operation, and other mining equipment shown as in actual service. This plan however, was not carried out, chiefly from the fact that the water line is only two and three feet below the surface of the ground. There is, however, a level extending from immediately underneath the east terminal of this tramway under the Mining building to the southeast corner, and in this is installed a railway, the cars of which are operated by a tail rope by means of a steam tail rope engine. In addition to this tramway and the equipment in the mining level, the Trenton Iron Company has an exhibit in the Transportation building which should be seen and carefully studied in connection with them, as wire cables of various kinds, especially this company's locked wire ropes and heavy traction cables, are exhibited together with mining cars and other manufactures of iron and steel. This company also manufactures a single track tramway, constructed under the Bleichert patents, which is less expensive to construct, but about the same in the cost of maintenance and which has considerable less carrying capacity than the two-wire system just described.

Freaks of Lightning.

During a recent thunderstorm a singular freak of lightning was noticed in the vineyard of Mount St. Mary's College, near Emmitsburg, Md. The lightning first struck a tree and killed it; the apples at present hanging on the tree withered. It then passed to the roots of the tree and tore up the ground, as if it had been plowed for a distance of about twenty feet. It then struck the end post of a grape arbor, knocking a large piece of the post that supported the vines a distance of forty feet. It then ran along the lower wire that supports the vines, about two hundred feet, to the opposite end of the grape arbor, where it pulled out the staple which was attached to the post, knocking a piece out of that post also. On the way, the grapes that hung near the wire were injured, so that they withered on the stem. The grapes that hung higher up were less damaged. The same effect, in a less degree, was produced on two adjacent arbors running parallel to the one just mentioned, one on each side of it, at a distance about thirty feet.

The Charleston Harbor Improvements.

The improvements in the harbor of Charleston, S. C., are beginning to show a marked increase in the depth of water in the channel, says the *Southern States*. Important progress has been made in the work on the jetties, and in the Swash Channel on July 7 the depth of water at low tide at the entrance was 15·9 feet, and at the inner shallow spot 15·7 feet. Add to this five feet of water, caused by the rise of tide, and it figures up 20·9 at one point and 20·7 at the other. With a strong east wind, which is often blowing on the bar, the tide rises at least a foot higher, making the water 21·9 feet and 21·7 feet, respectively. The dredges are working at the mouth of the channel and are excavating 2,000 cubic yards of sand daily.

LIGHT LOCOMOTIVES SHOWN AT THE FAIR.

This interesting exhibit includes five locomotives, four of them in the Transportation department, and one logging locomotive shown in connection with the Michigan logging exhibit. The engines shown do not by any means cover all the specialties made by the firm, which include compressed air locomotives for mines and for street railways, steam locomotives for underground use, several varieties of suburban locomotives, plantation locomotives of different types, steel and furnace work locomotives for service close to converters, coke oven locomotives, shifting locomotives, etc.

The five locomotives shown are of the regular commercial grade made by the firm, and are adapted for severe service and hard usage, where the tracks are often rough and badly laid, with grades and curves excessive, and where the work is frequently carried on continuously by different shifts of men. This has necessitated the use of the best materials, the making of parts strong, without clumsiness, and the utmost simplicity of construction. Among characteristic items differing from common practice are the following:

1. Hanging cross heads of steel, specially designed for replacing gibs, and lining up by removal of plate only.

2. Specially constructed spring piston rings, sprung into grooves, and piston head solid, except lightening core, with rod riveted in, so that no bolts or nuts can come loose, need adjustment, or break; the rings are first rough-turned, then a piece removed, then clamped and turned to true circle, causing them to press out equally, giving wearing surface always conformed to cylinder.

3. The links are skeleton style of casehardened mild steel, and will outlast objectionably heavy links. Lost motion can be taken up easily, and casehardened steel pins and thimbles are removable throughout, even the link saddle bearings being fitted with thimbles.

4. Tires are bored taper, and pressed on tapered centers, and can be taken off and renewed without a wheel press, and cannot come loose.

5. Driving box brasses (unless otherwise desired) are in sections, and can be put in place without a press.

6. All wearing brasses are made of ingot copper and tin, as hard as can be made, no scrap being used.

7. Cylinders and driving wheels are made of specially selected close and hard charcoal mixture of metal, no scrap being used.

8. For the smaller engines extra strong frames and bumper attachments are necessary, as these locomotives are used very roughly, especially in steel works and similar service, where solid heavy cast iron cars are used; it is also desirable to have these engines as narrow as practicable, as side room is usually limited. These conflicting requirements are met by flattening and deepening the frames at each end, securing extreme strength in the direction of heaviest strains. The bumper angle irons are extra heavy and well secured, and when desirable the bumpers are backed up by a cast tool-pocket between the frames, combining convenience with the strongest possible bracing, and not in the way, like the ordinary front braces bolted to the smoke box.

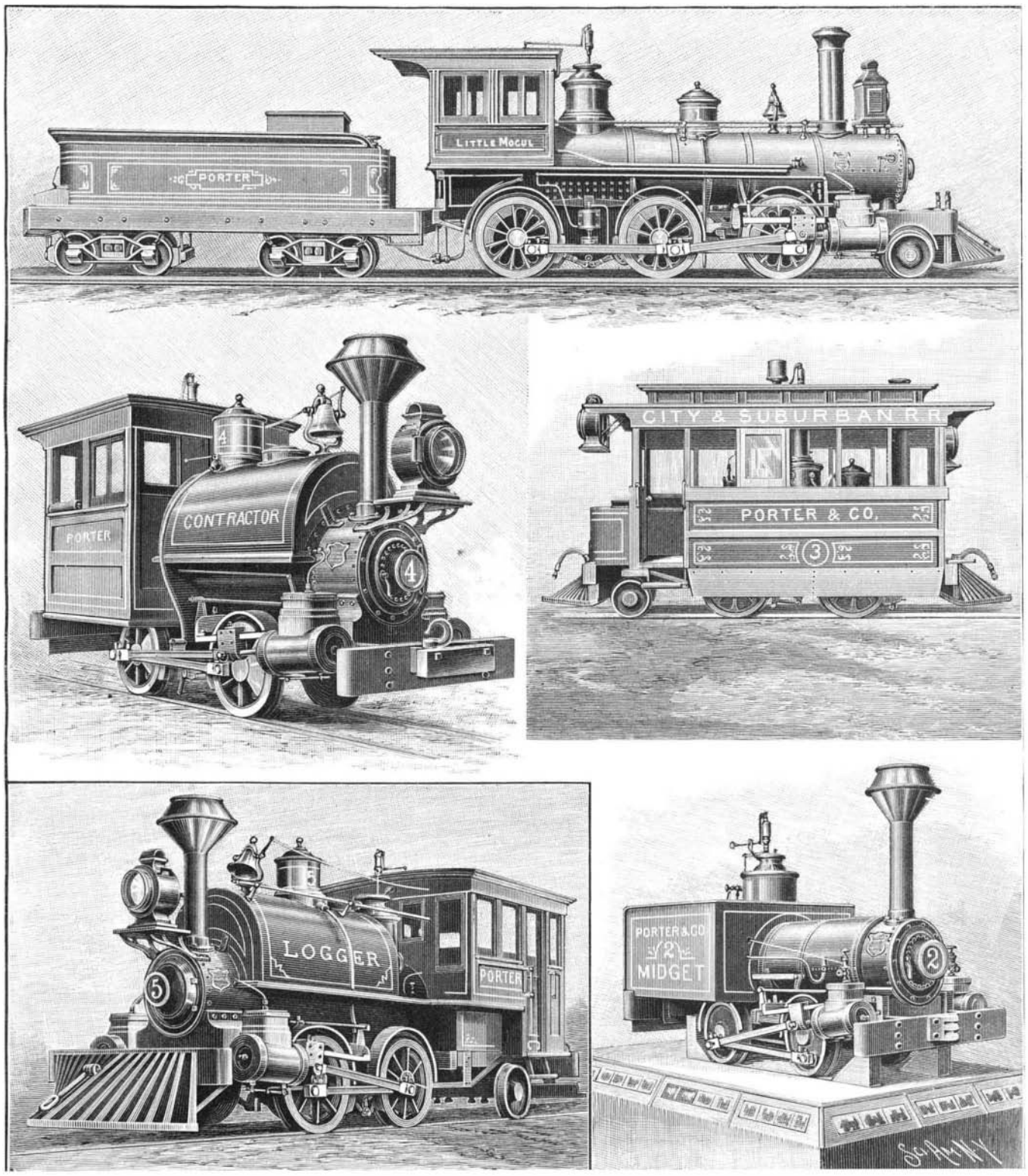
9. Pony trucks are a special design, adding a rolling motion to the radial, pivotal, and swing motions of the Bissell type of truck, so that curves otherwise impracticable are easily passed.

10. Fireboxes are made with sides and crown of one piece, avoiding two riveted seams, making a stronger firebox and diminishing formation of scale.

11. Rivets are hand riveted by special process, making both heads alike and equally strong.

The special points of excellence claimed for the Little Mogul, shown at the top of the picture, include adaptability of design to railroads of light character, admitting rails of 35 and 40 pounds per yard, and curves 15 to 30 degrees. Such roads are used for logging where the distance and the traffic are considerable, for mining districts, and for local purposes of all kinds, and can be operated at a good profit while developing new countries, where heavily equipped roads would not begin to pay for years. Its construction is marked by simplicity of details and general arrangement, and freedom from complications. Strength and durability are secured by intelligent use of materials, and its practical efficiency is secured by a large firebox and abundantly large boiler. The valve motion is planned for quickness and promptness, and adapted for passenger service at high speed, as well as for freight service at slower speed. Flexibility is secured by a complete system of equalizing, and by special design of truck, in combination with advantageous distribution of weight, combining power with ease on the rail, and easy curving and steady motion.

The "Midget" is of a style used by various manufacturing establishments, such as steel and iron mills, where small car loads of material are to be carried everywhere throughout the works with quickness and ease. It does the work of ten to thirty animals. As



THE WORLD'S COLUMBIAN EXPOSITION—EXHIBIT OF H. K. PORTER & CO., OF PITTSBURG, PA.

shown in the Exposition, this engine is blocked up on a platform and run by compressed air. The utmost power is secured by small driving wheels, with a correspondingly sufficient weight, all carried on the driving wheels. Sharp corners are easily turned, as the wheel base is short, sometimes but a little over 24 inches, in engines of this class. The engineer has an unobstructed view in all directions, which is desirable for safety when running through buildings and yards. All valves, levers, gauges, etc., are in easy reach. The cylinders are inclined sufficiently to avoid obstructions on the floor, and also to keep the machinery out of the dust. The links are also at a good height from the floor. The proportions of the boiler are such that only an occasional lump of coal is needed under usual conditions. This general type is built as narrow as 18 inches and 20 inches gauge, and one regular size still smaller, with 5 by 10 cylinders. This locomotive differs from the other four of the exhibit in having solid chilled driving wheels instead of wheels with steel tires.

The "City and Suburban" railroad locomotive is especially designed for light traffic where speed is needed, affording sufficient power, allowing the use of light rails and adapted to turn sharp curves in crowded city streets. Power is secured by as much weight on the drivers as is desirable for the proportions of cylinders to the driving wheels used, and ease of motion is secured by the equalizing of the driving wheels and the use of the rear truck. The special truck enables the motor to pass with ease curves that would be otherwise impracticable. The boiler is of abundant capacity and adapted to anthracite coal or coke. The noise of the ordinary exhaust is avoided by a simple design of exhaust which converts the usual intermittent noisy action into a quiet, continuous flow. Motors of this class are designed to make money where the distance is too long and the business too light to justify the extra cost of any other system, while when traffic is heavy, as on special occasions, they can be used to handle the greatest number of passengers at least expense.

The "Contractor" is designed for a wide range of special service, such as contractors' work, government improvements, coal and ore roads, quarries, iron, copper, fire clay and phosphate mines, industrial roads, etc. Tracks for these purposes are usually short, but with very bad curves and steep grades, and the work is continuous and severe. Power is secured by putting all the weight on the drivers and using small drivers. The wheelbase is short, so that the engine can pass excessive curves easily, but also long enough, compared with total length of engine, to avoid, to a great extent, the rocking and plunging motion common to four-wheel machines. The machinery throughout is designed so that repairs, whether due to accident or wear, can be made by an ordinary locomotive engineer without shop or special tools quickly and cheaply.

The "Logger" has special adaptations for running on logging railroads and similar service. These roads usually vary from 1 to 2 miles to 8 to 12 miles in length, and are laid with light steel rails, 16 to 30 lb. per yard, or sometimes with wooden rails. Power is secured by carrying the greater part of the weight on the driving wheels. These engines are designed for their size of cylinders, with a given length of haul and weight of rail, and grades and curves to get out a greater amount of logs per day, and be depended on to keep up their daily output for months at a time, without interruption, at less cost to operate than other engines.

We also present an illustration of a compressed air mine locomotive made by this firm, but not shown at the Exposition, these locomotives being especially desirable where the ventilation is bad. This locomotive may have one, two or three tanks for compressed air, to be charged up to 400 to 700 pounds pressure, and may be 4, 5 or 6 feet high, according to the height of the mine entry and passages. These locomotives are built of different capacities, to haul from 150 to 600 tons on a level.

The firm make and keep in stock duplicate parts for all standard sizes and designs of their machines, so that on receipt of a telegram the required piece is immediately shipped, which has come to be a necessity from the fact that their business, commercially as well as mechanically, is widely different from usual locomotive work. Their trade is largely in single engines, of all possible gauges of track, for all kinds of usage, of greatly varying sizes and designs, and requiring special modifications to secure best results in each separate case. Their output has increased constantly, and they have built over 1,500 of these light locomotives for use in the various States and Territories of the United States, including Alaska; and for export to Canada, Mexico, Cuba and the West Indies, Yucatan, Panama, Colombia, Venezuela, Guiana, Brazil, Argentine Republic, Uruguay, Peru, Chile, Equador, Hawaiian Islands and Japan. Their export trade amounts to about 15 per cent of their production.

The office of the company is at No. 543 Wood Street, Pittsburg, Pa. A large illustrated catalogue will be sent, on application, to interested parties.

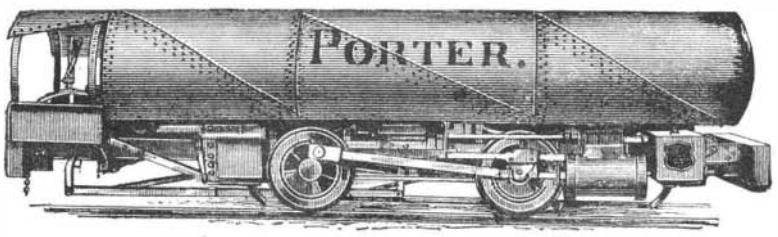
MOUNTING OF LARGE ANIMALS.

BY L. L. DYCHE.

The system shown in the accompanying views is called the statue method, from the fact that a statue is built to represent the body of the animal and over this completed statue or body form the skin is fitted. The most natural place with which to begin our description is the animal itself. A good prime skin from a good animal is the first requisite for good work. The individual animal intended to be mounted for a specimen should be well studied before and after skinning when this is possible. If this cannot be done, then some other animal of the species must be thoroughly studied.

Before placing the skin on the completed statue, it should be thoroughly tanned. In order that this may be accomplished, all fat and flesh should be carefully removed from it. It should also be shaved down, if thick like that of a moose or buffalo skin, to an even thickness all over. A draw shave and sharp knives can be used, but the regular fleshing knives used by tanners have been productive of the best results in my laboratory, especially with large skins.

The operator must know his animal before he can hope to produce its form in the shape of a statue. In order to facilitate his work he should have at hand a complete series of notes and measurements, giving all diameters, circumferences and anatomical characteristics of the animal. Drawings, sketches and photographs of dead and live animals are always of great value. Aside from all this, the operator should know his animal in another way. He should know it so well that he could produce a good sketch or small clay model of it from memory. Again he should know it so well that he could deduce all the essential measurements from a single bone, especially a leg bone. No difference what the circumstances are, he must know his animal and know it well before he can hope for any success in the mounting of it.



PORTER COMPRESSED AIR LOCOMOTIVE.

With the anatomy of the animal well in hand, looked at both from a scientific and artistic standpoint, the operator is now ready for the next step, which is to put up the so-called framework or core of the statue. This will be seen to best advantage by carefully examining the mechanism of Fig. 1. The midrib or body board, as it is usually called (on which the word Comanche is written in Fig. 1), is placed in the center as a backbone of strength, and roughly represents a vertical and longitudinal section through the body. This board extends from the base of the neck to the back part of the pelvis. A board about two inches thick is used in an animal the size of a horse. To the sides of it are fastened, in their proper places, L-shaped pieces, called in the language of the laboratory "angle irons" (see B, in Fig. 1). One end of the L-shaped piece or "angle iron" (made in this case from strap iron two inches wide and three-eighths thick) is bolted to the body board. The other end, which extends some five inches at right angles from the body board, has been twisted half way round and has a hole near the end large enough to receive the upper end of the leg iron. This latter has a thread cut on it which allows it to be securely fastened by nuts, one above and the other below the arm of the angle iron. The leg irons are bent to proper shape and the leg bones are fastened securely to them by means of stout cord and wire. This work should be done before the leg irons are fastened to the body board. In case the leg bones were not saved or have been lost, wooden ones are either carved to take their place or the statue is developed without them.

The skull is now properly adjusted upon stout rods, and the pelvis and shoulder blades, when the latter are used, are put in place. Perpendicular side strips are fastened to the body board, and to these laths are nailed. This not only makes the body hollow, and consequently lighter, but gives size to the body, and saves winding on so much wood fiber or excelsior. Upon the proper adjustment of the framework depends the success of the mount. This framework is one of the most difficult things the operator has to contend with. In no business can it be more truthfully said that "well begun is half done." Not only the legs, with all their bends and curves, but the height, length and width of the animal's body, must be determined at this early stage of development; in fact, the operator must see in this roughly constructed form his animal all completed and finished as a perfect specimen. A knowledge of comparative osteology is almost indispensable at this stage of the work.

The framework completed and corrected for every possible error, and the position or attitude of the animal determined, the next step is to begin the development of the statue proper. This is done by winding and sewing on wood fiber or excelsior. It takes time to become even a good mechanical winder. The excelsior should be wound on with an even compactness. The statue finished in wood fiber should be solid, and yet spring when the hand is pressed against it. There should be no soft places. With a year's practice men in my laboratory usually become very good mechanical winders. Figs. 2 and 3 represent the statue in process of construction. Fig. 4 represents the statue as finished by winding and sewing on excelsior, and should in a rough way represent the surface contour of the body of the skinned horse. This rough statue is now finished in modeling clay much after the fashion that a sculptor finishes a statue. The first coat of clay is, however, put on in a thin pasty condition and rubbed into the excelsior. Without anatomical knowledge and skill the operator cannot hope for much success either with the rough statue or the finished clay model. Fig. 5 represents the statue all finished in clay ready for the skin. The skin has been kept in tan liquor for at least six months, and is thoroughly flexible and soft. Fig. 6 shows the process of putting the skin on the complete statue of the horse Comanche. The skin is sewed up, commencing at the feet. Two needles are used, and the stitch might be called the double baseball.

As each leg is sewed up, care must be taken that clay is filled in wherever necessary to bring out each anatomical development. The work of sewing is finally completed, but the horse is still a sorrowful looking specimen. While the clay is yet soft the small anatomical details characteristic of the animal must be carefully worked out. The feet, joints, flanks, shoulders, ears, muzzle and eyes take days and sometimes weeks of painstaking labor to give them that delicate touch of ease and grace seen in the living, breathing animal. Too much pains cannot be taken with the head. It is frequently kept wrapped in damp blankets for two or three months, while the minute anatomy of the nose and eyes are being worked out in fine detail. A year sometimes passes before the eye gets its final finishing touches.

He Could Break the Crystal.

As a variation on the time-honored story regarding the perfection of control attainable with steam hammers, London *Tit Bits* gets off the following:

"I have been told," said Mr. Dubois, watching the great steam hammer in the rolling mill, "that a good hammerman can break the crystal of a watch with that 30 ton hammer."

"Yes, sir," said the hammerman, "it can be done."

"I should like to see it," said Mr. Dubois eagerly, feeling in his watch pocket.

"I can do it, sir," replied the man.

"And will you?" replied Mr. Dubois, drawing out his watch. "Come, I am anxious to see it tried."

He laid his watch on the great anvil plate. The hammer rose to its full height, and the next instant all its ponderous weight, with a crushing force which shook the ground for an acre round, came down on the watch.

"There, sir," said the hammerman, "if you don't believe that crystal is broken, just step down and you can see it sticking to the hammer."

Mr. Dubois swallowed a whole mouthful of lumps and gasped before he could speak.

"But I forgot to say," he exclaimed, "that it was to break the crystal without injuring the watch."

"Oh, yes," said the hammerman—"Yes, I know. I have heard that rubbish myself, but it's all gammon. I don't believe it. But you can break the crystal any time."

THE Chesapeake & Ohio Railroad Company have just inaugurated the Chesapeake & Ohio Steamship line, which will run between Newport News, Va., to Liverpool and London. Six new steamers have been built at West Hartlepool and Glasgow. Each boat will make the round trip in about six weeks. All of them will be devoted to freight traffic exclusively. Newport News is near the Mississippi, and considerable grain from the Northwest can be diverted from the northeastern lines to the C. & O. The harbor of Hampton Roads is superb, and the terminal facilities of the railroad at Newport News are excellent, its grain elevator stores 1,600,000 bushels, and its yard has room for 3,000 cars. There are seven great piers, the capacity of the export merchandise pier being 1,500 cars. The new vessel which was present at the inauguration was the Rappahannock, 370 feet long, 44 feet beam, with a gross tonnage of 3,860 tons; top speed, 14 knots.