Strontium-90 from Fallout

In two letters in *Science* (*1*, *2*) reference was made to our work described in *Bone and Radiostrontium* (*3*).

Commoner (*1*) states that a contradiction exists between our finding "that microscopic regions of the bone may receive a radiation dose about 40 times the average" and the heterogeneity factor of 5 suggested in the U.N. report (*4*). This is not necessarily a contradiction, for our figure is applicable to acute intake conditions, while the U.N. report considers intake over a number of years. That the existence of chronic intake conditions decreases the heterogeneity of the strontium distribution has already been pointed out (see, for example, *5* and *6*). In addition, it might be pointed out that the method of calculation used by Eisenbud (*7*) and criticized by Commoner (*1*) is correct in our opinion. It is, according to the U.N. report (*4*, p. 42, Table 2, note *c*), sufficient to consider the average dose if the corresponding maximum dose does not exceed the average by a factor of more than 80.

Kaplan (*2*) takes our recommendation of 0.1 μc of Sr^{90} as the body burden after acute intake and applies it directly to the fallout situation. This is not in correspondence with the view expressed in (*5*): [The Sr^{90} contamination] "corresponds to a situation with aspects that lie somewhere between those of acute and chronic Sr^{90} poisoning. Children in the 0- to 5-year age group are examples of individuals with chronic poisoning conditions. Adults above 20 years of age are more likely to be examples of acute poisoning."

A figure of 0.0001 μc of Sr^{90} per gram as a level at which bone cancers were produced in dogs was cited in *Bone and Radiostrontium* (*3*) and cited again by Kaplan. This figure refers to radiothorium, however, and not to Sr^{90}. Although the figure cited is much too low in comparison with other experimental data, it seems to have caused confusion in the discussion of the biological effects of Sr^{90}, and this we sincerely regret.

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"Next Question" and K. E. Tsiolkovsky

The editorial "Next question" [*Science* **130**, 1733 (25 Dec. 1959)] on attempts to pick up possible radio signals from the nearest stars (the project directed by Frank D. Drake) reminded me of analogous thoughts of Konstantin E. Tsiolkovsky, a Russian pioneer in rocketry. Tsiolkovsky's name is now well known to the American scientific public. His book *Exploration of Space by means of Reactive Apparatus* was published in Russia in 1896, and his name was given to one of the craters on the far side of the moon. In his little book *Monism of the Universe*, published many years ago in Kaluga, Russia, as well as in his letters to me (1933–35), he postulated the existence of highly developed intellectual societies in other worlds. Tsiolkovsky suggested, also, that such beings colonized many other planets by means of interstellar ships, painlessly destroying the products of unsuccessful biological evolution on other planetary bodies. The main objective of these intelligent beings is probably "humane colonization versus painful evolution," the evolutionary

process being left alone on some planets for the purpose of "biological refreshing" only, Tsiolkovsky said. In another booklet, *The Unknown Intelligent Forces,* also in Russian, he wrote that those "others" probably have not yet tried to communicate with earth or with other bodies in our solar system because we are still not prepared for this. Such a communication would create confusion and panic in our society, and it is probable that the "others" have decided to wait for our signals.

I must add that these speculations of K. E. Tsiolkovsky have not been praised highly by the Soviet Government, for they are considered groundless and antimaterialistic. The authorities in Moscow could not touch Tsiolkovsky himself, because of his fame and popularity, but his secretary lost his job. The book *Monism of the Universe* ends with 14 corollary "R.M.S. theses" ("R.M.S." stands for *razvye mozhno somnyevatsya,* meaning, "can one doubt that . . ."), which repeat briefly the main conclusions and are very optimistic in tone.

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Scientific Nomenclature

I have long been disturbed by the unscientific character of scientific nomenclature. In all the sciences nomenclature has grown up by a succession of historic accidents. Ideally the name of anything should convey as much information about the object as possible. In most sciences the names of things convey hardly anything in themselves, and any connotation which they have has to be painfully learned. Even where the name of a scientific object has some relation to it, the connotation frequently reflects some accidental property or obsolete theory. It is true, in a way, that hydrogen generates water, as men generate babies, though this may not be its most important property. The connection of tellurium with the earth or of selenium with the moon is obscure.

Fortunately most scientists are unacquainted with the dead languages from which their nomenclature is largely drawn, and so scientific names generally convey merely zero, rather than negative, information. Fortunately, also, physics and chemistry have few enough objects of study so that the learning of a set of arbitrary names is not a hopelessly burdensome task. In biology the problem is very serious but probably hopeless. Biological nomenclature is such a hopeless and vast hodgepodge of historical, geographical, and personal accidents that one despairs of ever reducing it to the slightest semblance of rationality, especially as the objects themselves seem to be the result of a hodgepodge of historical accidents also.

There is one field, however, where the objects of study have a nice rationality of *position* which makes possible a scientific nomenclature in which the name given to an object could be rich with information about it. This is astronomy. Like that of other sciences, astronomical nomenclature is a random historical mishmash of Greek, Arabic, and modern components. The name *Sirius* tells us even less about Sirius than the name *hydrogen* does about hydrogen. Star catalogs are a hopeless potpourri of letters and numbers obeying little or no rational principle. It is possible, however, to devise a system of star nomenclature whereby the name of any star would give in itself most of the essential information about it, so that, given the name, one could immediately deduce the position and properties of the star, or given its position and properties, immediately attach a name to it. It would probably be most rational to reform also the ancient method of counting degrees in sixties, and to go straight to a binary system of numbers. But this is perhaps too radical. Let us accept, therefore, the traditical definition of position in terms of degrees of right ascension and declination, or heavenly latitude and longtitude. There are 360 degrees around the celestial equator. There are 19 usable consonants in the Roman alphabet, if we exclude *q* and *x*, which cannot be used to begin syllables. By a providential accident, 19 × 19 is 361. Two consonants, therefore, will define a degree of right ascension, in the scale of 19. Suppose we number the consonants as follows:

b	c	d	f	g	h	j	k	l	m
0	1	2	3	4	5	6	7	8	9

n	p	r	s	t	v	w	y	z
10	11	12	13	14	15	16	17	18

I grant that the roman alphabet and the languages spelled in it are also in sad need of reform, but here again one reform at a time is probably enough. We can now express any number up to 360 as an ordered pair of consonants. Thus, 0 would be *b,b*; 100 (5 × 19 + 5) would be *h,h*; 200 (10 × 19 + 10) would be *n,n*; 291 (15 × 19 + 6) would be *v,j*. We only need 180° for the declinations, so we might use the first 180 pairs, or start with *b,b* at the South Pole, reaching *g,t* at the equator and *m,m* at the North Pole. We may note that translation from the scale of 19 consonants to the scale of 10 digits is very easy because every double consonant is a multiple of 20. Four consonants in order