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István Apáthy
TRIBUTE TO HIS MEMORY ON THE OCCASION OF THE 50TH ANNIVERSARY OF HIS DEATH*

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September 27 marked the 50th anniversary of the death of István Apáthy, the founder of the Department of Zoology at Szeged University, an excellent zoologist, an outstanding neurologist, and in his time the greatest microtechnician in the world. As the second successor in the Department, and as a researcher working in the same field, it falls to me to pay tribute to his memory on the occasion of the 50th anniversary of his death.

I. Apáthy is one of the eminent figures of Hungarian scientific life, well-known internationally, and regarded with honour and esteem. His life was full of struggles, sufferings and afflictions, but it was also rich in esteemed creations and values; the rapid passage of time has done little to detract from these, and indeed, if the facts and the honest strivings are considered, it must be stated that they have increased and become enhanced. He was a professor, and one of the best, who attained this high position at a relatively early age. He was a true research worker, who throughout his life was enthralled by the noble problems of the science of life. He was a pragmatic scholar, who everywhere and in everything sought the interdependences, the overall relations and the connections.

He was born in Budapest on January 4, 1863. After completing his secondary-school studies, he enrolled at the Medical Faculty of Budapest University. During his university years he studied with diligence and ambition, and as he was born a dominant personality, with his outstanding abilities he soon became one of the widely respected leading figures among the university students, who proclaimed and urged the need for the independence of Hungary in the political movements. After completing his basic studies, he entered the Department of Pathological Anatomy at the University, where he carried out animal histological examinations under the effect of initiatives received from Professor Margó. He had still not obtained his medical diploma when, in 1884 at the age of 22 years, he published a paper of more than 100 pages, under the title „Tanulmányok a Najádeák szövettanáról" ("Investigations of the histology of the Najades"), in the collected series produced by the Hungarian Academy of Sciences „Értekezések a természettudományok köréből" ("Treatises on the natural sciences"). At about this time he also published „Az út a révpart felé. Klinikai képek" ("The way to the roadstead. Clinical pictures"), a shorter literary work, in which, on the basis of what he saw and heard in the wards, he deals with the then social conditions and with the problems of the locally occurring poverty and social destitution. This work was closely followed by poems of various lengths, which later increased both in number and in

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value, for I. APÁTHY was a poetic soul, who throughout his entire life was inspired by the Muses, even when he was carrying out researches in the laboratory and when he was fighting difficult and passionate battles in the political life. In 1885 he acquired his medical diploma, and followed his inclination and enthusiasm for zoology by becoming assistant to the then professor of zoology and comparative anatomy, TIVADAR MARGÓ.

At that time T. MARGÓ dealt with the peripheral nervous systems of the insects and it is probable, therefore, that I. APÁTHY here received those impulses which later directed him towards his researches into the nervous systems of the invertebrates. After only one year as an assistant, in 1886 he joined the Stazione Zoologica in Naples, where with only a few breaks he worked for three years. The director of the institute, ANTAL DOHRN, wished a monograph to be prepared on the fauna and flora of the Bay of Naples, and since Apáthy's earlier work was directed towards such a field he was entrusted with the treatment of the taxonomy and anatomy of the leeches. APÁTHY liked this theme and thus began a systematic treatment with great pleasure and enthusiasm; of tremendous help to him in this, of course, were his rich knowledge in this respect, which he had gained in Budapest, and his already notable microtechnical ability and skill, which characterized his comprehensive genius and led and guided his particularly dexterous and practised hands. As a result of his love for the subject, his talent, his skill, coupled with great diligence, and his considerable familiarity with the literature, in the first three years he spent in Naples I. APÁTHY wrote some 17 scientific papers. Among these was his pioneering publication „Nach welcher Richtung hin soll die Nervenlehre reformiert werden", published in „Biologisches Centralblatt", which had a revolutionary effect on neurohistology. This was followed by „Das leitende Element des Nervensystems und seine topographische Beziehungen", similarly prepared in Naples, and published in „Mitteilungen aus der Zoologischen Station Neapel", Volume XII.

During the time spent in Naples he visited the Swiss, German, Belgian and Dutch universities and the scientific institutes in Paris. The period in Naples was suitable not only for him to carry out high-level investigations in the zoological sciences, but also to acquire a store of knowledge through his experience whereby he could reassuredly undertake the leadership of a university department at a later opportunity. Such an opportunity was not long delayed. In 1890 the Chair of the Department of Zoology in the University of Kolozsvár fell vacant, and I. APÁTHY was appointed to fill this vacancy at the age of 27 years. This appointment was followed some years later by another, when the leadership of the Department of Histology and Embryology too was entrusted to him.

The place he had come to was a little confined. It was particularly confined for that I. APÁTHY who was already acquainted with practically all of the universities in Europe, and who was already recognized, by virtue of his work and through personal meetings, by every respectable research worker in Europe. The Department of Zoology in the University of Kolozsvár was at that time housed in the Count Mikó villa. The department was very restricted for space, and the equipment was scandalously insufficient. Apáthy's aptitude, talent and foreign experience, however, provided a guarantee that the small Mikó College would rapidly expand, and that the results arising from the diligent work there would soon go out into the world. And this quickly came to pass. With all the requisite steps being taken, and if necessary with struggles and battling, the small department was soon equipped with everything desired, and the possibility even emerged of foreign guests being able to carry out

research work there. Places constructed for three such guests, and these were provided with all the necessary equipment for the microtechnical and histological investigations begun and directed under his leadership. The reputation APÁTHY had acquired in Naples, together with the personal contacts, led to many foreigners seeking out this small department, either to learn from what they saw there, or to master the APÁTHY microtechnical procedures. Among the first to appear in the department was the German, Bethe, one of Apáthy's greatest admirers, who remained a faithful devotee and disciple until the end of his life. Among others to visit the department were BOEKE, the later famous DUTCH neurohistologist from Amsterdam, PLATON STEWARD from Baltimore, MOLLIER and HASSELWANDER from Münich, JORIS from Brussels, KOVALEVSKY from Russia, GODLEVSKI from Cracow, SEMEN JEFIN LONDON, the Russian research worker, and ANNA KROSSUSKAJA, assistant to PÁL LESSHAFT, the Director of the Anatomical Institute in Leningrad. Another Russian, KOROTNEFF, sent his leeches collected from Lake Bajkal to APÁTHY for processing. Others to make pilgrimages to Kolozsvár included RIMOTTI and WALDEYER, Professors in Anatomy at Pisa and Berlin, respectively, and V. VIDAKOVICH from Buenos Aires. The visitors and research workers going to the department were attracted not only by the special research equipment, most of it made in Kolozsvár, but also by the special research methods, known as the APÁTHY procedures, which at that time were to be found en masse in the various journals and methodology books. They were also attracted by the person of Apáthy himself, who, with his gracious manner, his great knowledge and his extraordinary microtechnical skill, together with his personal endowments, which were particularly suitable for systematization and shedding light on the routes and directions to overall truths, captivated all those who came under the spell of his sparkling wit.

Although now perfectly equipped, the small Mikó college was in no way sufficient to provide a home for Apáthy's intentions, abilities, knowledge and comprehensive plans. Using his strongly enhanced respect before even the state leadership, he therefore did everything to ensure the financial basis for the creation of a Department of Zoology which he considered fit and appropriate for his research and teaching work. His unflagging efforts led to success: in 1909 a new Department of Zoology was established in Kolozsvár, the like of which was rarely to be seen throughout Europe at that time. In its exterior too this department differed from the others. The enormous two-storey building was provided with loggias and experimental earth-baths. There were balconies on every floor, and from spring to autumn the roof, walls and balconies were covered with flowers. In one part of the building a constant-temperature, deep cellar was fitted out, and the large basement was furnished for the experimental animals. In addition, there were special installations for the fresh-water and sea-water aquaria. The ground-floor of the building housed the wonderful zoological collection of the Erdélyi Museum Society and the lecture rooms. On the first floor were the students' work-rooms, the library and the administration offices. The second floor held four laboratories for those who carried out scientific investigations into their own themes. The living-quarters of the Director and his assistants were also to be found on this floor. The outfitting of the department was totally individual, and was prepared in accordance with original conceptions and plans. Everyone who saw it received the impression that as regards its form, its structure and its installations this department was quite original, and differed from all other departments of a similar nature in Europe. I. APÁTHY took pains not only with the beautiful new department, but also with provisions for his im-

pecunious students to be able to study free from financial worries. Thus, he created a cheap cafeteria for them and later, with the assistance of some friends of similar disposition, a modern students' hostel.

Under Apáthy's leadership serious teaching, pedagogic and scientific work continued in the new department for a long period. However, this work was later disturbed somewhat, both by the political actions of APÁTHY, resulting from his character, and also by the events which followed the First World War. Under the terms of the Peace Treaty of Trianon, Transylvania, Kolozsvár and hence the Kolozsvár University became Rumanian, while I. APÁTHY fell into Rumanian captivity for some months during the events associated with the annexation.

If we wish to assess the value of Apáthy's work during his career, then it is necessary to consider three fields where he was truly great, and where he produced lasting scientific results of immense worth. These three fields are those of zoology, neurohistology and microtechniques.

I. APÁTHY began his zoological investigations in Budapest and continued them in the Stazione Zoologica in Naples. These studies referred to the taxonomy and anatomy of the leeches. Apáthy collected the necessary material from the Bay of Naples and from Hungarian waters. Part of this material was preserved in the customary way, but the vast majority of it was fixed, embedded and subjected to histological processing. His papers which appeared on this topic were received with great interest and appreciation by his fellow-specialists. Kovalevsky, the noted Russian zoologist, described Apáthy's investigations as classical (Étude Biologique de l'Haementeria. Mém. d. l'Acad. imp. d. Scienc. d. St. Petersb. VIII-e ser. vol. II. N. 1. p. 40). Leuckart and Perrier too rated this work of APÁTHY highly, and used his results in their own papers.

His studies on the intestinal tract of the sea leech, *Pontobdella muricata*, with the aid of his gilding procedure, were of a pioneering nature and produced an almost evolutionary effect in the international literature. He was the first to stain with wonderful definition the intestinal nervous system of this leech. His preparations, the most beautiful of which are in my possession, even now still reveal the extreme definition and clarity of the intestinal nervous system and of the connection of this with the tissues of the intestinal wall. In my view this fact alone would be enough to make the name of I. APÁTHY of lasting fame, to ensure the positive international appreciation of his work, and to confer on him objective esteem. However, this is not all that I. APÁTHY discovered in connection with these investigations and established in durable form. He succeeded in proving and having accepted in his own age that fine fibrils (neurofibrilla) run parallel, or arranged in a network, in the protoplasm in the nerve cells, in the sensory cells and in their processes. Others before APÁTHY had considered the possibility of such formations. From the striation in the processes of the nerve cells, MIKSA SCHULTZE had regarded that there might be fine fibrils (primitive fibrilla) here, but in the absence of a suitable technique he was unable to demonstrate these. After osmic acid fixation Kupffer stained the primitive fibrilla in the myelinated fibres of the vertebrates by acid fuchsin but that such existed and could be detected in the nerve cells was due exclusively to I. APÁTHY.

APÁTHY considered the neurofibrils to be the conducting elements of the nervous system. Indeed, he went further in the morphological and physiological evaluation of the neurofibrils, and announced that these cross the cells, the centres and even the myofibrils and thereby form a connected system, which traverses the entire

organism and interlaces the total nervous system, together with all its elements, into a continuous unit. Apáthy's discoveries declared war on neurondoctrine and the study of synaptology, i.e. the transfer of stimuli by means of contiguity, and initiated tremendous battles of extreme intensity, which lasted over a long period, mainly between himself and such outstanding representatives of neurondoctrine as RAMÓN Y CAJAL, MIHÁLY LENHOSSÉK and others. In this brief appreciation, there is little room for us to give a detailed treatment of who was right in this question, mainly because we too are neuronists. However, it must be said that in our opinion of this affair APÁTHY, in revolutionary mood, overstepped the limits and possibilities objectively permitted by his preparations, which referred exclusively to leech material. We consider, and this is confirmed by the APÁTHY preparations in our possession, prepared from the intestinal tract of *Pontobdella muricata* in Naples in 1882, that APÁTHY overlooked certain facts and features when he reported cells in the intestinal wall which the fibrils (neurofibrilla) traverse continuously, continuing without interruption into the organism. APÁTHY gilded the intestines totally, in the form of a membrane, and thus worked on thick material; in this way there resulted drawings such as those published in his work „Das leitende Element des Nervensystems und seine topografische Beziehungen zu den Zellen". The great fight, which began with the appearance of the above work, was decided essentially in favour of neurondoctrine. The nerve pictures obtained with more recent procedures, the changes resulting from experimental intervention, and in particular the pictures obtained with the electron-microscope, indicate that there is no continuity, and that neurondoctrine has complete validity in both anatomical and physiological respects. As one who has spent more than 40 years in investigating almost all classes and organs of the animal kingdom, I have constantly held the view since the commencement of my research work into the histological structure of the nervous system, that there is neither plasmatic, nor dendritic, nor neurofibrillar continuity in the nervous system. All nerve pictures reporting such a continuity are either based on an oversight, or are the results of an inadequate technique. As regards the neurofibrils, I considered that these exist, but that they are not always apparent and never leave the region of the nerve cells. They are simply constituents of the neuron, just like the tigroid, the cytocentre, the Golgi reticulum, and the others. In spite of this, as a worker in a similar field, and as I. Apáthy's second successor in the Department, I acknowledge and proclaim that as a neurohistologist he performed pioneering work. It was he, who with his own gilding method first demonstrated to the world in an outstanding manner and with practically unsurpassable clarity and definition the intestinal nervous systems of the worms and the neurofibrils in the motor ganglion cells of the medical leech *(Hirudo medicinalis)*, and who, with his studies based on these investigations, initiated such a revolutionary movement in the field of comparative neurohistology, leading to intense battles and hence to the elucidation of the fundamental concepts. His nerve-investigation methods, pre- and post-gilding, can still be used today, but as he himself frequently emphasized, success demands a particular situation, much work, infinite patience and a special love of the subject.

The third field in which I. APÁTHY excelled was that of microtechniques. The preparation of organs and tissues for microscopic examination caused many headaches to those who attempted with good-quality magnifying systems to make the material the subject of a more thorough study. It required considerable ingenuity to devise those procedures which, at least in the main, inhibited the extensive contraction of cell-groups passing from life into death, and provided the means and possibility

of preparing thin, transparent sections from the material, so that the entire sections might be arranged in consecutive order and systematically studied. Nor was it a lesser problem to purify the prepared sections from the material necessary for the preparation, or to stain them in such a way that the individual constituents of the cells, large and small alike, should come under the magnifying lens of the microscope sharply distinguished from one another, and in a well-differentiated form. Another major problem was how to produce the impregnated or stained sections in a durable state, suitable for preserving for examination over a long period. Particularly in the beginning, the fixing, the embedding, the sectioning and the preserving all caused much thought to those who wished to see and study the structures of the tissues and the cells in a state and form at least somewhat approximating to those in the living condition. Much experience, many efforts and much ingenious conception was necessary for the histological and cytological examinations to acquire a firm basis, and for the findings to be accepted as fact and used as a sound foundation in the physiological and genetic studies. Many had worked in this field prior to I. APÁTHY, and many utilizable methods and procedures had come into the hands of the research workers, but it must be stated objectively that there had been extremely few histologists and cytologists who surpassed I. APÁTHY in care, accuracy, inventiveness, ingenuity and skill. He attended to the compositions of the fixants, to the development of these for the different animals and different organs, to the selection of methods for the complete removal of the fixant materials, to the preparation of the paraffin for embedding, to the establishment of the desired temperature, to the position of the microtome knife, to the arrangement of its honing plane, to the honing, to the staining, to the washing and to the preservation with accuracy and precision, so that everything he did in this field was a standard example of how one must work with microtechniques in order to produce results. As a consequence of the careful embedding, the correct preparation of the microtome, and the correct honing and accurate adjustment of the knife, they were able (as one of his students writes) to prepare 4000 sections in the Apáthy department at Kolozsvár from skin one millimetre thick, or from a "nerve fibre", while sections of the thickness prepared at that time in foreign laboratories could readily be split into four sections. The experience and results emerging from Apáthy's work, which have become exemplary for those wishing to learn, are generally recognized and many of them are still of great use. I am thinking here of double embedding, triple staining, gilding, etc. All this shows extremely clearly that I. APÁTHY was a brillant thinker, a reasoning and theorizing research worker, and a man who did things on a grand scale, who in all cases himself tried to plan and to create the instruments, the apparatus and the procedures whereby he could obtain an answer to the given questions of living nature. However, he then became really great as a microtechician, and known and recognized the world over, when he chronicled the empirical results and experimental facts acquired by himself and others, reviewed them and subjected them to criticism, and thereby raised the microtechnique to the rank of a science. His activity in this respect gave rise to his two-volume work on microtechniques „Die Mikrotechnik der tierischen Morphologie" (Abt. I. 1896; Abt. II. 1901).

As to the value of this publication, it is quite unnecessary even today to explain this to anyone working in this field. It is a systematic, exact and clearly written, outstanding work, which from the viewpoint of the present has only one main fault; as a result of the unfortunate turn of events the planned third volume was not produced. It is easy to conceive the significance of this work in its own time; it

was truly a bible, in which all of use and value in a microtechnical line was diligently treated. It was a guide, an example and a tutor to all those who found pleasure and strength in the cultivation of this wonderful auxiliary science, and in general in the dissection of the great biological problems. With regard to the actual opinions of the then specialists concerning this work, we can do no better than to let them speak for themselves. Schaffer introduced his review of the book (Wiener Klin. Wochenschr. Jahrg. XV. N. 12. 1902) with the following sentences: "The microtechnique is on its way to becoming a science. This is a characteristic text-book which, by treating the subject historically, critically and theoretically, raises it to scientific level." Heidenhain, the Tübingen histologist, wrote as follows (Münchener Medic. Wochenschr. Jahrg. 44. 1897): „Das Buch ist eine vorzügliche Arbeit, eines besonnenen und erfahrenen Gelehrten ist ausserdem nicht etwa trocken geschrieben und wir haben soviele vorzügliche Bemerkungen allgemeinen Inhaltes darinnen gefunden, dass unserer Meinung nach, auch der vollkommen durchgebildete Techniker das Werk mit Vergnügen lesen wird." On page 257 of the volume of the "Royal Microscope Society" for 1902, the following can be read as to the microtechnique of I. APÁTHY: "The facts, which are arranged in chronological sequence, are positively astonishing in number and their mere enumeration tells of the extraordinary labour which the author has bestowed on the work on the knowledge of the subject exhibited therein." PAUL MAYER, the grand-master of the microtechniques, in 1920 named APÁTHY as the greatest living microtechnician. M. LENHOSSÉK, the excellent neurohistologist, who as a neuronist was diametrically opposed to APÁTHY and fought tooth and nail with him, in his appreciative commemoration of him refers to I. APÁTHY as a microtechnician "magister mundi".

With what has been said so far we have in effect finished with I. APÁTHY as a great organizer, a research worker and a scholar. If anything remains to be said, it is only that thanks must be offered to Fate for blessing Hungary with such a great spirit, and such a comprehensive and internationally appreciated individual. If nevertheless we sense a little sadness at the thought of the name of I. APÁTHY, this arises from two sources: the first is that during the First World War and in the final decade of his life he dealt more with politics than the world of microscopes and the laboratory could allow without a little neglect; the second is that his death came far too soon. He was released from his imprisonment in Szeben in 1920 and came to the University of Szeged where, with the books and equipment which he brought with him, he strived to organize his third department of zoology in a building temporarily assigned for that purpose. However, this no longer proved possible. I. APÁTHY was a sick man, both physically and spiritually. He had long suffered from heart trouble, while psychologically the changes and sufferings preyed on his mind and tormented him. The sufferings were increased by the unjust procedure whereby his favourite subject, the histological lectures, was taken away from him and given to others, who were not his supporters. Even under such conditions he attempted to serve his popular science and poetry, with both heart and soul. In the twilight of his life he wrote one of his most beautiful poems „Az elszalasztott kikelet" ("The missed spring-time"), in which, meditating on the problems of existence, he raises the cruelly tormenting question: if he becomes old and incapable of "work and battle", will there remain for him "another spring", and will there be time for him to be able to enjoy the awakening, "May and the roses"?

His own poignant words grimly foretell the negative answer to the question: „ott halok meg egy bús november alkonyán s lelkemben elfagy élvezetlen a tavasz,

melyet úgy kíván" ("for I shall die one sad November evening, and the spring it so desires freeze in my spirit").

In the final years of his life he sought the balm for his gaping wounds between Szeged and Naples, but he could no longer overcome the ever increasing infirmities and anguished sufferings. He died on September 27, 1922 after long suffering. With his death an ardent intellect and a far-shining beacon left the stage of Hungarian science, but his spirit lives on among us and everywhere throughout the world where science is loved, and for this man is fired, will work and if necessary fight.

The cells comprising the nervous system, over the differentiation of which so many battles ensued, have by this time been reduced to a common denominator. The „nerve cells" have become Schwann cells, which serve to the capsule of the vegetative axons, linked to them by the mesaxon ducts, while the „ganglion cells" have been called nerve cells respectively neorons.

Neurondoctrine, against which so many bitter struggles were fought, has proved correct. The vesicles grouped in the synapses and the membrane thickenings on the axon terminals or on the cells and the dendrites have provided the final and irrefutable series of evidence in favour of contiguity.

The existence of neurofibrils can be proved only by impregnation, but even then not generally and only under the light-microscope. Under the electron-microscope the proeesses of neurons appear empty, while the fibrosity is represented in the neurites by the neurofilaments and in the dendrites by the neurotubules. The neurofibrils can not be seen in the body of the nerve cells; their place is probably occupied by the ducts of the endoplasmic reticulum and the tube systems belonging to the Golgi complex, or these may have been the formations considered as neurofibrils under the light-microscope.

The fixing and embedding, with their associated many types of skilful, delicate and complex activity, are slowly but progressively becoming outdated. In their place have come the freezing-microscope and the refrigerator, with which it is possible to prepare sections of convenient and necessary thinness for even the finest examinations. The stainings and impregnations too are slowly losing ground. Their place is being taken by the electron-microscope and histochemistry. Of the many endeavours and the great variety of procedures and modifications, only the Golgi method has withstood time, for this gives the most utilizable basis for the electron-microscope examinations.

The work carried out by I. APÁTHY in his researches into the structure and operation of the nervous system, and the struggles which he waged for this, were not unfruitful and for nothing, for he directed the attention of anatomists, histologists and physiologists throughout the world to the nervous system. It is a consequence of the ardent work of APÁTHY and others that research into the nervous system has today become a central theme internationally. Throughout the world at present great energy and particular diligence are devoted to investigations into the structure and functions of the nervous system, that wonderful and tremendous sphinx, who is so reluctant to give up her secrets. Whether or not this will lead to a result, and if so what and when, we cannot say. One thing, however, is certain. Regardless of whether an answer be attained, the work which I. APÁTHY carried out in his researches into the nervous system and in the field of the knowledge and reporting of the histological structure of the animal organism remains lasting, valuable and undying.

On the occasion of the 50th anniversary of his death, in the name of every anatomist, neurologist and histologist of Hungary and the world, with gratitude and respect I bow my head in recognition of his memory.

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