For using a quartz mill (other than hand-worked) without license $100 or two months.

For omitting to send returns of mill work, for every day's delay $20 or one month.

For not putting a fence four feet high around every pit of four feet or over in depth, not having been worked for eight days $50 or one month.

For taking a share in a mine by an inspector--$400 or one year.

For refusing entrance or assistance to inspectors—$5 or one month.

For refusing to appear as a witness—$5 or imprisonment until consent.

For all other misdemeanors, for every day of contravention—$20 or one month.

For neglect to set up or replace posts--$100 for each post.

For removing or damaging posts $100 for each offence.

For preventing arrest of offenders--$40 or two months.

Fines wholly recovered in the name of a complainant, are to be paid half to the complainant.

Liquor cannot be sold without a license within seven miles of a working mine.

Anthracite Mine Surveying.*

By R. Van A. Norris, E.M.

As the mining laws of Pennsylvania require accurate mine maps to be filed with the inspector of mines in each district, very extensive underground surveys are continually being made in the anthracite districts, all the larger corporations having their own corps of salaried engineers, and the smaller operators depending upon independent engineers who do the work either by contract or for fees.

The methods of surveying are almost as varied as the number of engineers. The following is the method used by the Susquehanna Coal Company, Mineral Railroad and Mining Company, Lykens Valley Coal Company and Summit Branch Railroad Company, corporations under the control of the Pennsylvania railroad, and it is believed to be as good as any other system in use.

The corps, as it goes into the mines, consists of a transit man, station man, backsight, foresight and chainman, with a fire-boss to attend to the safety of the party. The three-tripod method of surveying is used, but instead of tripod lamps, the wicks of which were found too large for accurate sighting, similar lamps are used with the wick replaced by a steel wire $\frac{1}{16}$ of an inch in diameter and $\frac{3}{8}$ of an inch high. The sights are always taken to the bottom of this wire, and measurements are taken on the line of sight with a steel tape 300 feet long, graduated every 5 feet.

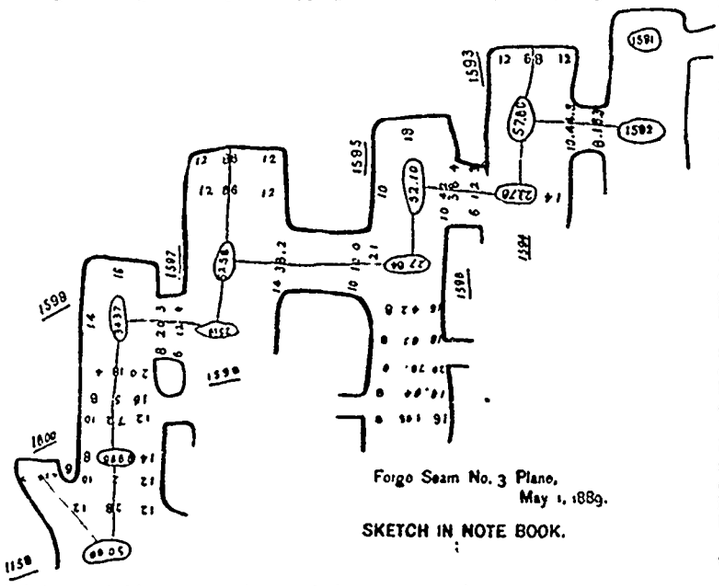
When in the mine, the station-marker keeps ahead of the party, and puts in and numbers the instrument stations. There are three ways of making permanent (?) stations in the roof in vogue in the region. A small conical hole is sometimes drilled, and the bob suspended from an iron rod with a notched end fitting the cone of the hole. With these stations, which are used principally with high roofs, the point is transferred to the floor by holding a bob with the iron rod, and placing some mark under it, usually a small bit of coal in the centre of a dab of white paint, the instrument being set up over this. This method has a greater liability to error than either of the others. A second method is to put a horseshoe nail, with a hole punched in the end, into a plug of wood driven into a drilled hole in the roof, and then to suspend the plumb from the ring, and set up the transit under the bob. A third and more convenient way of effecting the same thing is to drill a $\frac{1}{16}$ inch diameter hole in the roof with a twist drill, and put a shoe-peg, holding a small loop of fine (No. 26) copper wire, in the hole. We have used this style of station largely, and find it a most satisfactory one, the wire being flexible enough to allow the bob to hang true; and the station, with its ring of white paint and painted number, being readily found and never confused with any spads put in by the mine bosses.

The station marker is supposed to be familiar with the mines and with the engineer's methods of mining, and usually places his stations advantageously, being guided in some measure by the light of the fire-boss ahead of him and by the foresight's light behind.

The foresight man carries the forward tripod with him, and sets up under the station, plumbing to the wire on the "lamp," then holds his light to give foresight to the transit-man. He then waits for the chain-man to come up, and assists with the chaining. The transit man, after taking a sight and making the proper notes, follows the chain forward, making the sketch and taking the side-notes. Reaching the next station, he takes the exact distance on the tape with his pocket tape, measuring to a clip which has been put on by the foresight-man when the 300 feet tape was stretched. At the new station he finds his instrument, which has been removed from its tripod and brought forward to him by the backsight-man. As soon as the transit man gets a satisfactory backsight on his old station, he calls "move up," and, while he is taking his angle, the backsight brings up the rear tripod and hands it to the chain man. He then holds the end of the tape while the chain-man goes forward with the reel and tripod. By the time the angle is taken, the chain should be ready to stretch, the transit-man being responsible for the zero end, and the foresight for the other. As soon as the chain is stretched and the distance clip put on, the foresight-man takes the tripod brought to him by the chain man and the lamp from the tripod to which he has just measured, goes forward, and sets up under the next station, the chain-man and backsight-man meanwhile holding the chain for the transit-man to take his side notes from.

The accompanying notes, sketch and map are from regular work, being taken at random. In the notes, the instrument station and foresight station are entered thus: 1592–1593, the backsight being understood to be the previous station unless otherwise entered at the beginning of a survey, thus: Bs. 1287—1562--1563.

Continuous azimuth angles are run, plunging the instrument at each station, and the entries in the note-book consist of the vernier reading on a continuous graduation, 0 to 360, and also the quadrant reading or course. The compass reading is taken roughly, and has been found of great service in finding errors caused by reading in the wrong quadrant, or mistakes of even degrees. In starting, the vernier is set to the course of the starting stations taken from the note-book. The method has the disadvantages of danger of the plates slipping while the transit is being carried between stations, and that any error in adjustment of the instrument vitiates the survey; but, on the other hand, the courses are obtained directly, and, as all surveys are closed, any error is seen in the mine and the line re-run. In practice we find that a close more than 3' out for a chain of fifteen or more stations is very rare.



MAY 1, 1889.—CONTINUATION OF SURVEY ON No. 3 PLAN.

Stations.	Needle.	Angle.	Course.	Vert. Ang.	Tape.	Hor. Dist.*	Ht. Inst.	Rod.	Elevation.	Rem'ks.	Vert. Dist.
1591–1592	N. 4° E.						—1.45		+ 233 89		—6.02
1592–1593	N. 82° W.	173 46	S. 6° 14' E.	—6° 00	57 60	57 28		+ 1.90	+ 228 32	Face.	Face.
1593–x	N. 84½° E.	84 21	N. 83° 50' W.	—2° 56' 68	22 76	22 73		+ 2.25	+ 228 01		—1.10
1593–1594	N. 8° E.	170 45	N. 84° 21' E.	—5° 46	52 10	51 83		+ 2.05	+ 223 88		—5.23
1594–1595	N. 88° E.	91 24	S. 9° 15' E.	—3° 07	27 64	27 60		+ 1.85	+ 221 88		—1.50
1595–1596	N. 87° E.		S. 88° 36' E.	—3° 15	106—	105 92					
1596–x	S. 4½° E.	174 20	N. 85° 30' W.	—5° 56' 86—	52 58	52 30		+ 1.85	+ 216 95	Face.	—5.43
1596–1597	N. 85° W.		S. 5° 40' E.	+1° 30'							
1597–x	N. 86° E.	84 59	N. 88° 30' W.	—3° 42'	25 19	25 13		+ 2.10	+ 216 08	Face.	—1.62
1597–1598	S. 1° E.	177 33	N. 84° 59' E.	—3° 09	34 37	34 28		+ 0.90	+ 212 99		—2.39
1598–1599	S. 2° E.	107 50	S. 2° 27' E.	—4° 09	99 96	99 50		+ 1.90	+ 204 94		—9.55
1599–1600	S. 73° E.	80 12	S. 80° 12' E.	—5° 29'	50 00	49 87		+ 1.10	+ 201 14		—3.50
1600–1158	N. 81° E.		N. 78° 55' E.	—4° 01	Close.	1'out.					
1158–1157											

*Calculated in Office.

The vertical angles are read very carefully, as level is carried with the instrument. On this account the "lamps" were made of such a height that the bottom of the sight wire is just $\frac{1}{16}$ foot below the centre of the instrument.

The column headed "rod" gives the distance from the centre of the instrument to the station in the roof, so that the calculation for the level is thus:

Elevation 1594	228.01
Rod at 1594	2.25
Elevation of instruments at 1594	225.76
Calculated vertical distance	5.23
Elevation of lamp at 1595	220.53
Height instrument over lamp	.50
Height instrument at 1595	221.03
Rod at 1595	2.05
Elevation of station, 1595	223.08

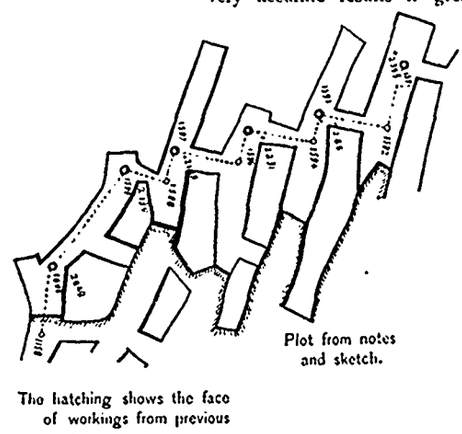
In this way level is carried through the workings, being checked by lines run in the gangways with a level. The method is found to give results sometimes surprisingly accurate, to within $\frac{1}{16}$ foot for lines containing 50 or more stations, and a difference of over one foot in the transit and level elevations is rare.

Working in this way it is possible to attain great speed, from 40 to 50 stations being considered merely a fair night's work.

As many of the seams are only reached by vertical shafts, it is necessary to "plumb" these before starting the underground surveys; two methods of accomplishing this have been used by the Susquehanna Coal Company at Nanticoke.

1st. Two 15-lb. iron plumb-bobs are lowered, attached to No. 20 steel wires, one on each side of the shaft, and the instrument is put in line with the two wires on the surface and again underground, continuing the surface line; the objections to this are the very short base line, as the sight has to be taken in one compartment of the shaft, the base is seldom more than 8 or 9 feet, and the difficulty has to be encountered of keeping the bobs in a 1000-foot shaft from swinging; they can be steadied considerably by immersing each in a bucket of heavy oil, but at the best they will swing somewhat.

This method, however, gives very accurate results if great care is used in aligning the transit at the bottom of the shaft, and is, perhaps, the preferable one.



The hatching shows the face of workings from previous survey

The other method is to hang the two wires at opposite sides of the outer compartments, and fix two stations under ground, and measure the angles and the sides of the resulting quadrilateral, and from these calculate the course between the stations, the course between the wires being obtained on the surface by putting them in line with the transit or by a method similar to that just outlined. The greatest objection to this method is that even a very small error in measurement, and it is not a very easy matter to measure accurately to a wire swinging in a wet shaft, will introduce serious error in the results.

Recently the two systems of plumbing were compared with a line run from the surface down two slopes and a plane, and with about a mile of underground traverse, and the three courses agreed to within a half minute, the first system of plumbing and the traverse line (which was run very carefully with an instrument reading to ten seconds) agreeing exactly.

All gangway stations are plotted from calculated latitudes and departures, and the stations in the workings filled in by plotting with a protractor; the outline of the workings is then filled in from the sketch taken in the mines. In making this sketch the transit-man walks along by the tape, and, taking his distance from that, measures at intervals to the rib at either side and to all openings passed; this measurement is usually, by experienced men, done by the eye; at the station the distance is put on the sketch, the number of the station being afterwards supplied from the notes. In surveying the breasts, either a line is run through the headings, as was the case in the accompanying notes and sketch, or, where this is impracticable, either on account of pitch of seam or gas, a line is run up every third breast noting all headings and the two intermediate breasts sketched in by measurements through the headings.

On many corps where the three tripod method is not in use, an extra man is employed, whose sole duty it is to take the side notes and make the sketch.

* School of Mines, Quarterly.