Letters

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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).