

## LUDWIK FINKELSTEIN

City University London  
Measurement and Instrumentation Centre  
UK, e-mail: l.finkelstein@city.ac.uk

### REFLECTIONS ON A CENTURY OF MEASUREMENT SCIENCE AS AN ACADEMIC DISCIPLINE-A TRIBUTE TO PROF. DR. ENG. ANDRZEJ JELONEK (1907–1998)

The paper reflects on the development of measurement science as a discipline over the last hundred years, viewing the field through the work of Professor Andrzej Jellonek, a notable Polish scientist and educator. It considers present challenges to the discipline. The paper also pays a personal tribute to Professor Jellonek.

#### 1. INTRODUCTION

The commemoration of the centenary of the birth of Professor Andrzej Jellonek is an occasion not only to honour a measurement scientist and educator of note, but also to reflect on the past, present and future of an academic discipline to which he devoted his career.

The conventions of scientific writing demand that it should be impersonal. However this is inappropriate in the present case. The personality of Andrzej Jellonek was very central to his contribution to science and so a few personal remarks are fitting.

Firstly, I owe Andrzej Jellonek gratitude for an invitation that brought me back to Poland, the land of my birth, three and a half decades after I left it as a deportee eastwards. His kind hospitality allowed me to establish bonds of understanding and friendship in Poland, among others a connection with this journal. They have lasted till now.

It would have been appropriate to write this tribute in Polish, because Professor Jellonek struggled for the maintenance of Polish culture and further because the love of Polish language and literature formed a bond between us. Nevertheless, I have decided to write this tribute in English, now the international language of science, in order to signal the international significance of his contribution and make this appreciation accessible to readers outside the circle of Polish speakers.

## 2. A CENTURY OF MEASUREMENT SCIENCE

Andrzej Jellonek was born in Kraków in 1907. It is proposed to look at measurement science in the century since his birth through the prism of his work.

At the beginning of the period surveyed here, measurement of physical quantities was mainly performed in a scientific laboratory. It was an art rather than a science. It was organised as a catalogue of apparatus and techniques for different measurands and was taught through laboratory practice.

Professor Jellonek studied engineering at the Technical University of Lwów, in many ways the mother of Polish technical universities. By the time of his graduation in 1931 serious scientific investigations into the operating principles and performance of scientific measuring equipment were an established line of scientific work. His doctoral work on resistors was typical of the direction of the work of the time.

The period between his graduation and 1946, when he came to be one of the builders of the Technical University of Wrocław, had seen the rise of electronics and its application in scientific instrumentation. This transformed the nature of measuring systems.

Measuring equipment began to consist of sensors that transformed the measurand physical quantity into an electrical signal, which was processed by electronic equipment, to be displayed or to be input to a control element. Measuring systems were used increasingly in automatic control and in other applications outside the laboratory. There was demand for dynamical, on line, measurements. The development of electronics, telecommunications and control led to the development of powerful mathematical methods of analysis and design of systems.

The increasing capability of measuring instrumentation, the wide range of application of measuring systems, the diversity of forms of measuring systems that could be realised, meant that the technology of measurement could no longer effectively be taught, or applied, as a catalogue of solutions to a limited range of problems. There was a need to develop measurement science as a systematic discipline. The sciences of control, information and systems served as paradigms and provided an arsenal of powerful mathematical methods of analysis and design.

Such a discipline was in fact developed. It treated measurement as an information process and measuring instruments as information machines. It treated measuring instruments as dynamic systems. It made use of mathematical models of instruments and instrument elements. It used the systems approach to the analysis and design of measurement equipment.

Professor Jellonek was a pioneer of the development of measurement science as an academic discipline. He did it through his books and his work as a teacher and university builder. His pioneering work was influential in Poland. The work of scientists educated or influenced by him promoted the discipline internationally. This was accomplished in the face of material difficulties and intellectual constraints imposed by difficult years of his country.

Professor Jellonek retired in 1977, having established a flourishing school of measurement science and having played a major part in the development of his discipline. His death in a tragic accident in 1998 was mourned by many disciples and friends.

### 3. THE CHALLENGES OF THE PRESENT

Measurement and instrumentation science and technology continue to change. The discipline of measurement science faces new challenges and can look forward to new opportunities. We best honour the founders of the discipline by facing the challenges and grasping the opportunities so that we develop the field.

Advances in the capability and cost-effectiveness of computer equipment mean that information within measuring systems is generally processed by computer equipment and analyzed and designed by standard information technology methods. The increasing size and complexity of measuring systems requires systematic methods of their analysis and design, increasingly based on systems engineering. Computer techniques have transformed the methods and capabilities of mathematical modelling and its application to measurement systems.

Measurement science has thus become closely associated with computer, information, control and systems science. Nevertheless it has its own specific concerns, which make it distinct.

Measurement science is concerned with fundamental principles of units and standards, their establishment, development, maintenance and dissemination. At its core are the principles of treatment of measurement uncertainty and statistical treatment.

Further, although measurement systems are generally implemented by computer hardware and software, analyzed and designed by information technology methods, sensors and their interaction with the system under measurement must be considered in terms of physical embodiment, demanding the application of physical science principles.

Professor Jellonek who laboured at the foundations also guided the transition to the new science.

There are new tasks and new opportunities before measurement science. Among the new opportunities is the wider range of applications in areas such as biology and medicine and in measurement in soft systems, to give but two examples.

The world in which measurement science is developed and taught has changed dramatically in the last decade and a half. Most significantly barriers against international scientific cooperation have fallen. All of this demands a new vision of measurement science and new ways in which teaching and research are to be organised.

It is for the people who have succeeded Professor Jellonek to take the discipline forward. They can see farther for they are standing on his shoulders.

#### 4. PROFESSOR JELLONEK AND POLAND

Finally, no reflections on Professor Jellonek can be complete without mentioning his love of his country and his endeavours to preserve and develop Polish culture. Much of his work was carried out in dark years of his country. It is not for reflections written from a scientific and international viewpoint to comment on them. I hope, however, that it is appropriate for me to recall that when I came back from Poland after visiting Professor Jellonek, I was asked at home what I learned. I replied that I learned that Poland has not perished. There can surely be no better memory that a Pole can leave.