moiselles d'Avignon not have been painted, had Shakespeare and Picasso not existed. But of how many scientific achievements can this be claimed? One could almost say that, with very few exceptions, it is not the men that make science; it is science that makes the men. What A does today, B or C or D could surely do tomorrow.

Hence the feverish and unscrupulous haste that Watson's book reflects on nearly every page. On page 4: "Then DNA was still a mystery, up for grabs, and no one was sure who would get it and whether he would deserve it. . . . But now the race was over and, as one of the winners, I knew the tale was not simple. . . ." And on page 184: "I explained how I was racing Peter's father [Pauling] for the Nobel Prize." Again on page 199: "I had probably beaten Pauling to the gate." These are just a few of many similar instances. I know of no other document in which the degradation of present-day science to a spectator sport is so clearly brought out. On almost every page, you can see the protagonists racing through the palaestra, as if they were chased by the Hound of Heaven—a Hound of Heaven with a Swedish accent.

There were, of course, good reasons for the hurry, for these long-distance runners were far from lonely. They carried, however, considerably less baggage than others whom they considered, sometimes probably quite wrongly, as their competitors. Quite a bit was known about DNA: the discovery of the base-pairing regularities pointed to a dual structure; the impact of Pauling's α-helix prepared the mind for the interpretation of the x-ray data produced by Wilkins, Franklin, and their collaborators at King's College without which, of course, no structural formulation was possible. The workers at King's College, and especially Miss Franklin, were naturally reluctant to slake the Cavendish couple's thirst for other people's knowledge, before they themselves had had time to consider the meaning of their findings. The evidence found its way, however, to Cambridge. One passage must be quoted. Watson goes to see the (rather poor) film *Ecstasy* (p. 181):

> Even during good films I found it almost impossible to forget the bases. The fact that we had at last produced a stereochemically reasonable configuration for the backbone was always in the back of my head. Moreover, there was no longer any fear that it would be incompatible with the experimental data. By then it had been checked out with Rosy's precise measurements. Rosy, of course, did not directly give us her data. For that matter, no one at King's realized they were in our hands. We came upon them because of Max's membership on a committee appointed by the Medical Research Council to look into the research activities of Randall's lab. Since Randall wished to convince the outside committee that he had a productive research group, he had instructed his people to draw up a comprehensive summary of their accomplishments. In due time this was prepared in mimeograph form and sent routinely to all the committee members. As soon as Max saw the sections by Rosy and Maurice, he brought the report in to Francis and me. Quickly scanning its contents, Francis sensed with relief that following my return from King's I had correctly reported to him the essential features of the B pattern. Thus only minor modifications were necessary in our backbone configuration.

Rosy is Rosalind Franklin, Max stands for Perutz.

As can be gathered from this astonishing paragraph, Watson's book is quite frank. Without indulging in excesses of self-laceration, he is not a "stuffed shirt" and seems to tell what he considers the truth, at any rate, so far as it concerns the others. In many respects, this book is less a scientific autobiography than a document that should be of interest to a sociologist or a psychologist, who could give an assessment that I am not able to supply. Such an analysis would also have to take account of the merciless persiflage concerning "Rosy" (not redeemed by a cloying epilogue) which goes on throughout the book. I knew Miss Franklin personally, as I have known almost all the others appearing in this book; she was a good scientist and made crucial contributions to the understanding of the structure of DNA. A careful reading even of this book will bear this out.

It is perhaps not realized generally to what extent the "heroes" of Watson's book represent a new kind of scientist, and one that could hardly have been thought of before science became a mass occupation, subject to, and forming part of, all the vulgarities of the communications media. These scientists resemble what Ortega y Gasset once called *the vertical invaders*, appearing on the scene through a trap door, as it were. "He [Crick] could claim no clear-cut intellectual achievements, and he was still without his Ph.D." "Already for thirty-five years he [Crick] had not stopped talking and almost nothing of fundamental value had emerged." I believe it is only recently that such terms as the stunt or the scoop have entered the vocabulary of scientists, who also were not in the habit before of referring to each other as smart cookies. But now, the modern version of King Midas has become all too familiar: whatever he touches turns into a publicity release. Under these circumstances, is it a wonder that what is produced may resemble a Horatio Alger story, but will not be a *Sidereus Nuncius*? To the extent, however, that Watson's book may contribute to the much-needed demythologization of modern science, it is to be welcomed.

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Alaska: The Measureless Wealth

Glacier Bay. The Land and the Silence. DAVE BOHN. DAVID BROWER, Ed. Sierra Club, San Francisco, 1967. 165 pp., illus. $25.

In *Glacier Bay*, the Sierra Club once again turns to the task of stimulating public awareness of the natural world and of imparting respect for the land. This magnificently illustrated and sensitively written volume, along with such earlier Sierra Club books as those on the Grand Canyon, the Big Sur coast, and the High Sierra, allow one to *see* and to marvel.

The wondrous scenes these volumes contain are themselves the best of all arguments for resisting needless encroachment on them by the mining companies, the loggers, and the dam builders. Although economic analysis is becoming increasingly useful in shaping policy on the use and conservation of natural resources, economists know no way to make benefit-cost analysis adequately reflect the intangible values of wilderness and other natural environments. A view of, say, the Grand Canyon's inner gorge is indisputably of value, but it is not a marketable masterpiece to be sold at auction. Indeed, to put a price on such a scene is to play into the hands of those who would plug the gorge with concrete and flood it. In the realm of benefit-cost analysis, as in the marketplace, the demand is not for abstractions but for ready coin.

Although some of them are keenly appreciative of natural values, economists seem not to have had much suc-

cess in tempering the apparent bias of their profession for headlong growth and development. For instance, the Gross National Product, now accepted as a principal indicator of the national well-being, rests on a limited concept of national accounting. The lumber company sawing up a grove of centuries-old redwoods, the strip-miner desecrating a landscape, and the paper mill spewing air and water pollutants all are making their contribution to the GNP, even though in doing so they commit acts of corporate vandalism.

How is one to correct the account? In time the national bookkeeping perhaps will be refined to show the losses that go along with the gains. Meanwhile, the Sierra Club tries to reveal to us places which never should be sacrificed to the claims of economic progress.

Alaska's Glacier Bay National Monument is such a place. This remnant of the Little Ice Age is well described by Dave Bohn, in photographs and text, as a land "sombre, bold, austere, and brooding," where the Fairweather Range rises spectacularly from the sea and where a "booming primeval thunder" comes from great glaciers. Reflecting on his first sight of the Monument, Bohn writes: "Below us was the great land, unique, wild, and magnificent. It should exist intact solely for its own sake. No justification, rationale, or excuse is needed. For its own sake and no other reason."

Yet for some Alaskans the value of Glacier Bay lies chiefly in the mineral wealth they suspect it may hold. The National Monument was established by President Coolidge in 1925 at the urging of the Ecological Society of America. In 1936, however, Congress enacted a law opening the area to mining. This was done largely at the instance of the novelist Rex Beach, who had appealed to President Roosevelt on behalf of his friend Joe Ibach, a prospector whose right to work certain mining claims antedating the establishment of the Monument had been somehow compromised. In 1939, by executive proclamation, the Monument was more than doubled in size (with 2.7 million acres, Glacier Bay is the National Park Service's largest unit), but then, as now, it remained open to mining, though to date mining has been negligible.

In recent years appreciation of Glacier Bay has grown among officials of the Park Service and the Department of the Interior. In 1965 the Advisory Board on National Parks recommended that Glacier Bay be elevated from monument to national park status and that the 1936 act allowing mining be repealed. Stanley A. Cain, Assistant Secretary of the Interior for Fish, Wildlife, and Parks, says that both he and Secretary of the Interior Stewart L. Udall are in full accord with these recommendations. A study to work out details of a park plan for Glacier Bay has been scheduled by the Park Service but will not be completed before next year. Following this study, legislation to establish the park could be submitted to Congress, although by then a full year (an election year, at that) will have elapsed, and Udall and Cain may no longer be present to promote it.

Alaska's congressional delegation does not want mining forbidden in Glacier Bay, and park status may therefore be long in coming. Legislation of this kind seldom gains headway in Congress against the opposition or indifference of the delegation from the state directly affected. There is slight chance that the people of Alaska will exert significant political pressure for the park proposal. In fact, some conservationists believe that the tendency of Alaskans is to look too much to the gold rush days of the past, and to fail to see that, in the future, Alaska may be known less for its mineral wealth than for its other resources—oil, forests, fish and wildlife, and spectacular scenery.

Glacier Bay National Monument makes up less than 1 percent of the land area of Alaska. While mineral deposits occur within the Monument, the park proponents do not regard them as significant enough to justify mining. Nevertheless, the possibility that sizable mining operations may begin in the next few years cannot be dismissed. In the summer of 1966 the U.S. Geological Survey, acting at the Park Service's request, investigated the Monument's known mineral deposits and also discovered some others. Found to be the most important were the Nunatak molybdenum deposit, adjacent to Muir Inlet, and the Brady Glacier nickel-copper deposit. Of the former, the Survey reported that it contained a large reserve of low-grade ore which, given current trends in price and demand, may be minable in the near future. Less is known about the Brady Glacier deposit, much of which lies under hundreds of feet of ice, but it, too, soon may be minable. The possibility that other mineral deposits in the Monument might be mined was considered more speculative and remote.

If there should be a critical shortage of metals, any prohibition imposed by Congress on mining in a Glacier Bay National Park could, of course, be lifted by Congress. In fact, such authority could be delegated to the President for use at his discretion. The fear of some that critically needed resources may be kept permanently "locked up" in wilderness preserves always has been baseless.

Ironically, Joe Ibach, the prospector whose appeals led to opening up the Monument to mining, was a free spirit who thrived in the immense space and solitude of Glacier Bay. As Dave Bohn concludes, had Ibach ever found himself crowded by an invasion of miners, he no doubt would have retreated to some place more remote, for his need was for space and his tolerance for the intrusions of an industrial society was low.

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Thermodynamic Information

Principles of Statistical Mechanics. The Information Theory Approach. AMNON KATZ. Freeman, San Francisco, 1967. xii + 188 pp., illus. $8.

It is one of the ironies of recent intellectual history that modern physics, which is the culmination and vindication of two or three millennia of atomistic and deterministic theories, is so much involved with the knowledge or lack of knowledge ascribed to some human observer. The experimenter with his measuring rod, clocks, and frames of reference is a well-known character in the theory of relativity, and according to its almost universally accepted interpretation the goal of quantum mechanics is to determine what an observer can expect to observe rather than what is objectively the case.

In statistical mechanics the connection between physics and knowledge is expressed through Boltzmann's principle, that entropy is proportional to the logarithm of thermodynamic probability. This practically important and suggestive principle has had a number of vicissitudes and transmigrations since Boltzmann stated it. L. Szilard showed by an analysis of appropriate thought experiments how the negative of ther-