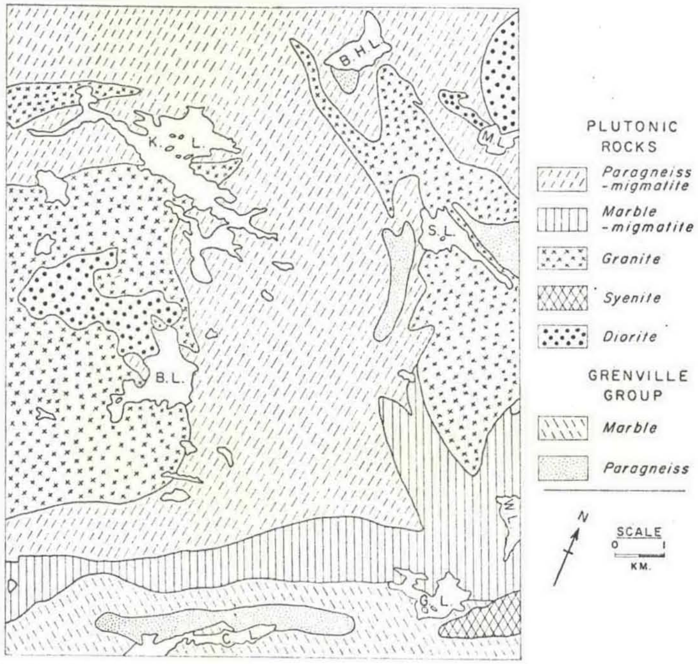

Fig. 1. Precambrian Geology of part of Glamorgan township. Geology by H. S. Armstrong and Ward Chesworth. The abbreviations are as follows: B.H.L.=Blue Hawk Lake, K.L.=Koshlong Lake, M.L.=Minniecock Lake, S.L.=Stormy Lake, B.L.=Bark Lake, W.L.=Wolf Lake, G.L.=Gooderham Lake, C.L.=Contau Lake.

Geological setting of Glamorgan township

Glamorgan township, in the Haliburton Highlands, is about 150 miles north of Toronto. The area studied (Fig. 1) is underlain by Precambrian rocks of the Grenville province. An approximate time scale is shown in Table 1.

Rocks of the Grenville group (Wynne-Edwards 1967) represented here include marble, paragneiss, amphibolite and quartzite. Granite of three contrasted compositions (Chesworth 1968) pervasively veins these rocks to form the migmatitic complex referred to by Adams & Barlow (1910) as the Glamorgan batholith.

The metamorphic grade is stated by Armstrong & Gittins (in press) to be of the almandine-amphibolite facies. In order to examine this characterization, it is worthwhile to consider some of the characteristics of the amphibolite facies in general.

Table 1. Precambrian (Proterozoic) time scale for the Haliburton Highlands, Ontario.

Age in m.y.	Dominant events
900	Post-metamorphic intrusions (pegmatite and diabase)
1000 – 1200	Metamorphism with formation of granite, pegmatite and migmatite
1200 – 1300	Pre-metamorphic intrusions (nepheline syenite, gabbro, diorite)
1300 – 1400	Grenville group sedimentary and volcanic rocks laid down

The amphibolite facies

The mineral facies concept has on the whole been a powerful aid to the study of metamorphic rocks. However, individual facies are not unambiguously defined (see Lambert 1965), and in the case of the amphibolite facies this fact becomes obvious on examining the boundaries of the facies at low and high grades.

The low-grade boundary is marked by Eskola (1939) with the breakdown of epidote and the appearance of plagioclase and hornblende existing together. Ramberg's (1952) boundary is an isograd along which epidote coexists with a plagioclase of composition $An_{30}\,Ab_{70}$. In real terms these two boundaries may not be significantly different if Ramberg's (1952, p. 51) epidote-plagioclase phase diagram is to be believed, but in any case it is probably more sensible to recognize that the low grade boundary is transitional in nature, a point made clearly by Turner (1968, pp. 303 ff).

The high grade boundary of the amphibolite facies is not so much ambiguous as meaningless for all practical purposes. Eskola (1939) marked this upper limit by the breakdown of all hydrous phases – a breakdown that could be marked by such reactions as

Hornblende = pyroxenes + water

Biotite = almandine + orthoclase + hypersthene + water

taken from Turner & Verhoogen (1960, p. 557). The absolute, upper stability limit for these hydrous phases would pertain to a condition in which equilibrium partial pressure of water is equal to load pressure ($P_{E_{H_2O}} = P_s$), a condition under which biotite and hornblende could be expected to remain stable beyond the point where melting and magmatic processes become dominant in the crust of the earth. Even though the condition $P_{E_{H_2O}} = P_s$ is unlikely to be encountered in an environment of regional metamorphism (a point recognized by Francis 1956, in his tentative metamorphic grid) it is still questionable whether at depth there exists a temperature high enough, or $P_{E_{H_2O}}$ low enough, for all hydrous phases to break down before the onset of melting. Certainly it appears that the assemblages of Eskola's (1939) granulite facies are not found except in the presence of hydrous phases (see for example the short review in Hsu 1955).

Further confusion arises with the various internal subdivisions that have