Letters

Proposal for an International Union of Solar System Physics

A vast expansion is taking place in the study of the physics of the solar system. The expansion is aggravating the overlap of interest and duplication of activities that has existed for some time in the operations of the International Union of Geodesy and Geophysics, the International Scientific Radio Union, and the International Astronomical Union. Attempts to deal with past difficulties led to the establishment of the Inter-Union Committee on Solar and Terrestrial Relationships, the Inter-Union Committee on the Ionosphere, and the Inter-Union Committee on Radio Meteorology. More recent developments in space science have led to the establishment of the Committee on Space Research, and other special committees either exist or are being proposed. It is time for serious consideration of a new Union structure capable of handling the situation that is now emerging. In the final report of the ICSU Committee on Future Structure, timely impetus for reform is provided in the following words:

"Recent developments of science have emphasized the growing importance of interdisciplinary activities, and indeed this has been made evident by the work of some of the Special Committees. For this reason the Committee would urge that the different Unions, and especially those dealing with the Earth's Sciences, should examine those fields in which they have a joint interest, with the object of obtaining a more efficient regrouping of activities."

It is proposed that there be established an International Union of Solar System Physics with an organization such as that suggested by Table 1. The organization has eight units arranged vertically in divisions and horizontally in associations. International scientific meetings would be held both by divisions and by associations, according to a schedule such as that shown in Table 2. Each unit would meet internationally twice every 6 years; on one occasion it would meet with its division and on the other occasion with its association. Thus, each unit would be involved in two orthogonal cross sections of solar system physics without any necessity for a scientific assembly of the entire union. For example, people interested in planetary atmospheres would have an opportunity to assemble with people interested in the solar atmosphere and in the meteorology of the terrestrial atmosphere. But people interested in planetary atmospheres would also have an opportunity to assemble with people interested in planetary surfaces and in planetary interiors.

Some units might need to be subdivided into commissions. For example, a unit might have a commission on wave phenomena, and the various units with such commissions might, from time to time, organize an international symposium on wave phenomena in the solar system. However, at an international scientific meeting of a division or of an association, each unit should be restricted to not more than, say, six 3-hour sessions, and liberal use should be made of presentation by written summaries. This would permit either a division or an association to complete an international meeting in a 2-week period with no overlapping sessions, if social activity were suitably restricted.

In countries where national scientific meetings are frequently held, the same system (see Table 2) could be adopted.

A short administrative assembly of the entire union could be held every 3 years. Special administrative assemblies involving selected units, divisions, or associations could be called, when required, to handle special international projects such as the International Geophysical Year and the International Quiet Sun Year.

In essence, the proposed International Union of Solar System Physics would be a reorganization and extension of the existing International Union of Geodesy and Geophysics. Nevertheless, it would be an arrangement that would avoid the colossal operation now involved in an IUGG assembly. However, other existing unions besides IUGG would be affected. In particular, the International Astronomical Union, while continuing to study the sun as one of the stars of the galaxy, would be able to relinquish responsibility for detailed investigation of the solar system.

The effect on the existing International Scientific Radio Union would be more serious. Historically this union was formed because of the necessity for international study of the ionosphere. It has extended its activities into the magnetosphere, interplanetary space, the solar atmosphere, radio astronomy, and radar astronomy. In all these fields an international approach is vital. However, URSI has extended its activities into radio studies of the troposphere, where internation-

Table 1. Proposed organization for the International Union of Solar System Physics.

Associations	Divisions		
	Solar Physics	Planetary Physics	Geophysics
Interior Physics of the Solar System	Solar Interior and Evolution of the Solar System	Lunar and Planetary Interiors	Earth's Interior
Surface Physics of the Solar System		Lunar and Planetary Surfaces (including orbits)	Geodesy, Oceanography, and Hydrology
Atmospheric Physics of the Solar System	Solar Atmosphere (including photosphere)	Planetary Atmospheres (including earth's ionized atmosphere and interplanetary space)	Meteorology

Table 2. Proposed meeting schedule for the International Union of Solar System Physics.

International	Scientific meetings	National meetings (where appropriate)
Summer 1971	Division of Solar Physics	Fall 1970
Summer 1972	Association of Atmospheric Physics of the Solar System	Winter 1971
Summer 1973	Division of Geophysics	Spring 1971
Summer 1974	Association of Interior Physics of the Solar System	Fall 1971
Summer 1975	Division of Planetary Physics	Winter 1972
Summer 1976	Association of Surface Physics of the Solar System	Spring 1972

al activity is less essential, and also into electromagnetic theory, electronics, and laboratory plasma physics, where international collaboration, although desirable, is not mandatory. Those activities of URSI where an international approach is vital are accommodated in the proposed International Union for Solar System Physics, particularly if appropriate units have commissions on wave phenomena. An exception is galactic and extragalactic radio astronomy, which is being steadily and appropriately taken over by the International Astronomical Union. On the other hand, those activities of URSI where international activity is desirable rather than mandatory probably belong in a modified International Union of Pure and Applied Physics. If URSI did not wish to be bisected in this way, it could continue with roughly its present organization, but its operations would almost certainly shift sharply toward the engineering aspects of radio science, perhaps to an extent that would permit joint operation with the International Radio Consultative Committee. However, it would seem far more desirable to merge URSI and IUGG into a single International Union of Solar System Physics, thereby simultaneously improving the organization of international science and reducing the number of unions by one.

It should be noted that Table 1 makes no adequate provision for the detailed studies of the earth connoted by the subject of geology. It seems appropriate that the International Union of Geological Sciences should retain its traditional function. The same applies to the World Meteorological Organization.

The proposed International Union of Solar System Physics would render unnecessary several existing or proposed special or inter-union committees. In particular, the functions of both the Inter-Union Committee on Solar and Terrestrial Relationships and the Inter-Union Committee on the Ionosphere could be taken over by the Association of Atmospheric Physics of the Solar System.

The proposed union could not take over all the activities of the Committee on Space Research, in view of the biological aspects of space science and the galactic and extragalactic aspects of observations made in space vehicles. However, a large part of COSPAR's activity is, in fact, in the field of solar system physics and, in particular, in the domains of the proposed Division of Planetary Physics and Association of Atmospheric Physics of the Solar System. The International Union of Solar System Physics would handle these matters in a way that would promote integration between vehicular and nonvehicular studies of the same phenomena.

It is believed that the proposal for merging IUGG and URSI into a single International Union of Solar System Physics (i) constitutes the reform currently needed in existing international scientific organization; (ii) indicates a pattern of development that should be studied by national academies, professional societies, and scientific journals; and (iii) draws the attention of universities to the emergence of solar system physics as an identifiable advanced educational discipline.

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Basic Research: Capabilities of Universities and Other Research Organizations

For the United States, one can certainly pick a date during the last 50 years previous to which practically all basic research in physical science was carried out in university laboratories. However, in the last decade or so, the origin of basic research has become much more diffuse. To study the problem one has to analyze a succession of individual cases, and I should like to report some data from the chemistry of inert gas compounds.

The advent of molecules containing chemically bonded noble gas atoms has produced a discontinuity in chemical thinking. This fact, together with the lack of a requirement for a large investment in specialized equipment and the rapid development of the field, makes this example an especially interesting "model case" for inquiry into the relative contributions of university, industrial, institutional, and national laboratories to basic research. The field being less than 1 year old, the necessary data on the origin of research are readily available from journals and the proceedings of a conference recently held at the Argonne National Laboratory.

The original discovery was made in a university laboratory and was closely followed by experimental advances of major significance coming from national laboratories. Universities have contributed about 45 percent of the total research effort, and national laboratories have dominated the non-university category, accounting for 50 percent. Further interesting figures can be obtained by separating the research into experimental and theoretical contributions: the university versus industrial, institutional, and national laboratory share is 30 percent versus 70 percent for experimental work. On the other hand, universities have contributed essentially 100 percent of the theoretical effort. This suggests that universities are maintaining their traditional leadership only in the theoretical aspects of basic research.

Although I have not carried out a detailed study, it seems likely that a similar analysis of the two or three most significant recent advances in solid-state physics would show a comparable division of effort. In this and other areas one will not find 100 percent of the theory coming from university laboratories because several nonuniversity organizations (for example, Bell Telephone Laboratories) have strong theoretical groups, but the relative degrees of participation may well be maintained. A discussion of advances in solid-state physics which is closely related to my observations has been given by A. B. Pippard [*Physics Today* **14**, 381 (1961)].

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