claims is particularly abhorrent, but just as many naive students may be swayed by unfounded assertions presented by a writer who is unaware of the criticisms. Buried in scholarly journals, critical notes are increasingly likely to be overlooked with the passage of time, while the studies to which they pertain, having been reported more widely, are apt to be rediscovered.

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3 February 1955.

Natural Dams of Havasu Canyon, Supai, Arizona

Inaccessible except on foot or on horseback, Havasu Canyon is a deep-sided canyon in the southwestern part of Grand Canyon National Park. It is reached only by steep winding trails.

Emerging from the Supai formation, some 2700 ft below the rim of the Grand Canyon, are a series of fresh-water springs whose overflows join and flow down through Havasu Canyon. This creek, bearing the same name as the canyon, once had beautiful blue-green water. Hence, the Indians living there are called the *Havasupais,* which, translated, means "the blue-green water people."

In addition to its phenomenally colored water, Havasu Creek deposits spectacular mineral dams across parts of its course north of the Supai village (Fig. 1). These dams sometimes build upward as much as 2 ft a year. The local Indians give little thought to this until the water levels at the fords become so deep

Fig. 1. Natural dams near the base of Havasu Falls.

that their feet get wet when they are crossing them on horseback. When this annoying height is reached, the dams are breached with explosives until the water levels return to a convenient fording height.

Although they readily encrust any submerged twig or root (Fig. 2), the minerals never seem to impregnate porous, dead bits of wood. Other than arching downstream, there is little consistency in the method of mineral deposition or in the structure of the dams. Anything resisting the flow of the creek tends to become encrusted with minerals and to initiate a dam. Analyses of mineral samples indicate that the subaqueous deposits are primarily calcite with some admixed clay. Remnants of older and higher deposits of minerals now visible along the lateral areas of Havasu Canyon contain layers of crystalline calcite, aragonite, and clay, as well as manganese oxide stains, on their weathered surfaces. Both old and recent deposits are rich sources of impressions of past and present vegetation in this region.

Water spray from the base of Havasu Falls drifts and covers the nearby trees. Evaporation of the moisture causes minerals to deposit as layers toward the direction from which the spray comes. Even living trees may have their twigs so heavily covered with mineral residues that their buds have difficulty emerging from any side but the one opposite the layers of minerals. These residues contain mostly aragonite, some calcite, and included clays.

A flash flood rampaged through Havasu Canyon in August 1954. Tumbling debris destroyed many of the mineral dams and altered the crests and spillways of

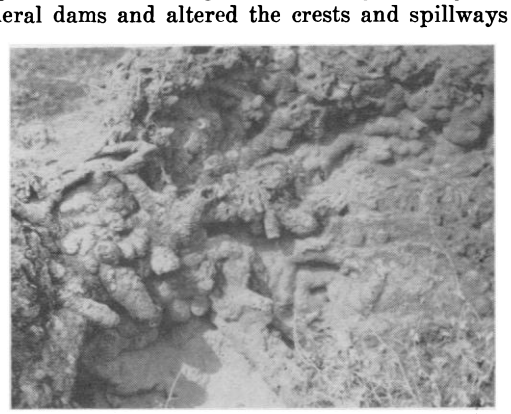

Fig. 2. Inside an old natural dam showing the nature of mineral deposits on twigs and branches.

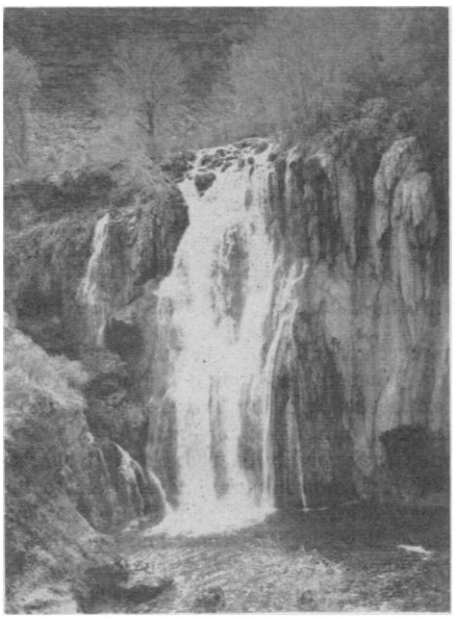

Fig. 3. Navajo Falls with its "draperies" of mineral deposits.

some of the waterfalls. The blue-green waters ran muddy. Supai residents report that, even after 6 mo, only the section of the creek above Navajo Falls is gradually turning blue-green again. Below the falls, the water still flows murky or cloudy.

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Security

The statement of the AAAS board of directors concerning national security [*Science* **120**, 957 (1954)] is fine as far as it goes. A suggestion that we consider the positive, as well as the negative, aspects of "security" is long overdue and altogether good.

It is disappointing, however, to find the board of directors accepting without question the vast majority of the premises that underlie our present practices and ignoring so many of the implications of these assumptions. It may well be that our present security system is the best possible compromise between conflicting necessities and that debate will leave us exactly where we started. It would be better, however, to reach this conclusion as the result of lengthy analysis and vigorous argument rather than simply taking it for granted. We seem to be making decisions of enormous importance on the basis of assumptions that have never been clearly defined or critically examined and with no consideration of alternatives.

There seems to be considerable danger that we shall destroy our traditional sources of strength in an effort to meet the Communists on their own ground. We are so fascinated by the thought of "fighting fire with fire" that we have ignored Hayakawa's comment that "professional firemen seem to prefer water. . . ." Can we outdo the Communists in secrecy, regimentation, and isolation? Is there any proof that we should be stronger if we did?

As long as the facts themselves are secret, it is impossible to say that the secrecy that surrounds so much of our present effort is good or bad. The burden of proof, however, would seem to be on those who advocate it: on the face of it, our measures have not greatly inconvenienced the Communists, but they have certainly hampered us. They not only have enmeshed our scientists and technicians in a web of red tape; they have also made government service repulsive to anyone who objects to working with the Gestapo breathing down the back of his neck. Secrecy gives us a temporary advantage at the cost of a permanent handicap. World War II was not won by secret weapons but by industrial productivity and technologic resourcefulness. If the millions of dollars that have been spent on secret police and loyalty reviews (and all the waste of time and talent that goes with them) had been spent on research, would we not be stronger?

It even seems possible to question the wisdom of the board of directors in affirming agreement with the popular belief that "disloyalty is not to be tolerated anywhere." "Disloyalty" is a too vague and changeable concept to serve as a safe foundation for policy. Increasingly, it seems to mean dissenting beliefs, excessive individuality, or simply lack of orthodoxy. But dissent and unorthodox opinions—even to the point of heresy—are as essential to the health of the body politic as exercise is to the human body. We cannot debate issues of national importance if no one will argue the unpopular side. And action without discussion should have no place in a democracy.

Even if this were not true, we must weigh the cost of tolerating heresy against the cost of extirpating it. (There is no real question of coddling traitors; we have adequate laws and an efficient FBI to control overt acts against the state. All that security regulations and loyalty purges can add is control of opinion and its expression.) To eliminate all "disloyalty"—under any definition—inevitably involves great damage to our traditions and personal relationships and great injustice to many innocent individuals.

Thomas Jefferson suggested that anyone who wished to destroy this Union be allowed to "stand unmolested, as a monument to the impunity with which error can be tolerated when reason is free to correct it." Has this principle served us so poorly in the past that we must reject it now?

The General Electric Company recently ran an ad-