

logged and saturated with metalliferous solutions, that they may be considered in a sense fossilized. I am told that an ax will hardly touch them, and doubtless if they were burned, something like a cast or replacement of the original fibers of the log would be found preserved in a metallic state. In the third level was an instructive example of faulty timbering, and of the importance of putting in timbers just right from the start. The stulls here, as in the other levels, are exposed to enormous lateral pressure from the hanging wall and are cracked, split and crushed; but unlike the newer timbering, we observed these stulls to be frequently out of place, bent inward, and in consequence that they had been propped up in all sorts of ways by the recent management to keep the level

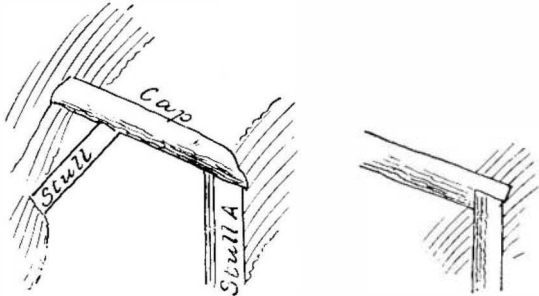


FIG. 11.—METHODS OF TIMBERING.

open. This was partly owing to the decay and age of the old stulls, but mainly owing to their not having been properly laid. The slope they preserved to begin with was too flat, and the butt ends, instead of being fitted into hitches, lay against the bare wall or rested on upright props, and their line of juncture with these props was so fixed that they would easily slide when pressure was applied. See Fig. 11. Large pockets of ore had been opened in big caves toward the end of this level.

To the north this level passes under the bed of the creek, yet strange to say but little water seems to seep down from this source. In excavations in the bed of the creek, they found that an impervious layer of clay lined its bottom. A large chute or body of ore occurs,



FIG. 12.—DUMPING ORE INTO THE SORTING ROOM.

however, beneath the creek. Further on the level passes beneath the crest of the mountain and another ravine on the surface.

Near the end of the level we climbed up by a rope ladder about 70 feet into a stope. Here we found a good example of a contact vein (Fig. 2) between porphyry and gneiss. Here the usual line occupied by the mineralized breccia gangue was filled by a solid mass of barren porphyry, beneath which, between the porphyry and the granitic footwall, lay the usual layer of rich smelting ore, composed of solid pyrites and bornite or purple copper, constituting a true "contact" vein between porphyry and granite. The ore below water level, that is, below the level of the creek, loses

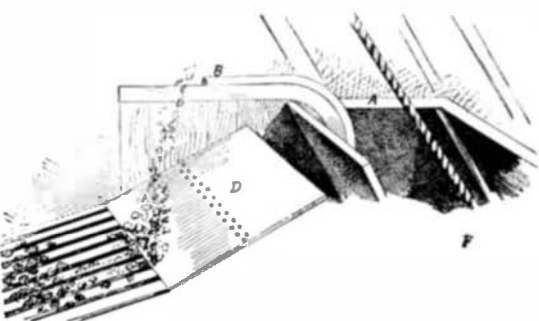


FIG. 13.—DUMPING ARRANGEMENT ON PLATFORM HEAD OF SORTING ROOM.

all its decomposed oxidized character and becomes solid unoxidized ore.

ORE SORTING.

Emerging from the mine, we visited the ore sorting room. This room, 50 by 25 feet, occupies the upper

story of a tall building; in the lower part are the bins and ore chutes, into which the sorted ore and refuse are thrown. The former is either wheeled to the mill for crushing, stamping and concentrating or passes directly through chutes into the railway car, to be shipped to Denver for smelting. The mouth, or top of the incline shaft comes directly up into this ore sorting room, at the back end, and dumps its cargo of ore through a screen called a "grizzly" on to the plates and bench of the ore sorters, and its useless rock into a bin connected with the outside, where it is trammed off in a car to the dump.

The sorting room is lofty, and an open little house or skylight on the roof receives the wheel and top of the incline shaft. The position of the shaft scaffolding is seen in our sketch (Fig. 12) rising above a platform, standing about 10 feet above the ore sorting floor beneath. Material from the mine below is drawn up by the rope to the point, A, where the skip runs out on a horizontal rail, and automatically dumps its load (Fig. 13) onto the deflector, B. This deflector or apron is a plate of iron, swinging in a sloping direction on a pivot, so that it can be reversed as needed. Thus when the

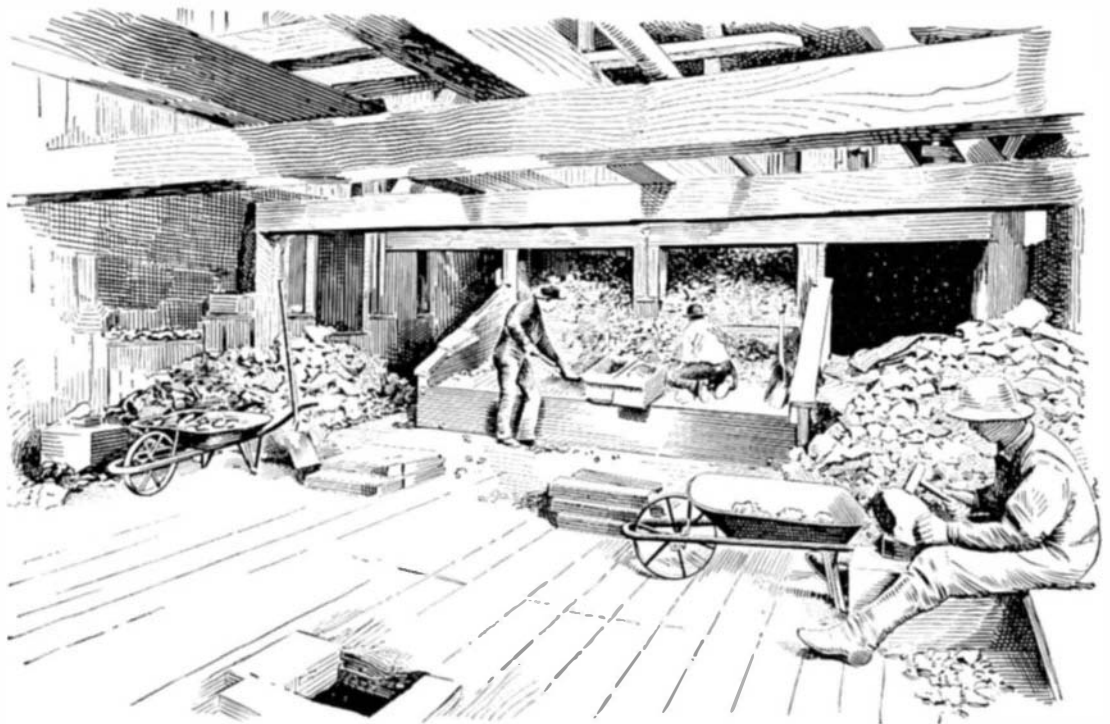


FIG. 14.—ON THE FLOOR OF THE SORTING ROOM.

skip brings up a load of ore it falls on the apron and passes over the screen, or grizzly, D, its larger pieces falling onto the sorters' table, E, on the floor of the room, and its finer stuff passing through the grizzly into a bin or chute below for immediate transfer to the mill. If again the skip brings up only dead rock, the apron is reversed and the rocks are discharged down the open space, F, to be carted to the dump, so no time is lost.

As the mass or blocks of ore bearing rock pile up on their table, the ore sorters, two or three men, select pieces, and break them up with hammers, distinguishing by long practice the different values.

The material divides itself into three or four grades.

1. Useless rock barren of ore.
2. Concentrating or middle class ore.
3. First class rich smelting ore.

The concentrating material is shoveled without much sorting into a mill hole, one of three in the floor, in a somewhat wholesale manner, as this class of ore preponderates, but from it is selected the first class ore. This is put carefully into wheelbarrows, wheeled to a scale at the further end of the room, weighed up to 400 lb. and dumped down a separate chute.

Often pieces of ore will contain half poor scatterry, concentrating ore, and rich smelting ore in the same piece. The sorter with his hammer breaks off the good

ever, the latter, unless thrown among dead rock, is not wholly lost, if it finds its place among the lower grade concentrating ore, because it only goes to further enrich the concentrates above their average.

Through the mill holes the ores drop into the chute bins, and pile up there, until the railway car comes along, at the bottom of the building. And then a series of iron doors called ore chutes are opened by a bar and the ore pours into the box car ready to receive it. Fig. 15 shows the method of opening and shutting the ore chutes.

(To be continued.)

WEARING AWAY OF METAL PLATES BY THE ACTION OF STEAM JETS.

By J. WALTER. Chem. Ind., 16, 170-171.

THE author was led to the consideration of this subject by the behavior of a steam jacketed copper boiling pan. The copper pan was originally 8 mm. thick, and the steam entered the jacket at its lowest point. Being rather too small, the copper pan, after it

had been at work some years, was replaced by a rather deeper one, but one which in all other respects was exactly similar to the original pan. After the second pan had been in use for about a year, a hole was blown through the bottom, opposite the steam inlet to the jacket.

Believing that the mishap was due to the metal having been worked down too thin at this point, a third pan was made, slightly thicker—12 mm.—which was carefully measured all over, before putting into use.

To avoid a second accident the pan was tested from time to time, and after about 14 months' work it was found that the bottom had been reduced to the thickness of paper.

This time the author attributed the wear to the hydrochloric acid used for cleaning out the pan. He had previously noticed the "pitting" produced on iron plates by the action of steam jets, and, although he could not in this case trace the wear to the steam jet, he placed the steam inlet at the side, as a precaution. Some 11 months later he was convinced that the wear was due to the steam jet, as he found the pan again worn away; not at the bottom, but opposite the jet. The reason the original pan lasted so much longer is due, the author thinks, to its being

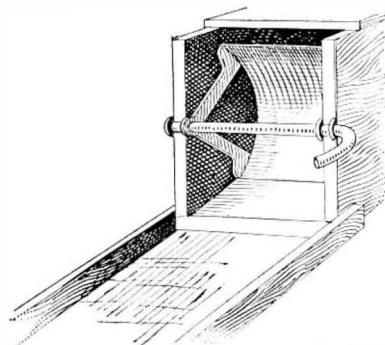


FIG. 15.—METHOD OF OPENING AND SHUTTING THE ORE CHUTES.

from the medium, and throws the latter into the mill hole for concentrating matter.

Besides this, is an intermediate class of large blocks, containing dead rock, and some ore, which are piled up in heaps on either side of the room, and are called "cobbing" ore, which the sorter cobs with his hammer at his leisure, extracting the good ore and throwing the barren rock down the rock chute. The sorters have each a box beside them, in which to put very valuable ore, prior to its being wheeled away. An ore sorter requires to be one who by long habit has become acquainted with the surface look of ores of the mine, and can tell at a glance pretty nearly whether it is to be classed as first or second class ore.

In some mines, as in the present one, where the distinction of the ores is very marked, ore sorting is not difficult, but in others where the values are very much obscured, it takes an old hand to discern between good, bad and indifferent, and even the oldest hand is liable at times to throw aside a valuable piece of ore. How-

shallower than the others, and, therefore, not so near to the steam inlet and not subjected to such intense action. The author mentions a similar case that occurred with a lead-lined vessel which was heated by blowing in steam from pipes perforated with rows of holes on each side, fastened to the bottom of the vessel by lead straps. From the stirring of the contents of the vessel one pipe got twisted, whereby the row of holes on one side pointed downward. Very shortly the steam jets issuing from them pierced a row of holes through the lead bottom.

It is pointed out that the action of a steam jet is similar to that of a sand blast. In the former the abrading particles, instead of being sharp grains, are minute particles of water and rust, etc., from the pipes. Besides the purely mechanical abrasion, there is also chemical action. The steam carries with it air, which oxidizes the freshly exposed surface, and the oxide film thus formed is more readily removed than the metal itself. The appearance of holes produced

by the impinging of steam jets on to copper and cast iron plates is described, and the author concludes by pointing out that once the cause of such wearing away is recognized, its prevention becomes easy.

This prevention can be effected by placing over the point of impact thick metal disks about 200 mm. diameter; by making the direction in which the steam enters parallel to, instead of across, the jacket space; or by placing a thimble closed at the top and perforated at the sides, over the steam inlet.

A FARINA FACTORY.

"WHAT may that be?" was my question to a passer by, and I pointed to the tall chimney of a factory which nestled on the hillside.

"Oh, that's a tatie mill," was the response.

I was in Scotland, near the village of Guay, on the Highland Railway, and the sound of shooting on the moors was evidence that grouse were still about. "Tatie" is Scotch for potato, and "mill" is universally used north of the Tweed for "factory." The reply carried me no further, but, ashamed to display ignorance, I determined to personally investigate the matter, which circumstance soon enabled me to understand that the "tatie mill" consumed potatoes, and turned out starch or farina.

A courteous foreman was my guide through the factory. There was a lot of money in farina twenty years

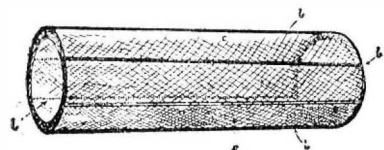


FIG. 1.

ago or thereabout, but German farina has shut up many a small factory in this country since the Franco-Prussian war. German farina was known and used here before that, but it had not the hold upon our markets it has now. The German stuff is cheaper than the British. I do not say that it is produced cheaper—I should rather put it the other way, for on our Highland farms potatoes can be grown as cheaply as in Germany, while adult male labor can be got at 12s. to 15s. a week, and water power for nothing. When Britain used British farina only, the manufacturers made fortunes quickly, and I fancy that it was their desire to hold on to this condition of things that gave the German manufacturers the chance of shipping in. It probably is true in this, as in other cases where the British "cost of production" is unfavorably compared with German, that the manufacturer's income is reckoned in the cost.

A mountain stream serves to drive the 15 foot wheel which does the chief work in the factory which I inspected. The wheel revolves slowly in sympathy with the energy of the neighborhood. Within the four walls are all the arrangements for crushing the tubers, sifting, washing, bleaching, drying and grinding. The potatoes are crushed and sifted three times, and each time starch granules are collected. There is little of special importance to note until the sifting stage is reached, and this is an ingenious method of filtration which it might be possible to adopt in some pharmaceutical processes. As the potatoes are crushed they are supplied with abundance of water, which carries off the finer material, the outgoing stream resembling nothing so closely as brown muddy water. In this condition it rushes to a filtering box, Fig. 2, in

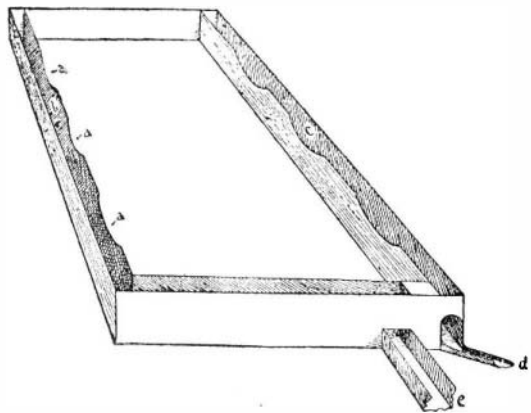


FIG. 2.

which are a number of hexagonal filtering frames, Fig. 1, the form of which is represented in the sketch. These are so arranged in the box that the stream of unfiltered material flows past and into the left ends. Each "sieve" is made up of six strong wood supports secured to the wheel ends, and round the circumference very fine muslin is stretched. Through this filtering medium the water and the finest of the starch granules pass with amazing rapidity, and the mixture is at once conveyed to long settling tanks, whence the water is drained off from time to time, and fresh wash water supplied if need be. The coarser material is re-ground twice, and the final coarse product, already freed by the previous washings from fiber and earthy matter, is carried to large settling ponds outside. To this I shall return later. There is nothing particular about the settling tanks. They are huge wooden boxes about 10 feet long by 3 feet wide and 3 feet deep, arranged side by side to the number of a dozen or so. The starchy mixture in these varies in color from a whitey brown to pale brown. After several wash waters, this magma is lifted into the bleaching vats, which are circular, about 6 feet deep and 12 feet in diameter. Here the starch is treated with bleaching liquor, the mixture being well agitated by a mechanical stirrer—two slabs of wood attached to an iron upright with a beveled cog wheel at the top. When the proper degree of whiteness is attained the mixture is allowed to settle, and the liquor is drained off. The

starch forms a solid but brittle mass, about a foot thick. It looks almost white and has a faint odor of the bleach. It has yet to be washed with several waters, one of which is made slightly acid with aquafortis—to "kill" the bleach, I presume—then it is drained and carried to the drying loft. There is nothing novel about the drying arrangements. A long range of perforated and movable shelves or trays stands in the center of the loft, and under each shelf is a steam pipe. Canvas boards are put up in front of the shelves, but quite loosely, so that the vapor has free way to escape. The drying of starch is a "kittle" thing—indeed, the risk of tumefaction has before now troubled the learned heads of the chemical side of Burlington House—but I could awake no terrors thereanent in the staid individual who guided me on this occasion. It is part of his business to dry starch, and it seems to trouble him no more than the eating of his porridge.

After the starch is dried it goes through a runner mill, and thus becomes marketable farina. On the day of my visit the drying trays were filled with a brown granular substance which reminded me of badly made ferri carb. sacch. eff. This was the coarse refuse which I have mentioned previously. When ground it goes to paper makers, who prefer it to starch for sizing. During the Franco-Prussian war this material was selling at £25 to £30 per ton. Potatoes can be bought at 24s. per ton just now.

This coarse stuff is of a dextrinous nature, and I have heard of some druggists to whom its origin is as mysterious as how the apple gets into a dumpling. I may be betraying a valuable trade secret in thus telling what I have seen. If it be so, what, I wonder, is the peculiarity of this brown refuse which makes it preferable to pure starch? It contains, I should add, all the diseased parts of the potatoes, and the coarse grains of starch, but very little fiber.—Chemist and Druggist.

THE GAS FIELDS OF INDIANA.*

By E. T. J. JORDAN.

THE history of the natural gas fields shows that they are of only temporary duration. Indeed, it is only natural that the accumulations of centuries should be exhausted in time by the constant and immense drains to which all the fields have been subjected. Nature cannot manufacture it as fast as it is being consumed, and the natural flow of the wells must soon become exhausted. Gas in the great fields of Pennsylvania and Ohio is a thing of the past, if the natural flow of the wells is to be relied upon for the supply. Affairs are in a distressing condition in those States, and especially in northwestern Ohio, as all the towns are left burdened with debt and with no other resources at their command. Their era of prosperity is at an end, so far as it depended upon natural gas. In many of these towns, as a natural result of the criminal waste of nature's most valuable fuel, and the unnatural business excitement and wild speculation that obtained for years, it may be truthfully said that "their last days shall be worse than their first." It remains to be seen whether the same disastrous conditions will mark the end of natural gas in Indiana. About the time that natural gas began to fail in Ohio and Pennsylvania, the great fields of Indiana were discovered, and their vast extent, as well as the apparent stability of the supply of the wells, seemed to warrant the belief that at last a permanent supply had been found. As a result of this discovery and the failure of the Ohio fields, the factories accepted the offer of the cities and towns in the Indiana gas field and removed their plants to this State. The loss of these factories to northwestern Ohio caused a terrible panic and collapse throughout that gas belt, and fortunes sank from sight as values declined to their normal conditions. Over \$300,000,000 has been invested in this State in manufacturing, and others are now being erected throughout the gas belt. Pipe lines were run to the gas field from Chicago and from many of the principal cities and towns in the State, and every effort has been made to gobble up as much of the territory as possible. Slowly the ends of these pipe lines have been converging to a given point, until now but little of the gas belt remains to be developed.

Already wells are being abandoned every month, and the rock pressure in many parts of the field is rapidly diminishing. The average field pressure has slowly but surely fallen off, and now stands reduced from 320 pounds original pressure to 240 pounds average pressure over the field.

At the rate of pressure reduction that is now going on, and by a continuance of the present extravagant and wasteful method of consumption, it is only a question of a very short time when artificial pressure will have to be used to force the gas through the pipe lines.

Indiana has the largest and best gas field ever discovered, and as no new fields are in prospect, it seems that these are the best fields that will ever be brought into requisition for manufacturing purposes.

A system of the strictest economy should be enforced, and the remainder of the precious gas should be distributed to the consumers as ordered by special acts of the legislature.

Immediately upon the discovery of natural gas in Indiana an era of prosperity began that has been unparalleled. Immense manufacturing establishments were located, and in time, when their fires, fed by nature's best fuel, started, great trainloads of their products were sent out from the gas belt every day. Villages became prosperous towns, and towns grew in a few months into thriving cities, and lots were sold at high prices many miles from their centers.

One of the worst features of the excitement that has prevailed was the belief in the idea that natural gas was to be perpetual.

This belief fostered extravagance and waste. It can be shown from facts obtained and recorded in this department that the waste of gas during the first four years after its discovery in the fields of Indiana amounted to more than \$20,000,000.

The supply in many places began to fall short, and there was much suffering during the hard winter of 1892-93. A great many factories in the towns deriving

their supplies from this gas field were shut off from the lines and asked to burn coal.

These stern conditions have at last aroused the people to view the situation in its true light. Much of the extravagance and waste has been stopped. Men are seeking to find out the best means for husbanding what remains of this valuable fuel.

The supply of gas is certainly failing. It may not be possible to tell just how long it will last, but the final exhaustion is inevitable.

The following is the pressure found in the different localities during the year 1893. At many of the places, however, the pressure given was obtained only from new wells at a distance of two to four miles from the towns, the wells in the towns and immediate vicinity showing far less pressure, and many wells being practically exhausted:

	Pounds.
Greenfield, Hancock County.....	250
Carthage, Rush County.....	120
Noblesville, Hamilton County.....	240
Sheridan, Hamilton County.....	240
Kokomo, Howard County.....	250
Marion, Grant County.....	250
Gas City, Grant County.....	300
Fairmount, Grant County.....	300
Elwood, Madison County.....	300
Frankton, Madison County.....	300
Anderson, Madison County.....	240
Alexandria, Madison County.....	300
Summitville, Madison County.....	300
Chesterfield, Madison County.....	290
Muncie, Delaware County.....	240
Albany, Delaware County.....	280
Eaton, Delaware County.....	290
Hartford City, Blackford County.....	260
Montpelier, Blackford County.....	250
Camden, Jay County.....	225
Dunkirk, Jay County.....	275
Greensburg, Decatur County.....	175
Fountaintown, Shelby County.....	210
Waldron, Shelby County.....	225

The gravity of the situation can only be understood when it is known that from 225 to 250 pounds pressure at the head of the main lines is absolutely necessary to force the gas to the different cities that lie outside, but are obtaining their fuel from the gas field, with sufficient pressure to distribute it through the low pressure city lines to the consumer. And this pressure, too, is needed when all the reducing stations and district valves are wide open and every facility afforded for free circulation.

What must we do? Are we willing to go back to the use of wood and coal? After having enjoyed the conveniences and luxuries of natural gas for so long a time, to do so would be a great hardship. In order to avoid doing so, or at least to put off the evil day as long as possible, consumers should be willing to adopt any method that would preserve this fuel and perpetuate its use for the longest possible period of time.

In order to do this, I have the following suggestions:

- (1) All gas should be sold by meter measurements, and this should be enforced by law.
- (2) Natural gas should not be used in the manufacture of bricks, tiles, nor in the rolling mills nor melting furnaces of glass factories. In these factories a coarser and less valuable fuel can be used.

The highest and best purpose to which natural gas can be applied is the domestic use. It is in this use that it does the greatest good to the greatest number, and it is for this use that it should be preserved.

Natural gas is a commodity, and a very valuable commodity, and every other commodity in the commercial world is sold by weight or measure. Experience has shown that this is the only just and equitable way of selling natural gas. The price per thousand feet should be approximately the same as charged in cities where conditions are similar. The following are the net meter rates per 1,000 feet charged in other cities: Detroit, Lima, Piqua, Dayton, Springfield, Toledo, Buffalo and Columbus, 25 cents; Pittsburg, Alleghany and Erie, 22½ cents; Jamestown and Corry, Pa., 21½ cents; Fostoria and Logansport, 20 cents; Indianapolis, Richmond and Fort Wayne, when sold to manufacturers by meter, 10 cents.

When the time comes that consumers will be compelled to pay for what they use, then, and not till then, will economy be practiced.

One of the great wastes of natural gas that exists in Indiana gas fields is the leakage from pipe lines. During the early days of the fuel, when most of the pipe lines were laid, experience had not then taught the necessity of using the best pipes and fittings. Cheap pipe and cheap connections were the rule. Especially is this true in what is known as "farmer lines," that is, lines that supply people who live in the country. These lines, as well as many that supply the towns and cities, were laid by persons of no experience, and were not tested as to their capacity to withstand high pressures. The result was that leaks were at almost every connection in many of these lines. Much improvement, however, has been made in many of these plants. Better material and better work has been substituted. Especially is this true of the plants that have been put in more recently. Good material is now used, and the lines are thoroughly tested before being subjected to the pressure from the gas wells. A fair estimate of the results of these improvements would be that the loss from leakage from the pipe lines has been reduced more than one-half. Not only was there a great loss of valuable fuel from this source, but there was a great danger to life and property. Many accidents have occurred that have resulted in the loss of life and the destruction of much valuable property that can be directly traced to leakage in pipe lines and mains.

All pipes used for the conveyance of natural gas should be tested by hydrostatic pressure up to at least 300 pounds to the square inch, and the pipe should be rapped with a hammer while under pressure.

Cast iron pipe may be generally used for low pressure, but it should not be used for high pressure mains. In conveying gas under a pressure of 50 to 250 pounds to the square inch, only the best of lap-welded wrought iron or steel pipes should be used. And on this kind of pipe, when the threads are cut, the metal should be made thick, so that the pipe shall not be reduced in strength at that point. One source of great weakness

* In the annual report to the State Geological Survey, some interesting observations are made, especially pointing to the necessity for careful economy in the use of natural gas. We make a few abstracts.