Editorial

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In several countries and regions in Europe and elsewhere, there have been dramatic changes during the last few decades. Almost every individual and group of people have been affected by political, economic and social changes in the society. This is particularly true for our own professional area, the scientific research, development and education within universities and industry. When defining and discussing problems, solutions, challenges and opportunities of today's society, it has often been a strong belief among many responsible politicians that knowledge and science are major keywords. In Scandinavia, much interest is presently focused on questions such as those which follow. How can we define knowledge? What type of knowledge is produced, where and how? How can knowledge and competence at individual and team/collective levels be related and how is our society to benefit from an increase in knowledge? From this discussion it has become evident that although we, as scientists and teachers, are devoted to create new knowledge, we may not (some of us say should not) easily provide answers to these questions. Several of us are engaged in the processes of generation of knowledge, including research and education, as well as the organization of these fundamental activities, not only in our research groups but also on department, faculty and university levels. Therefore, it is of interest for us to discuss and to try to find answers to these questions in a scientific manner. Today it is important to be able to explain with solid arguments why we believe, for instance, that research, development and education are non-separable components. We have to explain why universities have advantages in the process of generation of knowledge and, further, we have to find ways how our universities should be organized in order that they also become a main future source of knowledge.

The major scientific breakthroughs in our own research area have been made in universities. A prerequisite for a young person to invest in scientific work and pursue a scientific career is that he/she may plan some years ahead and he/she can benefit from the company of fellow scientists. The meeting between well-prepared and intuitive people requires a certain level of critical mass. Further, the preparation for the unusual and the time to wait and register the unforeseen, require some kind of resources. This requires a considerable investment in the scientists. In many areas of research, the basic, long-term support to research groups has disappeared, and the trade of knowledge occurs in a competition on a market which has strong similarities to that of the free enterprise market.

The patient perspective in inter-transdisciplinary biomaterials

Biomaterials research share the common goal with other research areas within the life sciences that an intervention (with a device) in order to replace/improve a deranged structure and function in the human body should lead to an improvement in the quality of life of an individual. It is therefore important to realize that it is for the ultimate goal of patients that we are engaged in this research and development. The patient is the end user of the knowledge which is created, developed, transferred and further developed in the clinical reality through a combined effort of a large number of individuals. The optimization of function and safety of medical devices requires documentation and control. Further, the assessment of the performance of a medical device in its intended application in the human body requires prospective trials, multicentre studies and continuous quality control.

The biomaterials research area is relatively new, and has a true inter/transdisciplinary character, and is, possibly a prime example of how knowledge may be generated in a mode different from the traditional, disciplinary one. Progress within biomaterials to the benefit of individuals and health care is therefore dependent on competence and knowledge generated in various scientific disciplines. It is, without doubt, true that the research and development of biomaterials cannot progress without a continuous interaction with what is traditionally regarded as the underpinning scientific disciplines and methodologies developed within these areas. However, ideas and devices not only evolve within traditional university disciplines, but are developed and refined within networks of competences. In most universities, we are part of, work in and have become familiar with an organization which has a traditional, disciplinary mode of knowledge production. An increasing number of scientists are seeing marked changes in the ways scientific knowledge is created, produced and transferred. A new, additional and growing mode of knowledge production has been identified in order to describe the changes which several of us have observed and of which we are in various degrees a part:

> "A knowledge production carried out in the context of application and which is characterized by its transdisciplinarity; heterogeneity, organisational heterarchy and transience; social accountability and reflexivity; and quality control which emphasizes context- and use-dependence. Results from the

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parallel expansion of knowledge producers and users in societies". (Gibbons *et al.* [1].)

Research and development: significant progress and new challenges

Significant progress has evolved within the relatively new area of interdisciplinary biomaterials research. The breakthroughs in different principles for anchoring of implants have resulted in a predictable treatment of osteoarthrosis/arthritis and edentulousness with arthroplasties and oral implants, respectively. New combinations of materials and surface modifications have entered the clinical stage and are used on new clinical indications, as well as to improve long-term success for various patient groups where conventional treatment has less-predictable success rates.

Combinations of autologous, viable, differentiated cells and templates and matrices of synthetic materials have been elaborated during the 1980s and have now been implanted in the human body. Such measures are, for instance, currently used for the treatment of tissue defects with promising results. In parallel with an increased understanding of tissue–material interactions, combinations of synthetic materials, viable cells, biological matrices and factors will be introduced for the repair and regeneration of tissues. In comparison with the presently used biomaterials, we may anticipate more complex assemblies of materials and molecules with time-controlled selective stimulation of processes which could ultimately lead to an improved structure and function of tissues and organs. Thus, most likely, biomaterials research and development will, in the future, also play a significant role in the possibility of improving the quality of life for large groups of patients. The elaboration of more complex assemblies of materials and biological components will also put strong demands on the function and safety of biomaterials, as well as improved techniques, to monitor and predict the performance of devices.

Communication and education

The 13th European Conference on Biomaterials in Göteborg was the major European meeting during 1997 devoted to biomedical materials and their interactions with biological environments. The annual Conference of the European Society for Biomaterials was a meeting place for 400 scientists, managers and decision-makers in basic, applied and clinical biomaterials research. It provided a communication and discussion of recent scientific results and critical issues pertinent to the field of research and development of biomedical devices. Authors of oral and poster presentations represented 27 countries. Based on the judgements by referees, the authors of the best abstracts were invited to write original articles. The articles in this Special Issue of *Journal of Materials Science*: *Materials in Medicine* reflect the interdisciplinary nature of the biomaterials research area.

About 50% of all participants at the 1997 Conference were graduate students. This will provide a challenge and opportunity for the biomaterials society. The mutual investment of young students and their tutors in this research area is a strong signal to improve our educational and research efforts on local, regional, national and international levels. The teaching and learning is performed with the use of several languages, from biomedical, clinical and technical disciplines. As tutors and teachers we are, therefore, obliged to define and imagine the essential features of the processes which lead to new knowledge within our scientific area. This may provide us with the ideas and tools with which further to improve the development of capabilities of young researchers within our research area.

1. M. GIBBONS, C. LIMOGES, H. NOWOTNY, S. SCHWARTZMAN, P. SCOTT and M. TROW, "The new production of knowledge. The dynamics of science and research in contemporary societies," (SAGE Publications, London. Thousand Oaks, New Delhi, 1996).