William S. Cooper then gave an illustrated paper of which the following is an abstract.

PRELIMINARY ACCOUNT OF THE FOREST SUCCESSIONS ON ISLE ROYAL, LAKE SUPERIOR.

Isle Royal, an island near the northwest shore of Lake Superior, is fifty miles long and six to ten miles wide. Its topography is determined by a parallel series of tilted beds of Keweenawan and Cambrian age, which dip southeast under Lake Superior. The result of this structure is a series of ridges extending northeast and southwest, parallel to the long axis of the island, with steep faces on the northwest, but sloping gently to the southeast. The ridges bound long narrow valleys which contain bogs and lakes, or harbors if below the present lake level.

The island was overridden by the continental glacier, and on the retreat of the ice was left entirely submerged beneath the waters of Lake Duluth. As the lake level subsided the island gradually emerged, finally reaching its present size. It has never been connected with the mainland since glacial times.

The dominant forest of the island is composed of white spruce, paper birch, and balsam fir. Whether this is the climax forest toward which the earlier successional stages tend cannot be determined at present. The uncertainty is due to two causes: the presence on the southwestern end of a well developed forest of sugar maple, which is the most important tree of the climax forest farther south; and the apparently unstable character of the dominant forest. It can be said with certainty, however, that the successional stages lead to the spruce-birch-balsam forest. Whether this in turn will tend to become maple forest is the doubtful point.

The devil's club (*Fatsia horrida*), first discovered on the island by W. A. Wheeler, was found in four isolated localities in the forest at the northeast end. It is a very common plant in the western mountains and is known nowhere in the east except on Isle Royal.

There are two main lines of normal succession leading to the spruce-birch-balsam forest as their ultimate or penultimate stage: the rock shore series and the lake bog series.

The rock shore succession is made up of the following stages: 1, crustose lichen stage; 2, crevice plant-lichen stage (Fig. 1); 3, Cladonia-Juniperus stage; 4, mature forest. The abrupt transition from the comparatively youthful third stage to the mature forest may perhaps be explained by the former presence of intermediate societies which have been "pinched out" by the advance of the forest toward the lower limit of plant growth, at the present time practically stationary, which is determined by wave action and ice. Suggestions of a xerophytic transitional society, dominated by jack pine, were found at a few points by Adams.

The lake bog series develops in the valleys and depressions which have been shut off from the main lake by the emergence of the island. The early stages are as follows: 1, aquatic stage; 2, bog sedge stage; 3, bog shrub stage. From this point two types of bogs develop. The first, in undrained depressions, is characterized by abundance of sphagnum and heaths, especially Labrador tea, followed by bog forest composed of tamarack and black spruce. The second type (Fig. 2), developing in basins possessing active inlets and outlet, is characterized by practical absence of sphagnum. The shrub zone is made up of Chamaedaphne and alder, and the bog trees following are tamarack and arbor vitæ. The condition and causes of the two bog types are still to be worked out. Both types develop into the spruce-birch-balsam forest, usually very soon after the bog forest is mature.

The changes brought about in the dominant forest by fires are as follows. If the humus is completely burned from the rocks, a succession is instituted which is essentially like the rock shore succession. If more or less of the humus and forest vegetation remain, certain species develop to the exclusion of the rest, and dominate for a time. The balsams are exterminated, while the birches increase enormously by sprouting from the stump. The result is a birch forest, under the shade of which the spruces and finally the balsams develop, the ultimate result being a return to the spruce-birch-balsam type of forest.

Fig. 1.
Fig. 1. Lichen and crevice plant societies on shore rocks. *Potentilla tridentata* as crevice plant.

Fig. 2.
Fig. 2. Bog of drained depression type. Sedge zone in foreground with pitcher plant and Alpine cotton-grass; alder and chanaedaphne in center and in front of trees; open water and aquatics at right; tamaracks behind, with spruce-birch-balsam forest on high ground at right.