; to one of the noblest departments of scientific research and activity. You are therefore to grow in scientific knowledge. Your learned professors have only started you in the paths of exploration. But while you are to study, you are also, I trust, to be very busy in your practice. Of course, then, you cannot sit down and say, "I'll devote this week or this day to study." There's a sore throat over the way, and an erysipelas five miles off, that knock that pretty design in the head. You will have no long delicious sails on the sea of medical learning. But you will have scraps of time, five minutes here and a quarter of an hour there, coming along very tantalizingly, but nevertheless coming along between two calls or between sawing the wood and holding the baby. Now, these scraps of time are your very fortune. Add up the minutes and you are astonished that they amount to whole days, and many of them. Have a valuable treatise on some branch of your profession always open on your table or desk, with your open note book and pencil by its side. Drop into your seat and catch at least one idea. The five minutes are gone and away you go, but you have caught and fastened a new idea. Go on in that way and you'll have a mountain of them in a year. Use diligently your scrap time. Don't lounge. Don't think fifteen minutes are so short that there is no use in applying one's self to anything in particular. Save up these pennies of time, and then hurrah for the pounds.

"*Obsta principiis*," which good old Matthew Henry translated by an English proverb, "Nip mischief in the bud." Begin your medical career with a careful avoidance or abandonment of bad habits, especially such as would harm your standing in the esteem and regard of your patients. A man whose clothes are saturated with stale tobacco smoke is not an agreeable visitor in a sick room. Nor is it reviving to a delicate organization to have stimulants applied through the physician's breath. Neatness in personal apparel and delicacy in manipulation may seem to be small matters, but I can assure you that their neglect may have a weighty influence toward failure.

Now, gentlemen, don't be proud because you are the world's benefactors. Beneficence can afford to be modest because its rank is so high. The real nobility need not be particular about publishing its titles. It leaves self-praise to quacks and mountebanks. Do your full duty as physicians, and you will have all the respect and praise that are your due without any effort to put feathers in your own cap.

THE LURAY CAVERN.

BY H. C. HOVEY.

(Continued from page 58.)

Stalactitic distortion is a new and fascinating study. The grotesque results have been repeatedly described, but the causes have been overlooked.

Consider, first, the normal growth of a stalactite. It is tubular and cylindrical. A drop of lime water, on evaporation, deposits a ring of its own diameter. The next drop makes a second ring exactly equal to the first, and cemented to it. Ring follows ring, in a continually lengthening tube, through which the water drips, never able to lay down its burden of carbonate of lime until it reaches the air. Myriads of these white and fragile tubes are to be seen thickly crowded together, from an inch to a foot in length, and sometimes extending for several feet from roof to floor.

When the flow of water exceeds the capacity of the tube, or the orifice is closed up, a series of layers will be formed by the overflow, thicker above than below. Thus the cylinder is transformed into an elongated cone. The distortion of these simple shapes cannot be due to fluctuations of the air, as in the case of icicles; nor to varied resistance of the medium penetrated, as in roots piercing the soil; nor to parasitic punctures, as in vines and stems, although simulating all these abnormal growths. Such causes are not in operation here. What agencies, then, have produced these extraordinary results?

Crystallization is one of the causes sought. A delicate tassel is often formed on the tip of a stalactite; it sometimes envelops the entire tube. The same growth also shoots up from blocks of limestone and nodules of flint, and from its resemblance to petrified moss, it is generally so called. But each pointed leaf is really a brown, yellow, or white crystal of aragonite, occasionally prismatic in shape, and more rarely rounded like delicate fruitage. The indications pointed to a temporary submersion, at some time, of the substance to which the clusters were attached.

On a renewal of stalactitic growth, the fresh deposit would, of course, be exterior to these increments, causing many curious distortions. The tassel, by incrustation, becomes a bulb. The enlargement is often so great as to inwrap contiguous stalactites, whose primary tubes appear, by a transverse section, like pipe stems piercing the excrescence.

Uncouth expansions grow wherever crystals having shot forth are afterwards coated with layers of carbonate of lime. Fungi also play an important and hitherto unnoticed part in stalactitic distortion. Our attention was called to numerous fine, elastic bristles growing on stalactites and other kinds of dripstone in all parts of the cavern. Each carries a little ball at its extremity, usually enveloped by a globule of water. We further observed that the conditions often favored a thin deposit of the carbonate of lime on these bristles, so that their shape remained after the substance had decayed. Many of these black setæ and white filaments were examined by the microscope, and the gradations were traced from the finest hairs up to great knots and tangled outgrowths.

This fungus is a new species of *Mucor*, to which I have affixed the specific name of *Stalactitis* (see Fig. 1), with the following botanical description, namely:

MUCOR *stalactitis*.—Sporangia, globose, membranaceous, dehiscent by a fissure, terminating threads; sporidia, subglobose and separating; flocci, tubular, indistinctly partitional, sometimes branching at the base, but never at the apex. Specific marks: sub-solitary threads; sporangia simple; height, one tenth to one half an inch; color, dark olive green; found on stalactites and other formations in caves; locality, Luray, Page county, Virginia.

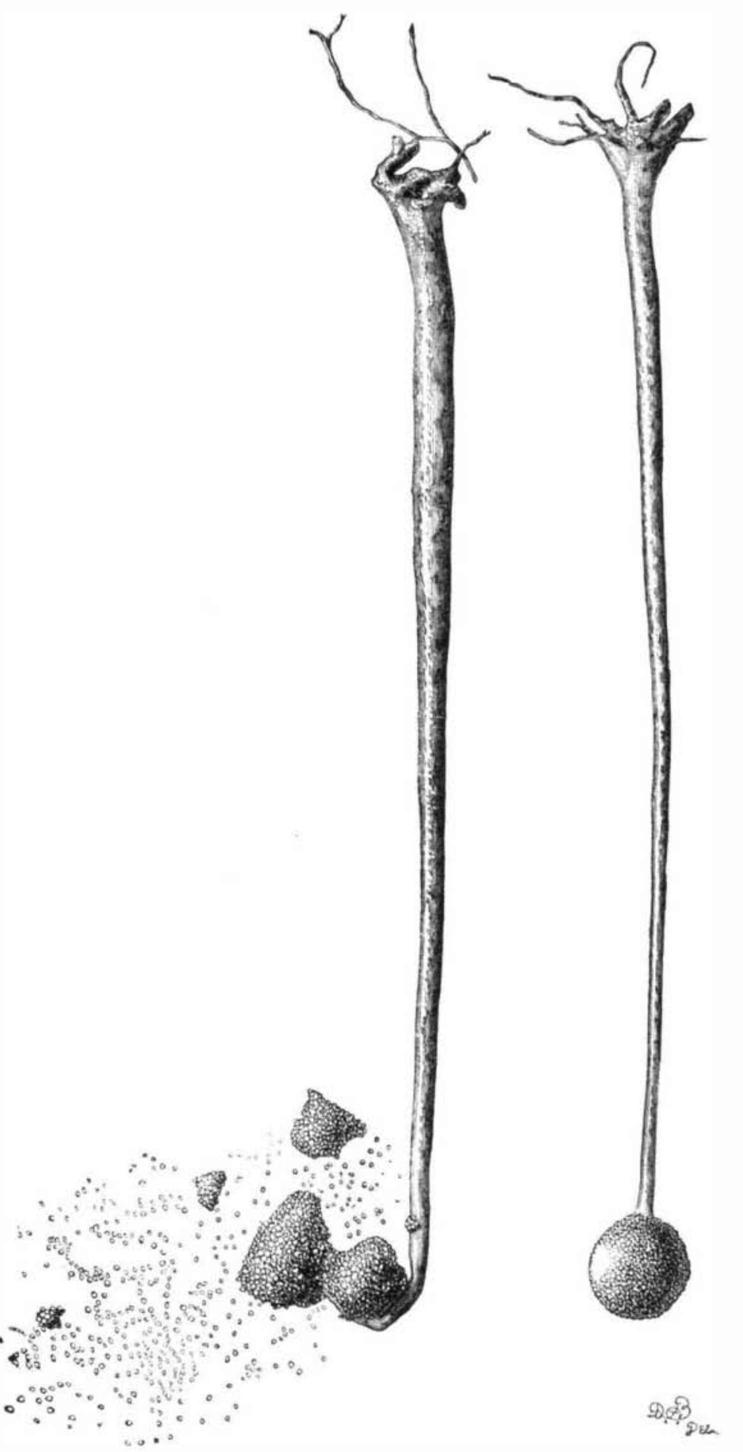


Fig. 1.—MUCOR STALACTITIS.—FROM LURAY CAVERN.

My thanks are due to Professor D. C. Eaton, of Yale College, for aid in examining this beautiful fungus; and also to W. H. Miller, M.D., of Luray, for help in collecting specimens.

Among many examples of lateral outgrowths having fungi for starting points, a single one must suffice for description, selected as exhibiting an extraordinary result of this kind of interference. (See Fig. 2, reduced to one fourth natural size.) The distortion is so symmetrical as to argue design. From a large stalactite two tendrils have grown, which we are sure, from careful examination, did not originate with crystals, but with fungi. The trickling lime water was arrested by them in its descent along the surface, and made a thin deposit, which was increased until the projections caught calcareous drippings falling directly from the roof of the cave. A structure was thus built up, of considerable magnitude compared with its slender support, and in which the ordinary relations of stalactite and stalagmite are interchanged, the stalagmite being uppermost.

Luray Cavern continually yields new discoveries of surprising beauty as the reward of perseverance. Explorations have been lately pushed through a long corridor, having a central row of stalagmites running through its entire length, leading from Stonewall Avenue into a splendid hall, about 100 feet in diameter and equally high. It is located, according to our topographical examination, under a sink observed about 100 yards southwest of the mouth of the cave, and within 200 yards of the entrance to Ruffner's Cave at the summit of the hill. We daily expect to hear of the discovery of some communicating passage between these two caverns. There are proofs that the Indians explored these hidden recesses by some other means than the present entrance.

One day we mounted the huge masses of dripstone, near the Double Column, by means of a ladder. Then creeping a long distance, unwinding a ball of twine as a clew by which to return, and breaking hundreds of delicate stalactites that it seemed a pity to disturb, but that barred our way, we emerged on an eminence, whence with some difficulty we descended into a deep ravine. This locality was thought to be the furthest point from the entrance, so far as known. And there, by digging with our knives in the dry bed of an old torrent, we unearthed an arrowhead and a quantity of charcoal. At a later day a party found moccasin tracks near the Double Column, covered by shallow water and incrusted by a thin coating of lime.

In a gulch near the Imperial Spring human bones are visible, including a jaw with three tooth sockets, the femur, the tibia, and the ribs, the latter fractured. The remainder of the skeleton is concealed under dripstone, for whose formation several centuries must have been required.

The conclusion that these are Indian remains would no doubt be confirmed by skillful exhumation, especially should any weapons or ornaments be thus brought to light. The unlucky adventurer, apparently a youth less than 18 years of age, is supposed to have lost his way amid the darkness, and to have fallen from the cliff at whose base his bones now lie entombed in alabaster.

We found in all parts of the cave vestiges of former occupants of the humbler forms of life, and especially observed thousands of tracks once made by rats, rabbits, raccoons, and wolves. In one locality we pursued bear tracks to a spot where bruin had left long scratches on a stalagmite not yet healed over. All these impressions looked fresh, but could not have been so, for it is years since any wild beasts have appeared in the vicinity. Marks in the tenacious clay might remain unchanged for centuries.

Various layers of excrementitious matter were noticed, and also many small bones of mice and bats, along with casts of