Fossils, both vegetable and insect, abound, and are, generally speaking, of similar type. These have been referred by the Geological Survey of Ottawa to the oligocene period of the tertiary.

It is not proposed here to enter into a lengthy discussion as to how coal is deposited, but as to the actual composition of coal it might be well to clear up some points upon which misconception exists.

The general division of coals is made by the amount of carbon shown to exist by a proximate analysis. Coal analyses may be of three kinds, viz: Proximate, which shows the amount of carbon, volatile matter, ash (non-combustible), moisture, sulphur, and sometime phosphorus.

Sometimes this analysis is given after the coal is dried, thus increasing the constituents apart from moisture proportionately.

2. Destructive analysis gives the further subdivision of the volatile matter into hydrogen, oxygen, nitrogen.

3. Assay of the per cent. of combustible only, volatile and non-volatile matter.

The coking analyses show the capacity of the coal for coking and its percentage. In this connection it should be noted as important that no estimate as to the coking quality of a coal or the nature of the coke if made can be deduced from its analyses. They do indicate, however, the probable purity of the coke made. It must be remembered that the ash is, in the case of an unwashed coal, made part of the coke, and in the case of a coal making 50 per cent. coke, i.e., two tons of coal making one ton of coke and containing 7.5 per cent. ash, there will be possibly 15 per cent. ash in the coke. For metallurgical purposes it may be said that a coke should be firm, tough and bright, sonorous, of long fibre, and should not contain more than 1 per cent. sulphur or 6 per cent. ash. A dense coke is objectionable by not allowing the air to penetrate and a very porous coke will not probably sustain the weight of the ore in the furnace. All the tests so far made seem to have been made for iron furnaces, where a weight of 50 to 60 feet of iron ore is supported by the coke. In a copper furnace there is probably never more than 8 feet of ore on the coke and therefore the question of strength may not be so important.

Roughly speaking it may be stated that with less than 20 per cent. volatile matter the coal will not fuse properly and with more than 30 per cent. the strength of the cell walls may be so small that the coke will be non-coherent. This refers mainly to the ordinary coke made in bee-hive ovens, unwashed. With washed coal and externally fired or narrow ovens these limits may be considerably expanded, and at the same time coals well within these limits will not coke at all. Probably the cause of this may be in proportions of O. H. and N., but this point has never been settled.

It is important in looking at a coal analysis to know which of the three styles of analysis has been used, as the following table will show:

	Ordinary Proximate Analysis.	Analysis of Dry Coal.	Per Cent. of Combustible.
Moisture	10	.....	.....
Vol. Matter	30	33.33	37.50
Fixed Carbon	50	55.56	62.50
Ash	10	11.11	.....
	of moist coal.	moisture eliminated.	includes ash in carbon.

The general classes of fossil fuels are: Peat, lignite, bituminous, semi-bituminous, semi-anthracite, anthracite.

The following analyses of coals, American and English, are given in order to define the boundaries of the various classes of coals. For the sake of clearness the decimals have been omitted, but the tables are taken from the best authorities.

Great misconception exists as to semi-bituminous coals. These occur between the bituminous and the semi-anthracites. Authorities differ somewhat as to the limits of these, but speaking generally it may be said that in a proximate analyses:

	Moisture.	Volatile Matter.	Fixed Carbon.	Ash.
Peat	*20 to 30	*25	*40	*10 and up
Lignite	*10 to 20	*35 to 50	*35 to 45	*5 to 20
Bituminous	1 to 10	30 to 40	45 to 60	3 to 10
Semi-B	1 to 5	15 to 25	60 to 75	3 to 10
Semi-Anth	1 to 3	7 to 10	75 to 85	3 to 6
Anthracite	2 to 4	3 to 5	80 to 90	5 to 10

*Physical properties enter larger into the classification of these.

As an instance of the unreliability of analyses as to coking qualities of coal the following may be of interest:

Montana coal 29 per cent. vol. comb. matter, uncokeable.

Colorado coal 30 per cent. vol. comb. matter, very good coke.

Cornellville, Pa., 31 per cent. vol. matter, standard coking coal of U. S.

Montana coal 32 per cent., uncokeable.

British Columbia coal 36 per cent., makes good coke.

When the volatile matters are divided up with O. H. and N. the matter becomes more complicated, but within one individual coal field it is possible to establish some limits.

It is also doubtful whether the ordinary laboratory test is of much value as to coking qualities, that is to say, a good coking coal may, and possibly will show coke in an analysis, but a poor coal may refuse to do so in a small crucible but might coke in a coke oven under proper technical direction. A good deal may also be done by using some of the later pattern coke ovens and finding which system is suited to the particular coal in question. The ash may be so disseminated through the coal as to form a barrier to its fusing properly. This can be eliminated by washing. The