Letters

Astrofantasies and Contracts

One of the recent letters commenting on G. G. Simpson's "The nonprevalence of humanoids" makes a number of statements of such definiteness that it seems to me essential to point out that these represent, at best, the opinions of a number of scientists in the mid-'60's, not some nearly finally crystallized consensus on a basic natural law, such as Newton's. I am referring to John Pfeiffer's letter of 8 May (p. 613) and to his statement—among others—that "a general point of view has developed during the past few centuries." One wonders how short is scientific memory, and if we really learn from experience.

While the Laplace nebular hypothesis held sway it was probably commonplace to talk about the plurality of inhabited worlds, but only 30 years ago H. N. Russell, then the dean of American astronomers, propounded the thesis that our solar system must have had a well-nigh unique origin—and the vast majority of astronomers followed him. In fact, during the '30's I was virtually the only astronomer who dared criticize the collision theory—and I was very nearly "read out of the party" for that offence. Now the pendulum has swung the other way, and many are willing, at the drop of a hat or of a NASA appropriation, to calculate precisely how many billions of inhabited planets there must be and why we should continue to listen for possible radio signals from possible intelligent beings living on possible planets circling other stars (project Ozma), even if it costs the taxpayers a hundred million dollars.

Pfeiffer says that "the sun is currently at a recognized stage in stellar evolution. . ." If this statement has any meaning, it must derive from current theories of stellar evolution. But only a little more than a decade ago an astronomer stated flatly, "I know more about what goes on inside the sun than about what goes on inside a boiling teakettle"—referring to the then current Bethe carbon cycle as the source of solar energy—and shortly thereafter came the proton-proton reaction; so that one could only conclude that that particular astrofantasist's ignorance of boiling teakettles must have been of abysmal profundity. Recently we have had at least two brief flare-ups of the belief that organic life was found in meteorites—but where is all that now?

During the past few years impressive evidence has been obtained about the existence of bodies with masses not much larger than that of Jupiter circling around other stars, but we do not yet know whether these are planets, or star-like objects, or different from either—they cannot as yet be seen. Arguing from general principles one might say that life could well exist outside Earth, but it seems to me that the only definite statement that is now scientifically tenable is that we do not know: we can neither prove nor disprove it. Is it possible that the sudden about-face comes from the desire to expiate the guilt of 40 or more years of fervent belief in the near-uniqueness of our solar system, or is it simply that the line for bigger NASA contracts forms to the right—in front of the rainbow labeled Life outside the Earth?

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Communication with the Humanities

I note a curious juxtaposition of two articles in the 5 June issue of *Science*. In a timely paper (p. 1199) Seaborg observes the apparent emergence of a new level of symbiosis between the arts, the humanities, and the sciences. He demonstrates his point through randomly selected representative examples and then goes on to the discussion of some rather broad principles, such as "the cultivation of equable and cooperative relationships among those of us who follow science and those dedicated to the humanities." The Seaborg article is immediately followed by Greenberg's useful warning in the form of a satire ("Let's hold a conference," p. 1204) showing how poorly planned attempts at interdisciplinary cooperation can degenerate into superficiality and waste.

In my view the two articles may be looked upon as complementary statements. When so considered, they point to the almost complete absence of unhurried, unfrivolous, formal dialogue between the sciences and the humanities about man's many ways of perceiving reality. Perhaps what is needed is a nontrivial common theme, such as the ubiquitous problem of *time* about which men of different professional backgrounds may speak with confidence without transgressing the limits of their fields of specialization. A written exchange of thought pertaining to a carefully selected central subject, planned and developed in detail, may then assist in guiding us to that "higher level of integration" for which Seaborg calls.

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While I have no fundamental quarrel with Seaborg's position, and have immense respect for any attempt to trace a route through this particular wilderness, I am somewhat uneasy with his treatment of the present state of symbiosis between natural science and the humanities.

It seems to me that two important qualifications are left unstated: first, that it is science which is providing the new frontiers for the humanities, not the reverse; and second, that the main applications of scientific techniques are to preliterate periods and to nonverbal activities. I do not mean to underestimate the significance of extending historical studies beyond the conventional boundary of Hellenic civilization. In my own field, politics, this new dimension is urgent for many reasons, among them the comprehension by Westerners of non-Western political institutions. Nor do I wish to demean the plastic and graphic arts.

Yet the core of the humanities, as I think we all understand them, is language and literature, and it is the relation of science to modern language and literature that is most at issue. How has science influenced the com-

munication of feeling and the quest for meaning? This is obviously a rhetorical question, and its reverse is even banal. But it remains true that many people who ask and attempt to answer such questions in a professional capacity view with bitterness, disdain, and fear the interweaving of science and contemporary affairs. They are not inspired, but repelled, by the multiplication of choice. What Seaborg calls symbiosis, they call parasitism.

I suggest that, in spite of their tone, these are not irrelevant considerations. Science may have to enlarge its house, to accept that it is not a temple but a kind of rambling, unfinished, temporary shelter, to accommodate this problem.

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Mathematical Authorship

As a mathematician, I have been following the recent discussion about multiple authorship with a certain amount of smugness, since the problem hardly exists in mathematics. Joint authorship is not uncommon in mathematics, but it rarely extends beyond three authors, and the almost universal custom is for the authors' names to appear in alphabetical order. This is so well understood that no mathematician ever assumes that the first author is in any sense the principal one. Moreover, most mathematicians who write joint papers will refuse ever to say who contributed how much. It seems to me that Cleveland's suggestion (Letters, 12 June, p. 1295) that "authors' names should appear in the order of the magnitude of their contributions" would inevitably lead to bad feelings and would not really solve any problems; I hope it will not be taken seriously. I find it shocking that senior scientists are so hungry for credit that they must get their names on everything that they had a hand in. Surely mathematicians are no more altruistic and no less subject to "publish or perish" than other scientists, yet I know of plenty of cases where a senior mathematician has been content with a footnote of thanks instead of joint authorship.

As for papers with thirty or so authors, why cannot a group, even one of varying composition, adopt a collective name, as the Bourbaki group of mathematicians does? To a young scientist, it should be worth more than many individual publications to be able to have it said of him that he has been a member of such a group; an established scientist shouldn't care anyway.

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Overkill and the Defense Budget

The News and Comment article by D. S. Greenberg in the issue of 17 April (p. 271) requires correction.

1) The report *A Strategy for American Security* (Lee Service, 45 East 21 Street, New York, 1963, 50¢) prepared by six colleagues and myself is described in the article as a "disarmament proposal." The "maintenance-of-present-forces budget" proposed therein allowed for maintenance of all the present weaponry and manpower of U.S. armed forces. It would entail a reduction of about $22 billion in military spending, leaving $34 billion—which includes all personnel and operation and maintenance requests of the Department of Defense. Some persons may regard any reduction in a military budget as disarmament, but that is another matter. The maintenance of current U.S. military power is not disarmament.

2) In order to estimate the destructive capability of U.S. strategic forces we assumed that 20,000 tons of TNT-equivalent in the Hiroshima bombing destroyed 100,000 people. Greenberg says, "The generally accepted figure is 68,000—a fact noted for the sake of accuracy, not as a consolation." Since no one has ever observed a nuclear war, all forecasts concerning the effect of the use of nuclear weapons on a large scale involve estimations for circumstances where the error of estimate cannot be known. Gauging the number of fatalities at Hiroshima involves this problem.

The U.S. Atomic Energy Commission (*The Effects of Nuclear Weapons*, 1962, p. 550) says that casualties at Hiroshima included 68,000 killed. The U.S. Strategic Bombing Survey reporting on *The Effects of Atomic Bombs on Hiroshima and Nagasaki* (1946, p. 15), stated that

> the exact number of dead and injured will never be known because of the confusion after the explosion. Persons unaccounted for might have been burned beyond recognition in the falling buildings, disposed of in one of the mass cremations of the first week of recovery, or driven out of the city to die or recover without any record remaining. No sure count of even the pre-raid population existed. Because of the decline in activity in the two port cities, with constant threat of incendiary raids, and formal evacuation programs of the Government, an unknown number of inhabitants had either drifted away from the cities or been removed according to plan. In this uncertain situation, estimates of casualties have generally ranged between 100,000 and 180,000 for Hiroshima . . . the Survey believes the dead at Hiroshima to have been between 70,000 and 80,000.

A Japanese study on *Atomic Bomb Injuries* (Nobuo Kusano, Ed., 1953, p. 60) accounted for 92,000 dead and missing by 2 February 1946, and further found that

> these figures do not include the deaths among the army in the city. According to information published later by Hiroshima City the number of dead, including those in the military employees and Army, and the injured who died in the meantime, is estimated at 210,000 to 240,000. Another estimate put the number of dead as 270,000.

The effect of a warhead like that used on Hiroshima is influenced by many factors—for example, population density, which is much higher in large modern cities. Estimates of deaths at Hiroshima range from 68,000 to 270,000. Deaths traceable to the Hiroshima bombing are still occurring and are not counted. Accordingly, we regard the figure of 100,000 fatalities at Hiroshima as one reasonable yardstick for estimating the destructive power of nuclear weapons.

3) In one of the short papers in the *Strategy* report, entitled "The Military Budget—Is There a Choice?" we presented the administration's defense budget for the fiscal year 1964, the maintenance-of-present-forces budget, and a finite-deterrent budget. The latter was given to illustrate a range of conceivable alternatives. We know from Jerome B. Wiesner that "studies made independently by the U.S. Army and Navy have indicated that, even in the absence of (international) agreement limiting force size and permitting inspection, 200 relatively secure missiles would provide an edequate deterrent." Your article describes the finite-deterrent budget as one "which would limit our military establishment simply to 200 secure missiles." The $9.2 billion of this budget estimate included $3.5 billion for military personnel, $4.2 bil-