Both moraines of Atwood and Mather's Wisconsin till have a moderately developed soil profile that is locally overlain or truncated by younger deposits. It is believed to have formed during the "altithermal" interval.

Deposits of two even younger glacial advances, not recognized by Atwood and Mather, are found in all the cirques in the Dallas Creek drainage. The older is typified by a bouldery moraine on the lip of the cirque northeast of Mount Sneffels at an altitude of 11,300 ft. The moraine is trenched about 20 ft by the stream. The soil profile on the till is thin, azonal, and very weakly developed as compared with that on adjacent till of late Wisconsin age. It supports scrub spruce and grass. Overlapping this moraine is a younger, large and well-formed rock glacier, which I believe to be of glacial origin and to have formed during the latest glacial episode. This and other rock glaciers in the region were mapped by Atwood and Mather but were considered of landslide origin. The deposit appears stagnant and supports some lichen, though no soil profile is developed on fine-grained till exposed at its surface. It grades into active talus at the cirque headwall. The deposits of these two youngest glacial episodes are both of Recent age, and are both included in the "little ice age" of Matthes (*3*). Deposits of the older advance are correlated with those of Hack's Temple Lake stage of Wyoming (*4, 5*), which I consider of post-"altithermal" Recent age. Deposits of the younger advance formed during the latest glacial episode from about A.D. 1640 to 1860. Reconnaissance shows that this glacial succession is widespread throughout the San Juan Mountains.

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On the Growth of Root Hairs

In a recent article on the growth and osmotic conditions of root hairs, Ivar Ekdahl (*1*) rejects my views and formulates a new hypothesis concerning the growth of these structures. Because of the fundamental importance of the problem, it seems that a comment on Ekdahl's article is in order.

At the end of a long series of experiments I (*2, 3*) concluded that the root-hair wall consists of cellulose and calcium pectate continuous with corresponding layers in the hair-forming cell. The presence of calcium pectate in the maturing hair walls renders them harder and less subject to distortion. During growth, the wall of the root-hair tip remains active and more yielding than that of the sides, and hardening is brought about by the gradual formation of calcium pectates from the tip of the hair to the base. The progressive hardening of the pectic layer confines this softer spot to a narrow area at the growing tip where new wall material is being constantly laid down, and this determines the narrow diameter of the full-grown hair.

Ekdahl explains the hardening of the growing root-hair wall in another way. He stresses the importance of pectic substances at the root-hair tip but ignores them entirely in the hardening process. In his opinion, "the hardening of the wall from the very tip to the sides may . . . take place through a gradual formation of cellulose strands, which are first dispersed, but, as the wall is thickened and matured, will be oriented in the direction of the long axis of the hairs." In rejecting the calcification theory of root-hair growth, he offers the hypothesis that elongation is brought about by the continuous softening of the growing apical wall by action of pectic and cellulosic enzymes.

The evidence marshalled by Ekdall in support of his hypothesis does not withstand critical examination. His chief argument in opposition to the formation of calcium pectates in the maturing hair wall is that little change in the rate of root-hair elongation took place within a wide range of calcium-ion concentration in the external medium. This observation, based on the rate of root-hair growth, is no proof that calcification did not occur. The *rapidity* with which root hairs elongate depends entirely on other factors and has no place in the argument.

Ekdahl's other argument, that root hairs develop vigorously in moist air where no external calcium supply is available, lacks creditability also. There is no evidence that root hairs grow any differently in moist air than they do in an aqueous medium, or that there is any difference in their cell walls (*2, 3*). In moist air, the calcium for cell-wall formation comes from that originally stored in the seed. A little calcium under moist-air conditions could go a long way in affecting the necessary linkages for the production of calcium pectates. Experiments *in vitro* with pure pectic acid (*2*) showed that there are weakly and strongly calcified pectates; and the more recent work on the chemistry of pectic substances reviewed by Ekdahl (*1*) serves to strengthen this opinion.

In discussing my calcification theory, Ekdahl makes no attempt to explain the fact that anything that prevents gradual calcification (whether ammonium oxalate, excessive acidity, or excessive alkalinity) also prevents the development of root hairs, at the same time bringing about the exact results one can foretell, assuming this hypothesis to be correct (*2, 3*). Neither does he take into account the marked cessation of abnormalities and the sudden burst of long, straight hairs that occurs when roots grown in ammonium oxalate solutions are transferred to a calcium solution (*2*).

Recent experimental findings by Dale (*4*) on root hairs, Facey (*5*) on leaf abscission, Weintraub (*6*) on leaf movement, Northcraft (*7*) and Anderson (*8*) on the separation of free-living cells, and Burström (*9*) on calcium as a growth factor emphasize the importance of calcium as a cell-wall constituent. This fresh evidence and the frailty of Ekdahl's supporting arguments do not warrant any immediate change in my theory of root-hair growth.

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Geology of the Iron Deposits of the Congonhas District, Minas Gerais, Brazil

Large iron deposits in the state of Minas Gerais, Brazil, have been the subject of a continuing study by geologists of the U.S. Geological Survey and its Brazilian counterpart, the Departmento Nacional da Produção Mineral under the sponsorship of the Institute of Inter-American Affairs. These deposits are very large and will unquestionably have great future importance, although they have not yet been extensively developed because of their remoteness from the world centers of heavy industry. Reports and maps on the Congonhas district (600 km^2) and other parts of the ferriferous region, which has a total area of several thousand square kilometers, will be published as the work in each district is completed.

The deposits are of three general types: (i) laminated iron formation, or itabirite, consisting of varying proportions of specular hematite (Fe_2O_3) and magnetite (Fe_3O_4), quartz (SiO_2), and lime-magnesia carbonate; (ii) masses of nearly pure specular hematite enclosed in the iron formation; and (iii) surficial cappings of limonite ($Fe_2O_3 \cdot nH_2O$).

Itabirite is a metamorphosed sedimentary rock that occurs principally as the middle member of the pre-Cambrian Minas series. Within the Congonhas district, it ranges in thickness from about 100 to 600 m or more. The average iron content is estimated to be 40 percent. Quartzite and mica schist underlie the itabirite conformably; phyllite with lenticular quartzite, dolomite, minor amounts of itabirite, and some volcanic rocks overlie it. It is believed that the unusual ferruginous sediments were deposited as chemical precipitates of iron oxide, colloidal silica, and alkaline earth carbonates brought into a restricted marine environment by one or more large rivers. The landmass was low; hence, little or no clastic material was introduced. Somewhat acid conditions inhibited the precipitation of carbonates over most of the period of deposition. An offshore volcanic arc probably cut off circulation between the basin and the open ocean, and volcanic emanations may have aided in lowering the pH below the "limestone fence."

Regional metamorphism accompanying severe folding produced specularite and quartz from the siliceous precipitates and magnetite, dolomite, and quartz from the carbonate-bearing sediments. Platy specularite was partially oriented to form an incipient cleavage.

Faulting, in the course of superimposing several large thrust slices, brecciated the iron formation and opened channelways for hydrothermal solutions of unknown source. These solutions replaced the quartz and dolomite with new specularite, giving rise to the local development of high-grade ore deposits. Preexisting bedding, cleavage, and breccia structures were faithfully preserved by fine-grained (average 0.01 mm), unoriented, interlocking hematite that contrasts sharply with the unreplaced platy specularite. Magnetite octahedra, some a centimeter across, were partly or completely altered to hematite. Both proximity to faults and variations in the carbonate content of the original formation localized replacement; the largest known deposit of the district occurs where dolomitic itabirite was overridden by a thrust block.

Descending ground water has leached most of the carbonate and part of the quartz from the itabirite above the water table. Hydration and reprecipitation of iron as limonite over most of the outcrop areas have formed hard cappings, which protect the underlying softened material from rapid erosion. Remnants of old surfaces several hundred meters above present-day intermontane valleys indicate intermittent uplift in recent geologic times.

Surficial leaching has dissolved minor quantities of iron from some hematite ores, destroying the intergranular cohesion and producing friable or powdery material. Mosaic-textured ore with interlocking, sutured grain boundaries resists this leaching better than ore with tabular, oriented specularite grains; and weathering, therefore, exhumes original sedimentary structures that were preserved during metamorphism and replacement.

As the Congonhas deposits have many features in common with numerous iron formations and hematite ores on all continents, their genetic environment, although unusual, was presumably not unique.

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Special-Purpose Terrain Evaluations

The U.S. Geological Survey in collaboration with the Soil Survey of the U.S. Department of Agriculture has been engaged for more than 10 years in making special terrain evaluations for application to military planning and operations. This work has been supported mainly by the Corps of Engineers, U.S. Army.

The major military problems considered in the work deal with two main types of use of terrain. The first is construction on and below the ground surface of a wide variety of structures, some peculiar to military activity, but most having counterparts in civilian life. The basic terrain problems in construction have been formalized as a result of extensive and prolonged world-wide research in engineering geology and soil engineering for military and civilian purposes.

The second broad use of terrain is in rapid move-