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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

DELAY IN BUILDING THE AMBROSE CHANNEL.

The failure of the company that has taken the contract for dredging out the Ambrose Channel at the entrance to New York harbor to live up to its contract is assigned by Lieut.-Col. Marshall of the United States Engineer Corps as the reason for the backward state of this work. It seems that the government has endeavored to be lenient and has made several modifications in the contract in order to encourage the contractors in pushing the work through to completion. The original appropriation for the digging of the channel was $4,000,000, and up to the present time the dredging company has been paid $1,200,000 of this amount. In order to assist in the prosecution of the work the government has expended $700,000 in the construction of two dredges of its own, of which one was put upon the work in the autumn of 1904, and the other in the spring of 1905. The contract is for a 40-foot channel, and Lieut.-Col. Marshall states that he hopes to have a 35-foot channel ready by the beginning of 1906.

As showing that the government has been lenient, it is stated that the first modification was to grant an extension of time. It was followed by an easing-up on the question of the amount that was to be dredged in a given time, the quantity being cut down from 1,200,000 to 400,000 yards per month. This last concession was accompanied by an agreement that the government should put its own plant to work and that all the work which it accomplished should be deducted from the dredging company's contract at the contract price of 9 cents per yard. Even under the last-named conditions the work does not seem to have progressed any better; if anything, indeed, it has moved more slowly. It appears that from the experience gained with the government type of dredge, the material can be taken out for from 3 to 5 cents per yard instead of the contract price of 9 cents. In view of the above facts we heartily agree with the engineer in his conviction that the best plan under the circumstances would be for the government to cancel the contract and hire the necessary dredges to finish up this important work.

AN OLD PROBLEM IN A NEW FORM.

The publication of our recent article on the leap-frog railway has awakened an active discussion of the question of the speed at which the two cars pass each other. Some of our correspondents claim that if each car has a speed of eight miles an hour when they meet, they must pass each other at a relative speed of sixteen miles an hour. Others again claim that when the over-riding car passes on to the rails carried by the lower car, its wheels continue to revolve at a rate corresponding to a speed of eight miles an hour, and the two cars therefore pass each other at that speed. One correspondent clinches his argument by quoting the supposedly analogous case of a person who is walking, at a speed of four miles an hour, to the rear of a passenger car which is running at a speed of sixty miles an hour. In this case, he argues, the man and the car pass each other at a speed of four miles an hour, the speed of the man, like that of the upper leap-frog car, being independent of any speed possessed by the object over which he is moving.

The fallacy of this last argument is due to the very common error of confusing absolute and relative speed, or speed with reference to a fixed object such as the ground, and speed with reference to a moving object such as the lower leap-frog car, or the train on which a man is walking.

In the case of the leap-frog cars, the lower car is moving (let us say south) past a fixed point on the ground at a speed of eight miles an hour. The upper car is moving (let us say north) at eight miles an hour with reference to the same fixed point on the ground.

The cars, therefore, are approaching each other at a speed of $8 + 8 = 16$ miles per hour, and if they were on different tracks, side by side, they would pass each other at a speed of sixteen miles per hour.

But they are on the same track, and one has to climb over the other.

What effect does this climbing have on the speed of the cars?

It absorbs some of the momentum of each car, and reduces the speed proportionately. Most of the energy absorbed is expended in lifting the north-going car through a height of six feet and a smaller portion of the energy is expended in overcoming the increased friction, shock, etc.

The loss is divided between the two cars (action and reaction being equal and opposite) and it amounts to a reduction of about four miles per hour in the speed of each car.

During the time that the north-going car is passing over the south-going car, the only new element that is introduced affecting the speed of the two cars with reference to the ground, or the *absolute* speed, is the work done in lifting one car and in overcoming increased friction, shock, etc.

This expenditure of energy results, as is shown when the cars are in actual operation, in reducing the speed of each car from eight to four miles per hour, speed being reckoned with reference to a fixed point on the ground.

Hence, while the cars are passing each other, the north-going car passes a fixed point on the ground at a speed of four miles per hour, and the south-going car passes the same point at a speed of four miles per hour, and they, therefore, pass each other at a speed of $4 + 4 = 8$ miles per hour.

Let us consider the leap-frog car problem under two conditions, A and B.

Condition A: If the lower car formed part of a train that carried upon its roof tracks that were, say, five hundred yards long, and the upper car started from rest on these tracks on the roof at the same time that the train containing the lower car started from rest, in the opposite direction, on its own tracks on the ground, and if by the time the two cars met, each car had accelerated to eight miles an hour *with reference to the track on which its own wheels were turning*, then the cars would pass each other at a speed of eight miles per hour only.

Condition B: But in the case in question the conditions are totally different. Both the upper car and the lower car start and accelerate to a speed of eight miles per hour on the *same* tracks *on the ground*. When they meet, the upper car, moving at an *absolute* velocity of eight miles per hour, passes on to a pair of rails that already have an *absolute* velocity of eight miles per hour in the opposite direction. The resultant *relative* velocity, as between the upper car and the rails on the roof of the lower car (and, therefore, the lower car itself) is evidently $8 + 8$ miles per hour (if we disregard friction and climbing effort) or $4 + 4$ miles per hour, if we allow for these.

The man walking toward the rear of a train is an analogous case to Condition A, but not to Condition B.

To make it analogous to Condition B the man must be walking towards the rear of the train *on the ground* at four miles per hour, and then, still facing the rear and still moving four miles per hour, he must *step on the train.*

His legs will be knocked from under him; but for the instant of time before he falls, and his body strikes the train and is retarded, he will be passing the train at $60 + 4 = 64$ miles per hour.

Similarly, at the instant that the forward trucks of the upper car first strike the inclined rails of the lower car, they are passing these rails at a speed of $8 + 8 = 16$ miles per hour. The retardation immediately commences, and is at its maximum effect by the time the steep grade to the roof has been surmounted, when the relative passing speed has slowed to about 8 miles an hour.

RUSSIAN ARMY HYDROGEN BALLOONS.

At the recent Aerostatic Congress which was held at St. Petersburg, Dr. Helbig described the new hydrogen generators which the Russian army is using for field work in connection with war balloons. The new apparatus has now been adopted by the aerostatic corps of the army. The process is designed to reduce the weight of the apparatus as much as possible, so as to make it easier to transport. Up to the present, hydrogen has been prepared for balloons by acting on iron with dilute sulphuric acid. But there is another reaction which is available, that of alkaline hydrates upon aluminium, in which hydrogen gas is given off.* Two different types of apparatus have been designed for the army, one for field work, mounted on a carriage, and a second for mountain use. These apparatus are built of iron, as the alkaline solutions have no effect upon that metal. A gas generator and a scrubber form the two different parts. The generator contains a caustic soda solution, in which is placed an iron basket containing aluminium scrap. At the upper part, the generator is connected with the scrubber by a long sheet iron tube. The gas bubbles through the water contained in the scrubber, leaving the traces of alkaline matter which are brought over. From thence the hydrogen is brought to the point where it is to be used, by a flexible tube made of canvas treated with impermeable varnish. If need be, several generators of the above type can be coupled together. The different joints of the apparatus are made by hydraulic pressure, and are very tight. When once commenced, the aluminium is attacked by the soda solution with great energy. The gas comes off very rapidly and the liquid heats up to the boiling point. But as the proportion of free soda in the solution diminishes, the reaction becomes slower. In order to finish the gas production with a sufficient activity, the generator needs a supply of caustic soda which is above the theoretical value. If the above formula is taken as the starting point, we find that to obtain 1 cubic meter (1.26 cubic yard) of hydrogen we need 1.8 pounds of aluminium and 7.9 pounds caustic soda. But as the commercial metal is generally only 99 per cent pure and the commercial soda only has 77 per cent at most of sodium hydrate, we need to use 10.3 pounds of the latter. The weight of raw materials which must be transported in order to furnish 1 cubic meter hydrogen is therefore 12 pounds. With the usual process using iron and sulphuric acid, the weight to be carried is 15.5 pounds. The new method thus gives an economy of 20 per cent as regards weight. There is also a reduction in the weight of the apparatus, which can be made much lighter, seeing that they are not built of sheet iron covered with lead, as in the other cases. The hydrogen which is obtained by the new process is of much greater purity. It does not contain any volatile hydrocarbons which increase its density and diminish the lifting force, nor any hydrogen arsenide which is often met with and renders the gas dangerous on account of its poisonous properties. The only impurities it contains are water vapor and traces of alkaline liquid. A great advantage is the use of soda, which is solid, as compared with the corrosive sulphuric acid, when we consider the question of transport. The only disadvantage which the new process shows is the cost of the hydrogen, which Dr. Helbig figures as high as $0.02 per cubic foot. Until the price of aluminium drops considerably, it is doubtful whether the process can be used except in cases where the cost is a secondary matter.

* This reaction is represented by the formula:

$$Al + 3\ NaO,\ HO = 3\ H + Al\ O_3,\ Na_3.$$

THE GOVERNMENT'S NEW COAL-TESTING PLANT.

For a long time the Kaiser's engineers have been testing the coals in the German empire. Coal measures have been surveyed and samples analyzed so that the government knows the chemical and relative values of its coking, steam-producing, domestic, and gas-producing coals. It has experimented with machines for compressing slack coal into briquettes. What was waste a few years ago now forms one of the best locomotive fuels. Slack coal is also pressed into what is called eggettes—forms small enough for stoves and grates.

The coal surveyors of France are not behind those of Germany, while Belgium profits by the investigations of both. On the British Islands lignites, peats, and even turfs, have been surveyed and their economy carefully ascertained by scientific methods. No nation has a more accurate knowledge of its fuel resource than Great Britain.

The people of the United States mine and consume more coal than do the French, Germans, or English. Our coal fields extend over more territory and supply a greater variety of mineral fuels than do the coal fields of any other people. We need coal tests more and have had them less than our competitors.

Since the first of last September the United States Geological Survey has conducted the initial line of government coal tests. They were preliminary. They were conducted under act of Congress, approved March 18, 1904. This act carried an appropriation of $30,000, increased by the general deficiency bill, approved April 17, 1904, to $60,000. Resulting from these preliminary tests came a suggestion of how more than a million dollars may be saved to the federal government annually in coaling naval vessels, at the same time increasing the efficiency of cruisers and men-of-war. The suggestion is still more important to manufacturers using coal under boilers. These dominating facts led Congress at the last session to appropriate $200,000 for a continuation of the tests.

Under the terms of the appropriation the United States Geological Survey is now entering upon a comprehensive and scientific examination of our coals and lignites. Two conditions attach to the availability of the appropriation: (1) Samples of coal in car lots must be furnished at the testing plant free to the government; (2) the service of machines, apparatus, and devices used in making the tests must be free. As coal mine operators and transportation companies are deeply interested in these tests, no difficulty attended the first condition. When the preliminary tests were made the plant lacked somewhat in unity and adapta-