long. The whole apparatus can be made to follow the sun. On May 20, in ordinary weather, 20 liters of water at 20° C. were let into the boiler at 8 : 30 h., and rose to 121° (two atmospheres) in 40 minutes, and then rapidly to 5 atmospheres, beyond which, owing to the slight nature of the apparatus, it was not thought safe to go. On the 22d July, at about 1 o'clock, under uncommon heat, the apparatus vaporized 5 liters of water per hour. The inventor claims that under favoring circumstances, he actually realizes about 10 calories per minute per meter, which is a trifle less than one horse power to ten feet square. Something exceeding this might probably be reached with the same apparatus in a drier air; upon the whole we are justified in speaking of one horse power to the square of ten feet on the side, as actually realized; one horse power to one square yard being about the limit of that which is theoretically realisable.

It must be remembered that, according to what has been stated, the sun offers us a source of power which is practically infinite both in amount and duration. According to what we believe we know with assurance, we can say that the sun is not a fire, fed by any fuel, but a glowing gas ball, maintained at an enormous temperature, and radiating enormous heat from a fund of energy maintained by the contraction of its volume, and by the impact of meteoric bodies. We can reckon with confidence that there will be no material diminution of its supply from these sources for a duration only to be reckoned by hundreds of thousands of years. As to the amount of heat supplied, it is inconceivable. The writer has made a computation of the time all the coal of the world would suffice to maintain the sun's radiation, were the actual source of it to fail, and were our whole supply of coal transported to its surface and burned there in its place. The result, otherwise stated, is that in any one second the sun radiates into space an amount greater than could be made good by totally consuming all the known coal beds of the world !

Something like 300 years separates the England of to-day, with her countless furnaces and engines, from the England of Elizabeth, in whose reign the spinning wheel was almost the most intricate piece of machinery on the island. Something like 300 years more, it is said, is all that separates the England of to-day from the future England whose furnace fires will have died out with the flame of the last bushel of coal under her surface; whose harbors send out only sailing craft ; whose manufacturing population has gone to other lands, and whose "black country" is growing green again as Nature covers the ashes of her burnt-out mineral wealth with new verdure for the few who remain on the soil. We do not pretend ourselves to join in such pessimist views, or try to look into the future so far, though this is a very little way compared with what we know of the rise of man to civilization. To us, in this country, such a time, if it is ever to come, is immensely distant. But what is certain is that if some such change do not take place it will be through the discovery of a new source of power, for of the old, the coal, when our underground supply is used up we cannot get any more. Let us remember, then, in time, that though the stock be great there is no renewal.

For a journal counting among its readers so many interested in the applications of power as the SCIENTIFIC AMERICAN, I have thought, elementary as this presentation of the sun's claim to interest, merely as a source of mechanical power, is, it is better to offer it. We are, in closing, led back to the suggestion with which these articles began, of the sun's influence in altering the conditions of existence for the human race.

Future ages, it has been truly enough observed, may see the seat of empire transferred to regions of the earth now barren and desolated under intense solar heat—countries which, for that very cause, will not improbably become the seat of mechanical and thence of political power. Whoever finds the way to make industrially useful the vast sun power now wasted on the deserts of North Africa, or the shores of the Red Sea, will effect a greater change in men's affairs than any conqueror in history has done, for he will once more people those waste places with the life that swarmed there in the best days of Carthage and of old Egypt, but under another civilization, where man no longer worships the sun as his god, but has learned to make it his servant.

A SHIP RAILWAY AT PANAMA.

In a letter to the *Tribune*, Capt. Jas. B. Eads proposes a ship railway instead of the contemplated ship canal across the Isthmus of Panama. He says:

The Isthmus Canal Congress, recently held in the city of Paris, has presented to the civilized world all the results of the various surveys and estimates which have been thus far made. I believe in the effort to overcome the great barrier interposed by the American Isthmus to interoceanic navigation.

The fact that the congress comprised among its members many of the most able and distinguished engineers and scientists in Christendom is at once an assurance that its estimates and opinions are entitled to the highest respect. From these it appears that the most economic solution of this great question by means of a canal must involve the expenditure of at least $140,000,000, and possibly much more, and that the execution of the work will occupy from fifteen to twenty-five years from the time the work is commenced. These facts justify the conclusion: 1st, That the amount of capital required is so vast that it will not pay to execute the work with private means alone. 2d, That the amount cannot probably be obtained unless the governments of the several maritime nations directly interested in the work can be induced to contribute liberally in aid of the enterprise. 3d, That the time required for consummating the work is so great that the enjoyment of the completed canal must necessarily be reserved to the next generation.

In view of these facts, is it not wise to carefully consider other engineering expedients which have been or which may be suggested for the transportation of ships and their cargoes across the Isthmus? It is, as I am informed, recommended by the Paris Congress that the Isthmus be cut down below the level of the two seas to such a depth as is needed for the passage of ships from sea to sea, and thus avoid the use of locks in the canal. To do this involves the construction of a tunnel four miles long through the Cordilleras, of such dimensions that the one under Mont Cenis dwindles into insignificance when compared with it. This method has been justly termed "the heroic treatment." The term, however, is not limited in its application, and suggests similar treatment to the Panama Railroad, or to some other road which may be constructed for transportation of the largest ships with their entire cargoes overland from ocean to ocean.

My own studies have satisfied me of the entire feasibility of such transportation by railroad, and I have no hesitation in saying that for a sum not exceeding one-third of the estimated cost of the canal, namely, about $50,000,000, the largest ships which enter the port of New York can be transferred, when fully loaded, with absolute safety across the Isthmus on a railway constructed for the purpose, within twenty-four hours from the moment they are taken in charge in one sea until they are delivered into the other, ready to depart on their journey.

HOW SPEED MAY BE RAISED.

On such a railway across the Isthmus there need be no grades steeper than those on our chief lines of railroads, and the road bed need not be over forty feet wide, nor have more than eight or ten rails laid upon it to sustain the car or cradle upon which the ship is placed. The vessel should be lifted from the sea to the level of the road by a lock or by other well known hydraulic devices, and placed upon a car or cradle of ample strength to sustain the vessel with her cargo without the possibility of injury. The lock should be twice the length of the ship, and only one-half of its length should be deep enough to receive the ship from the sea. The bottom of the other half of the lock should be at the sea level, and on this the railway should commence. Into this upper part of the lock the cradle to carry the ship should be run, and the gates at the land end should then be closed. The ship should then be floated into the deep end of the lock and the sea gates closed, after which water should be admitted to fill the lock to a height sufficient to float the ship on the car in the upper lift, after which the water should be drawn off and the gates of the land end opened, and the car and its burden be then started on its journey by rail. At the other end of the road the car should be run into a similar lock, the gates closed over the track, and those at the sea end of the lock closed also. This being done the lock would be ready for filling, after which the ship could be floated off the car and moved to the deep end of the lock. The water would then be allowed to escape from the lock, the ship lowered to the ocean level, the sea gates opened, and the vessel would then be ready to resume her voyage in the other sea.

Another method of transfer between the sea and the railway, equally practicable and perhaps less expensive, would be to have a platform of iron of sufficient strength to support—first, a portion of the railway; second, the car or cradle to receive the ship; and third, the ship itself. This platform should be supported on each side by a row of large iron columns sunk into the bottom of the harbor and extending up above water to receive the hydrostatic cylinders with which the platform would be raised and lowered. By this hydraulic apparatus the platform should be lowered to a depth sufficient to permit the ship to be floated in over the railway car on the platform, after which the hydrostatic presses would lift platform, car, and ship, until the railway track on the platform would correspond in height with and form an integral part of the railway extending across the Isthmus. The platform I have thus briefly endeavored to explain would simply be a huge elevator on which the terminus of the railway would be laid. Of course such an elevator would be constructed in a harbor at each end of the railway. The purpose of such elevators would be to lift the ship out of the sea at one end of the route, and lower it into the sea at the other, and thus avoid using a steep grade into the sea like the marine railways which are seen in almost every navy yard. Many ships are very long, and any change of grade would have a tendency to strain them. Any perceptible change of grade must, therefore, involve devices to prevent such straining, and these devices it is desirable to avoid. For the same reason, curves in such a railway should be avoided. If a change of direction be absolutely necessary, it can be managed by a turn-table at the locality where a change of alignment is desirable. The avoidance of curves would greatly simplify the construction of the car on which the ship is to be transported. This car would probably be formed by joining several separate sections together, according to the length of the ship. Each separate section would probably be 100 feet long and be supported by about 200 wheels, some of which should be drivers, actuated by propelling engines. Rubber or steel springs should be interposed between the axles of the wheels and the car. Each section of the car or cradle that carried the ship would really constitute a locomotive. The propelling engines would be placed on each side, and at such a height as to prevent submergence when the car would be sunk on the elevators or in the locks. The weight of the largest merchant steamers and their cargoes would not exceed 10,000 tons, and such a one would be carried on a cradle composed of five such locomotives. These would have about 1,000 wheels, bearing on eight or ten rails with a pressure of about twelve tons to each wheel. This is only twice as much as the pressure on the rails under the driving wheels of the locomotive of an express train. The total weight of ship, cargo and cradle would be distributed over an area of road bed 40 feet wide by 500 feet long, and would be only 1,200 pounds per square foot, allowing 2,000 tons for the weight of the car. This is not half the pressure on the earth under each tie when each pair of the driving wheels of an ordinary locomotive passes over it.

GREATER SPEED THAN IN A CANAL.

On moderate grades an ordinary freight locomotive will pull about fifty loaded cars from fifteen to twenty miles per hour. The weight of the cars and their load is about 1,000 tons, and this is carried on about 400 wheels. Hence the largest ship and her entire cargo should not require more than the power of a dozen such locomotives to move it at the same speed over similar grades. From this it must be evident that the ship once safely placed on a properly constructed car, adjusted to the railway of a substantial and well-ballasted road-bed, can be moved with certainty and ease at a much higher rate of speed than would be safe in the very best canal that has been proposed. I would, however, not expect to use a higher rate of speed on a ship railway than eight miles per hour.

The practicability of lifting the heaviest ships out of water with perfect safety on cradles adjusted to receive them is illustrated in every dock-yard in the country, and one of the methods I have referred to as being a huge hydraulic elevator, has been put to a practical test. A dry-dock was constructed upon this principle in England a few years ago, and sent to the East Indies, by which ships placed over a platform sunk to receive them are lifted vertically out of water by hydraulic pumps.

Of course, the works and devices required for the successful operation of a ship railway should be of the most substantial character, and the elevating machinery should be of such strength and power as to make the transfer of the ship from the railway to the sea, and from the sea to the railway, a matter of perfect safety and dispatch.

The actual cost of operating such a railway would be, I think, considerably less in proportion to the tonnage moved over it than that of the most successful railway line in this country, for the reason that the tonnage carried would be handled by machinery exclusively, and the ratio of paying cargo to non-paying weight would be much greater. The cost of maintenance in proportion to the tonnage carried should be much less also. This result may be safely anticipated, because the railway would be very substantial and durable, and very short compared with the magnitude of the tonnage carried; the machinery would also be very simple in character, and the ratio of cost of maintenance to gross receipts would therefore be proportionately reduced. But even if we assume that the operating expenses and maintenance be equal to one-half of the gross receipts, it will be seen that a ship railway will be a much more profitable investment than a canal, even if it cost half the price of the canal, whereas it should not cost more than a quarter as much. The gross receipts must be the same in either case, and the railway can be completed in three or four years, while it is safe to assume that the canal will require five times as long. The interest on the canal investment before completion would therefore be enormously greater than that on the railway. A single track railway, with provision for side tracks to enable the cars to pass each other at proper points on the road, would, I think, be ample to meet the demands of commerce at the Isthmus for many years to come.

The California Codfish Trade.

The following facts and figures with regard to the codfish trade of the Pacific Coast are given by the San Francisco *Alta*. The four firms engaged in this industry employ nine vessels. An ordinary catch for this number of vessels is 1,000 tons, and they carry from San Francisco 800 tons of salt to pack the fish for the return voyage. The season commences about March 1 and closes October 1. The fish are caught off the Alaska coast and Choumagin Islands on the American side, and in the Ochotsk Sea on the Asiatic side, where the fish are taken with hand lines, while trawls are exclusively used on the banks near the Alaska shore. Each fisherman has a dory to himself, and tries hard to make the best catch in the fleet. The hand line fishing is quite exciting, and the men take to it like sport. When the fish are hauled on board from the boats they are at once cleaned and packed in frames in the vessel's hold, a thick layer of salt on each layer of fish. At the close of the season sail is made for San Francisco, and here the fish are washed, soaked in brine, and dried for market.

U. S. FISH COMMISSION.—The headquarters of the U. S. Fish Commission for their summer work this year on the Atlantic coast is at Provincetown, Mass. Work was begun there about the middle of July.