Letters

Antarctic Research

The National Science Foundation has expressed to *Science* the view that articles on the antarctic research program appearing in recent issues, specifically those of 25 December and 1 January, do not by themselves fully reflect the international and organizational aspects of the program. For purposes of clarification, therefore, *Science* is glad to give the following summary of information which has appeared from time to time in earlier issues.

During the International Geophysical Year, the Special Committee for the International Geophysical Year (CSAGI) noted the need for continuing research efforts in the Antarctic beyond the termination of the IGY. A committee was therefore organized under the ICSU, to be known as the Special Committee for Antarctic Research (SCAR). The committee comprises representatives of the 12 nations supporting research in the Antarctic, together with representatives of the scientific unions with research interests in that area. The purpose of the committee is to give advice and make recommendations with respect to research problems in the Antarctic that it feels should be pursued. The committee is cooperating with another member committee of ICSU—namely, the Special Committee on Oceanographic Research (SCOR)—on problems of mutual interest. SCAR also submits its resolutions and research programs to nonmember countries to encourage their participation in new programs or in the maintenance of the antarctic stations which might otherwise be abandoned. SCAR has held three meetings to date: at The Hague in February 1958, in Moscow in August 1958, and in Canberra in March 1959. The next meeting will be held in Cambridge, England, in August 1960. The organization and operations of the committee are reported in detail in *ICSU Review* [**1**, No. 4 (Oct. 1959), pp. 169–124].

Adhering to SCAR on behalf of the United States is the Committee on Polar Research of the National Academy of Sciences (Laurence M. Gould, chairman), consisting of scientists experienced in arctic and antarctic research.

The U.S. scientific program in the Antarctic is funded and coordinated through the National Science Foundation, which set up an antarctic research program for this purpose in its Office of Special International Programs. Thomas O. Jones is program director for antarctic research, and J. Wallace Joyce heads the Office of Special International Programs. A. P. Crary has been designated by the director of NSF as chief scientist of the U.S. antarctic research program.

The NSF formulates the research program for the Antarctic, with the Committee on Polar Research making broad recommendations regarding desirable goals. Through its membership in SCAR, the Committee on Polar Research keeps NSF informed of the over-all program and of the interests of other nations in antarctic research. It also advises the foundation with respect to the international exchange of scientific personnel.

Logistics support is furnished by Support Force 43 of the U.S. Navy and continues the Navy's long tradition of exploration and research support in Antarctica. The full support operation is under the command of Read Adm. David M. Tyree.

The Interdepartmental Committee on Antarctic Research (ICAR), consisting of representatives of federal agencies with research interests in Antarctica, serves as an advisory group to the foundation in coordinating the government's interests.

The foundation works with the National Academy–Research Council and the Department of State in implementing exchanges of scientific personnel between antarctic stations of the U.S. and those of other countries and consults with the department in all other matters in which U.S. policy may be involved.

The foundation receives proposals for research in the antarctic region from universities, research institutions, learned societies, and federal agencies. All proposals are reviewed by the NSF scientific staff and are also referred for comment to the Committee on Polar Research and, as appropriate, to the Interdepartmental Committee on Antarctic Research, as well as to other groups. The NSF keeps the two committees informed regarding the award of grants and contracts for polar research.

In striving to develop a balanced research program in the Antarctic, the foundation looks for advice and suggestions not only to the national scientific community but to the international scientific community as well. The Antarctic is one of the best examples in the world today of the effective cooperation that can be achieved by scientists of many nations and widely divergent political persuasions.—ED.

The two articles on current research in Antarctica which appeared in *Science* [**130**, 1748 (25 Dec. 1959); **131**, 21 (1 Jan. 1960)] should be of value in informing the scientific community

of research opportunities in the physical and biological sciences available in Antarctica. There are, however, some misleading facts and attitudes in the 25 December article which I should like to correct.

The statement "The world-wide network of stations established during the IGY is no longer in operation . . ." is not true. Networks in meteorology, ionospheric physics, aurora and geomagnetism, and so on, with a few minor exceptions, have remained in operation since the IGY ended. Likewise, the statement regarding the shift in emphasis of the 12 nations involved in antarctic research in the direction of local studies gives a misleading impression. The National Academy of Sciences provides the U.S. representation on the Special Committee on Antarctic Research (SCAR) composed of the 12 nations; SCAR has reaffirmed the value of the broad synoptic programs instituted during the IGY and urges their continuance beyond the IGY period. Although not formally part of the IGY program, considerable work was carried on in biology and geology which might be considered "local" (that is, nonsynoptic) studies; both of these disciplines, plus cartography, have now been included in the research program fomulated by SCAR.

SCAR has issued three bulletins since its inception in February 1958, and these describe in considerable detail the program of each country. Reference to these bulletins by the reporter would have eliminated many errors and qualifying clauses, such as "according to reports," which litter the 25 December story. For example, the Norwegian station is not "reducing . . . its effort" or "ending operations in the near future." A cooperative arrangement has been worked out with the Union of South Africa to keep this program going. The United Kingdom stations are not "limited to surveys and mapping on the Palmer Peninsula" but include a first-rate scientific station at Halley Bay on the east coast of the Weddell Sea.

The "land-holding" motivation attributed to Argentina and Chile may or may not be true, but much of value scientifically can come from these stations and from their examination of the small-scale phenomena, as in meteorology. Emphasis of possible nonscientific motives does not contribute to the international cooperation in Antarctica which has been so evident during and since the IGY and which was an important factor in the recent signing of the Antarctic Treaty. Since cooperative efforts on the coldest continent on earth have led to such a thawing of international relations, we hope that correction of errors and misleading statements will help remove any potential source of annoyance among readers from other nations.

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The article published in the "News" section of *Science* [**130**, 1748 (25 Dec. 1959)] with reference to current antarctic research, does not reflect quite correctly the efforts made by the Argentine Republic to foster scientific activities in the Antarctic.

Indeed, the article certainly conveys to the readers the wrong impression when it states that *"according to reports* [italics mine], many of the Argentine stations are primarily land-holding establishments, set up with an eye toward future territorial claims. With the signing of the treaty on Antarctica this month in Washington, Argentina may give up some of her . . . stations."

Later on, the article further states that "Chile is reported to have only a modest program under way on the continent of Antarctica. Its concern, *according to reports* [italics mine], is much like Argentina's—to carry out a land-holding operation for political reasons. As in the case of Argentina, this effort may be suspended with the ratification of the treaty on Antarctica."

I do not wish to discuss at this point the political and historical grounds for Argentina's claims to a sector of Antarctica—which, incidentally, have been always applied to the same territory and not "with an eye toward future territorial claims." But to suggest that her stations are merely land-holding enterprises and that her scientific program is a modest one or is subsidiary to land-holding operations, as the article seems to do, is to grossly distort the truth. Furthermore, the political remarks involved seem quite out of place.

As a matter of fact, Argentina has eagerly participated in all matters referring to Antarctica. It is one of the very few countries which supports an antarctic institute as such, operating in close relationship with the Argentine Navy and staffed with an increasingly growing number of capable scientists in several fields, such as oceanography, physics, geology, meteorology, and biology. (It might be added here that the United States does not have, as yet, a similar set-up.) Such men work in close contact with the leading universities of the country. Argentina, and this staff, were recently hosts to an international meeting of the IGY, and the recent conference referred to in the article, both in its framing and implementation, received Ar-

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gentina's wholehearted support. Thus, it cannot be denied that this country has really made, for over 50 years, a sincere effort in connection with Antarctica. On several occasions, too, foreign investigators, including Americans, have been welcome to use the facilities furnished by the Instituto Antartico and the Argentine Navy. I am sure that those who have done so will endorse my statement.

It is quite obvious, on the other hand, that Argentina's resources and potentialities, as well as its scientific manpower, do not allow a comparison of results, on equal terms, with those obtained by the United States or, for that matter, with those of any of the major powers. But when ratios are compared, the achievements, I am proud to say, are quite outstanding, as has been stated on more than one occasion by American and other scientists.

Current projects in meteorology, glaciology, geology and mineralogy, oceanography, and some aspects of biology are now under way. The mineral, botanical, and zoological collections from the Argentine sector of Antarctica are among the most numerous and at present are being studied systematically by both Argentine and foreign specialists.

It is certainly not the intention of the government or of the entities concerned to diminish in any way the efforts that I have mentioned.

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Formulas in Linguistics

Several points seem in need of correction in the formulas in the otherwise excellent first article, "Current trends in linguistics," in *Science* for 30 October [**130**, 1165 (1959)].

Greenberg's first equation, $nt = C^n$ (Eq.1) (line 5, col. 1, p. 1169), is confusing because it equates a number, n, of millennia to a power of a constant, C^n, which is less than unity (since $C = .864$). This equates a time period of thousands of years to a proportion less than one of the original standard set of 100 words, whereas Greenberg evidently meant to say that the proportion of words surviving after n millennia (call it "p_n") would equal the nth power of C, where C is the proportion empirically observed ($C = .864$) to survive for 1 millennium, on the average. That is,

$$p_n = C^n \qquad \text{(1 rev.)}$$

Another confusion arises in the shift of meaning from n to t within the one paragraph. At first it is implied (next-to-last line, col. 3, p. 1168) that t is the millennium unit, while n is stated to be the number of such units (lines 3 and 5, col. 1, p. 1169). Then, in line 27 of column 1, page 1169, Greenberg shifts to speak of "t millennia," and his formula for t ($t = \log C / 2 \log r$) obviously indicates a variable number of millennia and cannot denote the constant 1000-year unit.

It would be simpler to omit n altogether and define t as the number of millennia or as time in millennium units. Then the proportion of 100 words surviving t millennia is simply the tth power of the survival rate—that is, $p_t = C^t$. Then the joint proportion (r) of words surviving in two similar independently changing languages which split apart is most probably the product of the two equal probabilities, or the square of the survival probability, namely:

$$r = C^t \cdot C^t = C^{2t} \qquad (2)$$

This is the joint probability from two identical exponentially decaying curves. This is Greenberg's "proportion of resemblance r."

To solve explicitly for the time period t elapsed since the two languages were one language, take the logarithms:

$$\log r = 2t \log C$$

Then, isolating t gives:

$$t = \log r / 2 \log C \qquad (3)$$

But the ratio of logarithms is here inverse to the (incorrect) ratio Greenberg gives (*1*) (in line 29, col. 1, p. 1169), namely:

$$t = \log C / 2 \log r \quad \text{(3 misstated)}$$

Alternatively, one can, of course, solve explicitly for the rate of survival constant C if one has the proportion of the 100 words surviving in both languages and an independent historical estimate of the time t elapsed since they were one language; thus:

$$\log C = \frac{\log r}{2t}$$

$$C = r^{\frac{1}{2}t} \qquad (4)$$

in terms of the survival rate C per millennium. This should remove confusion in these formulas for scientists not familiar with them.

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Note

1. With reference to Greenberg's reference (7), Kroeber's article appeared in volume 21 (not 29) of the *International Journal of American Linguistics*, on pages 91–104 (not page 223).