thrusting weapon of some kind; as a sword, dagger, or large knife. The other specimen is part of some round, awl-shaped implement; and a small fragment of the bone handle in which it was fixed yet remains attached to it.

The bureau is also in possession of another rudely hammered, small iron chisel or celt, found under somewhat similar conditions in a mound in the same section.

It is evident, from what has been stated, that we cannot ascribe the presence of this metal to an intrusive burial. The people who dug the pit, deposited here their deceased chief, or man of authority, and placed around him, and those buried with him, the pipes, celts, axes, engraved shell-gorgets, and other implements and ornaments, undoubtedly placed here, also, the pieces of iron.

Whether the burials were comparatively modern or pre-Columbian, the evidence furnished by these fortunate finds compels us to conclude that the people who made these polished celts and axes, who carved these pipes, who made or at least used these copper implements, and engraved these shells with the figure of the mystic serpent, so strongly reminding us of Central-American figures, also had in possession these iron implements, and were mound-builders. That this burial-pit was made by the same people who erected the mounds of this region cannot be doubted.

Cyrus Thomas.

PENNSYLVANIA ANTHRACITE.

Some of the commonest articles used, either for manufacturing purposes or in the household, are frequently those about which we have the least definite information as to their composition or value. Near the point of production or manufacture, the consumer is apt to exhibit the most discriminating judgment in the selection of special brands or grades, on account of closer competition and a greater variety from which to make a selection. This is frequently done on the basis of a personal estimate, without substantial facts to warrant it. To no natural product does this apply with greater force, at the present time, than to the Pennsylvania anthracites, which are now depended upon by manufacturers and housekeepers, either as a necessary or luxuriant fuel, throughout portions of the entire western continent, and are used at points as distant as China and Japan.

Both the manufacturing and domestic consumers are beginning to realize the fact that their coal purchased this year does not seem to burn so freely, does not fire with so little trouble, and does not last so long, as that purchased during the last and previous years, or *vice versa*. Where coals of different sizes, or from different districts, are offered to the trade by the same or competing salesmen, the question suggests itself, what shall we buy?

Among housekeepers, who are the smallest and most numerous class of consumers, distinction is seldom recognized between these anthracites. By other consumers the coals are grouped into those, which, when burned, will produce either a white or a red ash, special qualities being arbitrarily attached to each. Others, again, know only of three varieties: 1°, those from the Wyoming and Lackawanna fields, or the coals shipped from the northernmost basins over the railroads running through north-eastern Pennsylvania direct to New York (notably, the Delaware, Lackawanna, and Western, Delaware and Hudson, and Erie railways); 2°, those shipped by the Lehigh valley railroad, and the Central railroad of New Jersey, down the Lehigh valley; and, 3°, those over the Philadelphia and Reading railroad down the Schuylkill valley. Still other distinctions are arbitrarily made, which it is not necessary to note. In special localities, where a favorite coal is largely used, the consumer will speak of one class, that composed of his favorite coal, which possibly comes from two or three collieries, with a total aggregate annual production of less than a million tons; and of a second class, that composed of the coals from all other collieries, represented by an annual production of over thirty million tons. I have noticed this particularly in sections of New England, where even an intelligent consumer will sometimes speak of Lykens valley coal and of all other Pennsylvania anthracites.

The pressing demand which has been made upon the Geological survey of Pennsylvania, for some answer as to the fuel-value of different coals, has led me to consider what is the composition of Pennsylvania anthracite, as a preliminary step in the investigation.

Various percentages of fixed carbon have been assigned by different authorities to a typical anthracite. That which has been most generally accepted has been about 94, with all the accidental impurities, such as those which are generally classified under ash and sulphur, eliminated. Professor Rogers (Final report of first survey, vol. ii. pp. 969, 970) gives analyses of fifteen specimens of hard, dry Pennsylvania anthracite, which show an average, of fixed carbon, 88.05; of volatile matter, 5.81; of

ash, 6.14. Eliminating the ash from these analyses, the percentages of the constituents of fuel are as follows: fixed carbon, 93.8; and volatile matter, 6.2. This result is identical with the composition assigned by Newberry to a typical anthracite (Johnson's cyclopaedia, vol. i. p. 993).

The range of fixed carbon in the analyses of these fifteen specimens was from 94 to 80; the specimen showing the maximum being obtained from near Pottsville, and that showing the minimum from near Pine Grove, both from the Southern field in Schuylkill county. The range in volatile matter in the fifteen analyses is from 1.40 to 9.53; the minimum amount being in the same Pottsville specimen, and the maximum in a specimen from Black Spring Gap. The range in ash was from 2.90 in a specimen from Tamaqua, to 12.28 in a Pine Grove specimen. These results are certainly misleading; for it has been a long-recognized fact, that the coals obtained in the Southern field do not contain the highest percentages of fixed carbon.

Taylor (Statistics of coal, 2d ed. p. 609) gives analyses of a number of Pennsylvania anthracites reported from various sources. Twelve specimens from the Panther-Creek basin, between Mauch Chunk and Tamaqua, showed the following: —

	Averages.	Maximum.	Minimum.
Carbon	89.21	92.60	86.00
Volatile matter	6.38	8.00	4.54
Ash	4.41	7.00	1.28

Six specimens from the Lehigh region gave —

	Averages.	Maximum.	Minimum.
Fixed carbon	89.00	92.30	85.34
Volatile matter	7.05	9.60	5.36
Ash	3.93	8.73	1.28

All of these analyses, particularly those given by Taylor, are constantly quoted in numerous descriptions of Pennsylvania anthracite found in technical publications, both at home and abroad. The foreign books and journals have been reporting the higher results; so that the opinion prevails, that the hard, dry anthracite mined in the state will range from 90 % to 94 % of fixed carbon in the market product. Such is, however, not the case, as recent analyses[1] made by the Geological survey show.

[1] Andrew S. McCreath, analyst.

The results which have been reported in the Rogers and Taylor tables referred to may be taken as those of analyses of mineralogical specimens, which were in most cases carefully selected, either from the mined coal or from special portions of the bed. In no case, as I believe, are the analyses a guaranty of the character of the coal which was being mined or shipped as fuel from the individual localities at the time that the samples were collected. Even the specimens which were collected in considerable quantity, and analyzed and tested for their evaporative capacity by Johnson for the government in 1842 were not, I consider, fair averages of the coal which could be commanded in the market from the different mines for which his results were reported.

As indications of the composition of mineralogical specimens, the chemical analyses reported by Rogers and Johnson are of little scientific value, without a minute description of the physical characteristics and geological associations of the coal for which they stand. This conclusion could be substantiated by a number of instances to which I might refer; notably, one where I requested an experienced mining-expert to collect duplicate specimens from a point in one of the Mammoth bed mines, which, when analyzed, showed, much to my surprise, the following results: —

	Water.	Volatile matter.	Fixed carbon.	Sulphur.	Ash.
1 . . .	2.590	3.883	86.233	0.851	6.443
2 . . .	2.440	3.998	80.301	0.649	12.612

These two analyses are worthless as indications of the fuel-value of the coal, because it would be unreasonable to suppose that either one or the other specimen, showing such a wide range of composition, could be taken as a fair average of the coal shipped from this mine. Nor are they of scientific value, without certain facts, connected with the occurrence of the coal at this special point, to suggest some reason why such wide differences should exist.

If the amount of combustible matter in a coal is any criterion of its fuel-value, an examination which has recently been made by the survey shows how ignorant we are as to the actual worth of the different coals which we burn, and how readily we may be deceived by the special characteristics of a coal which we may have noticed, and by which we may have judged of its heating-capacity.

In order to test the value to be attached to

the judgment of the trade in discriminating between different coals, I requested one of the largest miners and shippers of anthracite coal, who has for a great many years been connected with the mines over a wide area in the region, to name a number of coals, which, by most consumers, were credited with being of about equal value. Specimens of these coals were collected from one or two hundred tons, as they were ready to be shipped to market; the amount collected for each analysis, ranging in weight from one to two hundred pounds, which was then reduced by the ordinary methods now commonly used in sampling any mineral product for qualitative and quantitative tests. The number of specimens obtained in this way aggregated thirty-three. The analysis of each individual specimen is recorded in detail on p. xliv. of my 'First report of the progress of the anthracite survey,' issued by the state printer on the first of this month. For our present purpose it is not important to refer to the results in detail.

The table of averages which I have compiled shows the mean character of the coal obtained from the more important coal-beds in the Northern field in the vicinity of Wilkes Barre, in the Eastern middle (Lehigh) field in the vicinity of Hazleton, in the Western middle field in the vicinity of Shenandoah, and in the Southern field on the property of the Lehigh coal and navigation company, between Mauch Chunk and Tamaqua. These results are shown in the following table: —

No. of specimens.	Name of coal-bed.	Name of coal-field.	Chemical analysis.						Specific gravity.	Percentage of constituents of fuel.		
			Water.	Volatile matter.	Fixed carbon.	Sulphur.	Ash.	Total.		Fixed carbon.	Volatile combustible matter.	Fuel ratio, $\frac{C.}{V.H.-C.}$
3	Wharton . . .	Eastern middle .	3.713	3.080	86.404	.585	6.218	100	1.620	96.56	3.44	28.07
5	Mammoth . . .	Eastern middle .	4.119	3.084	86.379	.496	5.922	100	1.617	96.55	3.45	27.99
2	Primrose . . .	Western middle .	3.541	3.716	81.590	.499	10.654	100	1.654	95.64	4.36	21.93
5	Mammoth . . .	Western middle .	3.163	3.717	81.143	.899	11.078	100	1.657	95.62	4.38	21.83
2	Primrose? (F) .	Southern	3.008	4.125	87.982	.506	4.379	100	1.584	95.52	4.48	21.32
2	Buck-Mountain .	Western middle .	3.042	3.949	82.662	.462	9.885	100	1.667	95.44	4.56	20.93
1	Seven-foot . . .	Western middle .	3.410	3.978	80.868	.512	11.232	100	1.651	95.31	4.69	20.32
7	Mammoth . . .	Southern	3.087	4.275	83.813	.641	8.184	100	1.631	95.15	4.85	19.62
3	Mammoth . . .	Northern	3.421	4.381	83.268	.727	8.203	100	1.575	95.00	5.00	19.00

These analyses are arranged in the order of the percentage of fixed carbon in the fuel constituents.

A comparison of these results with those already referred to, as given by Taylor for the Panther-Creek basin, shows wide differences. The two Primrose and seven Mammoth specimens reported in the table for the Southern field came from the Panther-Creek basin; the average of the two Primrose coals indicating 1.29%, and the average of the seven Mammoth specimens 5.4%, less fixed carbon than Taylor's average; the minimum fixed carbon in the survey's analyses being 78 as against 86 in Taylor's table, and the survey's maximum being 88 against 92.6.

These results evidently prove, 1°, that the specimens which were collected in the past for analysis were not sampled with sufficient care; for with the improvements which have been made in breaker machinery, and the greater care exercised in the preparation of coal for market, we might reasonably expect to find the higher percentages in the more recent analyses: and, 2°, the necessity of changing the basis upon which Pennsylvania anthracite has been rated in the past.

CHARLES A. ASHBURNER.

IMPROVEMENTS IN TESTING-MACHINES.

SOME philosopher has remarked that the prosperity of a nation is directly in proportion to the success of its people as constructors. According to this maxim, America occupies a very high place in the list of nations. With our almost inexhaustible ore-beds, and fertility in inventing new processes of mining and working metal, the necessity of becoming better acquainted with the properties of American building-materials is daily growing more apparent; and at present no question is exciting more attention among our constructors than that of the strength of materials.

About two years ago Messrs. Fairbanks & Co. conceived the idea of locating in New York a bureau so arranged that engineers and all interested could be afforded an opportunity