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 con-
tract for dredging out the Ambrose Channel at the
entrance to New York harbor to live up to its con-
tract is assigned by Lieut.-Col. Marshall of the United
States Engineer Corps as the reason for the back-
ward state of this work. It seems that the govern-
ment has endeavored to be lenient and has made sev-
eral modifications in the contract in order to en-
courage the contractors in pushing the work through
to completion. The original appropriation for the dig-
ging of the channel was $4,000,000, and up to the pres-
ent 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 con-
tract 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 con-
cession 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 de-
ducted 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 ex-
perience 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 engi-
neer 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 pos-
sessed 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 in-
creased 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 refer-
ence to the track on which its own wheels were turn-
ing*, 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 con-
ditions 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 com-
mences, 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 hydro-
gen 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 alu-
minium, 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 con-

* This reaction is represented by the formula :
$$Al + 3\,NaO,\ HO = 3\,H + Al\,O_3,\ Na_3.$$
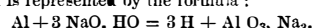
taining aluminium scrap. At the upper part, the gen-
erator is connected with the scrubber by a long sheet
iron tube. The gas bubbles through the water con-
tained in the scrubber, leaving the traces of alkaline
matter which are brought over. From thence the hydro-
gen is brought to the point where it 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 ap-
paratus are made by hydraulic pressure, and are very
tight. When once commenced, the aluminium is at-
tacked 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 for-
mula 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 arsen-
ide which is often met with and renders the gas dan-
gerous 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 trans-
port. 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.

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-pro-
ducing 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 loco-
motive 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 investiga-
tions 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, German, 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, ap-
proved 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 govern-
ment 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 manu-
facturers 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 com-
prehensive 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-