It seems that the rate of circulation of air through a coal pile has more to do with this question than any other condition outside of the character of the coal. The heating is mostly very irregular throughout a pile, as there are usually spots where the temperature is much higher than in the surrounding space. For this reason the usual method of taking temperature measurements in a pile by letting a thermometer down a set of pipes scattered throughout the pile is very unsatisfactory, as the hottest spot that will soon cause trouble may be missed entirely. The question, What is the safe limit for the temperature of a coal pile? is frequently asked, and it is rather difficult to answer, for a coal pile may heat up to a pretty high degree, then cool down without being moved. But if there is enough heat generated to raise the temperature of the coa l pile to 212 degrees Fahrenheit, the moisture being evaporated at or before this temperature is reached leaves only the dry coal, which has a comparatively low specific heat, to be heated. The heating takes place much faster and the rate of oxidation also increases with the rise in temperature. The carbon in the coal evidently oxidizes to a considerable extent, as large percentages of carbon dioxide have been found in coal piles at comparatively low temperatures.

(b) Many plants are so limited in boiler capacity, have such poor draft, or some kind of grate or stoker that it is possible for their boiler-room force to keep steam with only certain kinds of coal. While this is not an ideal state of affairs, it is a condition that exists in a large percentage of the power plants in this country, and unless a man knows what coal will develop the required boiler horse-power in his plant he may have the costly experience of shutting down a part or all of his mill. There is a great deal of difference in the rate of combustion of different coals. The percentage of volatile matter, coking properties, amount and nature of ash are the principal factors upon which depends this characteristic in various coals. It is not always the better or higher priced coals that give the best satisfaction under such conditions, for a cheaper coal might give more satisfactory results than are being obtained with the highest priced coal on the market, but the risk of experimenting has seemed too great for the management to consider stepping out of the well-beaten path.

(c) All minerals or raw material are bought because they contain some one ingredient or property that may by a certain treatment or operation be enhanced in value or utilized by the manufacturer in such a way as to cause him to make a profit from the principal product of his factory. It is seldom that any mineral or raw material does not contain some impurity or inert matter that may involve additional expense for its riddance or by a certain process may be converted into a by-product, and thus become a secondary source of profit. Coal varies more in character and quality than any other mineral produced. In character it is found in all successive stages between lignite and anthracite. Each different kind is more applicable for one purpose than another. In selecting a coal for making illuminating gas the yield of gas, measured in "candle feet," is of primary importance, while the coke and tar are by-products, and sulphur is the impurity that causes additional expense. For making coke the purity, structure and yield of coke are the properties to be considered, and the gas, tar and ammonia may be utilized as by-products. In buying steam coal the amount of heat that may be developed from it is the measure of its value to you. There is no by-product that may be utilized, except that in some cases the sale of ashes might be considered in this connection, but their removal is generally an additional expense. Two coals at the same price and containing the same number of heat units may not be equally desirable. The difference in volatile matter might cause the lower to prove more satisfactory under certain conditions of smoke restriction, while the higher volatile coal would probably be more applicable in a plant with fluctuating load. The amount and nature of ash in regard to the formation of clinker often needs to be considered.

The liability of spontaneous combustion of one coal more than another may make it advisable to pay several cents per ton more for one coal containing no more heat units than the other.

The following table shows the analyses and results of evaporative tests of some of the better coals together with their price f.o.b. cars at the plant of an inland New England mill. The relative values have been calculated by taking coal A as a basis and determining what will be the cost of the equivalent amount of coal required to produce the same number of heat units as coal A produces for $4.60 per ton. For example, should you buy coal F at $4.40 per ton, your coal bill would amount to the same as if you had bought coal A and paid $4.92 per ton for it, but as you can get coal A for $4.60 you would save 32 cents per ton by taking coal A instead of coal F at the given prices.

In this case it appears that neither the best nor the lowest priced coal would be the cheapest to buy.

Coal	Moisture.	Volatile.	Fixed Carbon.	Ash.	Sulphur.	B. t. u.	Lbs. water evaporated from and at 212°F.	Price f.o.b. plant.	Relative Cost per ton with Coal A as basis. By B. t. u.	Relative Cost per ton with Coal A as basis. By evaporation.
A	1.25	17.94	73.15	7.66	2.07	14354	9.93	$4.60	$4.60	$4.60
B	1.43	17.59	71.58	9.40	1.09	14032	9.73	4.55	4.65	4.64
C	1.17	30.51	61.01	7.31	0.99	14251	9.79	4.65	4.69	4.71
D	1.36	16.42	71.35	10.87	1.77	13811	9.60	4.58	4.76	4.74
E	1.75	19.58	71.95	6.72	0.82	14533	10.03	4.86	4.80	4.79
F	3.72	21.06	66.90	8.32	1.36	12834	8.80	4.40	4.92	4.96
G	1.74	31.16	53.68	13.42	2.93	12833	8.67	4.60	5.14	5.27

In this table the coals are arranged in order of cost for equal amounts of heat generated and equal evaporation, but in selecting a coal for any particular plant it might be policy to select a coal that would cost a little more money in order to obtain some particular advantage that a certain coal might have over another. Comparing coals A and B, coal A appears to be better in every way except that it contains about one per cent. more sulphur than does B. For steam purposes the sulphur is of little importance below two per cent. at least, so that coal A would probably be selected on account of its being five cents per ton cheaper on a heat unit basis, and there would also be less ash to handle. In case a plant had limited draft and boiler capacity a coal like C might be selected in preference to B, or even A, with a difference of nine cents per ton in favor of coal A. Should the prevention of smoke be an item of considerable importance, coal D would probably be purchased at an additional expense of seven cents per ton as compared with coal C. Of the two coals D and E there is a difference of only four cents per ton, and that would scarcely pay for the additional cost of handling ashes, the possibility of not being able to carry the load without the use of more boilers, and other expenses that are greater with a poorer coal.

While coal E is the best all round coal, it would not pay to purchase it when coal A could be obtained for 20 cents per ton cheaper on a heat unit basis, and 19 cents per ton cheaper on an evaporation basis.

Coals F and G are both much inferior to the others, and their purchase would not be considered when any of the other coals were available at the given prices. Judging from the ash and sulphur alone, it would seem that coal F would be better than either B or D, but a certain characteristic appears in this coal that makes it different from any of the others. It is "crop" or "red" coal coming from a part of the seam near the outcrop, and has become saturated with the surface water that has been percolating through it for hundreds of years. The moisture is much higher than in any of the other coals, and it contains a still larger percentage of combined water that is not driven off by the mere drying of the coal. If a man were depending upon the ash determination alone he would never detect that he was receiving an inferior quality of coal; in comparison with coal A he would be paying 20 cents per ton less for the coal, yet he would have to burn so much more of it to develop the same horse-power that he would actually be losing 32 cents per ton, or $16,000 per year on a 50,000 ton contract.

Coal G is high in ash and sulphur and correspondingly low in B. t. u., so that it would be a very expensive fuel to burn at the price quoted, and in comparison with the other