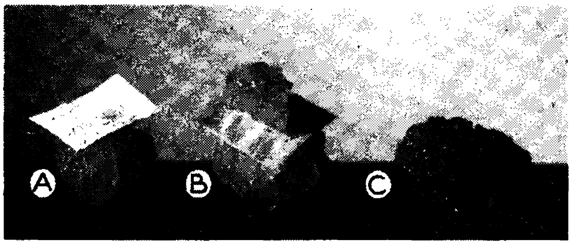

Fig. 1. *A*, filter paper, 8 × 8 mm, over sunflower culture. *B*, marigold culture of single-cell origin growing on filter paper over sunflower. *C*, marigold culture of single-cell origin, growing independently.

gall, where chromosome numbers vary (*6*) and normal and abnormal cells of several types may exist together. Cultures derived directly from single isolated cells might show less variation and prevent confusion from mixtures of cell types.

Cultures of animal tissue recently have been grown from single isolated cells (*7*). The present report describes the production of tissue cultures from single isolated cells of higher plants.

Single cells were obtained from tissue cultures of marigold (*Tagetes erecta* var. Sunset Giant) of crown gall origin (*8*) and of tobacco (*Nicotiana tabacum* var. Havana 38) from the normal stem. These tissues had been maintained in culture for several years (*9*). Their friable growth on agar media suggested that single cells might be obtained more readily than from firm cultures.

An abundant, diffuse type of growth consisting of single cells and small clumps of cells resulted when the marigold and tobacco tissues were grown in liquid culture on a reciprocal shaker (*10*). Suspensions of cells were easily removed and spread over an agar medium. It was more difficult to obtain single cells from tissue grown on agar.

Single cells, deposited on an agar medium, were located under a dissecting microscope and removed with a flattened needle under aseptic conditions. They were placed on 8 by 8 mm squares of sterile filter paper (Reeve Angel, crepe surface, No. 202). These squares had been resting for two or more days on the top surface of young tissue cultures (about 7 mm in diameter) of marigold, sunflower, or tobacco growing on an agar medium. Each filter paper square was then returned to the upper surface of the "host" culture from whence it came (Fig. 1). These operations required speed to avoid injury from excessive light and desiccation. At no time was the upper surface of the filter paper in direct contact with the underlying host tissue. Double layers of paper were used in numerous trials, including some that were successful. More than 1500 cells were isolated. Marigold and sunflower cultures were "hosts" for single marigold cells, because both grow well on the same synthetic medium (*9*). Tobacco cultures were "hosts" for single tobacco cells.

After precision was achieved, about 8 percent of the marigold and tobacco cells isolated grew and divided. Marigold cells grew on filter paper over either marigold or sunflower tissue. It was necessary to transfer the filter paper to a fresh host piece one or more times; for as a host culture became old and senescent, the young culture it supported also lost vigor. After reaching a diameter of 4 mm, which usually required 6 to 10 wk, cultures resulting from single cells were transferred directly to agar medium, where they grew well independently (Fig. 1). Several stocks of single-cell origin have been carried through four or more agar transfers, each of approximately 5 wk. The tissues were subdivided to a diameter of 4 mm each time, and no diminution in growth rate occurred.

The usefulness of plant tissue cultures of single-cell origin is apparent, for example, in studies on biochemical, morphologic, and genetic differences between normal and gall tissues (*11–13*), on virus-free and virus-infected tissues (*14*), on the habituation process for plant growth regulators, and on mutation to diseased or to healthy tissue. The single cell eliminates the possibility of culture change due to variation in the proportions of the cell types present in an original mixture.

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Till-like Deposits on Natapoc Mountain

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About 11 mi north of the town of Leavenworth, in north-central Washington near the center of the Chiwaukum quadrangle, is Natapoc Mountain (Fig. 1), an outstanding topographic feature that has been carved from Eocene sandstones (*1*). The summit of the mountain is 2 mi west of the Wenatchee River and is 4235 ft in elevation, rising 2530 ft above the river. The mountain lies within the Wenatchee River drainage area and is entirely surrounded by deep well-defined valleys. On the west is the crest of the Cascade Mountains and on the east are the Entiat Mountains, marginal ridges composed of granitic and metamor-

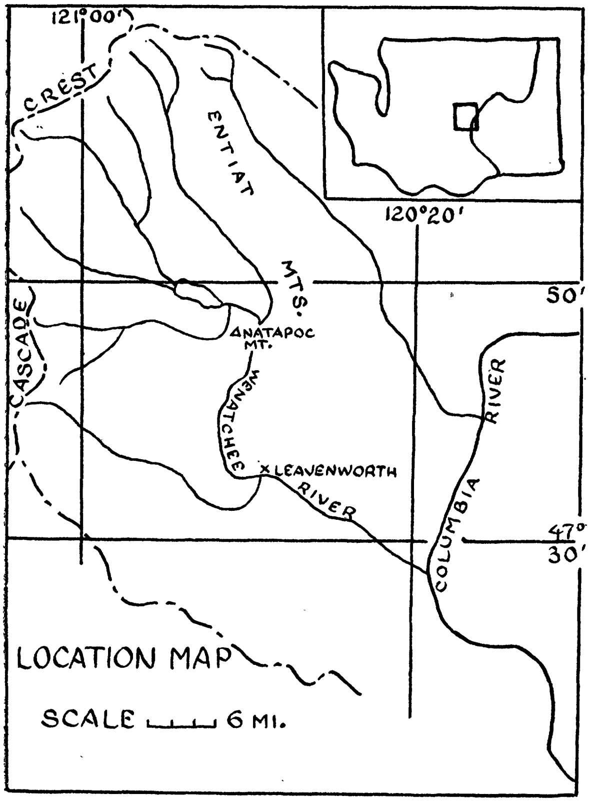

Fig. 1. The Cascade Mountains of north-central Washington. Inset shows position of this area in the state of Washington.

phic rocks and rising from 2000 to 3500 ft above the summit of Natapoc Mountain.

On top of Natapoc Mountain during a hasty reconnaissance, Parrott and Hougland reported finding a layer of till about 100 ft thick consisting of boulders and pebbles of basalt, granite, schist, peridotite, and quartz cemented in a matrix of clay and silt (*2*). They stated that glacial erratics and till are distributed rather promiscuously on upper ridges of the mountain. No other evidence was presented that would definitely indicate a glacial origin for the deposits.

A reconnaissance of the mountain that I made in Sept. 1948 suggested a similar origin for the deposits, but in June 1951, I conducted a field study of these deposits.

Three tenable conclusions regarding the origin of the till-like deposits present themselves. First, if glacial in origin, they could be deposits related to the recognized glaciations in the area. Second, if not identified with any known glaciations, they could belong to an older, hitherto unknown, and more extensive glaciation. Third, if not glacial, or transported, they could be residual, or derived from the disintegration of the underlying bedrock.

Ben M. Page, working in the lower Wenatchee Valley near Leavenworth, identified three alpine glaciations (*3*). Beginning with the earliest, he designated them as Peshastin, Leavenworth, and Stuart. Stuart till is fresh, young, confined to moderate and high altitudes, and retains much morainic topography. Leavenworth till is more extensive, retaining considerable morainic topography, and with contained granite stones showing thin weathering rinds. Peshastin till is still more extensive, with some morainic topography, and with granite stones largely decomposed.

In the vicinity of Natapoc Mountain in the upper Wenatchee Valley, I identified two tills and tentatively correlated them with Page's Leavenworth and Stuart tills. This correlation is made on the basis of weathering on granite stones, areal extent, and field relationships of the till (*4*).

The till-like deposits, if identifiable with these known tills, would almost certainly contain about the same percentages of rock types as do the recognized tills. Granite rocks, which are common in the tills, are rare in the till-like deposits, whereas andesite rocks, which are most uncommon in the tills, comprise at least 90 percent of the till-like deposits.

If the till-like deposits are glacial in origin, then one would expect to find other deposits containing rocks that are closely similar in grain size, and types and percentage of rock elsewhere within the Wenatchee River drainage area. It is significant to note, however, that no similar deposits are known to occur elsewhere within the area.

Terminal glacial deposits of Page's Leavenworth and Stuart stages lie within a vertical range of 700 ft, and the corresponding upper Wenatchee Valley tills are separated by about 200 ft of elevation. No more than 750 vertical feet lie between the Peshastin and the Stuart terminal tills. When a similar comparison of relative elevations is made between the younger upper Wenatchee Valley till and the till-like deposits, a very obvious discrepancy arises. Fully 2500 ft of elevation separates the till-like deposits and this younger till. Surely, this extreme difference in elevation eliminates the possibility of identifying the till-like deposits with the recognzed tills in the area.

Also, the very limited extent of the till-like deposits (confined to the upper slopes of Natapoc Mountain) is insufficient evidence to definitely identify them with a glaciation older than the Peshastin.

The till-like deposits, then, are not glacier transported but, instead, are residual. This interpretation is strengthened by the fact that flat-lying volcanic sediments which cap the mountain are similar, both lithologically and in grain size, to the till-like deposits.

Unconformably overlying the tilted Eocene sandstones from which Natapoc Mountain has been eroded are flat-lying sediments composed of agglomerates and coarse sandstones that are clearly of volcanic origin. The agglomerates consist of subangular and rounded pebbles and boulders of schist, peridotite, quartz, granite, and scoriaceous andesite cemented in a matrix of finer volcanic material. The andesite comprises at least 90 percent of the whole. About 20 to 30 ft of these volcanics are exposed in a cliff on the south side of the mountain, with rock fragments ranging in size from small pebbles to boulders 4 ft in diameter. The

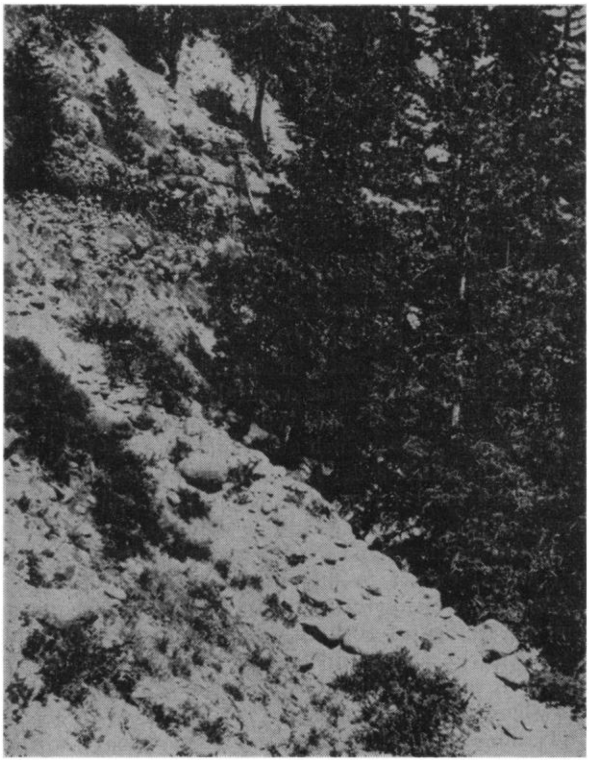

Fig. 2. View near the summit of Natapoc Mountain showing the 20 to 30 ft of flat-lying volcanic sediments capping the mountain. Note large boulders, which are mostly of andesite, protruding from the sediments. The bouldery debris at the base of the cliff has weathered from the loosely cemented beds. This debris is confined to the upper slopes of the mountain, except where it has been washed into and down canyons, and comprises the till-like deposits.

boulders are loosely cemented in the volcanic beds. Capping the volcanics are the 100 ft of deposits that Parrott and Hougland identified as till (Fig. 2).

Within the till-like deposits and on the summit of the mountain are many large boulders of andesite, and at first glance a casual observer would certainly assume them to be erratics of glacial origin. At several places along the summit ridge, however, the bedrock, which consists of large andesite boulders cemented in a dark gray matrix of finer volcanic material, is exposed. Except for limited exposures, the loose bouldery debris almost completely hides the summit bedrock from view.

The fact that bedrock is found at the summit of the mountain indicates that the till-like deposits do not form a thick layer as heretofore suspected but, instead, are actually a thin veneer of debris derived from the disintegration of the underlying volcanic beds. The volcanic beds, therefore, must be 100 to 150 ft thick, extending upward from the unconformity to the summit of the mountain.

Deep gulleys and ravines have scored the slopes of the mountain, exposing accumulations of water-worn pebbles and boulders which are mostly of andesite. In general, the rock types on the surface of the ground have moderately rough surfaces, usually reddish-stained, but exposures reveal only moderate oxidation, the material being almost identical in appearance to the rocks in the volcanic beds. No facets or striations of probable glacial origin could be found anywhere in these accumulations or in the bouldery debris capping the mountain.

In addition, the till-like deposits contain fragments of rock that are closely similar to the fragments of rock in the volcanic beds in grain size and types and percentage of rock.

If the andesite rocks can be used as an indicator, there is no discernible difference in grain size, quantity, and weathering between the andesite rocks in the volcanic beds and the andesite rocks in the till-like deposits. From the foregoing discussion, it can be inferred that a glacial, or transported, origin for the deposits is improbable. The till-like deposits on Natapoc Mountain, therefore, are residual, having resulted from the weathering and disintegration of the flat-lying volcanic beds capping the mountain.

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Distribution of Y^{90} in Ascites Tumor Mice Following Intraperitoneal Administration of Yttrium Chloride*

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It has been previously reported from this laboratory that lanthanum chloride containing La^{140}, when injected *intraperitoneally* into normal and ascites tumor-bearing mice, is localized mainly in the peritoneal cavity (*1*). Autoradiograms demonstrated the deposition of La^{140} on the surface of the liver and of other intra-abdominal organs. Furthermore, inhibition of growth of ascites tumor following the intraperitoneal administration of $La^{140}Cl_3$-containing carrier was demonstrated (*2*).

The favorable radiation characteristics of the yttrium isotope Y^{90}, a pure β-emitter of 2.2 Mev with a 60-hr half-life, as well as the similarity of chemical behavior of yttrium to lanthanum and other rare-earth elements, suggested the study of Y^{90} under conditions similar to those carried out with lanthanum. The choice of yttrium for intracavitary application

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