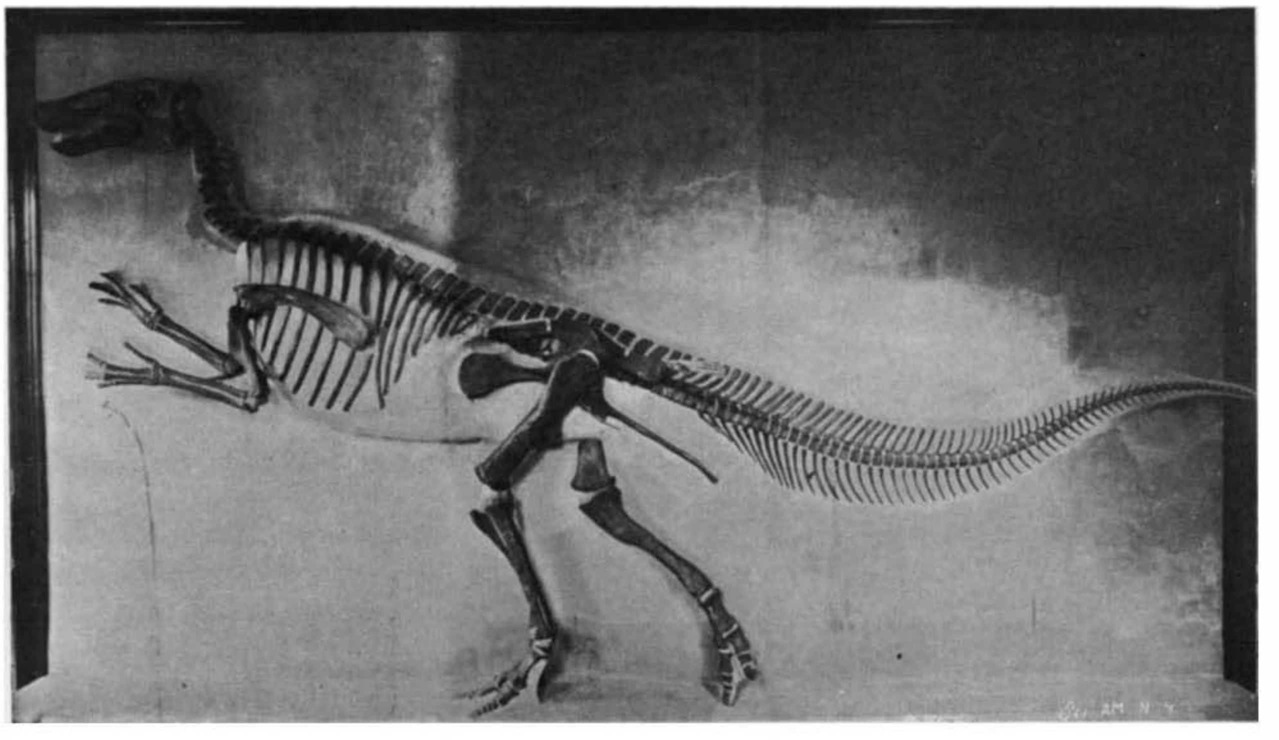
YALE'S LARGE DINOSAUR.

The large dinosaur, on the restoration of which the geological department of Yale University has been at work for a long time, has recently been placed in position. The particular specimen which the Peabody Museum of Yale possesses is of the variety known as Claosaurus. It was discovered by Prof. J. B. Hatcher and a party of friends, in the summer of 1891, while exploring for the late Prof. O. C. Marsh, in the Laramie Cretaceous of Converse County, Wyo. The specimen was in excellent condition, and was a new variety; it was named Claosaurus annecteus Marsh. There is but one specimen in the world which can be compared to it; this is in Brussels.

The dimensions of the skeleton are as follows: Entire length of animal, 29 feet 3 inches; height of head above base, 13 feet 2 inches; height of shoulder above base, 10 feet; length of tail, 13 feet 7 inches; length of hind limb, 9 feet 5 inches. The task of mounting such a gigantic specimen was far from being an easy one. Parts of the skeleton were so firmly embedded in the rock that it was almost impossible to dig them out without injuring the specimen. As much as possible was removed, and the gaps were built out with cement, making a solid background of stone on which the skeleton stands out in bold relief. It is mounted in a position which suggests motion, with one hind foot lifted a bit from the ground, while the front limbs, which are considerably smaller than the hind ones, are in the air, showing that the creature was in the habit of propelling itself by means of its hind legs. The fore limbs are adapted for walking and support rather than for purposes of prehension.



MOUNTED SKELETON OF DINOSAUR, PEABODY MUSEUM, YALE.

As is often the case with the small fore limb of dinosaurs, three fingers of the hand of this specimen were used. The first was a rudimentary one, the second and third of equal length, while the fourth was shorter, and the fifth entirely wanting.

The hind leg has three digits, all well developed and massive. These limb bones, instead of being hollow, are solid, which tends to confirm the idea that the Claosaurus was fond of the water. The whole backbone of this creature, consisting of ninety vertebræ, is complete.

The difference between the Claosaurus and other dinosaurs is mainly in the shape of the head. The skull of this Claosaurus is long and narrow, and this specimen must have possessed an exceedingly small brain. In the case of the Anchisaurus—the dinosaur which is said to have frequented Connecticut—the skull differs in many ways from that of the specimen in the Peabody Museum. It is larger and of much more delicate structure, resembling in shape the New Zealand reptile called the sphenodon. Succulent vegetation was the chief article of diet of the Yale dinosaur.

The work of mounting the specimen was carried out under the direction of Prof. C. E. Beecher, to whom we are indebted for our photograph.

The British Antarctic ship "Discovery" left London July 31 bound for the Solent and, after being inspected by King Edward, will take her departure for her trip of four years' exploration in the Antarctic Circle. The "Discovery" is believed to be the best steamship for navigation in the polar regions ever built. No iron is used in her construction because magnetic survey work is one of the chief objects of the expedition. The vessel is constructed so that if ice closes in around her she will rise and clear herself away. If the rudder and propeller are threatened both can be hauled on deck. One of the curious features of the ship is a system of air-locks between the exterior and interior. This will prevent cold air from entering the vessel when persons go on deck or below. Capt. R. F. Scott, R.N., will command the "Discovery," and Prof. Gregory, of Melbourne, will be the director of the civilian scientific staff. The expedition goes out under the auspices of the Royal Geographical Society.

SELF-PROPELLING FIRE ENGINES.

BY WALDON FAWCETT.

For almost half a century inventors in this country have been experimenting with self-propelled steam fire engines. More than a quarter of a century ago the municipal authorities of Boston purchased such a machine because of the prevalence of disease among the fire department horses of the city, and a little later the New York department secured one of the same type, but of greater dimensions. The steering apparatus on these engines was not all that could be desired, however, and most of them were gradually abandoned, although one or two of the old-fashioned propellers are still doing duty in one of the smaller Eastern cities.

The automobile fire engines of the Boston department were built in 1897, and have been in continuous service since that time. They weigh nearly nine tons each and are, of course, much heavier than any of the engines drawn by horses; and yet experience has demonstrated that they may be handled and placed in position at a hydrant with less difficulty than a horse engine. The Boston engines answer second alarms from boxes in the dangerous district and are considered more reliable hill climbers in all weathers than horses.

The largest size automobile engines when at work at fires throw an average of about 870 gallons of water a minute, or 52,200 gallons an hour, while the average horse engine usually throws less than half that amount of water. Upon exceptional occasions when throwing two streams simultaneously horse engines have been known to play almost 600 gallons of water a minute, but it will be noted that even this quantity is well under that discharged by the self-propelling engine under normal conditions. However, the value of the propellers as fire-quenching agencies has been most conclusively demonstrated at hot and extensive fires where the streams from their one and three-quarter-inch or two-inch nozzles appear to have several times the effect of those from the one and one-quarter-inch nozzles of the horse engines.

Some truly remarkable showings have been made by the "auto" engines during tests. On one occasion one of the propellers played over 1,500 gallons of water a minute, or 90,000 gallons an hour, as compared with about 1,000 gallons a minute, or 60,000 gallons an hour, by the largest and most powerful horse engine procurable. On trials through 100 feet of hose the stream of water from the propeller was projected through a one and three-quarter-inch nozzle to a horizontal distance of 349 feet, and through a two-inch nozzle to nearly 320 feet, whereas a one and one-quarter-inch stream was thrown into the air to a height of 236 feet. When the streets are clear the self-propelling engines invariably distance all the hose wagons drawn by horses. The machines will readily attain a speed of a mile in three minutes, and at tests have shown speed above twenty-five miles an hour. Steam being the propelling power, is carried at all times on these big engines, and as a rule the horseless engine can be depended upon to be started on its journey to the fire within seven seconds after the alarm has sounded.

The working boiler pressure of such an engine as has been described is 125 pounds to the square inch, and, of course, the cost of constantly maintaining about 100 pounds of steam is considerable; yet it is declared in no case to be more than the cost of feeding three horses, and the officials of the city of New Orleans who recently made a careful comparison of the operating expenses of their self-propeller and a three-horse engine (allowing for the death of horses, etc.) found that the horseless engine cost but $27 a month, as compared with $60 a month for the machine drawn by animals.

There are at the present time seven self-propelling fire engines in actual service in this country, and that this class of apparatus is expected to grow in popularity is attested by the fact that several firms are now placing automobile hose wagons. The heavier first cost will, of course, hold against the self-propelling engines in some instances, but this would appear to be offset by the reduced operating expenses. Then, too, the self-propellers have demonstrated their ability to go through snow in which half a dozen horses could not have drawn the lightest engine. Indeed, their great power has sent the Boston "auto" engine through the worst snow blockades which have occurred in that city in four winters. Finally, the introduction of self-propellers sounds the knell of the unsanitary conditions prevailing in those engine houses where the firemen have been obliged to sleep in the same building with the horses.

AUTOMOBILE FIRE ENGINE IN BOSTON.

Export of Russian Crabs.

Consul Hughes writes from Coburg, under date of June 20, 1901: A small fresh-water crab, very much like a diminutive lobster, is largely imported into Germany and Austria from Russia. During the years 1896 to 1900, 75,000 cwts. were imported by Germany alone. Austrian imports amount to some 6,600 cwts. a year. Without very much trouble this industry might, I think, be introduced into the United States.

Automobile News.

At the recent Derby, the great annual English race on Epsom Downs, there were a large number of automobiles in evidence, and the number of four-in-hands were visibly decreased, showing that the automobile is making rapid headway in England.

Madame Schmahl, in the Nouvelle Revue, proposes motor-car kitchens, her idea being a kind of ambulant restaurant from whence food can be served ready for the table. She points out that some plan of this kind is actually in working order in Berlin, but there the ambulant restaurant only concerns itself with the preparation of food for the sick and ailing.

The City Council of Newport has decided to grant permission to the National Automobile Racing Association to use certain parts of the Ocean Drive on August 30 for automobile races. The petitions which were circulated met with hearty approval, and several hundred signatures were obtained. A number of imported racing machines will contest. The course is about 10 miles long, and the road is an excellent one.

A curious accident to an automobile occurred in New York a short time ago. The owner of the vehicle got out of the carriage first and turned to help his companion down, but as the latter stepped from the carriage her dress caught in the lever of the machine, turning it on at full speed. She jumped and reached the sidewalk safely, but the carriage went its way up the avenue with great speed. This trip, of course, was not a long one, as in two blocks it ran into a horse-drawn cab, which it demolished. The automobile itself was not injured.

Our American inventors and manufacturers of automobile parts and sundries are having well-deserved success abroad. We have already noted that the French patent for the auto-sparker has been sold to MM. Panhard and Levassor. Now we are pleased to state that the English rights have been sold to the Motor Manufacturing Company, the largest company manufacturing gasoline carriages in England, for a considerable lump sum and a royalty on each machine manufactured during the life of the patent. This fact is significant as showing the great future in store for products of this kind, and the necessity for adequate protection by foreign patents.

An important test of military automobiles is to be made in England. The Minister of War has recently announced a concourse of automobiles for which three prizes are to be given—$2,500, $1,500 and $500; the prizes are to be awarded by a special commission after a series of tests which will commence on the 4th of December. The following are some of the conditions laid down for the tests. The vehicle must be able to run upon bad roads and even across fields. The total load carried is to be 5 tons, of which the tractor carries 3 and the rear wagon 2. The platform surface is to be 15 square feet per ton. The tractor and wagon must be provided with movable side pieces 2 feet high. The platform of the tractor, when empty, must be at most 4 feet 3 inches from the ground, and that of the rear wagon 4 feet. The train when loaded with its 5 tons is to give the following results: 1. A speed on level grade of 8 miles an hour. 2. A mean speed of 5 miles an hour upon average roads with up and down grades. 3. Upon the road it should, while fully loaded and by its own aid, mount grades of 1 in 8. All the parts of the mechanism are to be protected against accidents, mud and dust. The controlling mechanism is to be strong and powerful. The train should give 48 hours' work without extra attention or repairs. The driving-wheels are to have a diameter of at least 4 feet 6 inches. There is no restriction as to the choice of the combustible or type of motor.

The tour of Scotland, which has been organized by the British Automobile Club on the occasion of the Glasgow Exposition, promises to be an interesting event. The tour of 500 miles will begin on the 2d of September, and last 5 days. Among the points to be considered in the test are the price of the vehicle, its weight, the capacity of the motor, the number of persons or the weight transported, the price per horse power, price per person transported, force in proportion to the weight, the extra power of the motor and the flexibility of the mechanism as shown in the mounting of grades, and the simplicity of the transmission devices. Among other points are the value of the steering devices and of the mechanical parts, the ignition of the motor, appearance of the vehicle, its condition after the trip, stops and accidents, etc. As will be seen, the programme is of a distinctly practical nature. Five different tours are to be made. On the first day, Glasgow-Edinburgh and return, or 116 miles. Second day, Glasgow-Ayr and back, 108 miles. Third day, Glasgow-Callander and back, 96.5 miles. Fourth day, Glasgow, Stirling, Glen Devon and return, or 95.5 miles. Fifth day, Glasgow-Clianlarich and back, or 116 miles. Each firm has the right to enter two vehicles of the same size and make; racing machines will be excluded, as this is exclusively a touring race. Another event is the tour of Ireland, which is organized for the 4th of August. A number of leading chauffeurs are engaged. The trip, starting from Dublin, will last 15 days, and the public will have an opportunity to inspect the machines upon their return to Dublin.

Present State of the Production of Steel Castings.*

ABSTRACT OF A PAPER BY A. TISSOT.

It is to its chemical composition, and especially to its small proportion of carbon and silicon relative to cast iron, that cast steel owes its qualities of resistance and tenacity, but it also owes to them other properties which are of a nature to work against the different operations of casting, such as the formation of the mold, the cast, the cooling, and the perfection of the surfaces. The fusing point of steel is very high and ranges from 1,450 degrees to 1,500 degrees C., so that the metal must be cast at a high temperature to give it sufficient fluidity. This temperature varies according to circumstances from 1,500 to 1,800 degrees, and may reach 2,000 degrees C. The sand of the mold must thus be highly refractory to support the flow of the metal at this high temperature without erosion; but it must also be plastic enough to keep its form before baking, these forms being often quite complicated. These two qualities, which are somewhat contradictory, could only be realized together by using complicated preparations or natural sands unfortunately rare. Owing to the high fusing point, the great shrinkage of the steel upon cooling has been a source of difficulties; this reaches as high as 1.5, 1.8, or even 2 per cent, and causes considerable tensions in the piece. If the mold offers great resistance to its free action the piece is likely to break while hot, or if it does not, it presents differences of molecular tension in different parts which cause it to break when cold upon a slight shock or cooling. Again, the solidification, attended with diminution of volume, tends to the formation of empty spaces in the mass. Blow-holes constitute another grave defect; the metal in solidifying retains its dissolved gases or those disengaged by the mold. The united efforts of the metallurgists and the founders have successively triumphed over these difficulties, either in suppressing them or avoiding their harmful effects. The quality of the sand was first considered by the founders. Natural sand has been found, sufficiently refractory and plastic, containing about 85 per cent of silica and 10 of alumina, but owing to the cost of transport, an artificial sand was looked for, and this has been made by mixing refractory material (quartz and analogous substances) with a plastic element, such as clay. After a great number of experiments a good composition was finally reached.

The great shrinkage of the metal presented the greatest difficulty in the molding process and has exercised the ingenuity of the founders. Among the precautions taken may be mentioned: Reinforcing ribs applied to a weak portion, cores of sand to be embraced by the metal and oppose its shrinkage, the taking of the metal out of the mould just after the casting, and while still red, or in recent cases, flowing the metal into the mold before baking, when the sand, owing to the action of the vapor formed, falls off like a friable earth a few moments after the steel is solid. Against the unequal cooling of the mass, the usual plan has been to add an auxiliary mass which feeds the weaker part and keeps it heated longer. Among the recent improvements in casting may be mentioned the molding machine; its use has been made possible by the side-blowing converters, which furnish steel at a very high temperature, and it may be taken out in quantities as low as 100 pounds in a sufficiently heated state; this separation of the metal in fusion permits its use in the mechanical molding process, and at present 1,200 to 2,000 pounds of small pieces, weighing from 10 to 40 pounds each, are cast per day with one machine. A new process known as "air tempering" has greatly improved the metal, due to the application of the theories of Tschernoff and of Osmond and Werth. It was found that a simple annealing of the metal was not sufficient. Tschernoff showed that by fixing the amorphous state of the grain at a point above the critical temperature of iron, the grain became fine and homogeneous. In practice this is carried out by heating the cast steel to 1,000 degrees C. and cooling it suddenly in air from 1,000 to 600 degrees; the resistance to shock is greatly increased, and favorable tests have been made with car-wheels, etc. The air-tempered metal is much more elastic and tenacious than ordinary annealed metal.

The progress made in the manufacture of steel must also be considered. The production of steel by the Martin furnace has been greatly improved in the last ten years, and its capacity, as well as the quality and purity of the steel, has increased. The metal formed by the acid process has lost its former hardness, and it may be obtained for casting with a resistance to traction of 35 tons per square inch, 25 per cent elongation and a resistance to shock of 20 strokes of a 40-pound plunger falling from 3 to 6 feet height upon 1.2 by 1.2 inch bars, with 6.4 inches between supports. The castings have become more tenacious and resistant, with less risk of cracking; they are free from blow-holes and are more homogeneous. A new application is that of the basic Martin process; owing to the use of aluminium, etc., the basic furnace has even taken the lead, and besides using a pig containing more phosphorus, and therefore cheaper, it gives softer products and is favored for pieces to resist bending strain or shock. To cite average results, basic steel for casting tests at 30 tons per square inch, with elongation of 25 to 28 per cent and a resistance to shock of 30 plunger strokes. In both the Martin steels the hardening elements, carbon, manganese, and silicon, have been reduced. An average analysis gives: Carbon, 0.25 to 0.50 per cent; manganese, 1.00 to 0.50 per cent; silicon, 0.20 to 0.45 per cent. Owing to the increased use of cast steel, Martin furnaces have been constructed of increased capacity, now reaching 50 tons. The side-blowing converter is another great improvement and is largely used; it gives a resistant and tenacious metal, which for casting is softer than that of the Martin furnace and is obtained in qualities ranging from 28 tons per square inch resistance and 35 per cent elongation to 56 tons and 7 to 8 per cent elongation. Its temperature is 200 to 300 degrees higher than that of the former steel. From apparatus of 1 or 2 tons capacity, castings of 4 or 5 tons have been made by accumulating two or three successive runs, and the heat of the metal keeps it sufficiently liquid to allow this; more recently apparatus of 5 or 6 tons capacity have given castings of 15 tons, and nothing will prevent casting up to 30 tons with a converter of 12 tons capacity. The extremely high temperature permits of making pieces 25 to 30 feet long, either in one piece or in several lengths united by the welding process characteristic of converter steel; this is accomplished by re-melting under the action of a jet of steel the parts nearest the joint and letting them cool slowly. This gives to the welded part a resistance equal to the rest of the piece. Among other steel producing processes may be mentioned the Walrand-Legenissel, the Thomas converters, etc.

The results of these improvements in steel casting are shown by its numerous applications in the different industries. The smaller industries, agriculture, construction of bicycles and automobiles, etc., have demanded thousands of small pieces of new pattern, which would have formerly been cast of iron or forged, and which the converter process especially has permitted to turn out under the best conditions. The heavy constructions, whose needs are so diverse, have multiplied the uses of cast steel. One of the late examples is the construction of the arches of the Alexander III. Bridge at Paris, and the rapidity and regularity with which the 2,500 tons of castings were executed shows the point of perfection to which the industry has arrived. Its use in mechanical construction is well known, and among other pieces may be mentioned cylinders of hydraulic presses, valves, collectors of multitubular boilers tested at high pressures under 0.4 to 0.8 inch thickness; shafts of cast steel which nearly equal forged steel; foundation plates for machines or engines, twice as light and twice as resistant as those of cast iron; gear wheels up to 12 and 15 feet diameter, etc., etc. In railroad work, it has almost completely replaced iron and rolled steel for frogs and crossings, and is used extensively in car construction; the use of cast steel wheels or tires is now becoming general; especially noteworthy is its extensive use in locomotive construction, and in this it will soon predominate. Naval artillery has taken advantage of the facility with which complicated forms can be secured with all the resistance of forged steel, and has simplified the gun-carriages while making them render the maximum effect with the minimum of weight; pieces have been made which would not have been thought of ten years ago. In naval construction cast steel has furnished, in all the variety, importance, and complication of form demanded by contemporary naval art, the numerous elements required. The heavy pieces contrast with the lightness of the helices, special cylinders, certain foundations cast in 0.3 inch thickness, and various light pieces used in the construction of torpedoes.

The great extension of electrical construction has found in cast steel a powerful aid and in turn has furnished it a new and important outlet. The extent to which steel castings are used in dynamo and motor work need not be dwelt upon. The converter process is specially advantageous here, and a steel very low in carbon, manganese, and silicon is produced, whose softness is advantageous for the magnetic circuit. At the exposition have been shown some remarkable samples of castings containing, carbon, 0.14 per cent; manganese, 0.34, and silicon, 0.06, and giving a resistance to traction of 24 tons per square inch, with 35 per cent elongation. The cast steel industry, although recent, has thus gained an important place, and it is not surprising that its annual production has increased from 30,000 tons in 1889 to more than 200,000 at present.

*Specially prepared by the Paris Correspondent of the SCIENTIFIC AMERICAN.