Letters

Orbital Lifetime of the West Ford Dipoles

On 12 May 1963, the first radar returns were received from orbiting West Ford dipoles. The orbital elements of these copper radio reflectors, appropriate for the ascending nodal crossing at 16.002 GMT on that day, were T_Ω (nodal period of the satellite) = 166.5 min; e (eccentricity) = 0.004; i (inclination) = 87.4°; Ω (right ascension of ascending node) = 229.8°; ω (argument of perigee) = 67.8°. The total number of dipoles in the ensemble is about 4×10^8 with each member approximately 1.8×10^{-3} cm in diameter and 1.77 cm in length.

Recent radar measurements indicate that the cloud is lengthening at approximately the planned rate of 1800 km per day, with a consequent decrease in density. The possibility of detecting the dipoles optically is greatest in the early stages of the formation of the belt; accordingly, within a few hours after radar contact had first been established, the necessary orbital information was provided to a representative of the Space Science Board of the U.S. National Academy of Sciences for further dissemination to the West Ford Committee of the International Astronomical Union and to all interested astronomers.

Before the command was given to eject these radio reflectors from the parent satellite, orbital parameters were carefully determined from many observations. Extensive numerical computations were then performed to insure that not a single individual dipole would remain in orbit longer than 5 years. The lifetime calculations were made on a high-speed digital computer with an orbital prediction method described previously (*1, 2*). The physical perturbations included in our computations were: the second through the fifth zonal harmonic of the earth's gravitational field; the lunar and solar gravitational fields; direct sunlight pressure; earth-reflected sunlight pressure; and atmospheric drag (both neutral and charge).

It was necessary to make many calculations, covering a wide range of possibilities, since the dipoles' reflecting properties are difficult to measure precisely, their axes of tumble are randomly distributed, and the perturbations of their orbits produced by some small forces such as charge drag (*3*) are not known accurately. Thus, extreme models of charge drag were considered in which the magnitude was (i) independent of altitude but varied (in separate computations) from zero to infinity, (ii) dependent on altitude, and (iii) dependent on whether the satellite was in sunshine or was passing through the earth's shadow. Calculations were also performed for a wide distribution of tumbling axes of the dipoles whose reflecting properties were allowed to vary from complete absorption to complete reflection. Different models of the neutral atmosphere were used encompassing a range from an everywhere-zero density to densities corresponding to the peak of the last solar cycle. The sensitivities of all these results to small changes in the initial conditions were also investigated. In not a single instance did the orbital lifetime exceed 5.5 years and for presently anticipated physical conditions it was less than 3 years.

This lifetime prediction for the actual West Ford orbit is considerably lower than the average 7-year lifetime predicted earlier for dipoles in a hypothetical orbit (*1*). The contributions to this decrease are about equally divided between the effects of the smaller diameter of the wire and those of the differences in the initial orbits.

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References

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Manned Lunar Landing Defended

If we are willing to put an enormous effort into a gigantic engineering and development program, we can land men on the moon a few years from now. This is a challenge to the nation, a challenge which President Kennedy has accepted. It is a great adventure which fires the hearts of men. Shall we pass it up and settle comfortably behind our television screens or shall we sweat, struggle, and deprive ourselves of some comforts to accomplish this mission? If weakly we pull back now won't irreparable damage be done to the spirit of the nation?

This is a game we can well afford to play with the U.S.S.R. The loser can magnanimously congratulate the winner. In the other game with nuclear war heads there is no winner. Our economy is larger and more viable than Russia's. The smaller economy of the Soviets can only play by subtracting what they put into it from what otherwise would have gone largely into a military budget.

Landing a man on the moon is a simple and specific goal towards which our space program can be directed. It is an inspiring goal easily understood by the man in the street. It is, however, primarily an engineering, technological, and biomedical project, not a basic scientific effort. Consequently it does not have the enthusiastic support of many scientists. Nevertheless, it is a necessary developmental project for the scientific effort to follow.

Wouldn't we be much better off if we abandoned manned landing and put all our effort and funds into measurements by electronic instruments? The first fallacy in this argument is that funds are not transferable in this manner. Remove the goal which appeals to the public and the appropriations go with it. But the more important fallacy is that instruments can ultimately replace the man. Instruments are quite satisfactory for measuring many of the gross properties of the moon. The man can look around and at a glance pick the significant item or anomaly from among the tens of thousands of items which might be examined. When this point is reached the man becomes vastly more efficient than the instrument because he can discriminate, find, and interpret the unexpected.

There is no important military use for space at the present time, but we cannot afford to let others develop the capability of exploiting space without