United States Foreign Policy: View from a Sputnik

Sir Eric Ashby

Let Observation with extensive View,
Survey Mankind, from China to Peru.

So wrote Samuel Johnson two centuries ago. This is literally what Caryl Haskins has done in **The Scientific Revolution and World Politics** (published for the Council on Foreign Relations by Harper and Row, New York, 1964. 125 pp. $3.50). The theme of his book is the relevance of science and technology to American foreign policy. The United States has become the world's chief benefactor. Its benefactions take the form of aid in money and men and know-how to developing countries, partnership in promoting the economy of more sophisticated countries, and alliances to protect the way of life in the Western world. These are colossal responsibilities. They cannot be discharged through traditional channels of diplomacy and trade agreements and military pacts. The chief instrument for their achievement is education. Science and technology constitute the main substance of this education.

Accordingly Haskins considers the significance of science and technology for various kinds of nations: the impulsive, self-conscious, new countries of Africa, eagerly embracing modern technology; the Orient, integrating the post-Newtonian world into its ancient patterns of thought; Latin-America, gathering momentum under the impact of Western democracy. Naturally, in the compass of about a hundred pages, Haskins cannot offer more than a synoptic view, a photograph from afar as he orbits round the world. But, although his picture lacks detail, and indeed assumes a good deal of knowledge on the part of the observer, nevertheless it has the touch of authenticity. Here is an observer who knows how to interpret his data.

He begins by describing the sort of technology needed by the developing nations, and he makes two points which cannot too often be made: (i) that it is not fresh scientific research which these countries need for economic advancement, but the judicious selection and adaptation of well-known scientific data; (ii) that the export of technology to countries low in capital resources and high in unskilled manpower requires sharp judgment and severe restraint. It is not much use to propagate in Tanganyika technologies that would be appropriate in Texas. Atomic reactors in Africa can be both pretentious and demoralizing. As to the pursuit of pure science in developing countries, Haskins has some very perceptive observations to make. Even though indigenous scientific research may be relatively unimportant as a means of solving technological problems, it is important as a means of promoting "style" and sense of values of a scientific world; also a developing country gains self-confidence if its nationals play a part, however modest, in the advancement of science.

From his consideration of new developing nations Haskins turns to what he calls the "intermediate" nations. Some of these—Pakistan, for instance—are already investing more than 10 percent of their national income in technology. How can nations like the United States help such countries? By helping to consolidate a scientific community, by encouraging the country to create a sufficient density of scientists and of people who understand what science is about to constitute a viable society. This can be done in many ways: by sending "scientific emissaries" to these countries, by promoting conferences of scientists in them, by financing a traffic in men and ideas between the "intermediate" nation and American universities and academies.

Finally Haskins turns to consider political interactions between the United States and its peers—countries where science and technology are equally advanced, such as Europe and Russia. Here one wishes he could have written a longer book. As it is, he has to content himself with giving the reader tantalizing threads of argument which could, at greater length, have been woven into a pattern of absorbing interest. He asserts, for instance, that "there are few things more precious to us than our autonomy, our balance, our pluralism, in technology and science no less than in other aspects of our national being"; and he suggests that Soviet science may suffer from a surfeit of central planning and socialist pragmatism. And yet he has doubts about this, as most of us have. Is it really established that scientific research in Russia is distorted by the pressures of technology? If so, what about the distortion of scientific research in America by the seduction of research contracts? An expenditure of $3.6 billion in a single year, with the aim of putting a man on the moon by 1970, surely upsets the balance of science, even in a nation as wealthy as the U.S.! And, regarded as a gesture of international politics to impress uncommitted nations, would not the $3.6 billion be better spent in providing colleges and health services in tropical Africa? Haskins would put us in his debt if he would pursue in another book some of the ideas in his last two chapters, for upon these ideas may depend America's influence in the world of the 1970's.

Among many other frutiful ideas in Haskins' book is one which specially commends itself to a British reviewer. The British have more reason than Americans to be worried about the separation of the "two cultures." A British child, from the fourth year of high school, is subjected to a continually tightening process of specialization, whereas in the United States, a child is at least exposed to the humanities, the social sciences, and the natural sciences until his sophomore year. So it is refreshing to find that Haskins, himself a distinguished sci-

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entist, believes that the most significant means by which the United States could prepare itself to render scientific aid to new nations would be to set up advisory groups "dedicated to a continuing major effort to understand scientific revolutions as social phenomena." In other words, the key to effective technical aid is the study of social history. Haskins is right. It is to be hoped that his book will be read on both sides of the Atlantic.

Antisymmetry

Colored Symmetry. A series of publications from the Institute of Crystallography, Academy of Sciences, U.S.S.R., 1951–1958. A. V. Shubnikov, N. V. Belov, and others. Translated from the Russian by Jack Itzkoff and Jack Gollob. William T. Holser, Ed. Pergamon, London; Macmillan, New York, 1964. xxvi + 263 pp. Illus. $9.75.

The title of this book is misleading, for the volume is not concerned with the color of symmetry but with the symmetry that relates colored bits of patterns. A better short title would be "Color Symmetry." Actually, most of the subject matter is even more restricted, for only the last 19 of some 247 pages are devoted to general color symmetry, the remainder being limited to the symmetry that can be represented by two colors—that is, the symmetry of dichromatic patterns of various sorts. This symmetry, commonly called antisymmetry or black-white symmetry, is more elegantly expressed as the symmetry that can be displayed by real functions.

This book is, in brief, a translation of several major Russian contributions to antisymmetry, plus 19 pages also translated from Russian work on more general color symmetry. William T. Holser, the editor, has made the collection as uniform as possible without actually rewriting it.

The book is in two parts. Part I is a translation of A. V. Shubnikov's book, *Symmetry and Antisymmetry of Finite Figures*. Part II is a collection of six papers by N. V. Belov and various coauthors: the first four papers treat periodic antisymmetry groups in various dimensions; the others are on two- and three-dimensional color patterns. There is an 11-page bibliography on symmetry in which each citation includes the title. The list is valuable, although there are some obvious omissions—for example, all Barlow's works. But the list of Russian citations appears exhaustive.

Work in symmetry, one of those subjects which appeared to be closed, opened up again a dozen years ago when attention was drawn to the notion and uses of antisymmetry. Actually, antisymmetry was noted by a few workers as early as 1930 as the result of a publication by Heesch. I became acquainted with it, however, through the publications of Woods, who was interested in the "counterchange" symmetry seen in textile patterns. At that time I regarded the concept as unnecessary because this kind of symmetry was readily accounted for by considering the diperiodic patterns to exist in three dimensions. Woods was the real pioneer of antisymmetry, but his work is overlooked by present-day writers.

In 1951, some 16 years after the work by Woods was published, Shubnikov published (in Russian) his book, *Symmetry and Antisymmetry of Finite Figures*, in which he dealt with the antisymmetry of nonperiodic patterns —that is, with the antisymmetry of point groups. But the recognition of antisymmetry began in the western world with the publication a year later, in *Acta Crystallographia*, of Cochran's paper, "The symmetry of real periodic two-dimensional functions"; Cochran's paper aroused interest because everyone had considered crystallographic symmetry as relating actual objects, such as atoms, in a pattern, and atoms were represented by positive electron density. But it had just been shown that, if a Fourier synthesis were made by using as Fourier coefficients the amplitudes derived from an upper-level x-ray photograph, a new synthesis called a "generalized projection" of the electron density (or the Patterson density) resulted; this showed negative regions symmetrically related to positive regions. This development led Cochran to consider removing the restriction of "positive" from periodic functions and to consider the symmetry of functions which could assume both positive and negative (that is, real) values. Cochran's recognition of these patterns and their obvious application to crystallography is passed over lightly by the Russians, yet it must have been the stimulus which eventually started the Russians on their investigations of periodic patterns involving antisymmetry. Three years elapsed before the publication of their first paper in which Cochran's work was extended. Cochran's symmetries were also being found elsewhere. For example, I found them in partial Fourier syntheses.

A translation of Shubnikov's 1951 book, *The Symmetry and Antisymmetry of Finite Figures*, constitutes the first part of the volume being reviewed here. Shubnikov develops point-group symmetry from the beginning, including both classical symmetries and antisymmetry. A somewhat confusing aspect of his development of point groups is the use of roto-reflections rather than the roto-inversions which are now internationally adopted. But this is not unreasonable in Shubnikov's development; the matrix for a proper rotation requires merely a change of sign of one element to transform it from a rotation to a roto-reflection, and a change in the sign of another element to change from classical symmetry to antisymmetry. Unfortunately, Shubnikov's symbolism for a roto-reflection is the same as the international symbol for a roto-inversion having the same value of n. Confusion would have resulted from this (and from some other features of Shubnikov's notation), if the editor had not added to each symbol the one usually used in international notation.

Shubnikov develops the ways of combining rotations by substituting a pair of reflections for each rotation. A more direct approach, and one that is less confusing to a beginner, is to devise ways of combining rotations without involving nonexistent reflections. Shubnikov derives not only the point group symmetries (classical as well as antisymmetry) consistent with crystallographic symmetries, but also the noncrystallographic point-group symmetries, including those with $n = \infty$. Shubnikov's text is very clearly written, well illustrated, and easy to understand.

Part II, translations of six papers, two papers by Belov and four others by Belov and one or two of his colleagues, is not nearly as easy to read and understand as part I. There are a number of reasons for this: part II consists of several original papers (contrasted with a carefully planned and integrated book); it has too few illustrations; the separate parts appear more or less in the chronological order of the appearance of the original papers—three-dimensional groups (1955); two-dimensional groups (1956); two-