BIRD'S-EYE VIEW OF THE PAN-AMERICAN EXPOSITION.

We have so recently (November 10 and November 24) described and illustrated the general scope and the recent progress of the Pan-American Exposition that the accompanying bird's-eye view will be perfectly intelligible to our readers without any lengthy elaboration on our part. The point of view is supposed to be an elevation beyond the water gate, at the extremity of the large lake, which will form one of the most delightful landscape features of the Exposition. The Lake, including the North Bay, is approximately three-quarters of a mile in total length, and its sloping and gently undulating shores will be richly wooded down to the water's edge. To the left of the lake is seen that architectural gem, the Albright Art Gallery, its gray-white marble walls and columns showing in vivid contrast amid its setting of greensward and foliage. Descending the broad marble flight of steps and turning to the left over a bridge which separates the main lake from what is known as the North Bay, one sees across the latter sheet of water another marble building, not so large as the art gallery, but scarcely less charming in its architecture and landscape setting.

After crossing the bridge, and swinging somewhat to the right, one enters the magnificent main approach to the Exposition buildings, and the eye ranges through the long perspective of the Fore Court, the vast Esplanade, capable of holding a quarter of a million people, the Court of Fountains and the Grand Basin until it is arrested by the towering mass of the noble Electric Tower—the dominating architectural feature of the whole Exposition. To the right of the approach are the Ordnance exhibits, and adjoining them the numerous groups of buildings devoted to State and Foreign exhibits. Following down the main approach and through the Fore Court, one reaches the ornamental bridge which leads into the Esplanade. Inclosing the right wing of the Esplanade are the United States Government buildings, and the left wing is shut in by the Forestry and Mines building, the Horticultural building, the Graphic Arts building and the Temple of Music. Passing through the Esplanade, whose shorter axis measures 450 feet and its longer 1,700 feet, the visitor is confronted by the Fountain and Cascades, which, together with their setting of greensward and flower beds, extend down the main approach for 700 feet. Beyond the Cascades is the Mall, a broad, imposing concourse, extending entirely across the grounds, which measures 150 feet in width by 2,640 feet in length. Here one is confronted by a sheet of water 350 feet by 400 feet in length, from which there towers nearly 400 feet into the air the massive and pre-eminently graceful structure of the Electric Tower. To the right and left of the Cascades are the buildings devoted respectively to Manufactures and Liberal Arts and to Machinery and Transportation, each of which is 350 feet in width by 500 feet in length. At the back of the Liberal Arts building is the stock exhibit, while to the rear of the Transportation building are grouped in one structure the various offices of the administration. To the right of the Electric Tower is the building, 500 feet in length, devoted to Agriculture; while to the left of the Basin is another building of similar dimensions devoted to the Electrical exhibit. Behind the Electric Tower is the Plaza, surrounded by restaurants and the Propylæa, while immediately behind the Propylæa is the general station of the steam and electric railways. By no means least among the attractions of the Pan-American Exposition is the structure which will be given up to athletics and general outdoor sports, known as the Stadium. The major axis of the Stadium will be fully 750 feet in length and its minor axis 500 feet. The arena will be laid out as an athletic field and will be surrounded by a track for contests of speed. Seating accommodation will be provided at two sides and around one curve of the track for 12,000 people. On the opposite side of the Plaza to the Stadium will be the Midway, without which no end-of-the century exposition seems to be complete, if, indeed, judged by its popularity, it must not be considered its leading feature.

The present progress in the construction of the buildings and that essentially novel feature the color treatment, have been very ably dealt with in our recent articles contributed by Edward Hale Brush; and after studying the accompanying bird's-eye view, our readers will agree with him that the combination of

DR. EDUARDO CHAPOT-PREVOST.

the delicate, tastefully-tinted buildings with the broad plazas, the generous expanse of greensward and shrubbery, and the various carefully elaborated elements of the landscape gardening, will produce a *tout ensemble* which will give the Pan-American Exposition the leading place for beauty among the great expositions of the closing years of the present century.

THE Say sugar refinery in Paris is using the 20 ton electric truck for the transportation of sugar. It is intended to carry a 9-ton load, although it has carried 17 tons. It is capable of a speed of 7½ miles an hour, and 25 miles can be made without recharging. Electric motors are used to steer the two front wheels. The company will, it is said, order ten other trucks of similar construction.

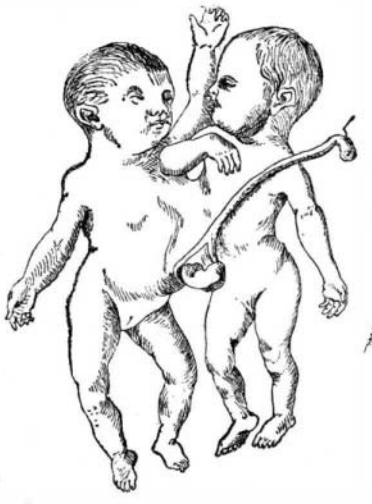


Fig. 3.—ANTERIOR VIEW OF CRUVEILHIER'S FŒTUS.

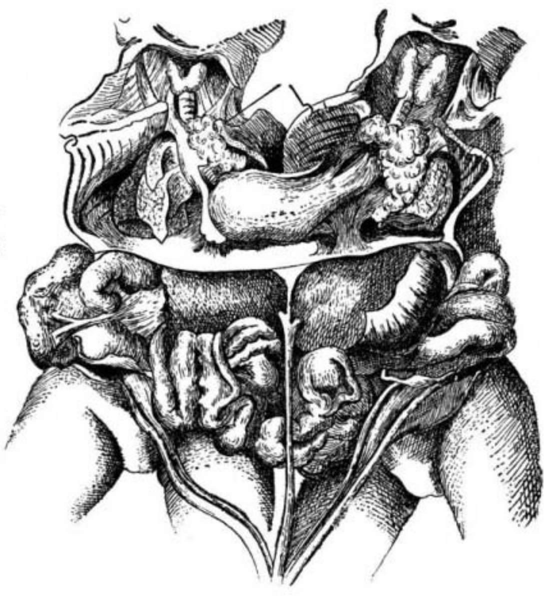


Fig. 4.—THORACIC VISCERA OF CRUVEILHIER'S FŒTUS.

SEPARATION OF THE BRAZILIAN THORACO-XIPHOPAGOUS TWINS.

The thoraco-xiphopagous twins of Brazil, who have attracted no little attention during the past year, have been separated by one of the most remarkable surgical operations chronicled within recent years.

In the SCIENTIFIC AMERICAN of February 24, 1900, we published an account of the preliminary operation performed by Dr. Alvaro Ramos, surgeon of the Hospital Misericordia, of Rio Janeiro, which revealed the fact that the livers of the two girls were united. Before undertaking this operation, an excellent radiograph was obtained, for the purpose of ascertaining as far as possible the exact location of certain internal organs. Strong doses of hyponitrate of bismuth were administered to the patients. Owing to its opacity to Roentgen rays, this substance was revealed in the stomachs and in portions of the intestines, thus proving that there was no connection of these organs in one abdominal cavity. A reproduction of this radiograph was published in the issue above mentioned. When Dr. Ramos discovered the serious nature of the operation that would be necessary to effect the severance of the two bodies, he concluded that for the time being the investigation should be carried no further. Valuable indeed was the information obtained at this operation, and Dr. Chapot-Prevost, lecturer of the Academia de Medicina, of Rio de Janeiro, decided to undertake a second and final operation.

Dr. Prevost first determined whether the liver could recuperate and whether hemorrhage could be controlled. Careful experiments with dogs proved that the liver healed readily, and grew with an astonishing rapidity. A careful physiological and psychological study of the twins convinced him that an operation might be successfully performed.

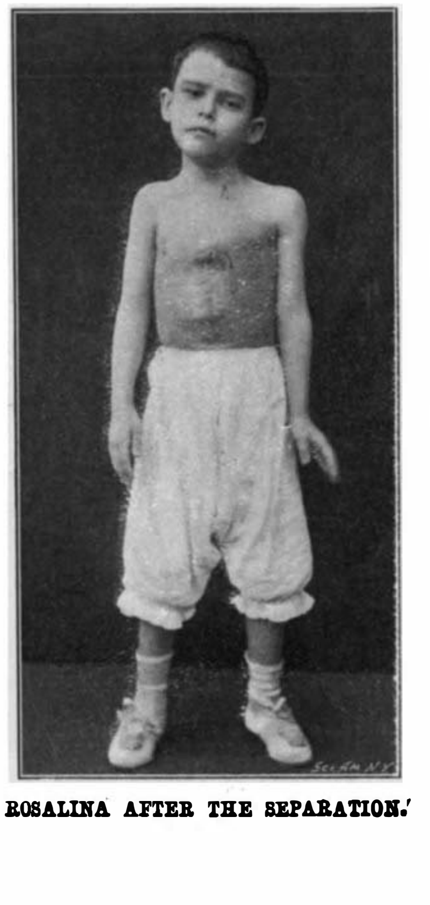
The modern surgeon has been taught by long experience that too much care cannot be taken in preserving the most perfect asepsis. In the present case the most elaborate preparations were made. The attendants took disinfecting baths, dressed themselves in new clothes thoroughly sterilized, and washed their hands and arms in six disinfecting solutions before entering the operating room.

The twins were prepared for the operation with the same elaborate precautions. They were washed with soap and water and with sulphuric ether, and were then wrapped in sterilized cotton covered with gauze. A specially devised operating-table was employed, so constructed that it could be separated into two parts.

The first incision made extended from the navel upward, its middle lying at the ensiform cartilage, near the false ribs of the right side of Maria. The anterior superior surface of the liver was exposed, when the flap was turned back toward Rosalina. It was found that the liver bridged the two cavities and occupied two-thirds of the connecting space. Below this bridge was a second bridge formed by the union of the two mesenteries. After the cartilage in the median line had been severed, still another bridge two centimeters long was discovered, formed by the union of the two pericardial sacs. The separation of this third bridge was a most delicate task. When the anastomosing branch of the two mammary arteries was severed, the blood streamed out in a red deluge. The points were seized and the hemorrhage controlled. The imprisoned tissue was cut, and the edges of each sac sutured with cat-gut. To prevent the intestines of the one body from passing into the other body, the mesenteric bridge was ligated with silk at two points; the intermediate portion cut, and the intestines placed in their proper positions. The pleura of Maria, it was found, extended across the line of union. This unforeseen difficulty was overcome by detaching the parietal pleura, and connecting it by means of a fine cat-gut suture with the median fold, which adhered to the pericardial bridge.

After the internal parts of the thorax had been thus separated, operations on the other side were begun. The skin and cartilage opposite the first incision were severed to expose the liver. Skilfully the surgeon cut the liver so as

THE TWINS BEFORE THE OPERATION.



ROSALINA AFTER THE SEPARATION.

to give each trunk an uninjured gall-bladder and duct. The final suturing was done on two planes, the deep peritoneal and the superficial, including the skin and muscular coat.

Fig. 1 shows the point of separation. The severed surface of Rosalina's liver is represented by *a*; *b* is the visible part of Rosalina's gall-bladder; *c* is the pectoral cavity of Rosalina, which communicated largely with that of Maria; *p* is the circular limit of the bridge of the pericardium cut vertically; *pl* is the case of the pleural sac, extending from the side of Rosalina beyond the point of union; the xiphordian appendix is represented by *ap p* and *app'*.

The condition of Rosalina after the operation was encouraging; that of Maria, less hopeful. On the second day after the operation, Maria's pulse ran up to 160, her respiration to 56, and temperature to 38·5° (C.) The condition of both children improved on the third day; but it was necessary to give Maria inhalations of oxygen at midnight. On the fourth day Maria was weak and could take no nourishment; but she improved after oxygen had been administered. The fifth day saw Rosalina in good health, and Maria improved. In the early part of the sixth day Maria seemed in so favorable a condition that she was pronounced out of danger; but fits of vomiting, although checked, weakened her so much that she was unable to rally under the supportive treatment given her. She died at 1:30 A. M. of the following day. An autopsy revealed an inflammation of the pleura and pericardium, with more or less exudate from each, but no inflammation of the peritoneum. The liver as well as all the external wounds were completely healed.

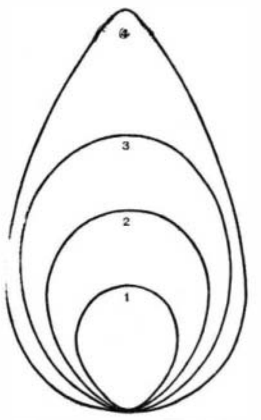


Fig. 1.—COMPARISON OF NOTABLE XIPHOID CASES.

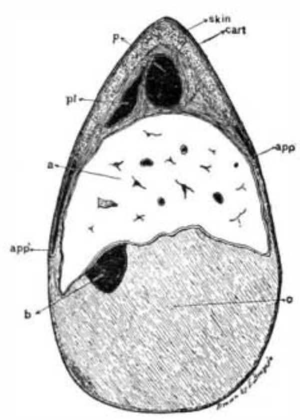


Fig. 2.—DIAGRAM SHOWING THE POINT OF DISSECTION OF ROSALINA AND MARIA.

Drawn especially for the SCIENTIFIC AMERICAN under the supervision of Dr. Chapot-Prevost by Prof. E. Braga.

Rosalina is now in excellent health. On August 16 she sailed with Dr. Prevost for Bordeaux.

Remarkable as the case of these twins may be, it is not the first of its kind known to medical men. As far back as 1834, Cruveilhier studied a double female fœtus brought to his attention by a Dr. Jolly. This curious phenomenon is shown in Fig. 3. The thoracic viscera of this fœtus are shown in Fig. 4. The twins were joined at the anterior portion of the trunk down to the sub-umbilical region of the abdomen. The two sterna were entirely independent of each other. Each fœtus had a thymus and two lungs; but the two hearts were merged into a single organ, horizontally located and imperfectly symmetrical. The right half of the heart was inclosed in the thoracic cavity of the right fœtus; and the left half in the thoracic cavity of the left fœtus. The upper concave portion conformed with the base of the thorax on the line of the xyphoid appendices; the lower concave portion rested on the diaphragm. There were four auricles—two on the right (an upper and a lower), and two on the left. The upper left auricle and the lower right auricle were much larger than the other two. In the illustration the aorta of the right side and the aorta of the left, the vena cava superior and inferior, are clearly shown.

A single diaphragm formed by the union of the two diaphragms was pierced by the two inferior vena cava.

There were two stomachs, two duodena, two pancreas, two ilea, two cœca, two appendices, two large intestines. But there was only one jejunum and one liver, with the anterior and posterior portions located, strange to say, in the epigastric region.

The case of Cruveilhier's twins in certain respects is similar to that of Rosalina and Maria.

In Fig. 1 we have graphically compared the most important xyphoid cases which are recorded in the history of medicine. The diagram indicated by 1 represents the case of Marie and Adele; 2 pictures the case of Chang and Eng; 3, that of Rodica and Doodica; 4, that of Maria and Rosalina.

In conclusion we desire to express our acknowledgment to E. Braga, Jr., formerly professor of mathematics in the College of Braga and professor of history and natural science in the College of Cuanberg at Rio de Janeiro, for information from which the above article was prepared and for the photographs and drawings which he has kindly furnished us. The drawings were made by Prof. Braga especially for publication in the SCIENTIFIC AMERICAN.

III. SIMPLE ELECTRIC MOTOR.

BY GEORGE M. HOPKINS.

Almost every young amateur mechanic is desirous of making something having the ability to move and show action. An electric motor does this; and while the mechanic is making a good piece of machinery, he is also learning the principles of electricity.

The motor we shall describe is intended to turn a fan or light machinery by means of a current derived from a battery. It will drive a light sewing machine or other machinery requiring a similar amount of power, and it is so simple as to admit of being constructed with the tools ordinarily possessed by an amateur.

To begin a motor at the right point is very important. The first thing to be done is to construct the armature—the part which revolves. On account of its simplicity, we have selected the Gramme armature.

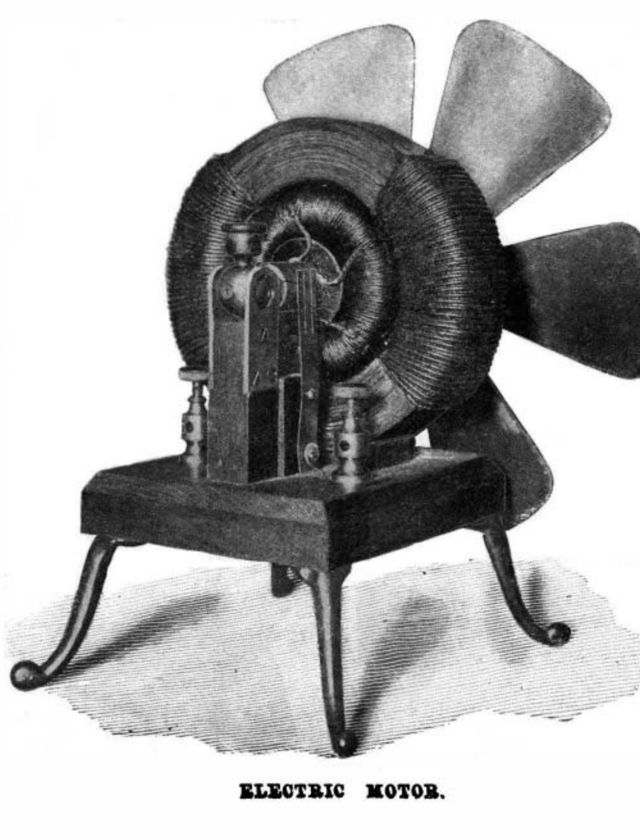
The core of this armature consists of a ring formed of No. 24 sheet iron. A strip ¾ inch wide and 8 feet long (the length of a sheet) is carefully cut from the sheet and wound upon a cylindrical piece of wood in the lathe or by hand. The wood cylinder is 1¾ inches in diameter and 1 inch thick, and in the edge is cut a shallow notch of a depth equal to the thickness of the sheet iron, as shown in Fig. 2. In the iron, ½ inch from the end, is drilled a hole countersunk to receive a wood screw which passes through the sheet iron into the wood, and fastens the end in the notch in the wood. The sheet iron thus attached to the wood may be wound closely around the wooden mandrel without a kink being formed by the inner end of the strip, which is in the notch.

Before beginning the winding, a piece of strong annealed wire, stove-pipe wire for example, is placed in a handy position, and when nine layers of the iron have been wound the strip is cut off and the binding wire is wrapped around the coil and twisted together at the ends, to keep the sheet iron from unwinding.

The wood and the coiled sheet iron are together removed from the lathe (or vise if it is being done by hand), and placed in a fire, which will heat the iron to a cherry red and burn out the wood. The ring is then covered with ashes and allowed to cool slowly. This anneals the iron, and improves its magnetic permeability.

After removal from the ashes, and while the binding wire is still in place. the ends are secured by passing rivets through them; the inner end, which was bent, is cut off, and the ends are beveled with a file, and all the sharp corners are reduced by the same means.

The core of the armature is then covered with adhesive tape (either electrical or bicycle tire tape), when it is ready to receive the magnet wire with which it is to be wound. The ring is divided into five equal sections, and marked with a pencil to show how much space each coil of the armature is to occupy. There are five coils on the armature, with five layers in each coil. No. 21 single or double cotton or silk covered wire is used. It requires about 28 feet of wire for each coil. The winding is a slow and rather laborious process. The length of wire for a coil is wound on a sort of shuttle-stick ¾ inch wide, 12 inches long, with a notch in each end. The end of the wire is wrapped twice or three times around the ring over a piece of stout thread, which is tied around the wires to fasten them together, to begin a coil. Of course, the beginning is at one of the marks on the ring.

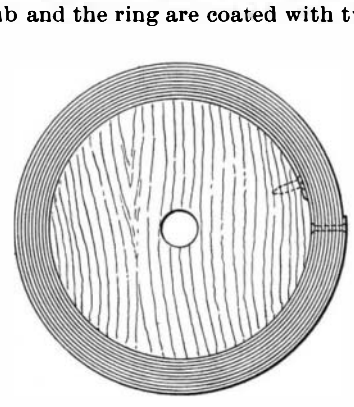


ELECTRIC MOTOR.

Now the shuttle is passed through the ring and brought back over the outside until one layer covers one space; then commencing the winding over the first layer the second is laid on, then the third, fourth, and fifth; all the layers are wound in the same way. The last three or four turns are made over a stout thread, which is tied when the last convolution is made.

The other coils of the armature are made in the same way; and when the winding is all on, the end of one coil is twisted with the beginning of the adjacent coil. A piece of well seasoned hard wood, hard maple, for example, is bored to receive a piece of $\frac{3}{16}$ inch drill rod—Stubs or something equally good—which constitutes the shaft. This rod is 4 inches long. A $\frac{1}{16}$ inch hole is drilled transversely through it at or near the center to receive a short pin which enters a slot in the end of the wooden hub.

This piece of wood is turned to fit the interior of the armature, and it is cut off about the same length as the armature. The coils of the armature and the wooden hub are now varnished with thin shellac varnish, and allowed to dry thoroughly. The armature ring is then slipped into its place on the wooden hub, and the hub and the ring are coated with two coats of shellac varnish, one coat being allowed to dry before applying the other.



THE ARMATURE CORE.

The next thing to claim attention is the commutator. This is a core of wood fitted to the armature shaft and turned to fit a piece of brass or copper tube ⅝ or ¾ inch in diameter and ¾ inch long. This tube is divided into five divisions, and parallel lines, preferably slightly spiral, are drawn from the divisional points marking the places where the tube is to be sawed to form the commutator bars. But before sawing, each end of each space which is to form a bar is drilled, and the hole is countersunk to receive a small wood screw, which passes into the wood and holds the bar in place when the brass tube is sawed on the lines to separate the bars. After sawing, the commutator is turned smooth and round, or filed in the lathe with a smooth file. The screws used in fastening the commutator bars must not touch each other or the shaft.

The twisted terminals of the coils are now stripped of the winding at the ends and soldered to the commutator bars, having been cut off the proper length to reach to the commutator.

Before soldering, however, the ends of the terminals and a small portion of each commutator bar are tinned to facilitate the work of soldering. To tin the copper wire, a little pulverized rosin is rubbed on the ends of the wires, and the solder is applied with a soldering iron.

The commutator bars are tinned for ⅛ inch at the ends nearest the armature ring in the same manner.

The terminals of the armature coils are bent so as to touch the commutator bars at the tinned surfaces; the beginning of one coil and the end of the adjacent coil being thus brought into contact with a commutator bar. They are then soldered by applying a drop of solder by means of the soldering iron. The wires are thus made to answer the double purpose of conveying the current to the commutator bars and of causing the commutator to revolve with the armature. Acid must not be used in soldering electrical connections.

To run smoothly, the armature must be in balance. To ascertain whether it is in balance, place the armature shaft on the edges of two level straight-edges supported about 4 inches apart. If the armature will stand in any position, it is balanced. If it rolls so that one side after a few oscillations of the armature goes to the bottom, the top must be made heavier to counterbalance the bottom. Probably the best way to add weight to one side of the armature is to apply it in the form of solder to a band of wire about ⅜ inch wide wound around the armature. Before this winding is applied, a strip of mica ⅝ inch wide must be wrapped around the armature and secured in place by shellac varnish applied to both the armature and to the mica and allowed to become nearly dry. It is not necessary to use a