SMALL ELECTRIC MOTOR FOR AMATEURS.*

BY GEO. M. HOPKINS.

Every piece of electric work done by a student or amateur is of value, not only as an addition to his collection of apparatus, but as a means of acquiring a positive knowledge of electricity and of electrical apparatus. The annexed engraving shows a simple and easily constructed motor, which very fully illustrates the construction and operation of the Gramme motor, and is well adapted to various uses requiring only a small amount of power.

This motor was built by Mr. W. S. Bishop, of New Haven, Conn., after the general plans of the simple electric motor already illustrated and described some months since in these columns, but the construction here shown is more simple and more easily carried out. The perspective view here given is two-thirds the actual size. The detail views (Figs. 2 and 3), showing the armature in process of construction, are full size.

The field magnet is formed of a yoke of Norway iron $\frac{5}{16}$ inch thick, $\frac{1}{2}$ inch wide and $2\frac{1}{4}$ inches long. In the yoke, near its ends and $1\frac{5}{16}$ inches apart, are drilled holes for receiving the quarter inch Norway iron cores of the magnet, which are driven into the yoke.

The polar extremities of the field magnet are curved to form a circular opening $2\frac{1}{16}$ inches in diameter. The winding of the field magnet may be applied to the magnet cores, as shown in the engraving, or the wire may be wound upon spools fitted to the cores. The spools are 1 inch in diameter and $1\frac{1}{8}$ inch long between the heads. Upon each spool is wound one ounce of double-wound, cotton-covered magnet wire. The yoke of the field magnet is fastened to the wooden base piece of the motor by screws passing upwardly through the base into threaded holes in the yoke.

The armature consists of a small Gramme ring mounted upon a wooden disk secured to the armature shaft. The armature core, *c*, is a ring formed of a piece of annealed iron wire, No. 13 B. & S. gauge, having its ends beveled and drilled transversely to receive a pin, as shown in Fig. 2. A core of this kind, although theoretically not as efficient as a laminated core, answers every purpose in this very small motor, and greatly facilitates the construction of the armature. The core has an outside diameter of $1\frac{7}{8}$ inches. The outside diameter of the armature is 2 inches, and the inside diameter $1\frac{1}{2}$ inches. Upon the armature core are placed 12 coils, *b*, of silk-covered, single-wound magnet wire, No. 25 B. & S. gauge, separated by rings, *d*, of soft iron wire No. 13, the rings forming polar extensions which add to the efficiency of the motor. The armature coils are formed in a lathe on a mandrel, separately, as shown in Fig. 3. This mandrel consists of a piece of No. 11 wire having two collars $\frac{3}{8}$ of an inch apart, one of the collars being fixed and the other being removable. To allow for any contingency, it is advisable to make the distance between these collars a little less than that given, say $\frac{1}{32}$ inch less. Each coil contains 4 feet 4 inches of wire wound in five layers.

To facilitate the removal of the coil from the mandrel, the first layer is wound loosely. After winding, and before removing the coil from the mandrel, the wire is cemented with paraffine or wax melted on the coil with a warm iron. After twelve coils have been completed, they are strung upon the armature core, *c*, in alternation with the iron wire rings, *d*, and when the core is filled, its ends are brought together and secured by means of the pin, as shown.

The wooden hub of the armature is now fitted to the ring, but before the ring is secured on the hub, twelve equidistant holes are drilled transversely through the hub, near its center, and in each hole is inserted a piece of No. 12 copper wire one-half an inch long. The ends of the pieces of copper wire are allowed to project one-sixteenth of an inch beyond the sides of the hub. The ring is placed on the hub, and ends of the wire projecting from adjacent coils, *b*, are twisted together, and attached by means of solder to the copper wire pins extending through the hub and forming the commutator bars, the covering being removed from the extremities of the wire. It will thus be seen that to each commutator bar is connected the beginning of one coil and the end of the adjacent coil, so that by means of these connections the winding of the armature becomes continuous.

* Full size working drawings for use of amateurs who wish to construct this motor were published in SUPPLEMENT of January 3, 1891, No. 783.

The posts in which the armature shaft is journaled are perforated near their upper ends with a hole of a size adapted to receive the armature shaft, and these holes are counterbored from the inner surfaces of the posts, and a wire of the same diameter as the shaft is placed in the position of the armature shaft, and Babbitt metal or type metal is poured into the openings around the shaft, forming the journal boxes. A hole is bored in the top of each post before casting the metal, to form an anchorage for the journal box, and after the casting, the anchorage is drilled through to the opening of the journal box, to form an oil hole for the armature shaft.

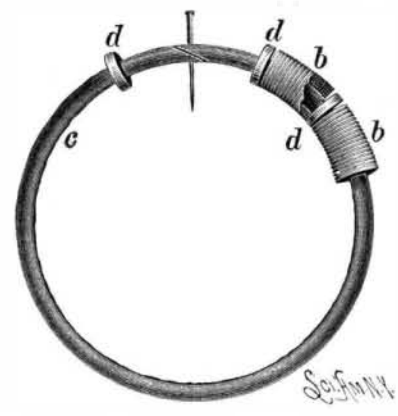

Fig. 2.–ARMATURE OF SMALL MOTOR IN PROCESS OF CONSTRUCTION.

The journal box on the side of the commutator is made to project beyond the inner face of the post, to receive the disk which carries the commutator springs. This projection is made by clamping to the post a piece of wood having in it a hole corresponding with that in the post. After the journal box is cast, the extra piece of wood is removed, leaving a sleeve upon which to place the disk. This disk is an inch and a half in diameter and $\frac{1}{16}$ of an inch thick.

Fig. 3.–APPARATUS FOR WINDING ARMATURE COILS.

To the inner face of the disk are clamped the commutator springs by means of small blocks, as shown in the perspective view, these blocks being held in place by screws passing through the disk into threaded holes in the blocks. The commutator springs are curved outwardly and their ends are turned backward toward the disk, and their extremities rest upon the commutator bars, as shown in Fig. 1.

The commutator disk and the clamping blocks are made of vulcanized fiber, which is strong and at the same time a good insulator. The commutator springs are hard-rolled copper, and their inner ends are adjusted so as to lightly touch diametrically opposite commutator bars. The best adjustment for the commutator springs is found by moving the disk in one direction or the other. It will be found that the maximum effect is secured when the contact surfaces of the commutator springs are nearly in a vertical line.

The commutator disk is clamped in any desired position by an ordinary wood screw, which passes loosely through the post and is screwed into a wooden thumb nut bearing against the outer surface of the post. The terminals of the field magnet are connected directly with the binding post and also with the outer ends of the commutator springs as shown.

With one cell of dry battery the motor makes about 1,800 revolutions per minute, but it does not develop its maximum power until one or two cells are added in parallel. Any of the dry batteries will run it for short periods, but if it is required to run it continuously for any length of time, one or two cells of Bunsen or Fuller battery should be used.

The motor being shunt wound, is practically self-regulating. Its speed with any amount of battery power does not much exceed 2,000 revolutions per minute.

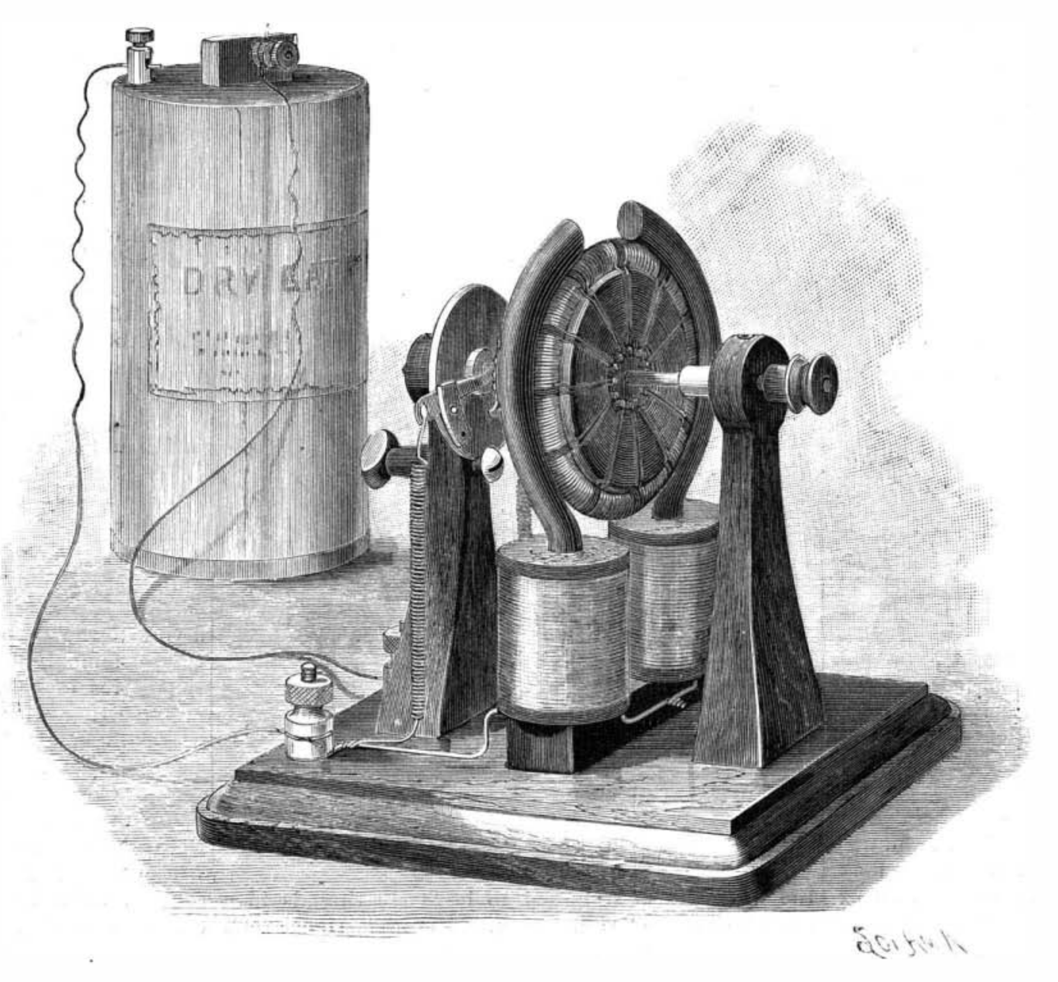

Fig. 1.—PERSPECTIVE VIEW OF A SMALL GRAMME RING MOTOR.

A Mechanical Cotton Picker.

The *Waco Day*, Texas, describes as follows the operation of a new cotton picker by Mr. Campbell, lately tried at that place :

The essential feature is 330 fingers or spindles projecting through and from a hollow cylinder. These fingers are ten inches long, and have at the end a brush or tip of fine wire, and set in four grooves radially is horse hair, clipped so it projects from the fingers about one-twelfth of an inch, the tip and the hairs on the side being the means of getting the cotton from the bolls. The fingers or spindles are given a whirling motion by a system of cog gear inclosed within the cylinder. Moving forward, the cylinder revolves, the fingers come in contact with the cotton, the whirling motion of the fingers entangles the cotton lint, and it is picked, then carried upward and backward until cleaned from the fingers by brushes, and thrown into receptacles holding sixty pounds of seed cotton.

The revolutions are so timed that the fingers which project at the spokes of a wheel strike the plant without a raking motion, for that would damage the plant. No injury comes to the leaf or boll from running the machine over the plant.

With a width of four feet, length seven feet, and height of five and one-half feet, the machine, complete, weighs about 1,200 pounds, and is of easy draught for two mules.

The rows were 185 yards long, and were gone over twice, the result being the cotton was cleanly picked out of the bolls, the machine being as thorough in this respect as the fingers of the negro. No injury to foliage, bolls or branches of the plant was noted.

In the morning, when the cotton was slightly damp, a gathering from one row made by the machine weighed a little more than thirty pounds. The waste knocked on the ground by the machine was picked up by hand and weighed five ounces. In the afternoon, with the cotton perfectly dry, the cotton picked weighed over twenty-eight pounds, and the waste picked up weighed nearly three and one-half pounds.

The time made was about five pounds a minute, or 300 pounds an hour. Allowing time, liberally, for emptying the receptacles, stopping for repairs, meals, and so on, the machine could easily work ten hours a day and would gather 3,000 pounds at a total expense of not more than $3 per day, making the total cost of the picking for each bale $1.50. At present prices the cost is fully $16.

Jamaica International Exhibition.

Shoe manufacturers of New England who are desirous of opening up business relations with South American countries will find an excellent opportunity for showing their goods at the international exhibition which opens at Kingston, Jamaica, on the 27th of January, and all the arrangements are made on a liberal scale, which gives assurance of success. Space is free, and all goods intended for exhibition will be admitted duty free. Kingston is an important point for distributing goods to Central and South America, as well as the neighboring islands. Jamaica, with 600,000 inhabitants, is only 90 miles from Cuba and about the same from Haiti, having direct steam communication with the other West Indian islands and the center of their trade.

Artificial Production of Cyanides and Ammonia.

A series of experiments upon the synthetical production of cyanogen compounds by the mutual action of charcoal, gaseous nitrogen, and alkaline oxides or carbonates, at high temperatures and under great pressure, are described, says *Nature*, by Prof. Hempel in the new number of the *Berichte*. Bunsen and Playfair long ago showed that when charcoal and potassium carbonate are heated to redness in an atmosphere of nitrogen, a certain quantity of cyanide of potassium is formed. Since that time Margueritte and Sourdeval have further shown that barium carbonate may be used in place of the potash, and that the barium cyanide produced may be again decomposed by steam into ammonia and barium carbonate. These reactions afforded a theoretically continuous process for the conversion of atmospheric nitrogen into ammonia, a process which, if it could only be worked on the large scale, would doubtless be of immense value. Unfortunately, however, only small proportions of the substances appear to enter into the reaction at ordinary pressures. Hence the yield is not sufficiently large to render the process economical. Prof. Hempel, however, by means of a simple pressure apparatus, has shown that the reaction is very much more complete, and when potash is used, very energetic, under the pressure of sixty atmospheres.

His apparatus consists of a strong cylinder closed at one end, and worked out of a single block of steel. The steel top screws tightly down, so as to form a closed chamber, and is pierced with two apertures—one for connection with the compressing pumps, and a second to admit the passage of an insulated copper rod. Within the steel cylinder is placed a smaller cylinder of porcelain, in which the mixture of the alkaline oxide or carbonate and charcoal is placed. Through the center of this mixture passes a rod of charcoal, which is connected above with the copper rod and below with the steel cylinder itself, in such a manner that when the wires from a strong battery or dynamo are connected with the projecting end of the copper rod and the exterior of the steel cylinder respectively, the rod of charcoal becomes heated to redness. The pumps are then caused to force in nitrogen gas until the desired pressure is registered on the gauge. Experimenting in this manner, it was found that the amount of barium cyanide formed in fifteen minutes under a pressure of sixty atmospheres was nearly four times that formed at ordinary atmospheric pressure; while in the case of potassium carbonate the reaction was so energetic that in a few seconds the heated carbon rod itself was dissolved. Hence it is evident that the formation of cyanides by heating together alkaline carbonates and charcoal in an atmosphere of nitrogen is greatly accelerated by largely increasing the pressure under which the reaction occurs.

Novel Life-Saving Belt.

Mr. Rossi-Gallico, from Italy, lately read a paper on the merits and adaptations of this invention before the members of the Balloon Society of Great Britain, London.

The belt is very compact, light, portable, and, in a non-inflated state, flat, and can be worn without the least inconvenience. Its inflation is effected by carbonic acid gas, instantaneously produced by the combination of acids and alkalies with which the compartments of the belt are charged on its being brought into contact with water. The one intended for passenger use inflates, as we have said, on touching water; that intended for the use of officers and seamen is made different. It is easily understood that a belt which would inflate simply by being brought into contact with water would be rather inconvenient to wear for those whose duties expose them more or less to a wetting. So to avoid this a special arrangement is made. The acid and alkali are introduced into the belt in a liquid form, and when the moment arrives for the services of the belt being required, all the wearer has to do is to pull two small tassels, which at once allows the chemicals to mix, and the belt is at once inflated. This was demonstrated at the lecture by Sig. Rossi-Gallico, who inflated both classes of belts, the one by wetting, and the other by pulling the strings, in something like fifteen seconds. The belt was also shown inclosed in a brass bomb furnished with cord to allow of its being swung to a distance from the ship, and is so constructed that on its touching the water it sinks for a second, and then a fully inflated belt appears on the surface with sufficient floating power to support two men for forty hours. The belt can also be discharged by rocket to a drowning person quite 1,000 yards away, and may carry a line with it to draw to shore or deck the person to be rescued.

The Atlantic Ocean Mail Steamers.

The Teutonic, City of New York, Majestic, and City of Paris will next year be run on different dates, making together a weekly service such as cannot be excelled in the world, since they are all 20 knot boats, and all come within a few minutes of each other in the duration of the now very fast transatlantic trip—about 5 days 20 hours.

LONG SPLICE FOR ROPES.

The illustrations show how to make a long splice by a method somewhat different from the regular way. It is especially valuable for uniting ropes used in

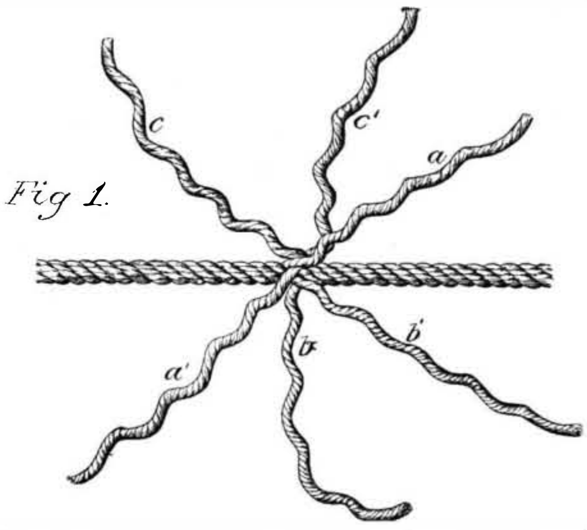

Fig. 1.

power plants. The union can be made so neatly as to be indiscernible.

The ends to be united are first unlaid for at least as many turns as there are threads in each strand. The ends are then "crotched," as shown in Fig. 1. The process of making a regular long splice is started.

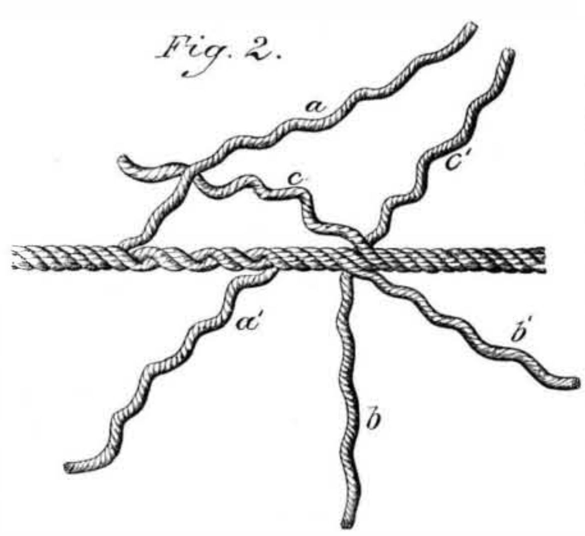

Fig. 2.

Strand *a* is unlaid and strand *a'* laid in its place. In regular practice this would be done without any reduction or tapering, which regular method is shown in Fig. 2 in process of execution. Then, when at a sufficient distance, *a* and *a'* would be allowed to meet. Half of each would be cut off, and the other half would be knotted and stuck away beneath the strands.

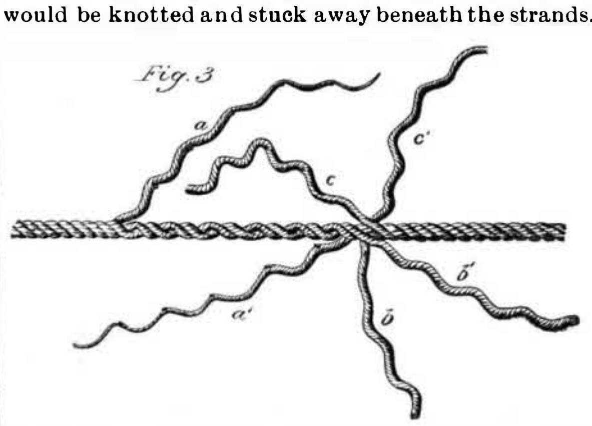

Fig. 3

In the method now to be described, a systematic tapering takes place. The place where the strands are to unite having been settled upon, half as many turns of both strands as there are threads in a strand, counting backward from the place where the two strands are to meet or unite, are unlaid. The rope shown in

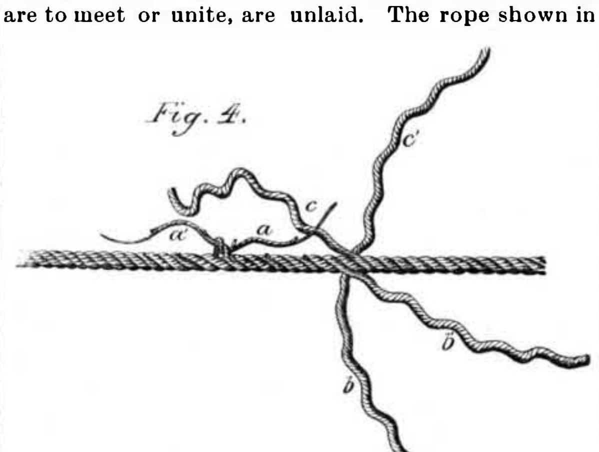

Fig. 4.

the drawings is supposed to have six threads in a strand, or to be "eighteen thread stuff." Hence each of a given pair of strands, say *a* and *a'*, is unlaid three times, counting backward from the place of meeting, and at that point a single thread is cut and removed. They are laid up each one more turn, and a second thread is removed; one more turn brings them together, when a third thread is cut out of each, leaving each of half the original thickness. Here they are knotted or twisted, as shown in Fig. 4, a right-handed knot being used. This knotting and consequent doubling of the reduced strands, it will be seen, maintains the original thickness of the strand, each strand at this point being three threads in thickness. The ends of the loose strands are again wrapped around the laid-up tapered strand until the next turn is reached, when an additional thread is cut out, leaving two. This reduced portion is twisted around the laid strand, which, at this point, is four threads in thickness, until the next turn is reached. There another thread is cut out, and the single thread left is wound around the laid strand, here five threads in thickness, and is finally cut off.

It will be observed that this leaves the strands in all places of the exact original thickness of six threads.

In ropes in which the number of threads are uneven, one strand is unlaid one turn further back and is reduced one thread more than the other at the first knot, and the same principle is carried out, the twisted or united strands always being kept of uniform thickness.

In Fig. 3, the reduction of the strands thread by thread is shown. It is better practice not to reduce them all at once, but to do it turn by turn as fast as they are laid up, as described above. The reduction after knotting is best accomplished in the same way, although the operation can be carried out as shown in Fig. 3 and Fig. 4. The threads too should be cut off so as to lie underneath the strand, and so be hidden, if a very neat job is wanted.

Strand *c* is unlaid in the opposite direction, or to the right, and *c'* is laid in its place. These are treated exactly as *a* and *a'* were.

Strands *b* and *b'* are each unlaid for half as many turns as there are threads in each, in the present case for three turns, and reduced one thread, laid up one turn each and reduced by another thread, laid up a second turn and reduced by a third thread, and are knotted and twisted as described, the loose strands being reduced one thread for each turn given in the finishing twisting.

This splice has been used with great success by Mr. W. A. Wood, of this city. He has employed it on rope driving bands of rawhide, as well as on manila rope, and it has given the greatest satisfaction. The splice being of uniform thickness, the band runs better and the spliced portion lasts as long as any other part.

Resuscitation of the Apparently Drowned.

In the *Transactions* of the Medico-Chirurgical Society of London, Dr. Bowles gives the following excellent advice: After the patient has been placed for a moment with face downward, to allow the escape of water from the mouth and throat, he is turned on the side and *kept on that side* continuously, except when (about fifteen times a minute) the body is rolled for a few seconds on the face again. By *keeping the same side always up*, the lung on that side becomes clear. Turning first one and then the other side up is dangerous, because thereby the partly cleared lung is suddenly flooded with fluid from the lung which was downward. It is better to clear one lung entirely than to have both half cleared. Each time the body is turned upon the face a little more froth and water escapes from the mouth and nostrils. If one lung is thus cleared it may escape the inflammation which results from the inspiration of water. When the upper lung has been almost cleared, it is useful to raise the upper arm above the head as in the Sylvester method, since the entrance of larger quantities of air into the lung is now safe. Pressure upon the back at each pronation assists the escape of water somewhat, and it has a good influence on the heart, aiding the propulsion of the blood toward the lungs. The continued use of the prono-lateral method is an excellent mode of keeping the pharynx clear of obstruction. The *Medical Record* speaks approvingly of this treatment in a recent editorial, and considers it superior to the usual Sylvester or Marshall Hall method.

Carbon Cores for Casting.

The well-known difficulty experienced by both iron and brass founders in making smooth, true holes in castings by coring has led to various experiments with a view to the discovery of something better than the cores commonly used. Mr. E. R. Dale, C.E., writes us that cores of carbon are coming into use in England and meeting with favor for work of all kinds, but especially for the class of work requiring long holes of small diameter.

At present they are supplied in 10 inch lengths from ½ inch to 1½ inches in diameter. They are smoother than sand cores, and will keep for any length of time without wasting. Holes may be cored in many kinds of work which would otherwise have to be bored. The carbon core does not break in the mould, and often may be used the second time.

These cores are said to resemble electric light carbons, and are perforated longitudinally.