"These figures, while showing many irregularities, prove the statement that the ratio of nickel to copper increases with depth. Many of the apparent irregularities are in reality not evidence of exceptions to this statement. The first few years output in several cases does not represent increase in depth alone, being offset by horizontal extensions of the pits. The last two years at No. 2 mine and Copper Cliff show reversal to higher copper ratio corresponding to robbing of pillars. Regular decrease in copper ratio is very noticeable in the figures for No. 2 mine for years 1899 to 1907, and the production for these years was from fairly regular increase in depth on a clean uniform chimney of ore. The figures for the Copper Cliff mine show a fairly regular decrease in copper ratio down to 1895, and then a much higher copper ratio in the succeeding years, were found on inquiry to correspond with the working out of one ore shoot and the development of a second deeper shoot."

"Another analogy between ore deposits and the furnace products is found in comparing the ratio of nickel to copper in slags with the ratio between these metals in the mattes. Small drops of sulphide are carried off by the slag, and analyses show the ratio of copper to nickel in slag to be always greater than the ratio of copper to nickel in the corresponding matte.

"Ratios of copper to nickel in matte and in slag:

Year.	Parts copper to 100 parts nickel. In matte.	In slag.
1910	44.3	47.5
1911	43.9	53.0

"An objection to comparison of these furnace products with the ore deposits lies in the fact that the iron has been oxidized and all put into this slag, while in the ore body it remains with the other sulphides. A better comparison would be obtained from products obtained on melting together rock and ore without oxidation. This is not a common practice, but has been done, and the resulting slag showed a copper ratio of 41.5 compared with a ratio of 32.8 in the matte.

"Interesting also are comparisons between the ratio of nickel to copper in marginal and in offset deposits. If the analogy between furnace products and ore bodies still holds we would expect to find in the offset deposits, where the molten magma penetrated far out into the surrounding rocks, that the ratio of copper and nickel is less than the marginal deposits. This is in fact the case. For the marginal deposits the only available figures showing the average for the whole output of the mine are for the Creighton. The figures given for the other properties are less truly representative. For the off shoot deposits the figures given are in each case the average for total output.

Ratios of copper to nickel in marginal and offset deposits:

Marginal.	Parts copper for every 100 parts nickel.
Victoria mine	87
Gertrude mine	50
Creighton mine	33
Murray mine	50
Blezard mine	50

Average for 5 marginal deposits, 54 parts copper to 100 nickel:

Offsets.	
Evans	88
Cliff	147
No. 1	96
No. 2	71
Stobie	74

Average for 5 offset deposits, 95 parts copper to 100 nickel.

Summary.

1. It has been shown by Drs. A. P. Coleman, T. L. Walker, A. E. Barlow and others, that (a) the nickel-copper deposits of the Sudbury district all occur in the same type of rock—a quartz-hypershene-gabbro or norite.

(b) The norite forms the lower part of a great spoon shaped laccolitic sheet and the ore bodies occur along the lower outer margin of the sheet and in narrow masses of norite, which occur far out in the surrounding rocks.

(c) The ore bodies, sulphides of nickel, copper and iron have been formed by a process of magmatic segregation.

2. The author calls attention to the processes involved in the solidification of the magma and suggests that it is probable (a) that limited miscibility of the molten constituents of sulphides in the molten constituents of silicates resulted in the formation of two solutions—a silicate solution and a sulphide solution—each containing some of the constituents of the other.

(b) The sulphide solution sank to the bottom, but the separation was not a clean one, and on solidification a zone of intermediate composition was formed owing to inclusion of large and small bodies of one solution in the other. (In the furnace a cleaner separation is obtained by adding fluxes.)

(c) In each solution also differentiation took place by early formed minerals accumulating at the margins and especially at the bottom. Such differentiation was very incomplete owing to high viscosity at the freezing temperature.

3. Mr. D. H. Browne gives a statement of relationships between ore deposits and furnace products. He states that (a) "Analyses of a pot of matte show marked tendency of the nickel to accumulate in the central part, well towards the bottom. In the ore deposits a horizontal section shows increase in the ratio of nickel to copper towards the middle of the ore body. The output of mines shows an increase in the ratio with depth. The 'marginal' deposits show a greater ratio of nickel than do the 'offset' deposits."

(b) "Analyses of slag and matte show the ratio of nickel to copper to be greater in the matte than in the slag, and the same relation holds true for ore and the rock that is mined with the ore." One reason, doubtless, lies in the fact that molten nickel sulphide is more mobile than the copper sulphide, and that therefore a greater proportion of the former would settle out from the mixture. The relative solubility of the molten sulphides in the molten silicate solution is an unknown, but probably less important factor."

4. The analogies which Mr. Browne has shown to exist between the ore deposits and the furnace products strengthen the view that the deposits were formed directly from a molten magma.

5. Since the first solidification all the deposits have been altered—some slightly and others almost completely. The localization of the ore-bodies, however, was determined by the primary deposition, and this is, therefore, the factor of chief importance. The extent of secondary alteration has been peculiarly dependent on very local conditions, and the discussion of the nature of the secondary changes calls for more detailed description of individual ore bodies than is at present available.