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Dedicated to Prof. Dr. Zvonimir Devidé on
the occasion of his eightieth birthday



Z. Devidé

Professor Zvonimir Devidé – to mark his eightieth birthday

The distinguished Croatian biologist and botanist, Zvonimir Devidé, Fellow of the Croatian Academy of Sciences and Arts, professor emeritus of the Faculty of Science in the University of Zagreb, has recently had the occasion to celebrate his eightieth birthday and over 50 years of work in science.

While retired in 1986, professor Devidé is still remembered as a teacher who shared his enthusiasm for plant biology with his students, as a research leader who helped his associates develop their individual professional personality (instead of forcing his own views upon them), and as a scientist who refrained from striving for personal fame, but used all his energy and outstanding talents to push Zagreb plant biology into the 20th century and into the international research community. He did his first lonely experiments with tools assembled from matchboxes and kitchen jars, to create, with persistence and vision, a modern laboratory, excellently staffed with competent scientists who now continue his work.

Because of his exceptional merits, professor Devidé was in 1973 selected as an extraordinary and in 1991 as a full fellow of the Yugoslav, now: Croatian Academy of Sciences and Arts. In 1976 he was awarded the *Ruđer Bošković Prize*, for scientific activity. And for his extraordinary services and the results he achieved in work important for the advance of the country, he was decorated with the *Order of Work with Gold Wreath*. In 1988, in recognition of his accomplishments in biological research he was awarded a State Prize for his life's work.

Professor Devidé was born on 6 August 1921 in Lenart, Slovenia. After completing high school in Maribor, he became a student of natural science at the University of Zagreb. He then moved to Vienna where he obtained his bachelor's degree in biology, physics and chemistry in 1944 and subsequently joined the laboratory of professor L. Geitler to gain experience in cytology. After returning to his country and completing his compulsory military service, he came to Zagreb, at the invitation of professor V. Vouk, first as an intern, and then as assistant (1948) in the Botanical Gardens, Institute respectively, part of the Faculty of Science. In 1954 he went to England on a British Council scholarship to stay for six months with professor C. D. Darlington at the John Innes Horticultural Institution, Department of Cytology (Bayfordbury).

After his return from England, in very modest conditions, he did research into the cytology of the colourless chemosynthetic sulphurous bacteria, which was subject of his doctoral thesis in 1954.

His enthusiasm for teaching and research in the biological sciences, and the expertise acquired in Vienna and England, were highly appreciated at the Botanical Institute and the newly founded Ruđer Bošković Institute in Zagreb, which invited him to establish a laboratory for electron microscopy.

He obtained his *habilitation* in 1960 from the Faculty of Science presenting a thesis on the structure and optical characteristics of pale-mottled and green leaves (19). After this he applied for the position of assistant professor at the Botanical Institute of the Faculty of Science, but the faculty council immediately appointed him as associate professor. His promotion to the rank of full professor ensued in 1970. In 1981, he was elected head of the Botanical Institute and the Botanical Gardens and performed these duties until his retirement.

The scientific opus of professor Devidé covers a wide range of topics, from cell biology and plant physiology to general biological issues, such as the conservation of nature and natural resources.

At the beginning of his career, he dealt with chromosome research (1). He then proceeded to clarify the microscopic structure of the large, chemo-autotrophic, colourless sulphurous bacteria (Leucothiobacteria) from the Adriatic that bind the energy they liberate by oxidising hydrogen sulphide, into a form that can be used in their metabolism (2). In addition to this, he made considerable contributions to the taxonomy of these micro-organisms (2, 5, 6, 7, 8, 10) and established new methods for their cultivation.

Investigating the karyology of the ciliates he managed to prove the existence of individual chromosomes during meiosis, and their transformation into chromosome aggregates during the formation of the micronucleus in exconjugates, thus explaining the, up to that time, incompletely understood mitosis and unknown structure of the chromosomes in the micronucleus of ciliates, and taking a significant step forward towards the understanding of the structure of the polyploid macronucleus, and the role of endomitosis in its formation (1, 3, 4).

Professor Devidé's research with junior associates (Sibila Jelaska, Dražena Papeš, Branka Kolevska-Pletikapić and Biserka Jelenčić) into growth and differentiation in plant tissue and cell culture was also largely motivated by his interest for the accompanying karyological changes, even though an enormous amount of background research had to be spent on optimizing growth media and the sources of the explants. By the Giemsa C-banding technique it became possible to identify even individual parts of broken chromosomes. Applying this method to *in vitro* cultures of *Vicia faba*, a considerable percentage of triploid cells with a particularly striking extrachromosome, as well as structural mutations, were detected in calli developing from primary explants. Interestingly, as the tissue was subcultured, the degree of polyploidy decreased in favour of diploid cells with a normal karyotype (41, 42, 46, 48, 49).

Bringing electron microscopy to the Ruđer Bošković Institute in Zagreb, professor Devidé first had to work out the methods (16, 17) which later enabled him to address the action of ionising radiation and other external factors on the development of plastids. With his associate Mercedes Wrischer he established that exposure to sublethal doses of X-ray radiation does not affect the transformation of the prolamellar bodies in greening etiolated leaves. The development of thylakoids and the formation of grana were, however, delayed in a dose-dependent fashion (23, 25, 28, 30, 31, 32, 33). These results aroused his long-lasting interest in plastid metamorphosis. With fruits, such as the orange and cultivated varieties of the pumpkin (*Cucurbita pepo* L. var. *ovifera*) he managed, together with his associate Nikola Ljubešić, to show that chromoplasts could, in certain circumstances, become green again, thus reverting into functional chloroplasts. The results of this work conclusively demonstrated the untenability of Frey-Wyssling's hypothesis on the monotropic development of plastids (34, 35, 36, 37), according to which chromoplasts are the final phase of

plastid development and cannot be transformed into chloroplasts. A second type of reversible plastid transformation is exemplified by the *aurea* mutations, which were investigated in *Acer negundo* var. *odessanum*, *Fraxinus excelsior* var. *aurea* and *Ligustrum ovalifolium* var. *aureum*. In all three varieties strong light prevents greening – the accumulation of chlorophyll. This appears to be the consequence of defects in the biosynthesis of carotenoids and other protectants against excessive solar radiation (the triplet carotenoid and the epoxide cycles), in which case chlorophyll is subject to photo-oxidation. Morphometric data for *aurea*-privet thus revealed that the plastids of the sun-exposed, yellow, leaves contain only about 10% of the mass of grana thylakoids normally present in the plastids of the green leaves growing in the shade. In spite of this, yellow *aurea*-leaves showed a much higher photosynthetic efficiency than would be expected on the base of their low chlorophyll content, an observation which suggests a smaller size of the photosynthetic unit (38, 39, 40).

With Mercedes Wrischer, professor Devidé also investigated the ultrastructural changes brought about by the action of inhibitory factors on the process of cell respiration. One of the effects observed was a considerable increase in the size of the mitochondria, such as had not yet been established (21, 22, 24, 26, 29).

The scientific interests of professor Devidé also spread to the effect of the photoperiod on the induction of flowering. Together with B. Krajnčić he determined the photoinductive periods for the transition from the vegetative to the generative phase (the differentiation of flowers and flowering), in axenic cultures of duckweed, including several species of *Lemna*, *Wolffia arrhiza* and *Spirodela polyrrhiza*. For the latter species, this was the first time flowering was induced in the laboratory. It was also shown that some amino acids accelerated the induction of flowering in *Spirodela polyrrhiza* and *Lemna minor* under long-day conditions, while others were effective under short-day conditions (43, 47, 50, 51, 52).

As a cytologist and physiologist, professor Devidé was keenly interested in biochemical research and thus collaborated with the tracer laboratory headed by Dina Keglević (20). To develop this kind of research in his university department, his young associate, Ivan Regula, was sent to the above laboratory to learn the necessary methods. Thus began research into the biogenic amine, serotonin, which had just been discovered in animal and human tissues and was intensely studied by many physiologists and pharmacologists. Professor Devidé's laboratory confirmed its presence, for instance, in the stinging hairs of the nettle, in the lower leaf epidermis of the oleaster (*Elaeagnus*), in the mesocarp tissue of the tomato, and in walnut seedlings (here together with tryptophan). Serotonin is formed through the shikimate pathway, via tryptophan and tryptamine. Its accumulation in seeds is believed to represent a mechanism of ammonia detoxification (and/or storage for later use). Serotonin also stimulates cell elongation in roots and oat (*Avena sativa*) coleoptiles (44, 45).

His expert knowledge of optics enabled professor Devidé to interpret the optical features of the blue shine of the fruits of *Viburnum tinus* (54). With Marijana Krsnik-Rasol, he introduced research into plant tumours. He also published a number of papers on the domestic flora (9, 10, 11, 12, 13, 14, 52) and contributed his experience in microscopy to joint ventures with colleagues from a variety of disciplines (15, 18, 27).

Not to be missed is his article on macroevolutionary theories and their cytogenetic basis (53) written jointly with his spouse Vanda Kochansky-Devidé, a palaeontologist with profound knowledge in biology. More recently, he returned to electron microscopy and plastid

ultrastructure, with emphasis on the development of chromoplasts and their compartments in which the carotenoids are localised (55, 56, 57, 58, 59, 60, 61, 62).

Professor Devidé's results were presented at about eighty scientific conferences at home and abroad, at a dozen of which he gave plenary lectures. The significance of his scientific work is reflected by the response it evoked in the international scientific community. His results were not only cited in over 40 international scientific journals but, more importantly, were also included in university textbooks by eight foreign and three domestic authors.

While professor Devidé was a member of the Botanical Institute, it was visited by more than 40 foreign scientists, including M. Bopp, M. Bukovac, J. Greilhuber, W. Haupt (thanks to whom the Botanical Institute of the University of Erlangen-Nürnberg donated a large number of volumes of the Encyclopaedia of Plant Physiology and plenty of essential scientific books, textbooks and manuals), K. Jones, R. Kandeler, E. Landolt, M. Nešković, J. Reinert, E. Schnepf, P. Sitte, M. Vardjan, H. Ziegler, and I. Zelitch. Some of these colleagues also served on the Ph.D. committees for junior members of the Botanical Institute.

Professor Devidé was the chief organiser of a number of scientific conferences, among which mention should certainly be made of the European Photobiology Symposium on Hvar in 1967, the symposium of the Yugoslav Society of Plant Physiologists in Stubičke Toplice in 1975, and the 5th Yugoslav Symposium for Electron Microscopy at Plitvice Lakes in 1986. In addition, he took part in the work of the organisational committees of many other domestic conferences.

Professor Devidé also wrote critical reviews of over thirty books and other scientific publications, over fifty review articles and popular articles in the magazines *Priroda* and *Proteus*, contributions to the General, Medical and Forestry Encyclopaedias, as well as articles covering subjects as diverse as the history of the natural sciences, and problems of ethics in biology. Of particular importance is his chapter in the book *The Microscope* by B. Varićak, where he explains the theoretical grounds of microscopy, the techniques of sample preparation and the use of the electron microscope in biology. Of no less significance is his participation in the translation of the 31st edition of Strassburger's Textbook of Botany for Universities (Školska knjiga, Zagreb 1982).

Professor Devidé was an outstanding lecturer, illustrating his lectures with useful drawings which helped to explain complex subjects, from the function of sophisticated instruments to structure and function of the plant cell. He always endeavoured to back up his statements through effective experiments. He showed particular kindness and understanding to students and their problems, while retaining the objectivity in his grading criteria befitting the reputation of Zagreb University.

A great deal of effort and time was devoted to the improvement of existing, and to the introduction of new, undergraduate courses (basic cytology, cell biology, microscopy, general methods and tools in scientific research, and, most of all, modern plant physiology). He was mentor for a great many undergraduate theses.

Professor Devidé was the head of the Graduate School of Botany and Experimental Biology at the Faculty of Science (1960–1970) and, after its reorganisation, head of the biology section of the Graduate School of Natural Sciences at the University of Zagreb (1970–1983). Personally, he was responsible for the following graduate courses: Biomembranes, Principles and Methods of Microscopy, Methods of Scientific Microscopy and for speciality courses on mitochondria, the structure and function of the photosynthetic

apparatus, and the submicroscopic organisation of the cell. Many master's and doctoral theses were written under his direction.

With his associates, he initiated such research areas as cell biology and plant tumours (Marijana Krsnik-Rasol), cytogenetics (Dražena Papeš), electron microscopy (Mercedes Wrischer, Nikola Ljubešić), plant tissue culture (Sibila Jelaska, El Mamoun El Khalifa from Khartoum, Branka Kolevska-Pletikapić, Branka Pevalek-Kozlina), the physiology of flowering (Božo Krajnčič, Maribor), biochemical plant physiology (Ivan Regula), the culture and physiology of algae (Elena Marčenko).

From 1974 on he spent a great deal of time pleading for the conservation of nature and a healthy environment, working in various committees and suchlike bodies (see the review *Scientia Yugoslavica*, Zagreb, 1987).

Professor Devidé held various important positions in a number of research and teaching institutions. At the Faculty of Science he was president of the Council for the natural science sections, head of the Biology Department and head of the Botanical Institute and Gardens (1981–1986). He was head of the Nature Protection Council of the Academy, of the Traffic Ecology Section of the Scientific Council for Traffic in the Academy, of the Inter-Academy Committee for Nature and Environmental Protection, a delegate of the Council of Yugoslav Academies in the OECD environmental committee (1985), and in the Committee for the Protection and Advancement of the Environment in the Yugoslav Parliament (1986). He was head of the Biology Section of the Croatian Society for Natural History (1974–1976), president of the Yugoslav Society of Plant Physiologists (1972–1974), president of the Croatian Society of Plant Physiologists (1974–1976), head of the electron microscopy section of the Croatian Society for Natural History (1984–1989), member of the managing committee of the Croatian Society of Geneticists and of international associations such as the Federation of European Societies of Plant Physiology, the International Association of Plant Physiology and the International Association for Plant Tissue Culture. He is a member of the editorial committees of the scientific journals *Periodicum Biologorum* (1973–1976), *Acta Botanica Croatica* (since 1967) and *Acta Biologica ASAC* (from 1987).

In addition to the previously mentioned public recognition for his outstanding work in science, professor Devidé was elected honorary senior scientist by the Ruđer Bošković Institute in 1980; he was made honorary member of the Croatian Biological Society in 1981, of the Croatian Society for Natural History in 1990, of the Croatian Society of Geneticists in 1998, and of the Croatian Society of Plant Physiologists in 1999. In 2000, the Croatian Biological Society gave him the Zdravko Lorković Plaque as founder member of the society.

Music has a very important place in the broad field of professor Devidé's non-professional interests. In his youth he performed as first violinist of the Youth String Quartet in Maribor, and also as solo violinist. Since 1954 he has been a member of the Society Orchestra of the Croatian Musical Institute in which, from 1975 to 1981, he was a member of the Board of Directors (Presidency), and since 1984, the head of the section for the viola and viola music. As member of the Society Orchestra (2nd and 1st violin and viola) he took part in over 280 public concerts in Zagreb and other Croatian cities. He also undertook musicological research on the history of the viola, in recognition of which the International Viola Association in Salzburg decorated him with its *Silver Viola Key*, in 1985.

With certainty, professor Devidé is one of the last of the biological erudite all-rounders, with a broad range of knowledge and wide views. He was among the first here to understand the dangers threatening the forests from air pollution and warned of the dangerous consequences of the destruction of agriculturally useful land and the contamination of water, for water resources, even more importantly than food, will be crucial for the survival of mankind. In many public lectures he has lent his authority to urge the protection of nature and the rational use of natural resources, always bearing in mind the coming generations and their needs. He has constantly had in mind the idea that »we have not inherited nature, but borrowed it from future generations«. Sarcastically, he used to say: »While the DNA of any organism contains the information for the formation of structures which can endure unfavourable environmental conditions, and while the DNA of any animal contains the information for the synthesis of the hormonal and enzymatic systems that guide the life of the individual to ensure the viability of its progeny under adverse conditions, the DNA of man (who in his conceit has called himself *Homo sapiens*) is not intelligent enough to keep him from the blindness of his wish for personal momentary comfort at the price of the destiny of his own descendants. We have to become much more modest in our demands until we achieve an equilibrium with nature«. He was aware that in nature there is neither reward nor punishment, but there are only consequences; in nature there are no leaps: what she denies us, no one else can give, for nature is the greatest even in the smallest. He often expressed concern for the future of mankind, understanding the dangers that the almost exponential multiplication of our species upon Earth leads to. Looking to the future of human life, if this kind of multiplication of the population goes on, there will certainly be shortages of goods and living space, which has always, in history, driven nations into conflict and led to the catastrophic destruction of goods and assets. For this reason he considers general disarmament and the establishment of world peace, with a reasonable birth rate and the conservation of nature, as the *conditio sine qua non* for the survival of the human species upon Earth.

Professor Devidé has woven his work as a scientist, teacher, and administrator into the lasting values of the Botanical Institute and the Institute for Molecular Biology of the Faculty of Science, and hence of the University of Zagreb, and made biological science as a whole his debtor. For everything he has done, he has certainly deserved the genuine respect in which he is held.

On the occasion of his 80th birthday, we wish him good health, good fortune, continued investigative curiosity and everlasting joy in observing nature in its amazing beauty and diversity.

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IVAN REGULA