Correspondence.

Liquid Air Promotion.

To the Editor of the SCIENTIFIC AMERICAN:

I want to thank you for your timely and effective exposure of the liquid air "grab." It is worth something to the American people to have one fearless paper that is able and willing to throw the search-light of scientific truth upon subjects like this, and save innocent people from deception and loss. It is well that there is one incorruptible and unpurchaseable medium that stands between the public and the pseudo-scientific "promotion" sharks, to counteract, in some degree, the conscienceless exaggerations of those who have stock to sell, and who seem to have no difficulty in loading respectable newspapers with their alluring advertisements. Your issue, containing Mr. Maxim's article, with your editorial comments thereon, was eagerly perused by hundreds of clerks in the departments here, who had been abundantly supplied with liquid air "literature," that had almost created another Klondike fever among them, and it sobered many of them so that many thousands of dollars in the aggregate were saved to them thereby.

All honor to the SCIENTIFIC AMERICAN and to Mr. Maxim for puncturing this colossal bag of (liquid) wind! L. S. PERKINS.

Department of the Interior, Washington D. C. March 19, 1900.

The Dams of the Nicaragua Canal.

To the Editor of the SCIENTIFIC AMERICAN:

In connection with the Nicaragua Canal question, it seems to me that one very important point has been touched upon very lightly,—too lightly, in view of its importance. I refer to the question of earthquakes.

I take it that we may consider the following statements as beyond controversy.

1. That there will be violent and severe earthquakes in the future, as there have been in the past, in the district through which the Nicaragua Canal passes.

2. That no large stone or concrete dam can withstand such shocks.

3. That the immense dams required in the canal, if built of stone or concrete, in the usual fashion, cannot reasonably be expected to last for as long as ten years, and that in bursting, through earthquake shocks, they may be expected to destroy large sections of the canal.

Since however, the canal is to be built, the only thing to do is to build a dam that cannot be destroyed by earthquake. To accomplish this result, I would suggest that the contracts require a dam constructed as follows:

Specification—All dams to consist of steel framework and a concrete filling. The framework to be of ample strength to support the full pressure of water and of the concrete filling, with the usual factor of safety. The steel framework to have all supports carried down to solid rock. The steel in no case to be in direct contact with the rock, but a casing or grouting of cement of at least 6 inches thickness to be between the steel columns and the drilled rock, i. e., the holes in the rock to be drilled 12 inches in excess diameter and the cement filled in between the steel column and the sides of the hole. The section of the dam to be of approximately inverted capital V shape, the only solid portion being the legs of the V, the space between the legs of the V being unoccupied except by tie bars and bracing, cemented to prevent corrosion.

The steel framework to be divided up into panels, so that there shall not be in any portion of the front or rear wall a space of an area of more than one square yard which is not crossed by beams or bracing. These spaces to be filled up with some such material as expanded metal, held in place by rivets. Where the pressure is greatest, several layers of this expanded metal to be used, back of each other, sufficient in number, when properly filled with cement, to give the requisite factor of safety.

The advantages of this form of dam are:

1. It gives really two dams, so that if one be seriously injured as a dam, it will still form part of a supporting structure for the other part.

2. No matter how severe the earthquake, it is not conceivable that the dam should receive such serious injuries as to permit any sudden discharge of water. The most that could happen would be that it would leak, and discharge the water slowly. With shutters or similar apparatus the leak could be checked and all serious damage avoided.

3. This composite structure would be so flexible that it is almost impossible for any earthquake to seriously affect its integrity.

In view of the fact that the wrecking of a masonry dam would cause damage to be estimated in millions, possibly tens of millions, of dollars and of the disorganization of commerce which would ensue, no precautions should be spared, and even if the above form were more expensive, it should be used. I believe, however, that when cost of erection is taken into account, this dam will be found to be the cheaper, on the whole. Incidentally, if this type of dam be adopted, most of the cost will be for material which will be bought and manufactured in the United States, and erected by skilled American workmen. It is always sound political economy to adopt, of two plans, that in which the cost is paid to the manufacturers of our nation and remains in the country, largely paid out in wages, in preference to paying the money out to cheap foreign labor. It is better to spend $80,000,000 on home-made steel and cement and $20,000,000 on foreign labor, than $20,000,000 on material and $80,000,000 on cheap foreign labor. The sides and bottom of the canal should, where there is danger, be constructed similarly, i.e., consist of steel framework and expanded metal with cement filling.

Allegheny, Pa. REGINALD A. FESSENDEN.

AMERICAN FREIGHT LOCOMOTIVES AND THE ENGINES OF THE "OCEANIC"—A COMPARISON OF HORSE-POWER.

We are told that "comparisons are odious," and the statement would seem to be based upon a fairly correct estimate of human nature; but as soon as we get outside of the range of human susceptibilities and apply our comparisons to insensate things, comparisons become not only extremely interesting, but at times a valuable means of increasing our general knowledge and our sense of the proper relative proportion of things.

The pictorial comparison to be found on our front page is based upon one of the mammoth freight locomotives which are being turned out in considerable numbers just now by the leading locomotive works of the country. In addition to the usual information as to dimensions and construction, Mr. R. Wells, the superintendent of the Rogers Locomotive Works, has favored us with particulars of some novel experiments which he carried out to determine the exact location of the center of gravity of this locomotive above the rails. He has also given us particulars of its horsepower and freight-hauling capacity on a level road, and it occurs to us that a comparison of the relative power of one of these engines when working up to its maximum indicated horse power with the maximum indicated horse power of the "Oceanic," the largest steamship in the world, will be attractive to that section of our readers that likes to have its facts enlivened occasionally with a touch of the fanciful and curious.

The locomotive shown is an extremely powerful Consolidation which was recently built by the Rogers Company for the Illinois Central Railroad for use on one of the divisions of their line where the grades are somewhat heavier than on the divisions connecting with it. It was designed to haul trains of a maximum weight of 2,000 tons over grades of 38 feet to the mile. The cylinders are 23 inches in diameter, by 30 inches stroke; the drivers are 57 inches in diameter and they carry 198,000 pounds weight of the locomotive out of a total weight of 218,000 pounds. The boiler, which is of the Belpaire type, is 80 inches in diameter at the smoke box; the fire box measures 42 inches by 132 inches, and there are 417 2-inch tubes which are 13 feet 8 inches in length. There are 252 square feet of heating surface in the fire box, and 2,951 square feet in the tubes, making a total heating surface of 3,203 square feet. The tender is exceptionally large, the capacity of the tank being 5,000 gallons, while the coal space has a capacity of 10 tons.

The increase in the diameter of locomotive boilers which has taken place of late years has necessitated their being carried above the tops of the wheels, with the result that the center of the boiler is in some recent locomotives as much as 9 feet above the rails. To the uninitiated these immense machines have an exceedingly top-heavy appearance, and it looks as though their stability would be endangered, especially when they are running at high speed around a curve. Before sending this engine out of the shops, the Rogers Locomotive Company made an experimental test to determine the exact location of its center of gravity. The result is certainly surprising, for although the top of the boiler is fully 9 feet above the rails, the center of gravity was found to be only 50½ inches above the top of the rails, that is to say, about 6½ inches below the top of the driving wheels. As a matter of fact, the great bulk of the boiler is very deceptive to the eye, and one is liable to forget that the greatest concentration of weight lies in the heavy frame, the wheels, the axles, cranks and running gear, and the heavy saddle and cylinder castings. The test was made by suspending the engine on the upper surface of two 3-inch steel pins or journals as pivots, the one at the front being located 6 inches in front of the cylinder saddle, and the one at the rear, 6 inches back of the boiler, both pivots being, of course, the same distance above the rails and on the vertical center line of the engine. After several trials, points of suspension were found which were in line with the center of gravity, which, as thus determined, was found to be 50½ inches above the top of the rail. As the bearing points of the drivers on the rails are about 56 inches apart, the base on which the engine runs must be 1·1 times as wide as the height of the center of gravity of the engine above the rails. It is evident from this test that the center of gravity of such a locomotive could be raised still higher without endangering the stability of the engine under the ordinary conditions of service.

A COMPARISON OF MARINE ENGINE AND LOCOMOTIVE HORSE POWER.

In order to secure a basis for comparison of the power of a modern freight locomotive with that of a modern steamship, we have chosen the greatest vessel of them all, the "Oceanic." This truly gigantic ship, which exceeds the "Great Eastern" in length and in displacement, is 704 feet in length, and on a draft of 32½ feet displaces 28,500 tons. As the depth of water in the entrance channels to New York harbor will not accommodate a vessel drawing that amount, for the purpose of this comparison we will suppose that the "Oceanic" is drawing 30 feet, at which draft she would displace about 26,000 tons. On this displacement her engines will indicate about 28,000 horse power when driving the vessel at a speed of 22 land miles an hour.

Now, it is estimated that the big Rogers Consolidation could haul about 3,250 tons weight of train at a speed of 22 miles an hour, on the level, and that while doing this work it would indicate about 1,760 horse power. Here then we have a basis of comparison, and we may apply it in two ways. Either we may ask how many of these locomotives would have to be crowded into the hold of the "Oceanic," and coupled to her main shafts, in order to drive her through the water at 22 miles an hour, or we may determine how many of these locomotives it would take to haul the "Oceanic" if she were placed upon a movable cradle of the kind designed by Capt. Eads for his Tehauntepec Ship Railway. In the first case, we know that when the main shafts of the "Oceanic" are making about 90 turns a minute, the engines are indicating about 28,000 horse power, which is their maximum capacity. On the other hand, we know that when the drivers of one of these locomotives are making about 150 turns a minute, and the maximum tractive effort is being exerted at the periphery of the wheels, it is indicating about 1,760 horse power, which represents its possible maximum indication at that speed. If now the sixteen necessary locomotives (the number being found by dividing the horse power of the ship by the horse power of the locomotive) were arranged in two lines, one above each main shaft, and the tractive effort of the drivers transmitted by means of friction wheels to the shafts, the speed of the rotation being reduced by intermediate gearing, in the ratio of 150 to 90, we should have the conditions shown in the upper engraving on our first page, where the locomotives, in double phalanx, are shown grinding merrily away at their unwonted task of driving a modern transatlantic liner.

To determine how many Rogers Consolidations it would take to haul the "Oceanic" over a ship railway whose grade is perfectly level, we will neglect the weight of the cradle and assume that its rolling friction is the same as that of a weight of loaded freight cars, equal to that of the ship. The displacement (that is, the weight of the water which the ship displaces at a given draft) on a draft of 30 feet would be about 26,000 tons, and dividing this amount by 3,250 tons, which is the maximum weight of train which one locomotive can haul at 22 miles an hour, we find that it would take just eight locomotives to haul the "Oceanic" by rail at a speed of 22 miles an hour. This result is particularly interesting as showing how quickly the resistance of the water to the motion of the ship increases with the speed. As a matter of fact it increases as the cube of the speed, with the result that, although the "Oceanic" could be moved at a canal boat speed of 2½ miles an hour by less locomotives than it would take to haul it at that speed on land, at a speed of 22 miles an hour it requires just twice the power on the water that it would on the land.

The "Oceanic," as she rests upon the ship railway cradle, represents both the dead and the live load; that is to say, the ship and the cargo. With a view to showing graphically what an enormous mass is represented by her 26,000 tons displacement, attention is drawn to the sketch showing an equivalent weight in loaded box cars of 40,000 pounds capacity, each of which with its load would weigh about thirty long tons. If this weight were made up into two separate trains each train would contain 433 cars and would be about three miles in length.

An Important Storage Battery Suit.

A decision has been handed down by the United States Circuit Court of Appeals for the First Circuit, at Boston, in the case of the Electric Storage Battery Company vs. the Hatch Storage Battery Company, which affirms the decision of the Circuit Court wherein the Hatch battery was held to be an infringement of the Brush patent owned by the Electric Storage Battery Company, and the latter court granted an injunction against the manufacture and sale of the Hatch battery. The Brush patent covers all batteries composed of "a plate or suitable support primarily coated or combined with mechanically applied oxide of lead or equivalent lead compound." The litigation has been pending for three years and the decision is a most important one.

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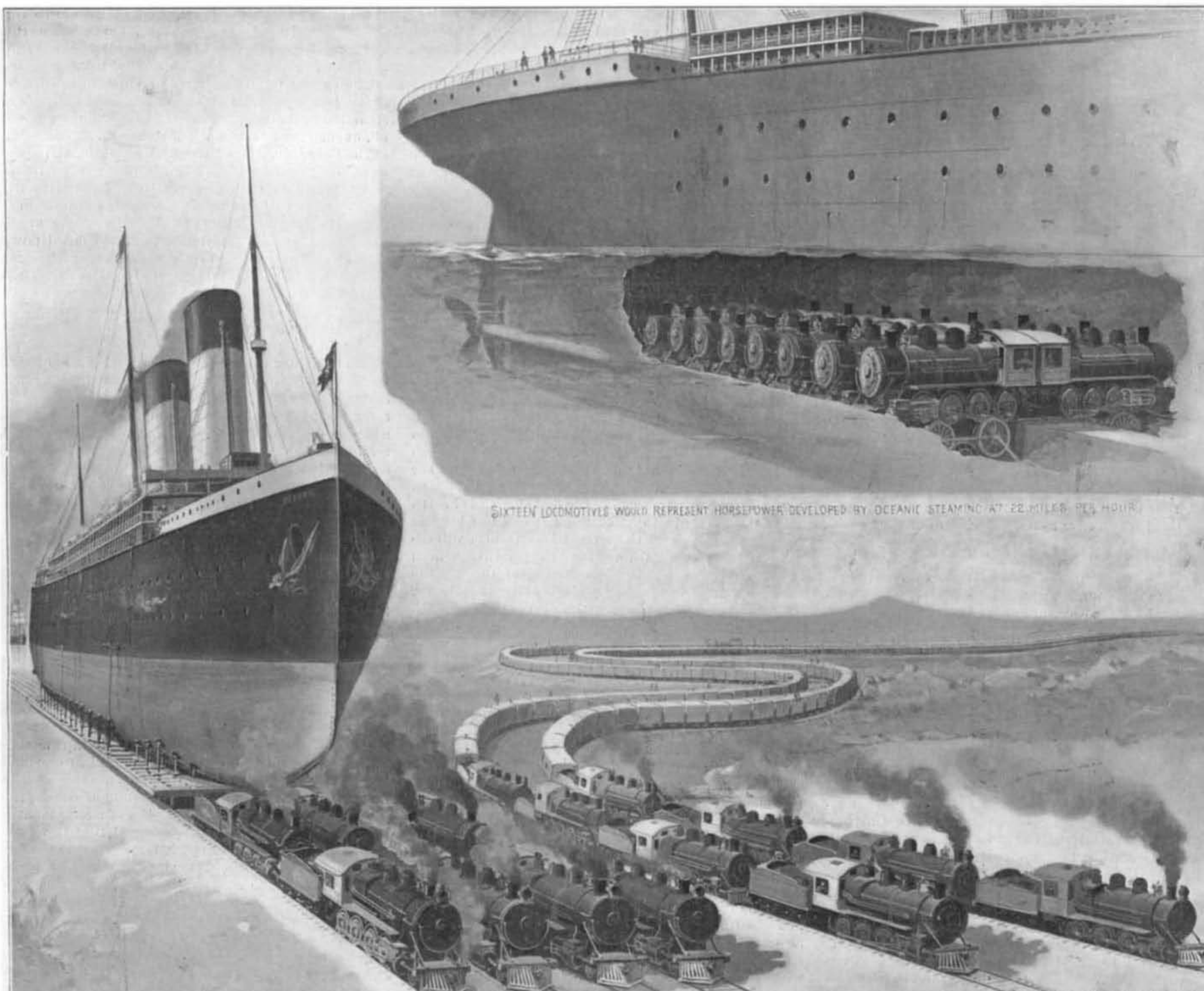
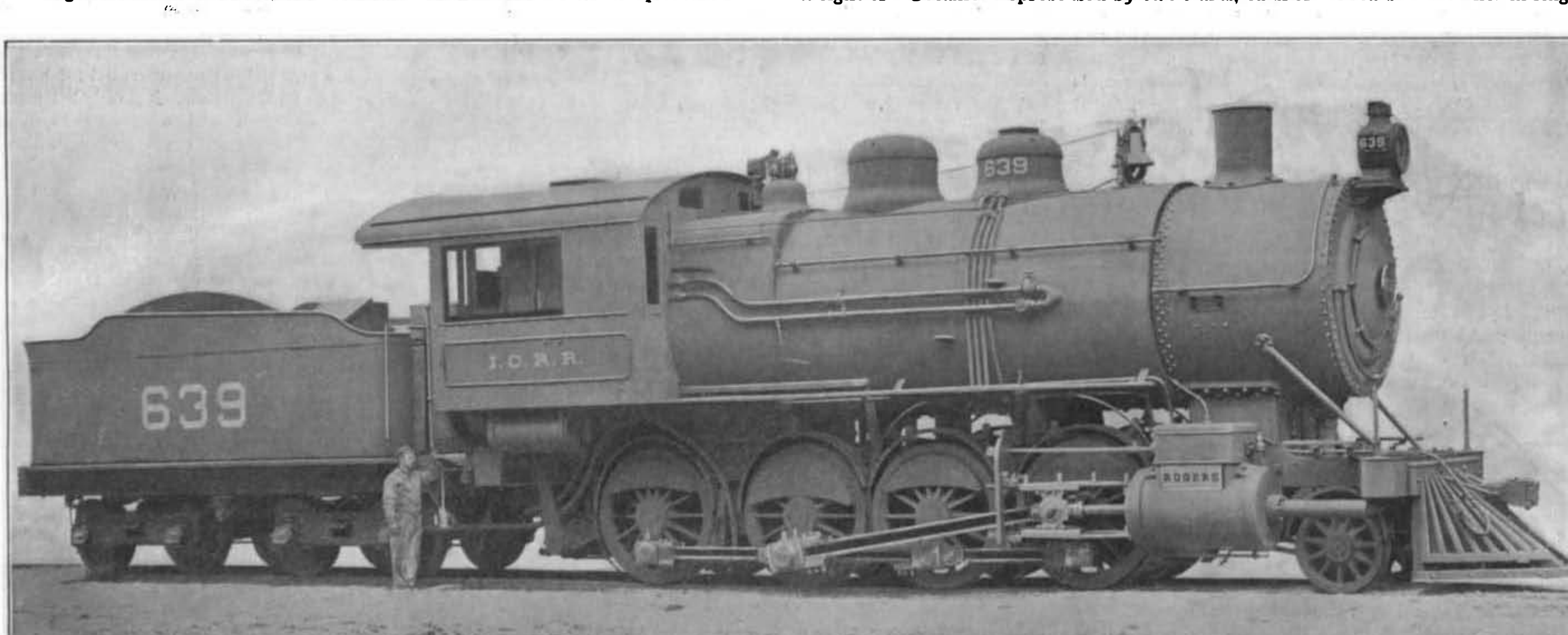


Eight locomotives would haul "Oceanic" on the level at 22 miles per hour. **Weight of "Oceanic" represented by two trains, each of 433 cars and 3 miles in length.**



Powerful Rogers' Consolidation for the Illinois Central Railroad.

THE HORSE POWER OF AN OCEAN LINER AND A LOCOMOTIVE COMPARED.—[See page 199.]