Editorial

Jan Evangelista Purkyně (1787—1869)

We celebrate, this year, the bicentennial of a prominent Czech physiologist, one of the fathers of experimental physiology, *Jan Evangelista Purkyně*. It was the heuristic research work of this leading personality, his restless educational, and organizatory activities that made foundation for a new comprehension of physiology as an experimental domain of science, and that created material conditions for the development of this discipline by establishing the world's first two specialized institutes of physiology.

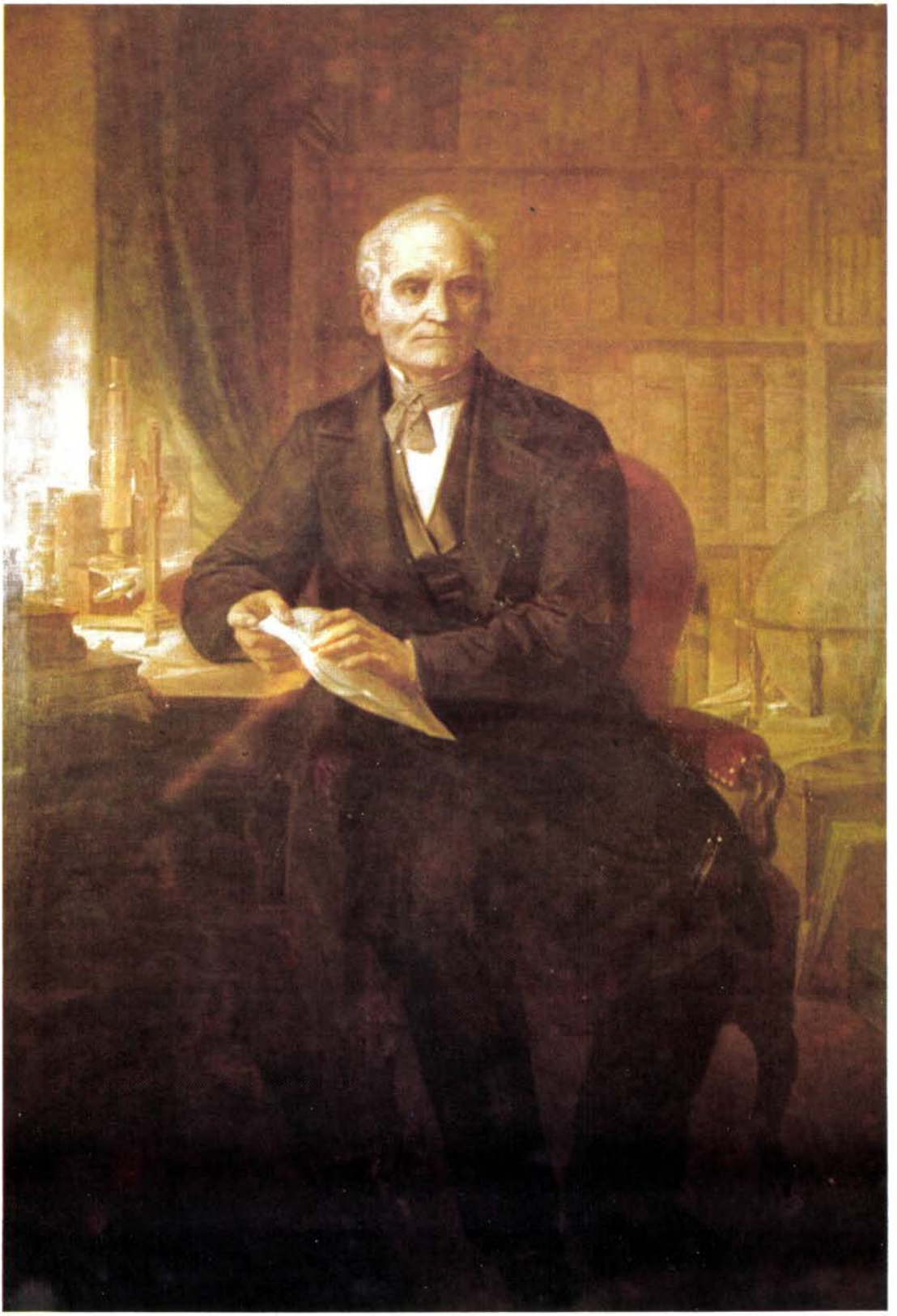
J. E. Purkyně was born on 18 December 1787, at Libochovice, a small village in northern Bohemia, as a son of the administrator on the estate of Dietrichsteins. After the precocious death of his father, Purkyně was sent to the Piarist monastery in Mikulov to finish his gymnasial studies. He then joined the Piarist order. He served as a teacher of the Piarist Gymnasium in Strážnice and Litomyšl, and was intensively studying languages, German philosophy and literature. He leaves, in 1806, the Piarist order "*to be more free and to deal more freely with science*". He studies philosophy in Prague and earns his living as a teacher with aristocratic families. Within 1814—1818 he studies at the Prague Medical Faculty, defends on 30 November 1818 his doctoral thesis "*Beytraege zur Kenntniss des Sehens in subjektiver Hinsicht*", and joins the Department of Anatomy of the Prague University as research assistant and prosector. The years to come were full of intense studies and research concentrated on sensory organs and their functions. He unsuccessfully applied for professorships at several departments in Prague, Budapest and Graz. At the age of 35, he was appointed in 1823 professor of physiology and pathology in Breslau (now Wroclaw, Poland), where he introduced himself by his habilitation writing "*De examine physiologica organi visus et systematis cutanei*". The 27 years spent in Breslau can be considered as the most fruitful period of Purkyně's life. The unusually intensive investigative charge and the large action radius of Purkyně's research interests brings a rich harvest of original results and disclosures in various fields of physiology which, in its contemporaneous comprehension, corresponded more to the modern concept of biology. The most interesting works of J. E. Purkyně include studies on the movement of brush-border epithelia of various organs, the disclosure of the egg germinative vesicle, the disclosure of special subendocardial fibres of the myocardial conductive system (*Purkyně fibres*), studies of the nerve system, and, last but not least, his contribution to the formulation of the cell theory. Since the first day of his acting in

Breslau Purkyně was spending effort to establish an independent department of physiology. It was not until 1839 that he succeeded in creating in Breslau the first independent department of physiology on the territory of the German speaking region of that time. The return to Prague which Purkyně had longed for years before, became possible in 1850 when he was offered professorship in physiology at the Prague Medical Faculty. As soon as in 1851 the new Purkyně-established department of physiology opened its doors. During the second Prague period Purkyně was eagerly engaging in national enlightenment, cultural and organizatory activities. Until his last days he remained appreciated and admired by the public, and restlessly active. He died on July 28, 1869 in Prague aged 82.

To review, although in brief, the rich work of a versatile personality like the Purkyně's, from his original research papers in a large field of biology or natural science as such, through his educational, organizatory, cultural, enlightenment and other activities, to approach Purkyně as a patriot, poet, translator, all this would require an extensive book. Purkyně's Collected works (*Opera omnia*) count 13 volumes, the first of which appeared in 1919, the last one in 1985; they include Purkyně's works which had appeared in various journals and books. The unusual richness and variability of Purkyně's research interests suggest a receptive, observant, penetrating, even eagerly curious spirit, enthusiastic to disclose the unknown, to search for new ways and methods of obtaining knowledge. The original, sober intelect of J. E. Purkyně was not satisfied by purely speculative analysis characteristic of the dominant German *Naturphilosophie* of that time; rather, he chose experimental approach, observations of various phenomena (e.g. sensory, or drug effects) on himself, or experiments performed with the aid of apparatus and device of his own construction. In a period in that theoretical medicine was based on anatomy, Purkyně's considerations were based on the concept of the unity of structure and function: he concentrated on microscopical analysis of tissue structure as related to the respective function. He was a son of his era, being charged by it and outgrowing it at the same time.

Purkyně was one of the pioneers of the cell theory, probably the most important theory in biology of the 19th century.

He was the first to describe, in his communication presented at the congress of German natural scientists and physicians hold in Dresden in 1826, on the development of hen egg before hatching („*Symbolae ad ovi avium historiam ante incubationem*") the germinative vesicle (*vesicula germinativa*); it could be shown later that this vesicle was in fact the egg cell nucleus. In this way Purkyně made his contribution to the history of investigation of animal cells. This work of Purkyně is among the most popular ones. It prompted intensive studies by other investigators and turned to be a basis of new disclosures that restructured accepted opinions.



Portrait of Jan Evangelista Purkyně by Petr Maixner. A gift to the University by the Union of Medical Students on the occasion of the 50th anniversary of Purkyně's promotion (10 December 1868, one year before Purkyně's death).

Cells with their nuclei had been known as principal structural units of plants as early as in the first half of the 19th century, because of the methodological ease to study plant body components microscopically. However, the existence of cells in animal organs and tissues used to be considered a hypothesis (Wolf, Dutrochet) rather than fait accompli. J. E. Purkyně did a lot of pioneering work just in this respect.

Until 1832 when he succeeded in acquiring an achromatic Plössel microscope (the Czech painter P. Maixner has included it into the composition of Purkyně's portrait), Purkyně systematically studied structure of various animal tissues. His observations were summarized and the principal thesis of the cell theory was suggested 150 years ago, at the congress of German natural scientists and physicians held in Prague in 1837; interestingly enough, this did not happen in a lecture dealing specifically with the topic itself, but rather, as if randomly, in a communication dealing with the structure of gastric glands and the nature of digestive processes. Purkyně described a uniform cellular structure (granular, „*körnige Grundform*" as termed by Purkyně) of various animal tissues. Granules — cells which contain smaller oval granules (nuclei) in their inside appear as the principal structural units of animal tissues and organs: "*The granular principal organisation forces an analogy with the plant the latter as generally accepted being almost entirely composed of granules*". Although brief, the clear and precise Purkyně's formulation presented in Prague in 1837 preceded by a year the preliminary, and by 2 years the extensive paper by Schwann, in which the latter discussed and analysed in detail the cellular structure of animal and plant organisms. T. Schwann and M. Schleiden thus definitely formulated the cell theory concept which would, for a considerable period of time, significantly influence the development of both biology and medicine (Cl. Bernard, R. Virchow). T. Schwann in his work employed several results obtained by Purkyně and his scholars. Hence, it should not seem immodest to point to the significant contribution of Jan Evangelista Purkyně to the formulation of the cell theory.

In studying microscopically various tissues Purkyně was turning special attention to the structure of the nerve system. His discoveries in this field evidence his admirable investigatory, methodological and technical invention. Again, it was 150 years ago that Purkyně presented at the Prague congress of German natural scientists and physicians results of his interesting observations. He accurately described and illustrated different cell types (*ganglion bodies*, as Purkyně termed them) in various parts of the brain and the spinal medulla (e.g. in the substantia nigra, the hippocampus, the cerebellar cortex, etc.). In the cells, he clearly distinguished the nucleus and the nucleolus. We still use the term "*Purkyně cells*" for large pear-like cells of the cerebellar cortex with upwards branching processes which Purkyně managed to describe and to draw as unique-

ly. Purkyně's drawings of cross-section of the cerebellar cortex are considered pioneering, first of its kind. Due to large numbers of "*ganglion bodies*", the regular occurrence of defined types in defined parts of the brain, Purkyně considered them as important constituents of the nerve tissue, as some kind of centers in which neural energy is accumulated, generated and distributed. This courageous assumption makes us feel traits of the neuron theory. In addition to nerve cells Purkyně also described nerve fibres composed of thick axial cylinders running in medullar sheaths.

Purkyně's congenial gift for observation allowed him, while studying innervation of various organs, to disclose in 1830 fine grayish fibres with polygonal cells sited at the inner surface of heart ventricles; he described this specific fibre type of muscle tissue which is now known as the *Purkyně fibres* of the myocardial conductive system. Since Purkyně did not deal with this discovery in a special paper, it remained unknown for long years to the broad public. Time to explain the function of Purkyně fibres was ripening gradually. Schmalz in 1886 was the first to assume correctly the functional importance of these fibres, but it was not until 1906 that S. Tawara definitely cleared this question. Of the Purkyně's works in cardiovascular physiology, an interesting study concerns the suction work of heart in association with the work of the valves; this communication was presented at the conference of Hungarian physicians and natural scientists in Bratislava in 1865, and ingeniously illustrated by *kinesiscope*, an apparatus of Purkyně's own construction. Together with his scholars he described the course of muscle fibres in the heart atria and ventricles and related them to the work of the heart.

Purkyně believed that physics and chemistry are of key importance for the understanding of life phenomena; he had good knowledge of physics himself. His attitude to basic natural science is clearly documented in his inaugural lecture (Prague 1851): the course in physiology, according to this lecture, should include lectures in physiological physics and physiological chemistry. The concept of our journal *General Physiology and Biophysics* has been based on this philosophy as well.

Let us, full of esteem, take the heritage of Jan Evangelista Purkyně, the indefatigable, original investigator, discoverer who, being always modest and broadheartedly unselfish, used to insist that the knowledge of the new has always priority over one's own merits and praises. These generous and noble traits arose from his belief in the power of science and the capacity of its acting in favour of the mankind. This belief he clearly expressed in 1857 by the following prophetic words:

"*Just as in spring, when everything has first been covered with snow, then here and there some blossoms show their smiling faces, until suddenly the whole countryside appears green and flourishing and teeming with merry life — in the*

same way there will dawn even upon science the blessed hour when it will forever descend to the realm of public life in order to become its nervous system, setting all its spiritual and physical powers into motion" (Purkyně 1948, 1985).

Works of Jan Evangelista Purkyně (Purkinje)

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Purkyně J. E. (1960): Opera omnia, tomus VIII (Eds. V. Kruta and Z. Hornof). Nakladatelství Čs. akademie věd, Prague (Writings in natural science in Czech)
Purkyně J. E. (1965): Opera omnia, tomus IX (Eds. V. Kruta and Z. Hornof). Nakladatelství Čs. akademie věd, Prague (Writings and speeches on science, education and politics, mostly in Czech)
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