been done without reference to the regional landscape—in a sense out of its context. Dr. Thompson has developed herein a broader viewpoint showing that the mountain landscape developed as a response to all the factors acting upon it. This work has principal significance to glacial geologists and glaciologists in that it puts glaciers into their geomorphic context in New England and it thereby provides a format for similar studies elsewhere.

WILLIAM L. PUTNAM

P. KASSER. Ein leichter thermischer Eisbohrer als Hilfsgerät zur Installation von Ablationsstangen auf Gletschern. *Geofisica Pura e Applicata*, Vol. 45, No. 1, 1960, p. 97–114.

KASSER has designed a thermal ice-drill that receives its heat for drilling from hot water pumped from a heater at the surface down through a two-conduit rubber hose to the hotpoint and back to the heater in a closed circuit. Kasser has used this equipment since 1950, and with it has drilled numerous holes to depths as great as 63 m.* in temperate ice on various Alpine glaciers (mainly the Grosser Aletschgletscher) and 30 m. in cold ice at the Jungfraujoch (about −2° C.) and in Greenland (about −10° C.*).

The hotpoint consists of a thin brass shell (shaped like a slim paraboloid of revolution 38 cm. long by 3·6 cm. maximum diameter) with a jet inside that directs the hot supply water against the inside of the tip and then forces it to pass upward in close contact with the inside of the shell. Especially noteworthy is the fact that this hotpoint, unlike an electrically heated one, cannot burn out. The heater is simply a closed heavy-gauge aluminum pot affixed to a single-burner gasoline stove. The pump is of double-acting piston type mounted inside the heating pot and operated by hand by means of an external lever. A pressure-equalizing chamber, excess-pressure safety plug, and gauges to measure pressure and temperature complete the heater assembly.

The equipment is designed to be transported by back-packing. The heaviest single item is the heater assembly, which weighs 17·3 kg. and is permanently mounted on a wooden pack-frame that weighs 4·0 kg. The hotpoint weighs 1·2 kg.; its rigid guide tube, which is weighted with lead, weighs 2·7 kg.; and the two-conduit rubber hose, which is weighted to compensate buoyancy exactly, weighs 1·0 kg. per meter. Tools, fuel, and, on occasion, water and ethylene glycol antifreeze also must be carried.

Kasser reports that in a typical drilling operation in temperate ice on the Aletschgletscher the hotpoint penetrated the ice at a speed of 15 m.hr.$^{-1}$ and operated at an efficiency of 81 per cent (cross-sectional area of hotpoint divided by cross-sectional area of hole at top of hotpoint). In this operation pressure at the pump was maintained at 4 atm., which caused 102 l. of water per hour to circulate. The average temperature of the water on leaving the heater was 75° C., and on returning 42° C. Though the instantaneous temperatures fluctuated as much as 20° C., the drop in temperature was practically constant at all depths down to 30 m. Fuel consumption was one liter of white gasoline per hour, which corresponds, according to Kasser, to a heat supply of 7,000 kcal. hr.$^{-1}$. Of this heat, 3,600 kcal. hr.$^{-1}$ were lost in the heater, 2,040 kcal. hr.$^{-1}$ were lost in the hose, and 1,360 kcal. hr.$^{-1}$ were actually delivered to the hotpoint. Thus, Kasser's apparatus achieves an efficiency of about 20 per cent, as compared to the 5 per cent that is ordinarily attained by lightweight portable electric power plants using two-cycle gasoline engines.

Experience has shown that thermal drilling is superior to mechanical drilling for making holes more than a few meters deep in water-saturated ice. Thermal drilling with an electrically heated hotpoint, however, is inconvenient for making holes less than a few tens of meters deep, especially if they are numerous or widely separated, mainly because of the heavy power plant involved. Kasser's ice-drill, on the other hand, is especially suited to drilling holes in this range; thus, it should satisfy the need, frequent in glaciological field work, for

* These facts have been supplied to the reviewer by the author.

many holes of intermediate depth, not only for setting ablation stakes but also for placing seismic shots.

Kasser's system is interesting not only because of its special usefulness for intermediate-depth drilling, but also because of its great potential for further improvement. For example, by making the pump separate, the heating pot could be replaced by thin-walled aluminum tubing coiled and baffled to obtain more efficiency with less weight. In addition, changing the action of the pump lever from an up-and-down motion to a side-to-side motion should reduce operator fatigue, which must be considerable after a few hours of drilling with Kasser's equipment; however, Kasser* tried both before selecting the up-and-down motion. Operating the heater under pressure, by connecting the pump to its inlet rather than to its outlet, would permit higher water temperatures (even greater than 100° C.), which would result in greater drilling speed; Kasser* points out, however, that the superheated water will boil explosively if the pressure is for any reason suddenly released; also, he found in actual trials that wear on hoses, gaskets, valves, and other parts was markedly increased by operation at greater temperatures and pressures. Machining the shell of the hotpoint out of aluminum or copper, roughening or corrugating it on the inside, and making it thinner at the tip would tend to increase heat transfer, and hence to improve still further the drilling speed.

Suggesting improvements, however, is easier than putting them into practice. Kasser is to be congratulated, therefore, for having produced a practical design that is extremely simple, highly efficient, fast-drilling, easily portable, and, not least important, completely burnout-proof.

R. L. Shreve

S. P. Suslov. *Physical geography of Asiatic Russia. Translated from the Russian by Noah D. Gershevsky and edited by Joseph E. Williams.* San Francisco and London, W. H. Freeman and Co., 1961. 594 p. £5 5*s*.

Sergei Suslov who died in 1953 was a Professor in the University of Leningrad, and was an outstanding authority on the physical geography of Soviet Russia. The second edition of his book was published posthumously in 1956. It covers the geology, zoology, botany, geomorphology, and hydrology of Asiatic Russia, and thus enables the Western reader to understand something about the nature of this vast and practically unknown region.

The work is divided into four sections—Western Siberia, Eastern Siberia, the Far East, and Central Asia.

The ice of the Kara Sea and the glaciers of Novaya Zemlya and the Severnaya Zemlya Archipelago (p. 20), are shown on a very adequate map accompanying a description of the region. The Quaternary Era and its ice advances and retreats are well covered, those of Severnaya Zemlya being shown in greater detail on a larger scale in a map on p. 167.

Permafrost is believed to cover nearly 45 per cent of the U.S.S.R., and considerable space, accompanied by an excellent map, is devoted to a detailed account of its incidence and features.

In the hydrology section of Eastern Siberia, there are maps showing the isochrones of the freeze and break up of river ice.

The Sea of Okhotsk naturally has an important influence on the climate of its coasts and these, including those of Sakhalin Island, are dealt with very fully. The Bering Sea, with its sea ice, currents and salinity, is also very well handled. In the Far East the same applies to the Sea of Japan. The Sayan Mountains in the south of Central Siberia, with their cirques and glaciers, are described in considerable detail.

Probably the most important part of the work for the glaciologist is that describing the mountain regions of Central Asia—Stalin Peak 24,590 ft. (7,500 m.), the highest summit in

* These facts have been supplied to the reviewer by the author.