1. A GENERAL FRAMEWORK: NEEDS AND METHODS FOR THE POPULARIZATION OF SCIENCE

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contributions from all over the world. Such contributions, together with the present document, will form the basis for reports and discussion in Leeds. The resulting *Proceedings* of the meeting will then be published as ICMI Study 5.

1. A GENERAL FRAMEWORK: NEEDS AND METHODS FOR THE POPULARIZATION OF SCIENCE

Let us begin by making a few simple observations.

Advances in science and the day-to-day lives of humans are indirectly but, nevertheless, intimately connected. Strategical choices by states relating to economic, military and environmental matters, are fashioned by changes in technology and give rise to new technological challenges. Chains of relationships are then built up affecting all types of employment, the environment, public health, communications, home and family life, ... An informed citizen, whatever his or her occupation, should have some understanding of the crucial points on which these strategical choices are taken, some knowledge of the scientific advances appertaining to the technologies under consideration. Such a general scientific understanding is a democratic and economic need in every modern society and the provision of it may well be one of the decisive social challenges in the future.

However, there is now an increasing divergence between the advancement of science and the general understanding of the vast majority of human beings. Though science is universal and should help promote unity amongst people, we see that scientific research and scientific education may actually be organised in ways which increase inequalities and frustrations. Although scientific concepts are involved in every modern device used in everyday life, too many people are unable to grasp scientific ideas, do not know what a scientific way of thinking is, and, as a result, are too frequently pushed into irrational modes of thought. Even those who were well educated and equipped with some scientific knowledge all too often lack the time and incentive to enlarge their scientific understanding and to keep abreast of modern developments.

This, then, is the situation to which those involved with the popularization of science must respond. On the one hand there is an exponential increase of scientific knowledge produced by, and circulating amongst, small groups of specialists. On the other hand, there is a general, social need for a popular understanding of scientific discoveries, scientific achievements, scientific ideas, and scientific modes of thought. Any efforts to bridge that gap are part of popularization in its widest sense. In a more restricted sense, and that which this study will consider, the popularization of science involves all efforts made,

or which might be made, to bridge the gap between scientific advances and public knowledge and information, apart from those which take place within school systems and in higher education.

The process of popularization involves three factors: the topics to be considered, the sections of the public it is wished to interest in the topics, and the media to be used in the processes of communication. To help in the making of consequent choices there will be a clear need to identify specific aims and criteria for decision-making.

No topic should be excluded *a priori.* Whenever there is a real advance in science it has to be known outside the small circle of specialists which participated in that advance — or it risks becoming lost. Any effort to make it known, to explain its meaning to a wider audience, is part of the process of popularization which can take place at a number of levels. At the highest level, the dissemination of advanced topics (through, say, expository papers) is an extreme, but an essential, stage in the general process. Yet there are many other topics of interest apart from contemporary research: for example, the history of a subject, its applications (particularly any of a novel character) and an understanding of the type of people involved in that science and of their motivation.

Similarly, no section of the public should be excluded. Children of all ages, workers, citizens, all types of professionals, even other scientists. All motivations have to be considered: professional interest, curiosity, general knowledge, ... , but also prejudices and fears.

All channels, too, must be exploited: books, newspapers, periodicals, films, exhibits, TV and radio programmes, software, ... Education and continuing education will play a decisive rôle complementary to that of popularization. Games and competitions will have a part to play — particularly in mathematics. Whatever the medium, popularization will be analogous to translation, and its quality will depend upon the skills and experience of the translator. Some of these are professionals: scientific writers and journalists. These may well have a catalytic rôle to play in involving scientists, teachers and other professionals in the general process of popularization.

2. Special features of the popularization of mathematics

The popularization of mathematics gives rise to certain special problems. First, many people's relationship to mathematics is governed by what happened to them in school. The affective consequences were often considerable: love,