

form drawbar of some kind, and it would save the lives of many men.

Mr. Roach, of the same association, followed, speaking of the danger of coupling the link and pin with the M. C. B. type. All of the new type couplers were a detriment and annoyance to the switchmen.

J. T. Chamberlin, master car builder of the Boston and Maine R.R., said that their employees who had spoken knew better what was wanted than the officers. The men of his road all favored the link and pin type of coupler. The vertical plane drawbars had broken badly on his road, and now they had none.

Wm. McWood, of the Grand Trunk R.R., said that, personally, he was opposed to the vertical plane type. The switchmen's views coincided with his. He did not think the M. C. B. type gave good satisfaction. The pin still remained, and if it became bent the knuckle would not work. Neither were the knuckles interchangeable, which was a serious objection. More satisfaction and better results could be had from a good automatic link and pin coupler.

Commissioner Rogers asked: What can we do? Shall we go back to the link and pin, or compel the adoption of the M. C. B. type? Mr. McWood said he would not like to answer that question.

Col. H. S. Haines said the vertical hook type was defective as long as the knuckle had to be opened by hand. But a majority of railroad men felt that the M. C. B. type of coupler had come to stay.

Mr. M. N. Forney outlined the difficulty the Master Mechanics and Master Car Builders' Associations had experienced in arriving at standards on anything, and told what had been done in adopting the M. C. B. type of coupler. Also the trouble in keeping the various parts in stock. No organization could say what coupler was complete and perfect. A forced adoption now would mean a device imperfect and incomplete, and would stop progress. The best couplers of to-day were all defective. Investigation and progress would settle this in time.

From the information placed before the committee, it appears there are 1,200,000 freight cars in the United States, of which 200,000 are equipped with the M. C. B. vertical plane spring hook couplers. It costs \$25 a car to put on this form of coupler. To equip the entire rolling stock would cost fifty millions of dollars.

The number of locomotives in this country is stated to be 27,150.

For the year ending June 30, 1890, 300 railroad employees were killed in coupling cars, and 7,841 were injured.

OIL FUEL UNDER STATIONARY BOILERS.

Oil fuel, though for a long time used with success in forges for heating iron and steel, it is within comparatively a recent period that users have become convinced of its economy for use under boilers. Among its advantages are increased intensity of heat, lessening of labor and riddance to ashes.

The *Safety Valve* recently obtained a statement of results from those who have been using various types of oil-feeding apparatus for this purpose. Out of a total of 35 users distributed over the country who furnished our contemporary with their experiences with oil fuel, only three have abandoned it, and these because situated close to the coal mines, where coal or its refuse is to be had for scarcely more than the cost of carting it away. The first of these, an iron company of Sharpsville, Pa., discarded oil, and now use gases from their blast furnace for raising steam; the limited amount of fuel required in addition being more economically supplied by the cheap coal of the vicinity. The second, a salt company, of Le Roy, N. Y., say that in estimating the difference in cost between oil and coal, they weighed all the coal used under one of their 150 horse power boilers for 15 days, which proved to be 110½ gross tons of hard coal dust costing \$1.70 per gross ton. They then put in two oil burners and burned one tank of oil. It lasted 180 hours steady burning and cost two cents the gallon. This they calculated made the cost of oil 88 cents per hour and coal a little more than 52 cents per hour. Then they tried a better type of oil burner and did still better, but it could not compete with coal at \$1.70 a ton.

The third was an iron works company, of Erie, Pa. They use the cheap slack coal of the vicinity, and oil fuel could not, they found, compete with it. Against this thirty-two witnesses appear, not, of course, so favorably situated for cheap coals. Few of them seem to have adhered to the type of oil-feeding apparatus they started with, but all have had such success with oil fuel from an economical standpoint as to lead them to pin their faith to it.

A rolling machine company, of Fitchburg, Mass., say their oil fuel costs them 10 per cent less than coal or coke and that they save from 25 to 50 per cent in time and make similar gains in point of production. A maker of mowers and reapers, of Akron, O., says oil fuel costs him not much, if anything, over one-third what he used to pay for coal. The oil is stored in a large underground tank located close to the railway track, and is drawn from this tank and fed to the burners by a small rotary pump. It saves him what

used to be a large cost for labor, handling coal and ashes, and he no longer needs a fireman. A bicycle making concern, of Hartford, Conn., say that the use of oil in their furnaces has resulted in very largely increasing their product with a less number of men.

A drop-forge works, of Gloucester, Mass., do not find any difference between the cost of coal and oil, but "the oil fuel needs no attention, once it is started, and will run all day without ashes, clinkers," etc.

A bicycle manufacturer, of Toledo, O., says he is unable to speak as to the comparative cost of oil and coal fuels, as he never got anything like the amount of heat from coal that he is now getting from oil, but is sure that oil is the cheapest besides being more convenient and cleanly.

A steel company, of Steelton, Pa., finds no difference in cost between oil and coal, but saves largely in cost of labor.

A manufacturer of Plantsville, Conn., says: "In comparison with coal we save about 25 per cent, also gain from 10 to 20 per cent more work in same time."

A maker of agricultural implements, of Clayville, N. Y., says he effects a saving of about 40 per cent by the use of fuel oil in his furnaces instead of coal.

A bridge building company, of Toledo, O., pay one cent per gallon for oil delivered, the price of coal being \$2.25 per ton. At these figures they find oil to be far cheaper.

An axle company, of South Egremont, Mass., do not find any difference between the cost of coal and oil, using the latter.

A saw company, of Middletown, N. Y., find oil fuel far cheaper than coal, and still more important to them, they get an intenser heat, the same being maintained steadily throughout the day, "thus," so they say, "improving the quality of our goods over that which it was possible to attain with coal as fuel. On the whole, we can say it is a grand success with us."

An agricultural implements company, of York, Pa., say: "We have made tests between oil, coal and coke. As bituminous coal is cheap here, there is no advantage in point of economy farther than the men can work more continuously and there is less lost time. We find oil fuel a good thing, all things considered."

A sand company, of Chicago, Ill., say: "We find it (oil fuel) very clean; it can always be regulated, always appears to be of uniform quality, and we find very little annoyance from its use, such as new grate bars and breakage of different kinds, which is always the case with the use of coal."

Irrigation in Arizona.

The proposition is to construct a diverting dam across the Gila River, at a point about twenty-two miles above Gila Bend Station, on the line of the Southern Pacific Railroad, where the stream has cut through a mountain range, leaving the rocky barriers standing opposite each other, and at a distance comparatively short. The site chosen for the dam is a good one, and affords conditions which could not be obtained at any other place on the river. The dam will be 1,800 feet in length, and about twenty feet in height at the channel. The dam will be constructed of piling and earthwork. It is not intended as a retaining dam, to impound a vast quantity of water, but simply to divert the water from its channel, and convey it in a great canal to the lands below the dam, which consist of 200,000 acres of as fine agricultural land as can be found in the Territory of Arizona. The overflow of the dam is to be 600 feet wide, though the natural channel is only 250 feet in width. The water will be taken out at a point above the highest overflow.

The canal will reach the railroad at Gila Bend station, on the line of the Southern Pacific. At that point it turns west, and lateral canals will be run out to every available point on the Gila River mesa.

It is one of the largest irrigation schemes on foot to-day, and will cost less money than any of those in California. The dam is estimated to cost \$20,000, and will be completed by February 1.—*San Diego Union*.

The Silk Threads in Paper Money.

In spite of the skill and industry of counterfeiters, they have never made a bill which did not have one or more vulnerable spots. Some of the products of their handicraft may seem perfect to the untrained eye, but the expert will find that each one, like Achilles, has something lacking in his armor. Perhaps the feature of good United States Treasury notes which counterfeiters have found it most difficult to imitate is the two blue silk threads which run lengthwise through them. They are a little over an inch apart, and though sometimes almost invisible, they form part of every bill issued by the Government Bureau of Printing and Engraving. A. L. Drummond, chief of the secret service of the Treasury department, who has had a long experience with counterfeiters and their wares, explained to a *Tribune* reporter recently why it was so difficult to copy good bills in this respect.

"In the first place," he said, "the silk threads are put in the paper when it is made at the factory. To make paper of the kind used by the government re-

quires a big plant and lots of capital. So counterfeiters are kept out of it. Even if they had the necessary money, they wouldn't be fools enough to risk it all for the chance of making bogus bills. It would be exceedingly unprofitable for a paper manufacturer who already has a factory to make the paper, because to do so is a penitentiary offense."

Mr. Drummond then showed the reporter a counterfeit two dollar bill, which had a single thread running lengthwise through its center. "This is the only bad bill that I ever saw with a silk thread in it. Even this has only one thread instead of two, so it would not be dangerous to a skilled teller. I have never heard of more than two other bills like this one. It is easy to see that the counterfeiter split this note, put in his thread, and then pasted the two parts together again. The frayed edges showed that. The fellow must have been very stupid not to know that genuine money has two threads instead of one. An expert can easily tell when a bill has been split in two and pasted together again, so the silk threads would not deceive him."

Pyrophosphoric Acid as a Manure.

BY DR. JAEHNE.

A process for preparing a manure containing pyrophosphoric acid consists in acting upon ferruginous phosphates with a weak solution of sodium bisulphate, evaporating to a paste, when a reaction takes place, calcium sulphate separating out. The mixture of sodium sulphate and monocalcic phosphate is heated until the pyrophosphate is formed.

As an example, a sample of ground coprolites having the following composition was employed:

Tricalcic phosphate.....	50.20 per cent.
Calcium carbonate.....	8.80 "
Ferric oxide.....	15.00 "
Aluminum oxide.....	1.00 "
Silica.....	20.00 "
Other constituents.....	5.00 "
	100.00 "

On treating this sample with one and a half times its weight of NaHSO₄ dissolved in 4 parts of water (constituting a solution of 1.162 sp. gr. or about 20° B.), and thoroughly agitating the mixture, the ferric oxide is not attacked, but the calcium carbonate is decomposed, and the phosphate converted into monobasic phosphate. The liquid after separating the CaSO₄ by settling tests 24° B. at 15° C.

By evaporating in the open, the air coming in contact with the pasty mass forms a yellowish salt, having the composition 2 Na₂SO₄ + CaH₄P₂O₇H₂O.

This salt can be utilized by mixing with all kinds of compositions. It can be obtained in a state of complete dehydration by heating it to the fusion point.

By so doing a compound, containing 4 parts of sodium sulphate, 1 part of calcium pyrophosphate, and 1 part pyrophosphoric acid is obtained, which is universally used as a manure.—*L'Engrais*.

Life-Shortening Occupations.

The *Medical Age* contains the following abstract from the *Journal of the American Medical Association*:

One of the curious features of modern life is the extent to which the most hazardous trades are overrun by applicants for work. The electric light companies never find any difficulty in obtaining all the linemen they need, notwithstanding the fact that the dangers of that kind of business have been demonstrated times without number. The men who work in factories where wall paper is made frequently joke one another over the tradition that a man's life, in this trade, is shortened ten years. A similar belief is prevalent in factories where leather papers are made, and among men who have to handle them, and whose lungs are said to become impeded by inhaling the dust arising from such papers. In certain other factories, where brass ornaments and fittings are made, the air is laden with very fine brazen particles, which are, when inhaled, especially irritating to the lungs. But one of the most singular advertised calls for employees that was ever printed appeared recently in a Connecticut newspaper, signed by a firm engaged in the business of building towers. It called for applicants only among those who are young, strong, and courageous, and closed by saying: "We warn all seekers for this job that it is of the most dangerous nature, and that few men continue in it more than a few years. In fact, it is almost certain death to the workman who follows this occupation."

A Word to Mail Subscribers.

At the end of every year a great many subscriptions to the various SCIENTIFIC AMERICAN publications expire.

The bills for 1892 are now being mailed to those whose subscriptions come to an end with the year. Responding promptly to the invitation to renew saves removing the name from our subscription books, and secures without interruption the reception of the paper by the subscriber.