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Adjuvantibus

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J. NEMCSÓK, L. SZALAY, F. ZSOLDOS**

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SZALAY LÁSZLÓ, ZSOLDOS FERENC**

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OBITUARY



ANDRÁS FRANKÓ died under tragic circumstances in Greece on 15th of August 1990.

He was born in 1947 to a traditional family of pharmacists. He finished his studies at Attila József University in Szeged, and began his scientific career in the Limnological Institute of the Hungarian Academy of Sciences in Tihany. There he dealt with the algal population of Lake Balaton. In the mid-1970s he returned to Szeged, and continued his scientific work at the Department of Microbiology of Attila József University, as an employee of the CHINOIN Pharmaceutical Company. His early research interest focused on applied aspects of microbiology, namely the efficacy and applicability of new antibacterial and antifungal compounds. He prepared his Ph.D. Thesis from the results of these experiments, and defended it in 1981. More recently he also performed electrofusion and genetic transformation experiments with different filamentous fungi, such as *Aspergilli* and *Fusaria*. He took an active part in the education of the students by holding practical exercises and tutorials, and supervising their work for these submitted for doctoral degrees.

His main scientific publications:

- FERENCZY, L., KEVEL, F., SZEGEDI, M., FRANKÓ, A., and ROJK, I. (1976): Factors affecting high-frequency protoplast fusion. - *Experientia* 32,1156-1158.
- FERENCZY, L., FRANKÓ, A., HAMAR, N., HEGEDŰS, E., and PFLIEGEL, T. (1983): Interactions between benzimidazole fungicides and other types of systematic fungicides. - In Proc. International Symposium on Systematic Fungicides, Reinhardtsbrunn 1983, (Berlin: Akademie-Verlag), 107-112.
- FERENCZY, L., FRANKÓ, A., HEGEDŰS, E., GAJÁRY, A., and PFLIEGEL, T. (1983): Structure-activity studies on salicylanilides. - In Proc. International Symposium on Systematic Fungicides, Reinhardtsbrunn 1983, (Berlin: Akademie-Verlag), 265-269.
- FRANKÓ, A., VÖRÖS, J., HEGEDŰS, E., FERENCZY, L., and KELEMEN, M. (1984): Appearance of the phytopathogenic fungus *Diaporthe helianthi* in Hungary, and possibilities of its control. - *Tag.-Ber., Akad. Landwirtsch. - Wiss., Berlin*, 222, 309-312.
- FRANKÓ, A., HAMAR-NEMES, G., KELEMEN, M., and SZENTE, L. (1986): Antifungal activity of β -cyclodextrinperhnarinnol complex. - In Proc. International Symposium on Systematic Fungicides, Reinhardtsbrunn 1986, (Berlin: Akademie-Verlag).
- FRANKÓ, A., and FERENCZY, L. (1988). Electrofusion of *Aspergillus nidulans* protoplasts. - *Acta Microbiol. Hung.* 35, 126.
- FRANKÓ, A., and FERENCZY, L. (1988): Transformation of *Aspergillus nidulans* and *A. niger* by using pKIM7 plasmid - Progress Report 6, 42.
- FRANKÓ, A. (1990): Formation, mutation, regeneration and fusion of protoplasts from *Gibberella fujikuroi*. - In 4th Int. Mycological Congress, Regensburg 1990, Abstracts 175.
- FRANKÓ, A., and VÁGVÖLGYI, Cs. (1990): Elektrotransformation of *Aspergillus nidulans* protoplast subclasses. - In 4th Int. Mycological Congress, Regensburg 1990, Abstracts 183.
- VÁGVÖLGYI, Cs., BRÜCKNER, B., and FRANKÓ, A. (1990): Size dependent regeneration of *Gibberella* protoplasts. - *Acta Microbiol. Hung.* (in press).

Both in the laboratory and in his private life he was constantly active and full of energy. His colleagues will always remember him with affection.

DR. LÁSZLÓ SZALAY, PROFESSOR OF BIOPHYSICS IS 70 YEARS OLD



Professor LÁSZLÓ SZALAY founder and head of the Department of Biophysics at the József Attila University, Szeged was born on December 19, 1920 in Budapest. He spent his childhood at Kakucs, village in the Great Hungarian Plain near the capital. After finishing his studies with excellent results in the secondary school of Kunszentmiklós, he was enrolled to the teachers' training program in mathematics and physics at the Faculty of Natural Sciences of the University of Szeged. His interest and talent for theoretical and experimental physics was soon recognized and he became a research fellow at the Department of Experimental Physics as a third-year university student in 1943. After graduation, Dr. PÁL FRÖHLICH, professor of physics at the University of Szeged appointed him to his chair as an assistant and started his high-rising scientific career. In 1947, LÁSZLÓ SZALAY passed his examination for doctorate of philosophy (Ph.D.) in physics with "summa cum laude" on the subject of molecular luminescence. He was awarded the degree of Candidate of Physical Science in 1951 and defended his academic doctoral thesis on polarized luminescence of molecules in 1964. He founded the Department of Biophysics at the József Attila University, Szeged in 1969, gave the chair a characteristic educational and scientific profile and brought it in many respects to international level. In

addition to his duties at the University, he founded the Department of Biophysics of the Biological Research Center of the Hungarian Academy of Sciences at Szeged in 1971. The broad research field in photo-, neuro- and membrane biophysics, started here and partly conducted by him, became internationally recognized. From 1973, he has devoted all his time and energy to the education and research at the University.

Early in his undergraduate years, his research interest became engaged in the absorption and luminescence spectroscopy of organic dyes and he remained faithful to it all over his scientific career. Although the Department of Experimental Physics of University Szeged had some history in that field before his activity, the World War II caused serious losses both in teaching staff and properties. First as a young assistant, later as one of the prominent leaders of the department, he contributed substantially both to the reconstruction work and the establishment of new directions and methods in molecular spectroscopy. Dr. SZALAY was especially gifted in formulating and solving problems but was well trained in experimental works as well. He successfully joined to the work on the determination of the true luminescence characteristics of the dyes. This was not just a theoretical problem but had important practical consequences. The directly measurable fluorescence parameters (spectra, degree of polarization, quantum yield and lifetime) are sometimes heavily distorted by reabsorption and secondary (tertiary etc.) emission of light. He, together with his colleagues among others professors Á. BUDÓ and I. KETSKEMÉTY) managed to develop a method to derive the true (molecular) fluorescence characteristics from the observed macroscopic quantities, and determined the conditions where the corrections were negligible and the measurable values delivered the true values directly. The migration of electronic excitation energy among organic dye molecules was one of his favorite topics. The basic principles of the energy transfer by inductive resonance were formulated by TH. FÖRSTER (Stuttgart) at the end of the forties. Dr. SZALAY immediately recognized the importance of the FÖRSTER's theory and applied it to his polarization studies. He saw clearly how the transfer of electronic excitation energy decreased the observed degree of polarization of fluorescence. Based on his essential and principal depolarization experiments, Dr. SZALAY has become an internationally acknowledged expert on polarization and energy transfer of molecular luminescence. In the second half of the sixties, his attention turned to photobiological problems and he soon established an active workshop and later a school of photophysics/biology. He focussed his research interest to the spectroscopy of fluorescent amino acids (tyrosine, tryptophane etc.) and photosynthetic pigments (chlorophylls, carotenes etc.). He studied the role of proper spatial and spectroscopic arrangement of the light-harvesting (absorbing) pigments in the funnelling of the excitation energy to the reaction sites (centers) of photosynthetic organisms.

Although Dr. SZALAY has consistently shown up significant scientific results and has been building up connections with scientists abroad, the (political)

atmosphere in Hungary and at the University did not favour the long-term research visiting status in laboratories abroad. He was already 45 years old and an acknowledged professor of biophysics when, for the first time, he could accept a one-year fellowship to the famous photosynthesis laboratory at the University of Illinois at Urbana, USA, headed by Dr. E. RABINOWITCH.

He has built up excellent cooperation with many laboratories in different countries and is highly interested in promoting the international relations among scientists. He facilitated the participation in common scientific research programs with among others the Institute of Plant Physiology of the University of Göttingen (Dr. W. WIESSNER), the Institute of Biophysics of the University of Illinois at Urbana (Dr. C.A. WRAIGHT), the Laboratory of Photosynthesis, CNRS, Gif-sur-Yvette (Dr. J. LAVOREL), the Institute of Biophysics of the Lomonosov State University of Moscow (Dr. A. RUBIN), Laboratory of Biochemistry at Moscow (Dr. A.A. KRASNOVSKY), Christie Hospital and Holt Radiation Institute at Manchester (Dr. R. DALE) and Center of Fluorescence Spectroscopy at the University of Maryland at Baltimore (Dr. J. LAKOWICZ). Dr. SZALAY was invited lecturer in a number of international congresses, guest-professor in the USA (Albany, New York, 1970), in Germany (Tübingen, 1974) and in Egypt (Cairo, 1976). He was the organizer of several congresses and international symposia. Dr. SZALAY was present at the organization of the European Society for Photobiology (ESP) and worked for three years in the executive committee. In 1989, he was awarded the precious prize of the ESP for his pioneering activity in photobiology.

Beside his research activities, he always stressed the significance of teaching. Dr. SZALAY co-authored two books (Luminescence in Biology and Medicine, 1983 and Biophysics, 1985) and edited numerous university textbooks and practice-manuals for students in medicine and biology. About ten of his co-workers have been awarded the degree of Candidate of Biological Science and at least three times more students have made the Ph.D. work under his supervision. Since his enrollment as freshman half a century ago, Dr. SZALAY has attached firmly to our University. He has never left it (he kept the chair when he was the director of the Institute of Biophysics of the Biological Research Center of Szeged) although the temptation for better research conditions was sometimes very high. He served the institution on different levels: Vice-Dean (1956-59) and Dean (1969-72) of the Faculty of Natural Sciences, Pro-Rector (1965-68) of the University and Head of the School of Life Sciences during two terms.

It is impossible to close the appreciation without mentioning his kind personality. Even in critical situations, he can find the right way to treat people. This is a rare and highly positive feature and its cohesive effect on the structure and function of the School of Life Sciences was utilized several times. He never thrust himself forward but always did his best to help the scientific career of others. One of his striking achievements has been the realization of international cooperation with

numerous laboratories, and he offered many opportunities for his co-workers. He always remained a soft-spoken man of no pretension and guided us imperceptibly to the world of science, education, culture and humanity. We are very much grateful to professor SZALAY and wish him lifetime of happiness and good health.

DR.PÉTER MARÓTI

DIE 50 JAHRE DES ANTHROPOLOGISCHEN LEHRSTUHLES IN SZEGED

Ein sehr wichtiges Datum der ungarischen Anthropologie ist 19. Oktober 1940, wann in der Szegeder Universität von dem Minister für Religion- und Unterrichtswesen ein anthropologisches Institut gegründet wurde.

Zwischen den Jahren von 1930 bis 1940 hat sich leider in der ungarischen Wissenschaft – durch in erster Linie von LAJOS MÉHELY, der ein Zoologer war – die sogenannte "rassenbiologische" Wirkung gezeigt. In den Namen des Szegeder Institutes wurde diese nicht schmeichelhafte Benennung angeführt. Das neuentsandene Institut niemals war ein Befürworter oder ein Pfleger dieser Richtung geworden. Es muss für den damals ernannten Leiter des Institutes, Professor LAJOS BARTUCZ, bedankt werden. Er hat damals gleichzeitig das Szegeder Institut und auch das Anthropologische Institut in der Budapester Universität nach dem Tode von Professor AURÉL TÖRÖK im Jahre 1912 geleitet. Dieses Institut hat nach dem Tode von AURÉL TÖRÖK ohne einen ernannten anthropologischen Professor funktioniert.

Über die erste 30-jährige Tätigkeit des Szegeder Institutes wurde früher eine Bewertung veröffentlicht (LIPTÁK im Jahre 1971 in Acta Biol.Szeged.), und jetzt gehen wir auf diese Sache nicht detailliert ein. Es muss aber erwähnt werden, dass unter der Leitung von Professor LAJOS BARTUCZ das Südungarische Wissenschaftliche Institut entstand. Das Ziel dieses Institutes war es, die Publikationen aus den biologischen, anthropologischen, ethnographischen und archäologischen Bereichen des ungarischen Südtieflandes zu veröffentlichen. Diese Anregung ist leider wegen des Krieges geschreitert.

LAJOS BARTUCZ war der Leiter des Szegeder Institutes bis 1959, und dann hat zwischen 1960 und 1980 PÁL LIPTÁK, früher als ein Dozent und später als ein Professor die Forschungs- und Unterrichtsarbeit des Lehrstuhles (in neuerer Zeiten ist das die offizielle Benennung anstatt des Institutes) geleitet. Seit 1980 hat der Verfasser dieser Zeilen diese ehrevolle Aufgabe erhalten.

Die Gesamtzahl von Lehrer des Lehrstuhles war nie zu gross. In den früheren Zeiten bis 1960 wurde die Forschungs- und Unterrichtsarbeit ausschliesslich durch einen Professor und einen Assistent durchgeführt und dann die Gesamtzahl auf 1990 erweitert wurde und heute werden ein Professor, eine Dozentin, ein jüngerer Assistent und zwei Forscher in dem Lehrstuhl gearbeitet. Zu dieser Zahl gehört auch der Lehrer der biologischen Fachmethodik. Neben den Lehrern werden bei der Lösung der Aufgaben von drei technischen Mitarbeitern geholfen.

Von dem Lehrstuhl werden folgenden Lehraspiranten, Forscher und Studenten unterrichtet:

Lehraspiranten, bei denen die Fächer Biologie und Chemie, Biologie und Geographie und als Ergänzungsfach Biologie sind. Die Forscher, bei denen das Fach Biologie ist und die Studenten, die Archäologie studieren.

Leider in den vergangenen 50 Jahren entstand eine radikale Reduzierung der wöchentliche Vorlesungszahl.

Die Forschung hat sich, von Anfang an, auf das Studieren der im Gebiet von ungarischen Südtieflandes gefundenen historischen anthropologischen Funden gerichtet. Das wird von der Skelettsammlung, die mehr aus 13000 Funden besteht, des Lehrstuhles gesichert. Der Gründer dieser Sammlung war FERENC MÓRA, der in den 30-er Jahren Ausgrabungen gemacht hat. Diese Sammlung ist von 1950 bis 1960 signifikant gewaschen wegen der opfervollen Arbeit der Archäologen der Museen des ungarischen Südtieflandes. Bei dieser Sache spielt eine sehr wichtige Rolle OTTO TROGMAYER der Direktor des Szegeder "Ferenc Móra" Bezirksmuseums.

Man kann für 10000 schätzen, die Zahl der sogenannten ethnischen Untersuchungen, die sich die heute lebenden Erwachsenen beziehen. Von Ende der 50-er Jahre bis 1984 haben wir die Forscher des Lehrstuhles mit der Zusammenarbeit von Mitarbeitern anderer Anstalten, die Untersuchungen des Körperwachstums bei mehr als 80000 Kindern und Jungen verwirklicht.

Das Szegeder Lehrstuhl nimmt sehr aktiv bei der Bildung der Anthropologen teil. In Rahmen der Universitätsbildung wurden bei unserem Lehrstuhl 94 Diplomarbeit gefertigt. Von den absolvierten Studenten (von 1960) konnten 27 Personen Doktorarbeit schreiben und verteidigen aus anthropologischen Themen. In dem Lehrstuhl wurden vier akademische Kandidat- und zwei Doktorarbeit geschrieben.

Mit der Ausnahme von einem oder zwei Jahre hat der Lehrstuhl immer einen solchen Leiter gehabt, der ein Universitätsprofessor war.

Bei dem Ausbau der internationalen Beziehungen des Lehrstuhles spielte eine entscheidende Rolle und heute spielt auch eine wichtige Rolle die Periodik der biologischen Lehrstühle, namens die Acta Biologica Szegediensis. Während der Vergangenheit von 40 Jahre von dieser Periodik ist und war der Hauptredakteur hauptsächlich ein Anthropologer. Man kann die Zahl der Publikationen für mehrere Hundert schätzen, welche von Mitarbeitern des Lehrstuhles von Anfang an bis zum heutigen Tag geschrieben wurden. Diese Publikationen werden teilweise in den ungarischen, teilweise in den ausländischen Zeitschriften veröffentlicht. Einen guten Überblick über die Themen kann man von der Bibliographie in ersten Linie bekommen, die in der Zeitschrift "Anthropologiai Közlemények" (Anthropologische Mitteilungen) veröffentlicht werden.

Besonders von 1960 an, besuchten zahlreichen ausländischen Fachleute den Lehrstuhl, und einige von ihnen hat mit uns gemeinsamen Themen gearbeitet hatte.

Unsere Gäste waren:

aus der BRD: I.SCHWIDETZKY, H.WALTER, V.P.CHOPRA, H.SCHMIDT, R.PROTSCH, L.KÁROLYI, I.KÜHL, H.DANKER-HOPFE;

aus Bulgarien: S.MUTAFOV, I.PETROV, G.NIKOLOV, M.NIKOLOVA;

aus der DDR: H.GRIMM, K.SOMMER, H.BACH, L.SCHOTT, H.ULLRICH, U.CREUTZ, I.WUSTMANN;

aus Frankreich: G.OLIVIER, H.NABIL;

aus Griechenland: N.XIROTHIRIS;

aus Indien: S.NEGI, R.QAMRA, V.RAMI REDDY, S.TEN;

aus Mongolien: N.S.ODJAV;

aus Österreich: E.M.WINKLER;

aus Polen: P.BERGMANN;

aus der Sowjetunion: G.F.DEBETZ, I.CSEBOKSZAROV, J.CESNY, R.JANKAUSKAS, N.ZVETKOVA;

aus der Schweiz: R.MENK;

aus der Tschechoslowakei: M.STLOUKAL, M.DOKLÁDAL, K.HAJNIS, S.TITLBACHOVÁ, M.CERNY, J.JAKAB, J.JAMBOR, V.SMIRCKA;

aus den USA: M.FINNEGAN, B.HEATH, S.MOLNAR, R.EIBEN, S.MARITS, T.KOERTVELYESSY, H.CRAWFORD, J.O'SHEA, S.LOTH, I.ISCAN, E. REGA;

aus Jugoslawien: Ž.GAVRILOVIĆ, M.GIRIĆ, L.SZEKERES.

Die Erfolge und Misserfolge der vergangenen 50 Jahre fordern eine bedächtige und überlegte Bewertung an. Die Entwicklung der ungarischen Anthropologie und die, von den ausländischen Kollegen anerkannten Ergebnisse fordern an, dass wir unsere bisherige Tätigkeit sehr kritisch und die Zukunft anblickend auswerten. Die Entwicklung ist zweifellos in den vergangenen 50 Jahren. Aber diese dürfen wir nicht für so bewerten, dadurch wir überheblich sein werden. Wir sollen die Zielsetzung der internationalen Anthropologie und Humanbiologie, und die Aufgaben der Zukunft ermessen und wir als die Mitglieder einer älterer Generation, müssen in maximalen Massen bei der Entwicklung der jüngeren und begabten Kollegen helfen. Es ist sehr wünschenswert, dass sie viel mehr erreichen können, als wir. Auf dieser Art und Weise wird der gute Ruf der ungarischen Anthropologie "verältert" und so können sie viele, nützliche Beziehungen mit den ausländischen, zusammenarbeitenden Kollegen ausbauen.

Zum 50-sten Jubiläum organisierten wir eine wissenschaftliche Tagung. Dort wurde gesichert, alle Teilnehmer über seine eigenes Thema Vorträge halten zu können. Auf dieser Art und Weise könnten wir ein Bild über die Ideen ausländischer Forscher bekommen, die als Informationen zu unserer Arbeit beigetragen werden könnten.

Mit diesen Gedanken wünsche ich den zukünftigen Mitarbeitern des Lehrstuhles für Anthropologie der Szegeder Universität, viel Erfolg und mehrere

Ergebnisse, als es früher erreicht wurde. Mit diesen Erfolgen können sie eine Anerkennung nicht nur für die ungarische Anthropologie sondern für die unsere Szegeder Universität zuehren. Ich möchte der früheren und heutigen Leitung der Universität von Szeged meinen aufrichtigen Dank und meine Anerkennung dafür aussprechen, dass Sie die Anthropologie immer mit Anerkennung und Unterstützung akzeptiert haben.

DR. GY. L. FARKAS

RELATIONSHIP BETWEEN IAA CONTENT AND ADVENTITIOUS ROOT FORMATION IN BEAN SEEDLINGS TREATED WITH CCC

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(Received: June 15. 1990)

Abstract

We investigated the connection between the IAA content and IAA distribution in intact bean seedling, stem- and primary leaf-cuttings, originating from seeds treated with CCC.

The promotive effect of CCC on the rooting process in intact plants and stem-cuttings correlates with a higher IAA-content in the basal part of hypocotyls of the treated plants.

After the treatment with CCC the IAA content of the primary leaves increases, whereas that of the petiole is lower than the control. Formation of adventitious roots in CCC-treated leaf-cuttings is inhibited. This inhibition can be released by IBA, ABA and ethylene-generator treatment. In all three cases, with the STS pretreatment, the initiation of root primordia can be prevented. These results indicate, that ethylene is the hormone that can play a key role in this system, in the induction of adventitious roots.

Key words: abscisic acid, adventitious roots, bean, CCC, indole-3-butyric acid, IAA content, IAA distribution, ethylene, *Phaseolus vulgaris*, rooting, STS.

Introduction

The change in the shoot/root ratio in the CCC (chlorocholine-chloride)-treated seedlings is not only the result of the inhibition of shoot growth, but CCC also stimulates the formation (GIRI et al., 1982) and elongation of roots, too (HOFFMAN, 1973).

The retarding effect of CCC on shoot growth is generally explained by the inhibition of certain steps of the mevalonic acid pathway (GRAEBE, 1987). The stimulating effect of CCC on rooting can be correlated with its effect on IAA metabolism, and it is generally accepted that IAA has an important role in rooting (TORREY, 1976; HARTMAN and KESTER, 1983).

In our work we investigated the relationship between the rooting process and IAA content in intact beans, stem- and primary leaf-cuttings, originating from seeds treated with CCC.

Materials and Methods

In our experiments we used *Phaseolus vulgaris* L. cv. Juliska seedlings. After the seeds had been soaked in a CCC (Merck-Schuchardt) solution of 500 mg/l in a thermostat at 25°C, they were sowed in garden mould. Plants were grown under controlled conditions (CONVIRON Cabinet model EF7, equipped with 4x50 W Sylvania incandescent lamps, at 25/20°C day/night temperatures respectively, 16 h illumination with 60 Wm⁻² and 65% relative humidity). The IAA content of the hypocotyls was measured in six-day-old plants, while that of the primary leaves in fourteen-day-old ones.

Measurement of IAA content: the IAA contents of 100 hypocotyls and that of 100 primary leaves were determined after extraction with 80% cold methanol. The extract was evaporated to dryness under reduced pressure, then 0,5 M K₂PO₄ solution was added (pH 8,5).

The purification and fractionation were carried out according to the methods of KAMISAKA and LARSEN (1977). The amount of IAA present in the final acidic ether fraction was measured by the indole- α -pyrone fluorescence method (KNEGT and BRUINSMA, 1973; HEMBERG and TILLBERG, 1980) with a Perkin-Elmer spectrofluorimeter.

Stem- and primary leaf-cuttings were rooted in a fourth strength Hoagland nutrient solution supplemented with 1 ml of complex solution of micronutrients.

In order to promote rooting the primary leaves were evenly moistened with 1 μ l of 1 mg/l indole-3-butyric acid (IBA, Reanal), tryptophan (TRY, Reanal), abscisic acid (ABA, Sigma), and 1 μ l of 10 mg/l gibberellic acid (GA₃ Reanal) solution containing 0,05% TWEEN 80 as a detergent.

The ethylene treatment was carried out by "Rol-Fruct" an ethylene-generator, containing 40% 2-chloroethyl-phosphonic acid (Chinoin Co., Budapest). 0,04 μ g of agent was spread over the entire surface of one leaf.

All treatments were repeated twice within an hour.

0,1 mM silver thiosulfate (STS, 0,1 mM AgNO₃ + 0,1 mM sodium thiosulfate) was applied to inhibit the effect of ethylene.

Results and Discussion

The effect of CCC-treatment on the growth of bean seedling is presented in Table 1. and Figure 1.

These data show that besides retarding seedling growth and increasing stem-thickening, CCC results in thicker and longer roots. The stimulating effect of CCC on rooting can be noticed, not only in intact beans, but also in stem-cuttings (Fig. 2).

Table 1. Effect of CCC on the growth of bean plants (Data of six-day old plants)

	hypocotyl				root		
	length (mm)	thickness (mm)	fresh weight (g)	dry weight (mg)	fresh weight (g)	dry weight (mg)	length of primary root (mm)
Control	67,5 \pm 3,2	3,4 \pm 0,25	1,325 \pm 0,3	56,42 \pm 4,06	0,176 \pm 0,014	15,47 \pm 2,45	80,5 \pm 9,5
Treated	35,2 \pm 2,3	4,8 \pm 0,23	1,038 \pm 0,19	50,16 \pm 4,50	0,310 \pm 0,012	18,56 \pm 2,22	125,5 \pm 11,5

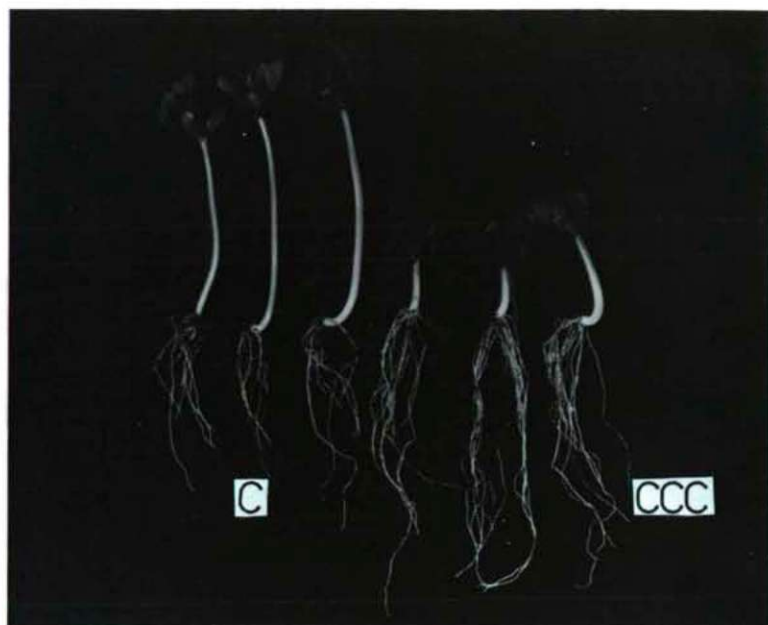


Fig. 1. Effect of CCC on the growth of six-day old *Phaseolus vulgaris* cv. Juliska seedlings

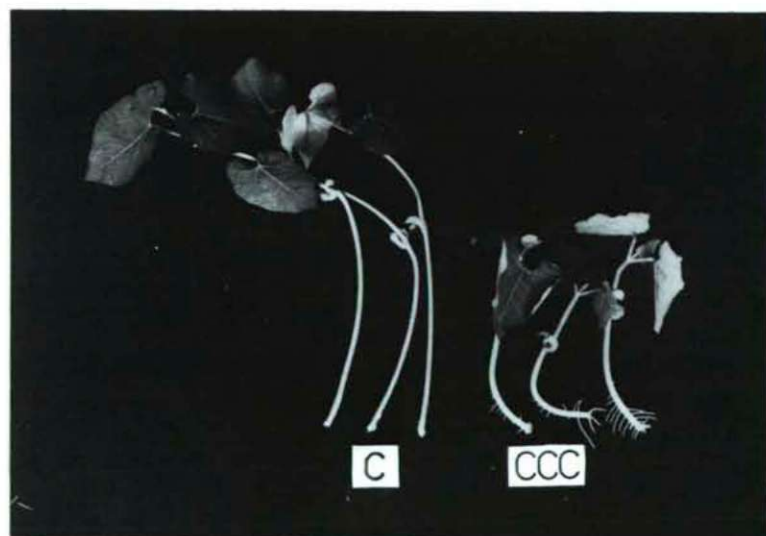


Fig. 2. Adventitious rooting in hypocotyls of bean. Left: control, right: treated with CCC.

CONNECTION BETWEEN THE IAA CONTENT OF HYPOCOTYLS AND THE EXTENT OF
ROOTING

It is well-known that plant hormones play an important role in the rooting process. Auxins seem to be the most important of these, since in the case of exogenous application, IAA or synthetic auxins, stimulate formation of adventitious roots (TORREY, 1976; HARTMAN and KESTER, 1983).

Table 2. illustrates the distribution of the IAA content in the apical and basal parts of hypocotyls. As these data show, in the hypocotyls of the treated plants there is less IAA than in the control. However, the IAA concentration of the hypocotyls (the amount of IAA per gram fresh weight) is higher, because the hypocotyls of the treated plants are much shorter than those of the untreated ones, and their fresh weight is also smaller. It is the amount of IAA in the basal part of the hypocotyls that is of importance in the rooting process. Our results demonstrate that the distribution ratio of IAA between the apical and basal parts of the treated plants is 1:3,69, whereas that of the control is 1:1,41.

Table 2. Effect of CCC on the IAA content and quantitative distribution between the apical (A) and basal (B) parts of hypocotyls

IAA content	Control		Treated	
	A	B	A	B
ng IAA/hypocotyl part	5,1±0,8	7,2±0,8	2,3±0,6	8,5±0,55
ng IAA g ⁻¹ fresh mass	7,76	9,23	5,75	17,45
Distribution% of the total IAA quantity	41,46	58,54	21,29	78,71

We found a similar tendency in respect of IAA concentration, the ratios are A:B = 1:1,90 and A:B = 1:3,03 in the control and in the treated plants respectively.

These results unambiguously indicate that the stimulating effect of CCC on rooting can be correlated with the higher amount of IAA in the basal part of hypocotyls. At the same time the basal parts of the hypocotyls of treated plants exhibited a higher ethylene production (NAGY and TARI, 1986).

EFFECT OF CCC TREATMENT ON ROOTING OF PRIMARY LEAVES

Since the primary leaves of bean seedlings can root very well and are excellent subjects to study the hormonal regulation of adventitious rooting, it was interesting to investigate whether the stimulating effect of CCC on rooting would prevail in leaves as well. For rooting experiments primary leaves of fourteen-day-old bean

plants were used. Results are presented in Fig. 3. In the case of bean leaves we could not observe any stimulating effect of CCC on rooting, on the contrary, the formation of root primordia were definitely inhibited in petioles.

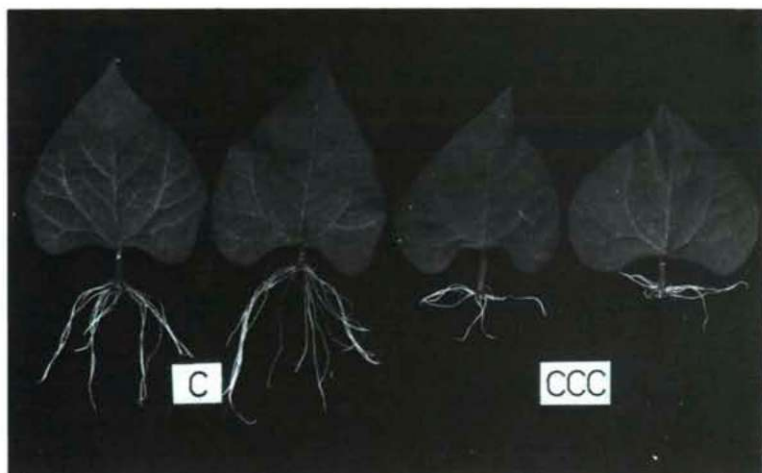


Fig. 3. Adventitious root formation of detached primary leaves of CCC treated bean plant

CONNECTION BETWEEN FORMATION OF ADVENTITIOUS ROOTS AND IAA CONTENT OF PRIMARY LEAVES

The IAA content of the primary leaves was measured at the time of their placement in rooting solution. Our results are summarized in Table 3.

We concluded that the IAA content of the treated leaves is higher than that of the untreated, but the majority of this IAA as contrasted with the control, can be found in the blade. After CCC treatment the distribution of IAA changed in the case of leaves as well, but this change is disadvantageous for adventitious rooting.

Table 3 Effect of CCC on the IAA content of the primary leaves of bean

IAA content	Control		Treated	
	Lamina	Petiole	Lamina	Petiole
ng IAA/leaf part	1,57±0,16	2,31±0,22	3,0±0,21	1,52±0,17
ng IAA g ⁻¹ fresh mass	3,2	28,5	4,15	20,4
Distribution% of the total IAA quantity	40,46	59,54	66,37	33,63

THE EFFECT OF VARIOUS HORMONE TREATMENTS ON ADVENTITIOUS ROOT FORMATION OF PRIMARY LEAVES

Knowing the physiological fact that growth and development of plants are regulated by hormones which are in interaction with each other, we applied various hormone treatments to promote the rooting process of primary leaves of CCC-treated seedlings. Data represent the results on the 10th day following the treatment. Later, to estimate the effectiveness of these treatments, we shall consider leaves of CCC-treated plants as the control.

Since gibberellins and cytokinins generally inhibit adventitious root formation, these hormones were not applied as an independent treatment.

Effect of IBA treatment on formation of adventitious roots

The inductive phase of the rooting process is characterised by high IAA-oxidase activity and low IAA content; in the second, initiative phase the IAA-oxidase activity decreases and the IAA content rises (GASPAR, 1981; MALDINEY et al. 1986; MATO et al. 1988; MONCOUSIN et al. 1988). In the initiative phase rooting needs a high auxin level (WELANDER, 1983; MALDINEY et al. 1987).

IBA, a compound generally used to stimulate adventitious rooting, acts as the auxin reserve at the time of high auxin oxidase activity – as it is not oxidized by the peroxidases –, when in the second phase of rooting the IAA-oxidase activity decreases, the IBA is metabolised into IAA (EPSTEIN and LAVEE, 1984; ALVAREZ et al. 1989).

Consequently, it is not the IBA that stimulates rooting, but the IAA formed from it. Furthermore IBA – like other synthetic auxins – alters the IAA-oxidase activity, in this way also increasing the endogenous auxin content for rooting (KEVERS et al. 1981; DRUART et al. 1982; MATO and VIEITEZ, 1986).

Besides those mentioned so far, IBA treatment modifies the distribution of cytokinins in the leaves as well which results in less cytokinin in the petiole of the treated leaves than that of the control; this circumstance is advantageous for rooting (BRIDGALL and VAN STADEN, 1985). In our case this effect can be of great importance since the CCC treatment increases the cytokinin level (SKENE, 1968).

The effectiveness of IBA in stimulating rooting is probably in connection with high ethylene production in the region of adventitious root formation, throughout the majority of the rooting process (RIOV and YANG, 1989).

The result of IBA treatment is presented in Figure 4. The rooting process of the primary leaves was effectively promoted by IBA. In our experiments pretreatment with STS prevents the effect of IBA in root initiation.

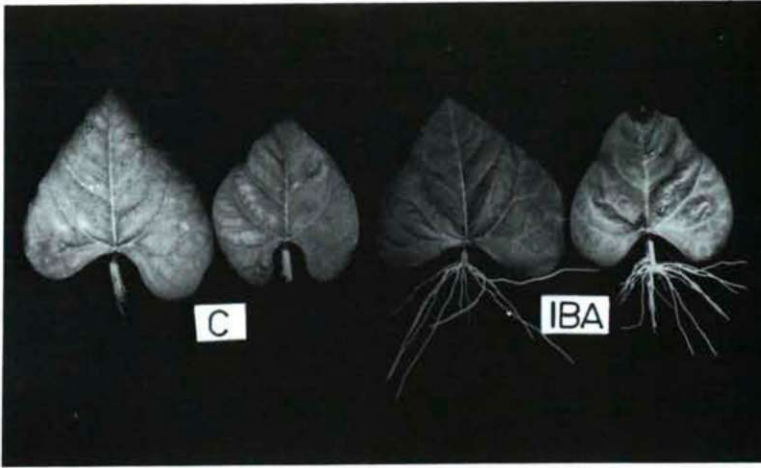


Fig. 4. Effect of IBA on the adventitious root formation of detached primary leaves of bean plant pretreated with CCC

Effect of tryptophan treatment on adventitious root formation of primary leaves

In the inductive phase a favourable auxin level can be achieved by a tryptophan treatment, a precursor of IAA biosynthesis, the result of which is presented in Fig. 5. Tryptophan treatment has no effect on the process of root formation in this case.

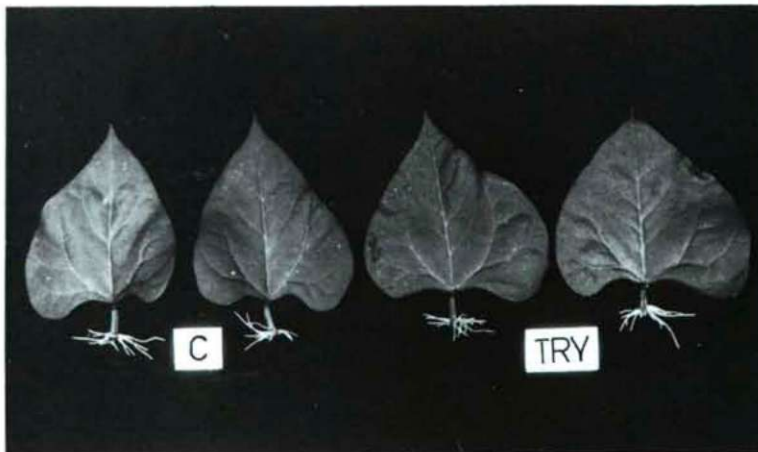


Fig. 5. Effect of tryptophan on the adventitious root formation of detached primary leaves of bean plant pretreated with CCC

Effect of tryptophan and gibberellin treatment on adventitious root formation of primary leaves

It is known that the transformation of tryptophan into IAA is stimulated by GA (JINDAL and HEMBERG, 1976; LAW and HAMILTON, 1984). According to KUTAČEK (1985) the GA treatment stimulates the activity of the enzyme of IAA biosynthesis, the indole-3-acetaldehyde oxidase; LAW (1987) reported that the GA transforms the L-tryptophan into D-tryptophan, which will become the precursor of auxin synthesis. The effect of the tryptophan and gibberellin treatment on the rooting of leaves is presented in Fig. 6. This treatment was also ineffective in initiating root primordia.

From the ineffectiveness of the tryptophan and tryptophan plus gibberellin treatments we can conclude that the increasing IAA synthesis due to the increasing tryptophan level, does not take place, or is negligible with regard to rooting in treated leaves.

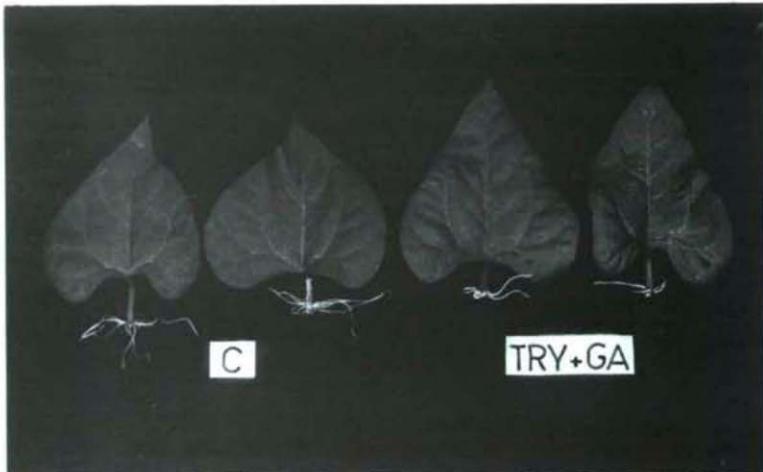


Fig. 6. Effect of tryptophan and gibberellin treatment on the adventitious root formation of detached primary leaves of bean plant pretreated with CCC

Effect of ABA treatment on adventitious root formation of primary leaves

ABA treatment is also effective in initiation of adventitious roots (BATTEN and GOODWIN, 1978). In the natural process of adventitious rooting the endogenous level of ABA rises (FOONG and BARNES, 1981), since the leaf tissues synthesise ABA under the influence of stress (WALTON, 1980; SOTTA et al. 1985; BERTHON et al. 1989).

The effect of ABA treatment on the rooting of bean leaves is presented in Fig. 7. In our experiments the promoting effect of ABA can be prevented by STS pretreatment.

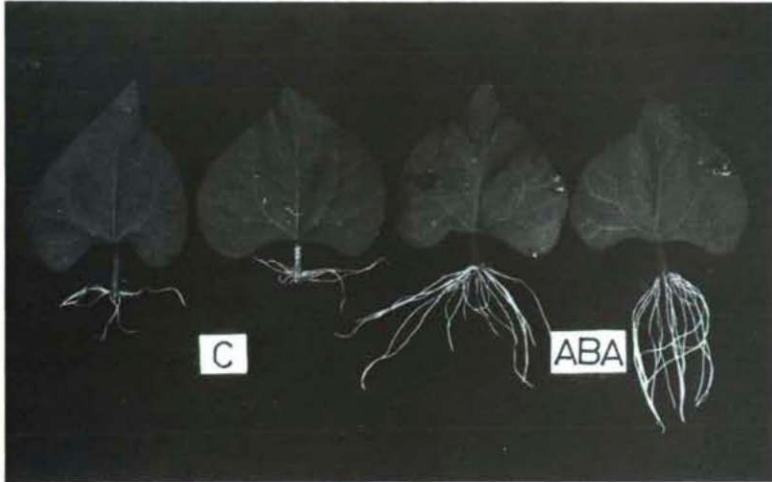


Fig. 7. Effect of ABA treatment on the adventitious root formation of detached primary leaves of bean plant pretreated with CCC

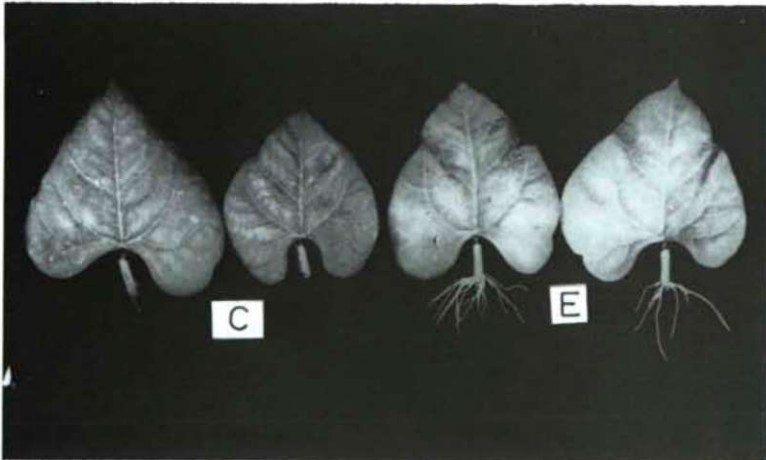


Fig. 8. Effect of ethylene-generator (E) treatment on the adventitious root formation of detached primary leaves of bean plant pretreated with CCC

Effect of ethylene generator on adventitious root formation of primary leaves

It is well known that ethylene stimulates the formation of adventitious roots in leaf-cuttings (FABIJAN et al. 1981; ROBBINS et al. 1983; 1985; RIOV and YANG, 1989), if the applied concentration is sufficiently low (JUSAITIS, 1986; LIU et al. 1990).

The effect of "Rol-Fruct" treatment on rooting of primary leaves is presented in Fig. 8. The stimulating effect of the ethylene-generator on rooting is inhibited by the STS pretreatment in our experiments.

Conclusions

The stimulating effect of CCC on rooting in intact plants and stem cuttings correlates with the higher IAA level and ethylene production in the basal part of the hypocotyls in the treated plants.

The higher IAA level in the primary leaves of bean did not result in an increase in formation of adventitious roots, because the IAA content of the petioles was reduced by the CCC treatment.

In the case of the plants originating from seeds soaked in CCC the rooting process of the primary leaves was effectively promoted by IBA, ABA and ethylene-generator treatments. The common feature of IBA and ethylene is that they are capable of producing a high auxin level for rooting, IBA by metabolising into IAA (EPSTEIN and LAVEE, 1984), the ethylene by means of raising the endogenous auxin content (VARGA et al. 1982; WEIGEL, 1984).

The rise in the endogenous ethylene level increases the endogenous ABA content also (MAYAK et al. 1972; KORABLEVA, 1986). The rise in the ABA level, on the other hand, in other cases results in the elevation of ethylene production (MAYAK and DILLEY, 1976; GOREN, 1979; LIEBERMAN et al. 1977; SAGEE et al. 1980; WRIGHT, 1980; RIOV et al. 1990).

The CCC treatment is likely to inhibit the formation of the appropriate endogenous ABA concentration in bean plants; as this inhibition of ABA biosynthesis has been observed in *Cercospora rosicola* (NORMAN et al. 1983).

It has been known for a long time that auxin increases ethylene production (YANG and HOFFMAN, 1984), so the effectiveness of IBA in initiation of root primordia may be due to the induction of ethylene production by the auxin in the region of adventitious root formation (RIOV and YANG, 1989).

The common feature of our IBA, ABA and ethylene generator treatments is that all three are capable of inducing intensive ethylene production. In all the three cases, in our experiments with the STS pretreatment, the initiation of root primordia in the leaf-cuttings can be prevented. Therefore, on the bases of our results ethylene is the hormone that can play a key role in this system, in the induction of adventitious roots.

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THE VEGETATION MAP OF THE SZAPPAN-SZÉK UNESCO BIOSPHERE RESERVE CORE AREA, KISKUNSÁG NATIONAL PARK HUNGARY

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Abstract

The paper presents the vegetation map, on a scale of 1:4500, of the Szappan-szék UNESCO biosphere reserve core area and a short description of the mentioned vegetation units.

The dominant association in the exceedingly alkaline water of the Szappan-szék lake is *Parvipotameto-Zannichellietum*. The following associations form zones after the drying out of the lake (towards the deeper parts): *Agrostio-Caricetum distantis*, *Lepidio-Puccinellietum limosae* and *Suaedetum maritimae hungaricum*. The dominant associations of the surrounding sandy territories are *Brometum tectorum* and *Festucetum vaginatae*. The *Diplotaxi-Agropyretum* and *Tribulo-Tragetum* associations can be found in the old-fields and the abandoned vineyards, respectively. A scheme of the possible transformation processes of these weed communities into the natural ones is also presented.

The most important environmental problems of the core area can be traced back to the regional decrease of the water-table.

Key words: aerial photograph, biosphere reserve, halophilic vegetation, saline lakes, vegetation mapping, vegetation of sand dunes

Introduction

The Szappan-szék UNESCO biosphere reserve core area is situated in territory IV of the Kiskunság National Park (Fig. 1). It borders on the Szívós-szék core area, the vegetation map of which has been presented (BAGI, 1988). The area of Szappan-szék is about 25 hectares (cf. TÓTH, 1985).

Szappan-szék is one of the saline lakes which has emerged in a dip between the sandy dunes, that consist of sand of Danubian origin. It covers a long stretch with an orientation in a NW-SE direction due to the most frequent NW directional wind. The lake emerged at the end of the Pleistocene period. It has been proven that the water-impermeable carbonate mud layer was sedimented directly onto the loess of the Würm₃ glacial (MOLNÁR and MURVAI, 1976). On the strength of this finding, the lake can be regarded as the oldest one in the Kiskunság National Park since the surrounding lakes undoubtedly emerged in the Holocene period (cf. MIHÁLTZ and FARAGÓ, 1946; ZÓLYOMI, 1953; MUCSI, 1963; JÁRAI-KOMLÓDI, 1966; 1969). The difference in the location of the buried carbonate mud and the present situation of

the lake bed shows that the extension and location of Szappan-szék had changed a lot since the time of its emergence. The area of the lake, in all probability, decreased since a carbonate mud layer has also been deposited under the bordering sand dunes.

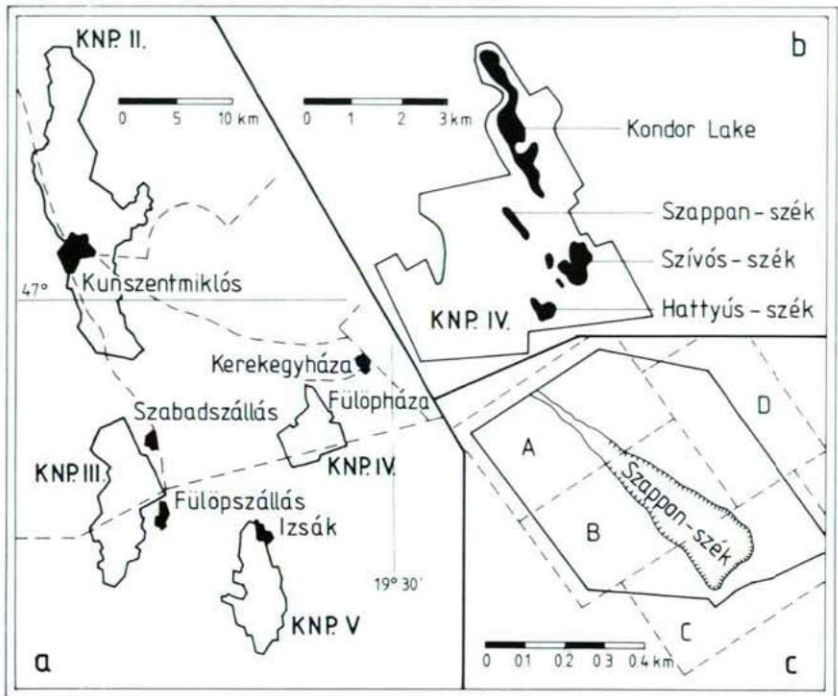


Fig. 1. Geographical location of territory IV of the Kiskunság National Park (a) and the Szappan-szék biosphere reserve core area (b). The figure 'c' shows connection of four map sheets (A,B,C,D).

Szappan-szék belonged to the lakes with the most permanent water level; it very rarely dried out entirely in the past (e.g. in the '40s), but the decrease of the water level of Szappan-szék was especially in recent years, and, furthermore, it dried out in years 1987-1989. According to opinion of many scientists, the permanent lack of water is traced back to the undesirable effects of water management; The water management works implied a drastic interference in the life of lakes: It led to a regional decrease in the water-table, which is the water source of these lakes (ANDÓ, 1964). The direction and intensity of salt and water transport were considerably modified by the diking. Due to canalization, the water impervious carbonate mud layer has been damaged, therefore, a large amount of water may infiltrate to the lower sand layers (MOLNÁR, 1985). Apart from the decrease of the average water level, the salt loss of the lakes can also be detected. The water of the Szappan-szék

lake shows the most alkaline pH reaction in the Kiskunság National Park. (Its Hungarian name refers to this, the word Szappan is soap in English.) The pH value of the water may be 11 by the end of summer.

The fast hydro- and haloecological changes caused a radical transformation in the vegetation of the lake. Such drastic vegetation change has to be taken into consideration in the sandy territories that surround the Szappan-szék core area: a significant part of these territories was plough land, the cultivation of which was ceased for an environmental protection reason. Therefore, an important task is also to pay attention to the regeneration processes of the natural vegetation of the sand dunes. Apart from this, vegetation transformation processes are induced by the decreasing water-table (SZODTFRIDT and FARAGÓ, 1968; SZUJKÓ-LACZA, 1986). Hence, it is important to elaborate and documentate the present state of the vegetation of the biosphere reserve core area and its surroundings. The first step is the preparation of a vegetation map.

Materials and Methods

The vegetation map has been prepared on the basis of a colour aerial photograph, the magnification of which was to a scale of 1:5000. The mapping of the relatively narrow zones of vegetation in the lake required a magnification of the aerial photograph to a scale of 1:4500, hence, the scale of the published map is also 1:4500. The map shows the core area with its surroundings. The map is issued in the form of sheets joining without overlap. The four map sheets and their key are formally published as an appendix to this paper (BAGI, 1987; 1988).

The description of vegetation units follows the system and methodology of the Zürich-Montpellier Phytosociology School, despite the fact that the categorization of several transitional vegetation units (which have been developed due to the intensive vegetational transformation processes) encountered difficulties. The denomination of the species and syntaxa are according to the work of Soó (1980).

The map was elaborated in 1987.

Results

The associations of the mapped territory can be classified into two quite different groups. The vegetation units of the first group have evolved on soil deposited onto the terrestrial sediment of the former bed of the lake. Due to the water-impermeability of carbonate mud, these associations have high water demands. Depending on the salt content of the surface layers, the spectrum of the soils covers the soil-types from solonchaks to solonetzic meadow soils (VÁRALLYAY et al., 1985). Dryness tolerant associations belong to the other group. These vegetation units have evolved on sandy soils.

The mentioned cenotaxa may be classified by the cenosystematical order as follows:

- LEMNO-POTAMEA Soó 68
 Potametea TX. et PRSG. 42
 Ruppialia J.TX. 60
 Ruppion maritimae BR.-BL. 31
 Parvipotameto-Zannichellietum pedicellatae Soó (34) 47
 Ranunculo (Batrachio) aquatili-Ranunculetum polyphylli Soó (33) 47
- PUCCINELLIO-SALICORNEA Soó 68
 Thero-Salicornetea (TX.55) TX. et OBERD. 58
 Thero-Salicornion (BR.-BL. 33) TX. 50
 Suaedetum maritimae hungaricum Soó 47
 - *Puccinellia* facies
 Cypero-Spergularion SLAVNIC 48
 Acorelletum pannonicum Soó (39) 47
 - *puccinellietosum limosae*
- FESTUCO-PUCCINELLIETEA Soó 68
 Puccinellietalia Soó 40
 Puccinellion peisonis (WENDELBG. 43) Soó 57
 Lepidio-Puccinellietum limosae (RAPCS. 27) Soó 57
 - *Puccinellia* facies
 - *Acorellus* facies
 - *Aster tripolium* facies
 Juncion gerardii WENDELBG. 43
 Agrostio-Caricetum distantis (RAPCS. 27) Soó 30
 - *festucetosum pseudovinae*
 Artemisio-Festucetalia pseudovinae Soó 68
 Festucion pseudovinae Soó 33
 Achilleo-Festucetum pseudovinae (MAGYAR 28) Soó (33) 45
- FESTUCO-BROMEAE JAKUCS 67
 Festucetea vaginatae Soó 57
 Festucetalia vaginatae Soó 57
 Bromion tectorum Soó 40
 Brometum tectorum (Soó 25) BOJKO 34
 - *Secale silvestris* facies
 - *Cynodon dactylon* facies
 Festucion vaginatae Soó 29
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The cenological characterization of these vegetation units is reported at a depth necessary for the interpretation of the units on the vegetation map. The cited literature can be regarded as a comparative cenological standard.

a) VEGETATION OF THE LAKE BED

Due to the high pH value of the water, *Parvipotameto-Zannichellietum pedicellatae* association develops in the water of the lake. A large amount of the biomass of *Zannichellia palustris* ssp. *pedicellata* and the *Potamogeton pectinatus* is produced towards the middle of summer. The denominative species of *Ranunculo aquatili-Ranunculetum polyphylli* association can also be found (PIETSCH, 1982).

After the drying out of the lake, *Suaedetum maritimae hungaricum* association develops in the deepest part of the lake, where perennial species are not able to survive the long inundation. The coverage of the annual vegetation sometimes reach a level of 80%. The decisive majority of the vegetation consists of only one species, which is *Suaeda maritima*. The *Chenopodium glaucum* and *Chenopodium opulifolium* are found by threads. The pH value of the surface layer of the soil is usually more than 10 in the case of this association (cf. TÍMÁR, 1954; 1957; BODROGKÖZY, 1962; 1977).

The perennial *Puccinellia limosa* is able to survive, where the period of water coverage is shorter than the deepest part of the lake, at the same time, the *Suaeda maritima* still has a significant coverage. The spreading of *Puccinellia limosa* well reflects the direction of vegetation transformation processes of the next years, which will be manifested in a gradual turfing of the lake bed. Besides the above mentioned species, the *Aster tripolium* ssp. *pannonicus*, the *Bolboschoenus maritimus* and the *Acorellus pannonicus* also appear by threads.

The next mapped zone towards the higher reliefs are covered by *Puccinellia* facies of *Lepidio-Puccinellietum limosae* association. The facies is poor in species, the vegetation almost entirely consists of *Puccinellia limosa*. *Acorelletum pannonicum* association develops where the *Puccinellia* grass become thin (caused by grazing or trampling). Moreover, the *Acorellus pannonicus* appears in a significant percentage in the higher parts of *Lepidio-Puccinellietum* community, it is particularly characteristic of the western side of the lake. The *Aster tripolium* ssp. *pannonicus* form facies at the highest parts of the zone of *Lepidio-Puccinellietum* association. Every vegetation unit characteristic of which the significant dominance (more than

50%) of *Puccinellia limosa* was drawn together into one zone in the vegetation map (cf. RAPAICS, 1927; MAGYAR, 1930; MOESZ, 1940; SOÓ, 1947; BODROGKÖZY, 1962).

The higher parts of the lake bed are covered by *Agrostio-Caricetum distantis* community. Due to the narrowness of this zone, it was not possible to separate the lower units of this association. (But cf. the case of Szívós-szék UNESCO biosphere-reserve core area (BAGI, 1988).) Altogether two zones were distinguished in the vegetation map: the typicum of the association at lower reliefs and *festucetosum pseudovinae* at the higher reliefs. Due to the sand-blasts, the latter often forms transitions with the unit of *Festucetum vaginatae holoschoenosum*. Despite the fact that only the typicum and *festucetosum* are represented in the vegetation map, these units have no homogeneous vegetation. At the lower parts of the typicum unit, a zone highly dominated by *Juncus compressus* can be found. The 15-50% coverage of *Juncus compressus* is characteristic of this zone. Its most typical stands are at the north-western part of the lake. In the other parts of the lake it is substituted a zone in which the dominance of *Agrostis stolonifera* is higher, the dominance of *Carex distans* in this unit is lower than their coverage in the typicum: Coverage of *Agrostis stolonifera* here is 25-30%, the *Carex distans* has 1-3% coverage here. In the typicum unit, both have coverage of 20-25%.

In the higher parts of the *Agrostio-Caricetum distantis* association a *festucetosum pseudovinae* subassociation developed. The coverage of *Festuca pseudovina* is from to 10-20%. This zone also is not homogeneous: in some parts of the lake bed zones with a higher dominance of *Cynodon dactylon* and *Poa angustifolia* can be recognized. Due to their small width, these units have no representation in the vegetation map; the given scale did not make it possible (cf. KÁRPÁTI and KÁRPÁTI, 1959; BODROGKÖZY, 1960; BAGI, 1988). The nearness of the sandy territories is indicated by the occurrence of the following species in their stands: *Silene conica*, *Holoschoenus vulgaris*, *Tragopogon floccosum*, *Scabiosa ochroleuca*, *Echium vulgare*, *Carex flacca*.

b) VEGETATION OF THE SANDY TERRITORIES

In previous years, wine-growing was the most important agricultural activity on the surrounding sand dunes. There were plough-lands on the flat territories. The cultivation of corn, first of all rye, was traditional here. Economical and environmental protection reasons caused agricultural utilization to be abandoned.

Depending on time of the giving up of agricultural utilization, the regeneration processes of the natural vegetation have reached different stages. On the site of the former plough-lands, *Diplotaxi tenuifoliae-Agropyretum repentis* association developed (cf. MÜLLER and GÖRS, 1969; MUCINA, 1982; GRÜLL, 1985; KOPECZKY, 1986). The characteristic vegetation type in the abandoned vineyards is *Tribulo-Tragetum corispermetosum*. Elements of *Digitario-Portulacetum* association often can be found (cf. FELFÖLDY, 1942; TÍMÁR, 1955; BODROGKÖZY, 1955, 1959a). The

above mentioned associations can be regarded as the starting state of the regeneration processes of the vegetation. The direction and the speed of these processes are in close connection with the exposition and inclination of the slopes of the sand formations. A fast regeneration of *Festucetum vaginatae* typicum (rarely *stipetosum sabulosae* subassociation) takes place on the tops of sand dunes and their southern-like slopes. In the depressions between the sand dunes, the regeneration of subassociation of *salicetosum rosmarinifoliae* of *Festucetum vaginatae* community (often a *holoschoenosum* facies, occasionally *calamagrostiosum* facies of this unit) rapidly takes place. The regeneration processes are the slowest on northern-like slopes of the dunes. The weed communities develop in a direction of *Secale silvestris* facies (in a lower ratio *Cynodon dactylon* facies) of *Brometum tectorum* association.

The first step of regeneration on the more extended flat territories leads to the formation of *Brometum tectorum cynodonosum* community. Depending on the degree of grazing, later, this community develops in the direction of *Potentillo-Festucetum pseudovinae danubiale* (in the first step it has a *cynodonetosum* subassociation) or in a direction of *Festucetum vaginatae* (lower units of this are dependent on the relative distance of the surface from the water-table) (cf. BODROGKÖZY, 1959b; SZUJKÓ-LACZA, 1986).

Typical *Brometum tectorum* association has developed only in the south-east part of the mapped territory where an abandoned sand-pit can be found. The possible regeneration processes are summarized by means of a flow diagram (Fig. 2).

Typical stands of associations of the sandy succession can be studied on the high sandy dunes (sandy hills) and in territories that were not under agronomical utilization. They have been mentioned in connection with their regeneration processes (cf. SOÓ, 1929; ZSOLT, 1943; BORHIDI, 1956; BODROGKÖZY, 1957; 1982; BODROGKÖZY and FARKAS, 1981; KÖRMÖCZI, 1983). The associations of sandy vegetation, its lower units and the transitions between them were situated in a very detailed manner, in order that the vegetation map may be a useful basis for studies on the vegetation transformation processes, including also the regeneration processes.

The *Achilleo-Festucetum pseudovinae* association has very small stands in the core area. The more heavy soil and the high organic matter content are important edaphic factors in the development of this unit. Its small patches can be found in the shore zone of the lake (cf. SOÓ, 1947).

A smaller part of the territory is covered by a characterless woody-shrubby vegetation. This consists of the following species: *Robinia pseudo-acacia*, *Populus canescens*, *P. alba*, *Ailanthus glandulosus*, *Ribes aureum*, *Crataegus monogyna* and many kinds of fruit-trees. According to their herb layer, the stands can be classed into cenotaxon *Bromo sterili-Robinetum* (PÓCS 54) SOÓ 64 (cf. SOÓ, 1937; HARGITAI, 1940; PÓCS, 1954; BABOS, 1955). The herb layer sometimes overextends from beneath the woody vegetation and mixes with elements of *Festucetum vaginatae*

association (more often with elements of *Calamagrostis* facies of *salicetosum* subassociation).

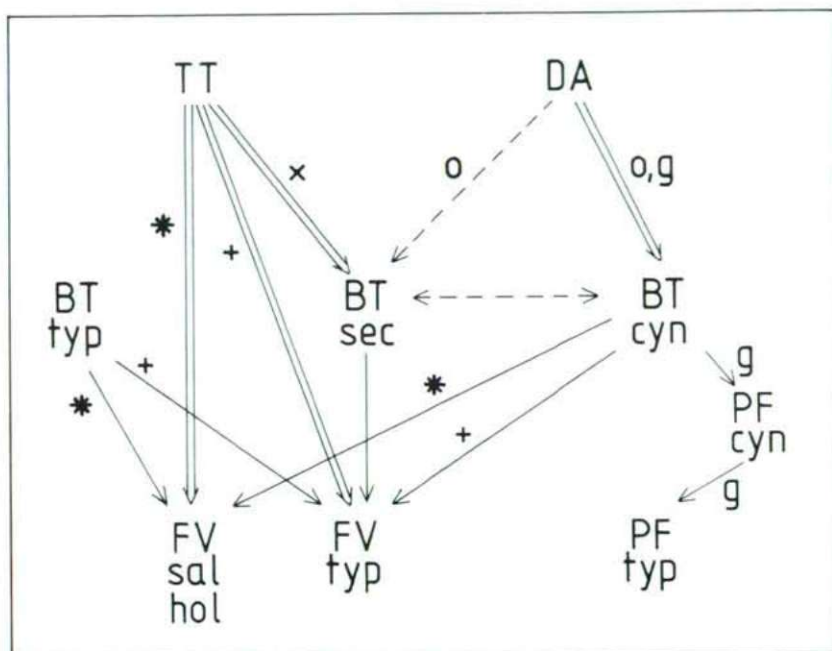


Fig. 2. Possible ways of regeneration of natural communities of sandy grassland; TT: *Tribulo-Tragetum*, DA: *Diplotaxi tenuifoliae-Agropyretum*, BT: *Brometum tectorum*, typ: typicum, sec: *Secale silvestris* facies, cyn: facies or subassociation of *Cynodon dactylon*, FV: *Festucetum vaginatae*. sal: *salicetosum rosmarinifoliae*, hol: *Holoschoenus* facies, PF: *Potentillo-Festucetum pseudovinae*, +: top of dune, #: depression between dunes, x: slope of dune, o: flat territories, g: grazing. Double arrow refers to fast, simple arrow to slow, dotted arrow to uncertain or probably insignificant processes.

c) RECOMMENDATIONS FOR THE PROTECTION OF VEGETATION AND UTILIZATION OF THE CORE AREA

The most important values of the nature in the Szappan-szék core area are the lake itself, the unique(plant)communities in the water and the special mud vegetation in the dried lake. Unfortunately, these will disappear if the decrease in the average water-level and the alkalinity of water continues. Further investigations are needed to search for the causes of the long term fluctuations of the water level and of the water-table: The insufficiently available data refer to a periodicity of 50 years: the water-table increases during 20-25 years and then after decreases to the same level during the same length of time. The investigations of the role of water

management – including the diking – in the development of the present situation must be an issue to consider. Another question is: what if the diking caused an irreversible shift in the (determination of) level of the water-table.

Besides the regional problems of the Szappan-szék core area, there is a problem of this territory which needs obvious and urgent solution. The problem indirectly issues from the decrease in the height of the water level; the paths – originally leading to the shore – simultaneously with the water loss of the lake, moves more and more away towards the deeper parts. Trampling destructively affects the vegetation, even if the vegetation of territories that are no lower trampled on only very slowly regenerates (BAGI, 1988). The eastern part was spared in recent times, therefore, the vegetation form a complete zonation system there. Meanwhile, this part has become suitable for vehicles to be driven. The problem of such passage must be solved by increased control and there must be heavy penalties imposed on trespassers.

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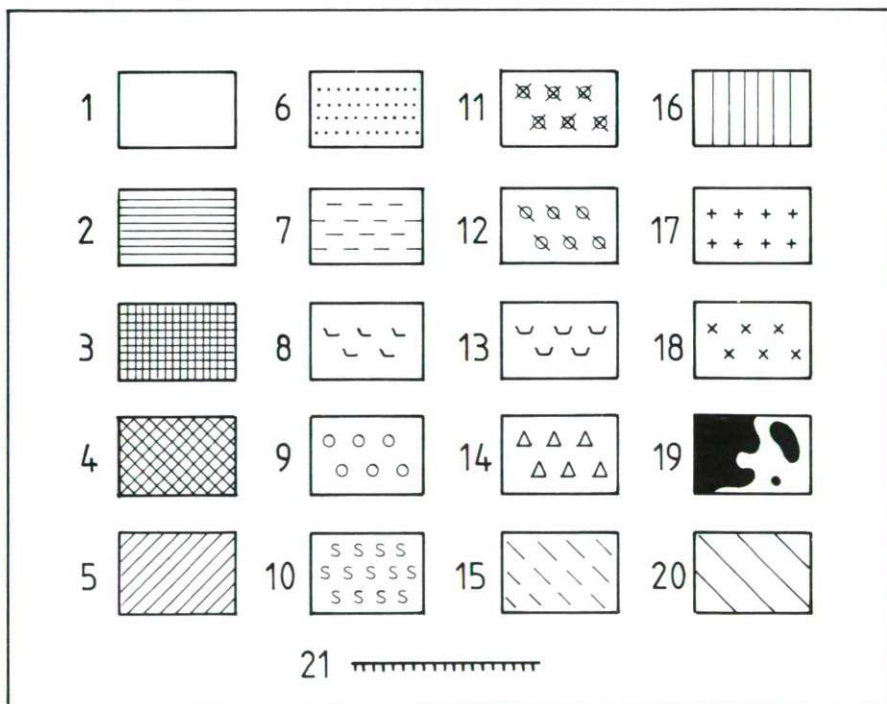
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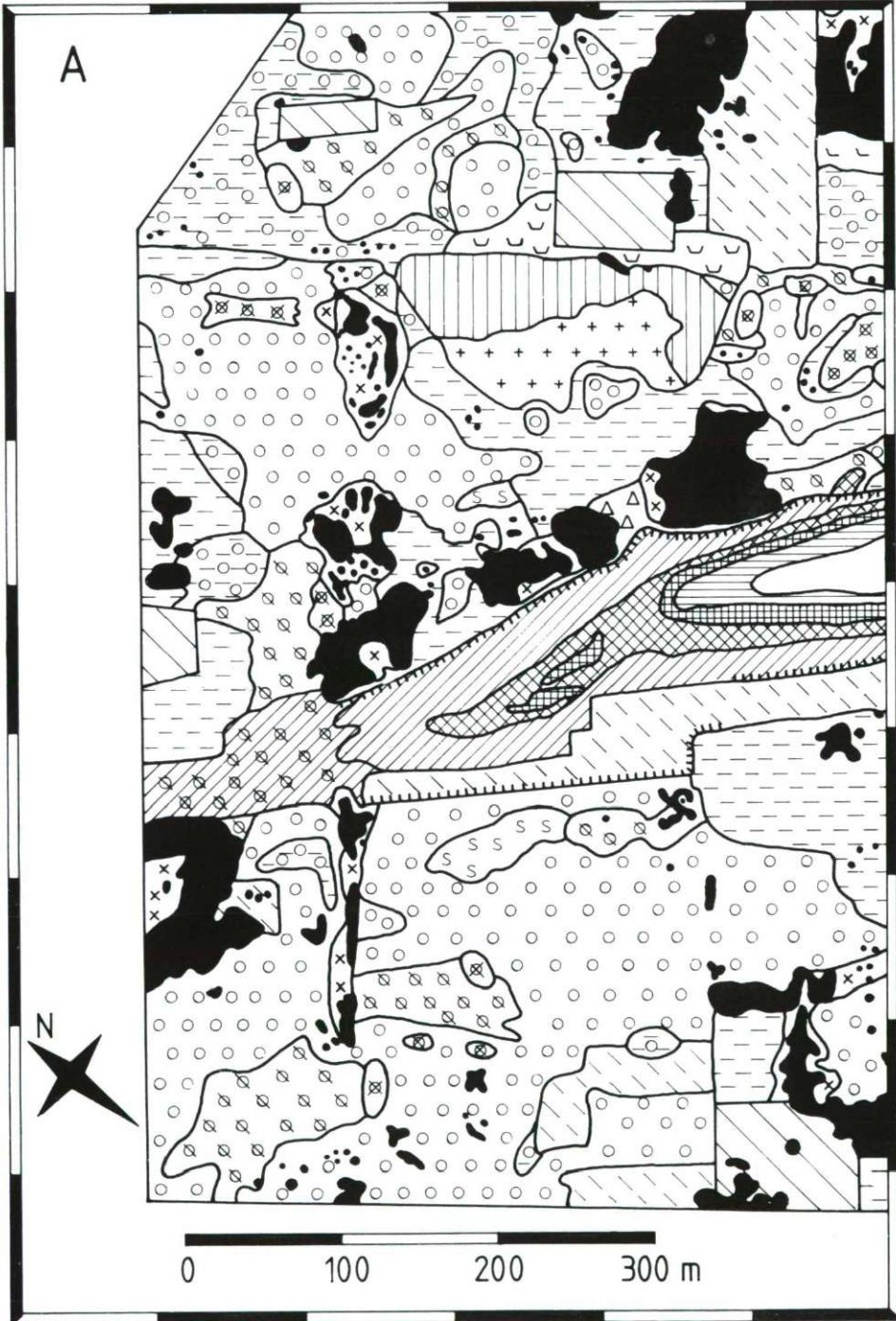
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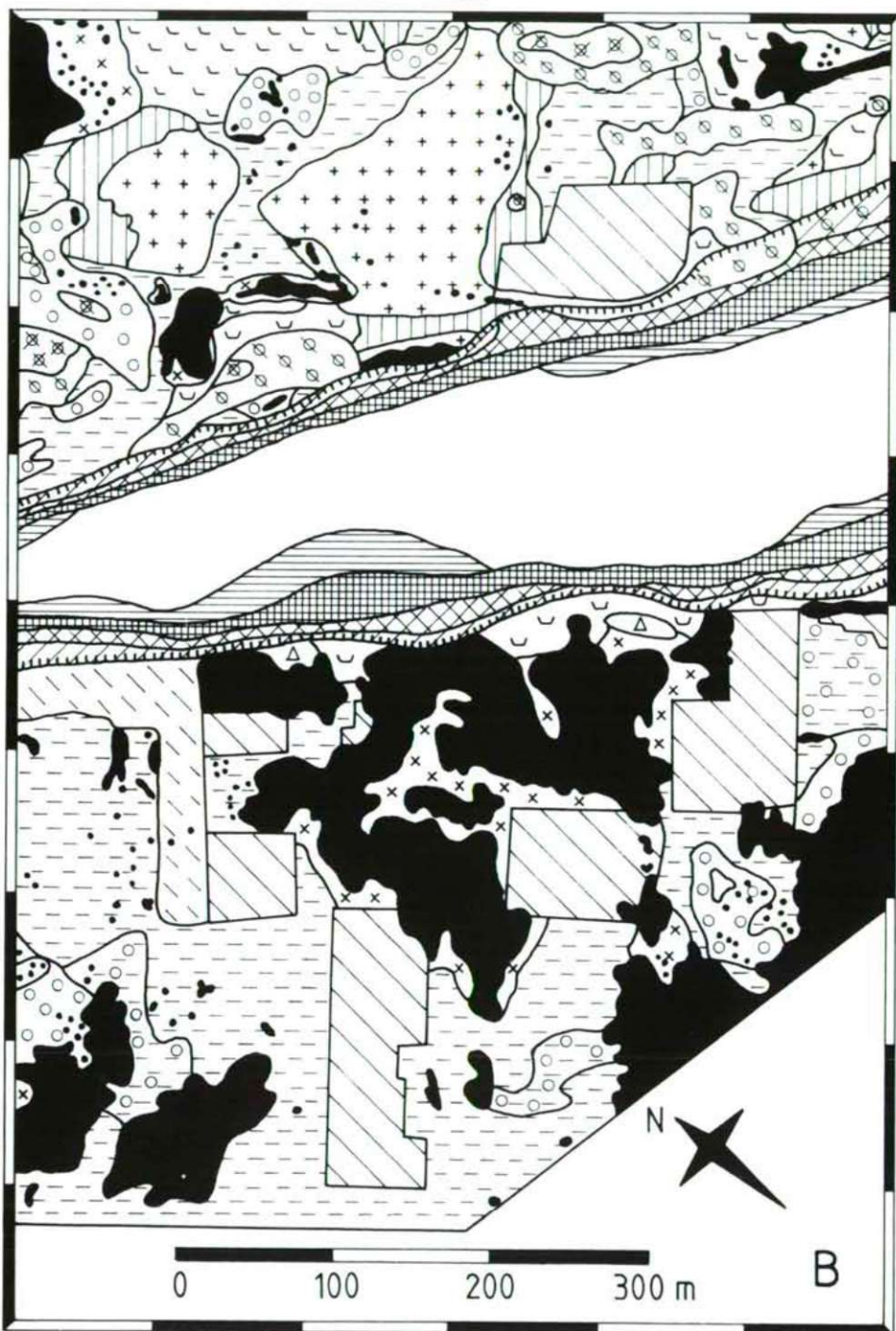
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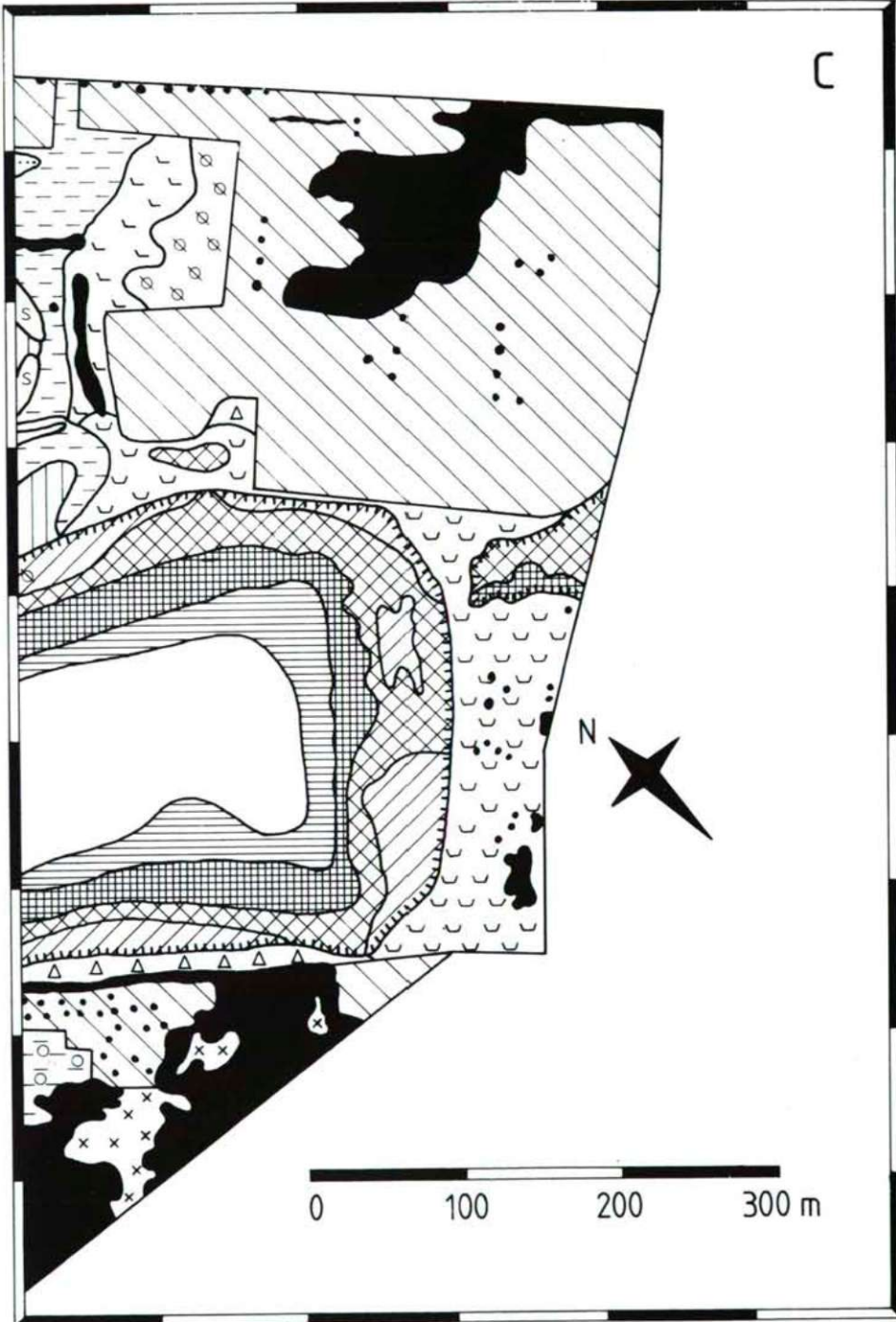
The key for the identification of the units of the vegetation map of the Szappan-szék biosphere-reserve core area: 1. *Suaedetum maritimae hungaricum*, 2. *Suaedetum maritimae hungaricum Puccinellia* facies, 3. *Lepidio-Puccinellietum limosae*, 4. *Agrostio-Caricetum distantis* typicum, 5. *Agrostio-Caricetum distantis festucetosum pseudovinae*, 6. *Brometum tectorum* typicum, 7. *Brometum tectorum Cynodon* facies, 9. *Festucetum vaginatae* typicum, 10. *Festucetum vaginatae stipetosum sabulosae*, 11. *Festucetum vaginatae salicetosum rosmarinifoliae normale*, 12. *Festucetum vaginatae salicetosum rosmarinifoliae Holoschoenus* facies, 13. *Potentillo-Festucetum pseudovinae danubiale* mainly *cynodontetosum*, 16. *Diplotaxi tenuifoliae-Agropyretum*, 17. *Diplotaxi-Agropyretum* x *Brometum tectorum Cynodon* facies, 18. *Bromo sterili-Robinetum* underwood x *Festucetum vaginatae Calamagrostis* facies, 19. Forests, (clusters of) trees, 20. Cultivated lands: plough-lands, orchards, 21. steep slope of the lake shore.

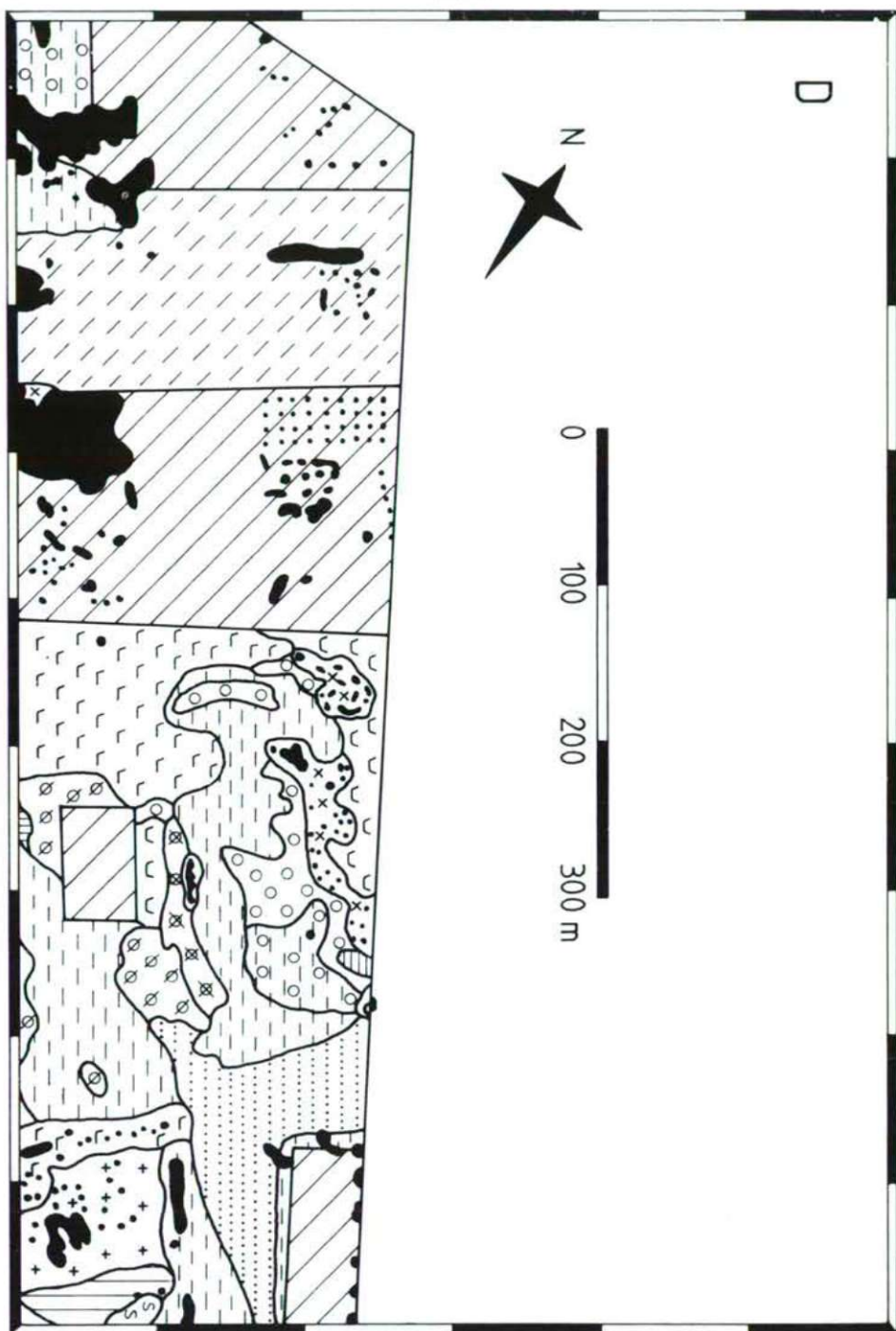
The combined symbols mean transitional vegetation units.











LEAF - ANATOMICAL CHANGES IN PERISHING ACALUOUS OAKS

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Abstract

We examined the damaging effect of airpolluting substances emitted by the Cement and Lime Works in Vác on the leaves of *Quercus petraea* L. ssp. *petraea*. We found the foliage damage to be the greatest near the factory and at a distance of 5 and 10 km it gradually decreases. The surface of foliage-leaves significantly, 30-54%, decreases. The number of stomata on the abaxial epidermis also decreases in 6,5-36,5%, at the same time the closing cells are greatly distorted and there are frequent twin-stomata. On the sick leaves 1-2 radial cell hairs appear instead of the 3-5 cell trichomes on the healthy leaves.

We have concluded from the facts mentioned above that air-polluting substances have an inhibitory effect on leaf-forming meristems, as well as on the stomata and trichome initials, which results in changing the structure and distortion.

Key words: *Quercus*, damage of leaf, air-pollution.

Introduction

It is well-known that the rapid development in industry and agriculture in our times is full of contradictions. To protect the cleanness of water purity and air, or at least to decrease the rate of pollution is one of the basic tasks to be solved.

The air-pollution in the industrial regions is growing, which means a threat to our environment. When changes in pollution exceed the tolerance threshold of bioconosis, it is the living beings which indicate this threat in the shortest time. The most sensitive vegetative organ of a tree is foliage leaves the surfaces of which are greatly exposed to the air. This fact may explain the work of some scientists - among others - PAUL and HUYNH-LONG, 1975; DÄSSLER, 1976; EVANS and CURRY, 1978; JÄGER and KLEIN, 1980; JAKUCS, 1985, who dealt with the damage of foliage.

In our country, from the point of view of forestry, the perish of *Quercus petraea* is of the greatest degree due to antropogenic pollution. During the past years we have been trying to answer the question of what type of anatomical changes were caused in the epidermis of the leaves of acaluous oak by the air-pollution of the Cement and Lime Works in Vác, or by its damaging effect in a 5-10 km distance

from the factory. Since the leaves are continuously growing in the first phase of the growing period, the degree of damage could be detected continuously. Taking into consideration the fact that examinations of this kind are rare in Hungary, we would like to present data which gives a complex explanation of the causes of oak perish.

Literature survey

Air-pollution varies between different industrial regions, but is still increasing on a global scale. The characteristic feature of anthropogenic in regional pollution concentrations is that the highly industrialised countries of Western-Europe (England, Holland, Belgium, France, FRG) are situated on less than 1% of the Earth surface, their emission of sulphur makes up the 13% of the artificial emission of sulphur of the World (SASVÁRI, 1984).

In Hungary in the early 1970 there were some air-polluted regions which emerged in the wake of polluting sources, and these regions follow the pattern of industry and town agglomerations.

50–60% of air-pollution in Hungary is of foreign origin. 45% of Hungarian air-pollution comes from industrial activities, 35% from traffic, 20% from communal smoke. 1 million 200.000 metric tons of SO₂, 547.000 of dust and 370.000 tons of NO_x is released into the air in this country altogether by burning fuel and by industrial emission. The towns Ajka, Füzfő, Vác and their regions are considered to have most polluted air (HORVÁTH, 1986).

Atmospherical rain fall, and the small amount of nitrogen, sulphur, phosphorus, etc. dissolved in it are known to be important nutritional sources for plants. If these elements are in higher concentrations in the air, then when they get on the plants they form acids. The acids disturb the plant life cycle and upon reaching the soil change its pH. This phenomenon has become known as acid rain. The greatest damage to plants have been detected in forests (MÉSZÁROS, 1984).

The forest districts of the Earth decrease annually by 10 million hectares, mostly in the tropical areas and this loss cannot be counterbalanced by new plantations. The alarming news about the death of European forests is accumulating. About one third of FRG forests are attacked. The situation in Austria and Switzerland is not better at all. In Czechoslovakia the death of pine and oak forests causes the main concern. Data about the decay of acaluous oaks, *Quercus petraea* (MATT) LIEB. were first reported from Romania. The peak of this decay was between 1976–77. Several papers about the severe devastation of acaluous oaks in Slovakia have been published.

In Hungary the disease, known as withering of the tree, first of all devastates our acaluous oaks, has been reported by the foresters since 1978. The devastation of our acaluous oaks began first in the central range of mountains. Today, however, it

can be found in the Trans-Danubian central mountains, in the Mecsek mountains and in Somogy county, as well.

According to the survey made so far about 10% of the Hungarian forest regions has been damaged and the devastation of acaluous oaks makes up about 7,5% of the total (LÁNYI, 1986; BORHIDI, 1987; BERCZIK - BORHIDI, 1979.).

It is well known that the increase in the sulphur dioxide content of the air can slow down photosynthesis to such an extent that the degree of cell-division and cell-elongation in the meristem of the leaf will decrease too. This process results secondarily in deforming the cellular elements and forming chlorosis and necrosis.

JÄGER and KLEIN (1980) claim that the air-polluting substances enter the leaf, firstly, through the stomata where they exert a harmful influence, not only on the function of the mesophyll, but on that of the stomata cells, too, e.g. transpiration.

EVANS and CURRY (1979) write that the acid rain damages the upper epidermis, the gaseous substances do harm to the abaxial epidermis besides the mesophyll. Around the trichomes on the bottom of the leaves there is considerable damage.

PAUL and HUYNH-LONG (1975) in their article stated that the toxicity of sulphur dioxide causes the formation of abnormal cellulose cell walls.

BABOS (in his verbal statement) said that on the attacked leaves the stomata are smaller and the number of stomata in a unit area decreases.

On the basis of the facts mentioned above it is obvious that the growth of the trees with attacked foliage, and the production of organic substances are less than the average.

The Hungarian and foreign publications concerning this theme could fill a small library, so we are not going to give any more details about them. The opinions on the primary causes generating the disease differ, but every researcher agrees that they encounter a complex problem. This complexity may be explained by several factors: the soil pollution, the decrease in the number of root hair, bacteria, macro and micro fungus, insect pests, etc. directly or indirectly also may contribute to the devastation of oaks in the damaged environment.

The Cement and Lime Works in Vác, mentioned previously let 10 thousand tons of polluting substances (dust, SO₂, NO_x, etc.) into the air.

In our present survey we are trying to define the effect of damaging materials of the factory on the leaves of acaluous oaks.

Materials and Methods

In Hungary acaluous oak park comprises three subvarieties. We chose the leaves of *Quercus petraea* L. ssp. *petraea* to be examined. According to our hypothesis if the substances released by the factory in Vác damage the foliage-leaf, this harmful effect is the greatest near the factory and gradually decreases with distance. So the samples of leaf were taken from three places taking into account the prevailing wind:

1. From the trees near the factory
2. From the forest of the village Rád, 5 km from the factory, and
3. From the vicinity of the village Szendehely, 10 km from the factory

The control, healthy leaves were collected in the forest near the village Valkó. The samples of leaves were taken from the central third of the south-east foliage. The collected leaves were kept until examination in 40% ethanol. In comparison the following data were processed on the basis of epidermis skinning from the middle of the leaves:

- the number of stomata mm^2 /each leaf
- the state of the adaxial and abaxial epidermis cells
- the number and form of trichomes

Beside this we examined the formation of the healthy and damaged leaf area.

In order to be brief in this survey we are not going to deal with the gradual yellowing and withering of the foliage leaves with the damage of shoots etc. which were also detected.

To measure the leaf-areas we copied 100-100 pieces of leaves on tracing-paper, then they were cut and weighed on analytical scales and the differences were given in per cent. In order to examine the number of stomata, epidermis cells and trichomes, adaxial and abaxial skinning was prepared from 50 and 50 pieces of leaves, respectively. The obtained preparation was then purified in 5% sodium hypochlorite and then washed in 10% acetic acid. The cell walls were stained with methylene blue. Then with increasing ethanol concentrations - generally used in plant microtechnology the preparations were dehydrated, and after fixation in Canada balsam examined. The measurements were carried out in the field of view of a research microscope of NU-2 and NFK types, magnified 160 times. The data concerning the leaf areas were processed on a Commodore computer.

Results

The gradual change of foliage indicates the beginning of the damaging effect of air-pollution. It is already in June that the light green leaves begin to turn into yellowish green. Later on, in August some of these turn into yellowish brown and the leaf totally dies by the middle of September. The withered leaves do not fall off the tree for a long time.

The blatant deformation in the leaf lamina exposed most to air-pollution may be observed, too. The number of the lobes of leaf lamina decreases. A lobe number of 4,5,6 is characteristic for the leaves of a sick tree, in contrast to the healthy ones which have 9-10 lobes. The decrease of the leaf lobe area - due to the increase of air-pollution - becomes greater and greater (Table 1.).

Table 1. Size of leaf lobe.

area of samples	size of leaf lobe in%
VÁC near the air-polluting factory	46,2
RÁD 5 km distance from it	58,8
SZENDEHELY 10 km distance	70,5
CONTROL (VALKÓ) healthy leaves	100

The differences at 0,1% level are significant.

Measuring the longitudinal growth of a one-year-old shoot we obtained similar results.

It can be stated that the proximity of the air-polluting source decisively influences the growth of the leaf.

If we take into consideration the fact that the large scale decrease of the leaf lobe is true for the whole foliage, it can be stated that the production of foliage by a forest, and at the same time the amount of dry fallen leaves, decrease.

In addition these sick leaves decay in a more difficult way, so humification in the soil will be poorer.

Examining the abaxial epidermis skinnings of the leaves we found that the number of stomata on a unit area is decreasing. The degree of decrease is indicated in Table 2.

Table 2. Number of stomata of leaves.

Number of stomata/piece in 15.000 μm^2		
Area of samples	number of stomata/piece	value in%
VÁC near the air-polluting factory	10,8	63,5
RÁD 5 km distance from it	12,7	74,7
SZENDEHELY 10 km distance from it	15,9	93,5
CONTROL (VALKÓ) healthy leaves	17,0	100

The results at the 0,1% level are significant.

The cause of the decrease in the number of stomata may be explained by the fact that the formation of stomata cells is inhibited by the air-polluting substances. This may lead to a smaller zone of inhibition around the stomata mother cells, since twin stomata often appear on the sick leaves (Plate I. photos 1-2.).

On the basis of 1-4 photos in Table I. we may conclude that the size of stomata becomes heterogenous under the influence of air-pollution and there is a frequent deformation of guard cells and air openings. On the other hand, the decrease in the number of stomata may result in less gas exchange ($\text{CO}_2\text{-O}_2$ exchange), as well as in less transpiration. The hairs formed on the leaves of acaluous oaks have a large area exposed to air, so air-pollution has an effect on the formation of trichomes of the abaxial epidermis (Plate II.). The 3 to 5 radial cells of the stellate hairs are to be found most frequently on the healthy leaves (Plate II. photos 1-2-3.). On the sick leaves these trichomes develop only 1-2 radial cells (Plate II. photos 4-5.).

The damaging substances may be supposed to exert an inhibitory effect, resulting in fewer numbers of radial cells. Some changes in the adaxial epidermis cells are also detectable which become more and more characteristic as the summer ends. The cells deform, shrivelling, their radial walls become uneven (Plate III.).

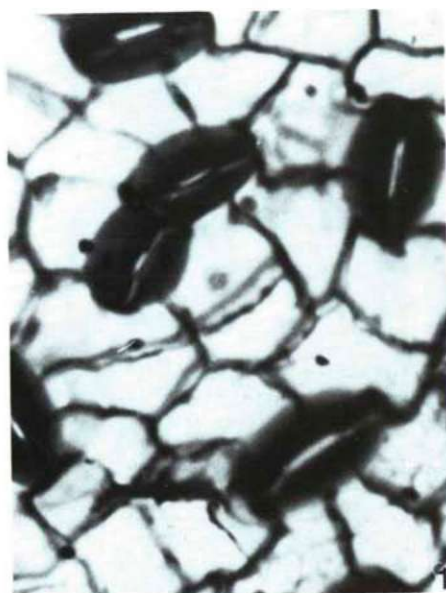
The results of the experiment verify that the distance from the cement factory, which is in direct proportion to the concentration of air-polluting substance plays a decisive role in the morphological and anatomical lesions of foliage-leaves of *Quercus petraea* L. ssp. *petraea*.

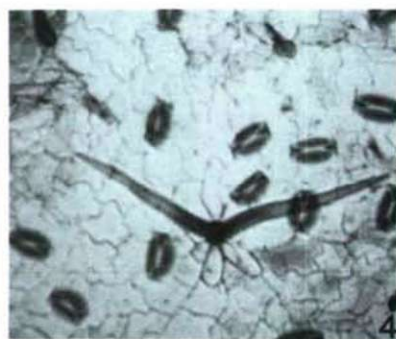
Therefore the damaging effects of air-polluting substances: cement dust, soot, SO_2 , NO_x of the cement factory gradually decreases moving away from the source of emission.

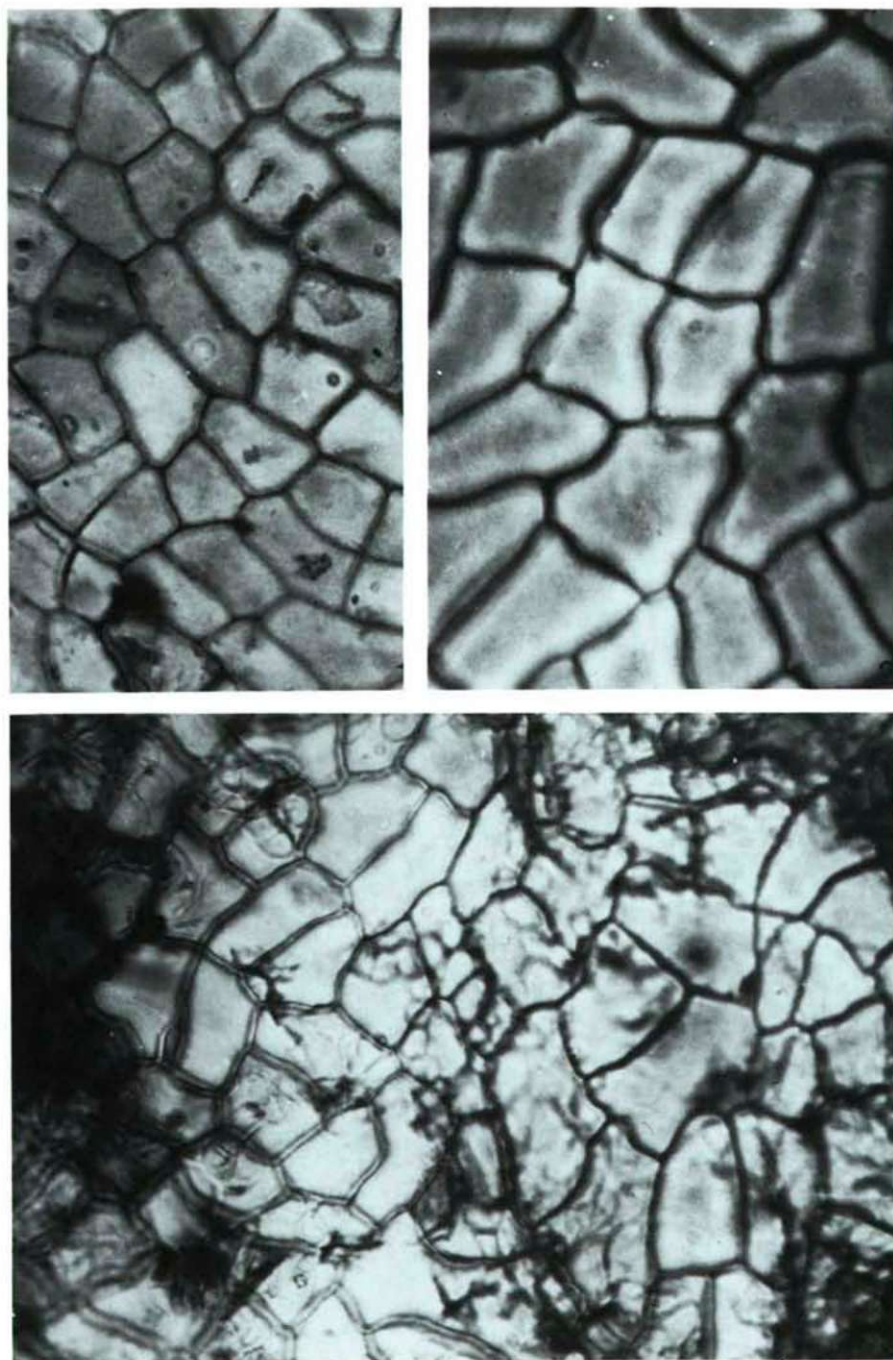
Plate I. *Quercus petraea* L. ssp. *petraea*, abaxial epidermis is alone and together with twin-stomata. Photos 1-2=less damaged epidermis in early July, magnified 310 times. 3 = severely damaged, disorganized epidermis at the end of August, magnified 250 times. 4 = healthy epidermis in early June, magnified 250 times.

Plate II. *Quercus petraea* L. ssp. *petraea* abaxial epidermis with trichomes. 1-2-3= healthy epidermis with multi-branch hair, magnified 120 times. 4-5 = damaged epidermis with stomata and trichomes, magnified 120 and 240 times.

Plate III. *Quercus petraea* L. ssp. *petraea* adaxial epidermis. 1-2= healthy, magnified 310 and 450 times, 3 = damaged epidermis, magnified 310 times.







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TYPES OF NEURONES REVEALED BY NBT/NADH STAINING IN THE ENS OF STURGEON AND CARP

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Abstract

A chondrosteian and a teleostean fish: sturgeon (*Acipenser ruthenus*) and carp (*Cyprinus carpio*) were studied for the comparison of their enteric nervous system, especially the distribution and size of myenteric neuron types with light microscopic NADH-diaphorase staining.

Although the gross morphology of the sturgeon alimentary tract was found to be more complicated than that of the carp, the histological layers of the various gut segments were similar in both species. The NBT/NADH staining revealed both neurons and nerves in the myenteric plexus of sturgeon, while only perikarya were stained in the carp. The number of stained cells was obviously less in the sturgeon but their size was considerably larger than that of the neurons in the carp myenteric plexus. Three types of stained myenteric neurons were described in both sturgeon and carp: large bi- and multipolar types, moreover a small cell type with narrow cytoplasmic rim around the fairly large nucleus. The average diameter of large cells was measured around 50-60 μm in the sturgeon and about 15 μm in the carp. The small cell type had an average diameter of 20 μm in the sturgeon and less than 10 μm in the carp.

The large multipolar cells are thought to be intrinsic sensory and motoneurons, the bipolar cells can be considered as interneurons and the small neurons as undifferentiated stem cells.

Key words: fish, enteric neurons, morphology, NBT/NADH

Introduction

With the recalling of LANGLEY's (1921) concept of enteric nervous system (ENS) neuroscientists hoped to get access to a model-system which seemed to be less complicated than the central nervous system (CNS). The ENS is easily accessible even in the living animal and its main, well-defined function is the regulation of the gut peristalsis (GERSHON, 1981). The main subject of these studies has been the mammalian ENS (GABELLA, 1972; FURNESS and COSTA, 1980; GERSHON, 1981; BURNSTOCK, 1986). However its complexity became soon evident and the interest turned the ENS of lower vertebrates, especially some groups of economic importance like fish and birds (BURNSTOCK, 1959; SALIMOVA and FEHÉR, 1981; ANDERSON, 1983; ROMBOUT and REINECKE, 1984; HALASY and BENEDECZKY, 1985; HOLMGREN, 1985; BUDDINGTON, 1986; HALASY et al., 1986;

ROMBOUT et al., 1986; BJENNING and HOLMGREN, 1988; BURKHARDT-HOLM and HOLMGREN, 1989). Amazing differences were found between the various fish species according to the organization of their ENS (HOLMGREN, 1985). Our aim was in this study to reveal some morphological similarities and differences between the ENS of two different fish species belonging to different subclasses.

Materials and methods

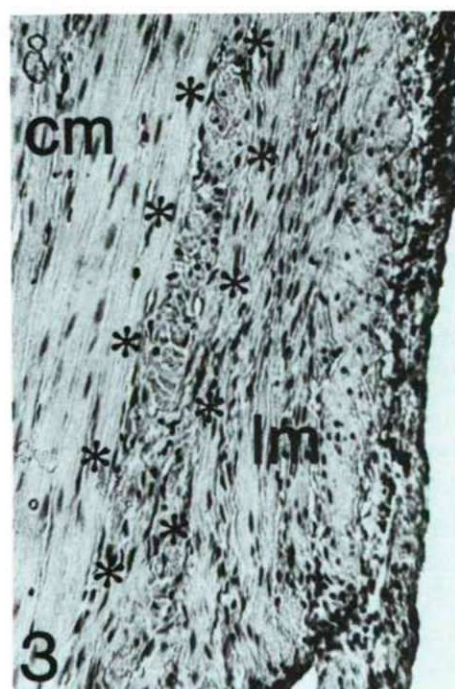
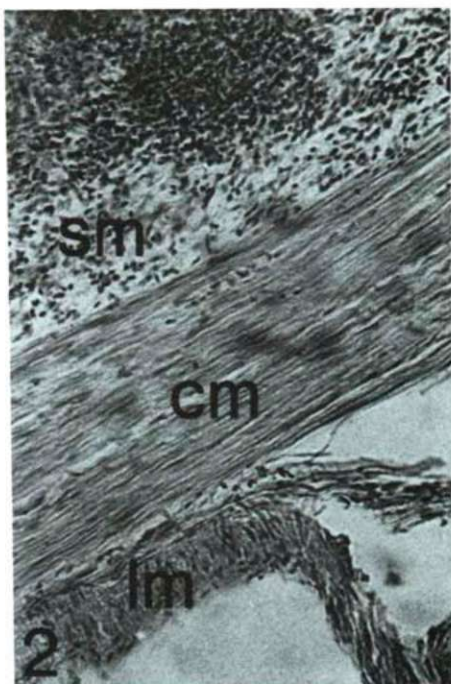
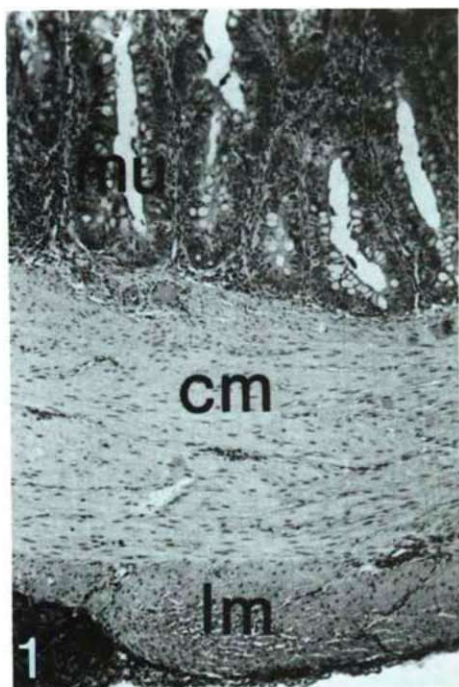
The adult individuals of sturgeon (*Acipenser ruthenus* L.) and carp (*Cyprinus carpio* L.) were obtained from the Szarvas Fish Breeding Research Institute.

The fish were killed by a blow on their heads, the alimentary tract was removed and distended in Krebs-solution in the form of small sausages. These were kept for 15 minutes in Krebs solution containing 0.3 % Triton X 100, then incubated in NBT/NADH solution for 30 minutes. (For details of the method see: *Gabella, 1967*). After the incubation the material was fixed in 10% neutral formalin for at least 24 hours, then 0.5-1 cm rings were cut from the gut wall, the mucosa was removed and the remaining muscular layers were stretched on slides as whole mounts in glycerol and covered with cover slips. Photographs were taken in a Zeiss light microscope.

Results

Comparing the gross morphology of the alimentary tract in the two studied species, the gut of the chondrosteian sturgeon was found to be more complicated, than the teleostean carp's one. While the carp gut is a fairly simple tube with various diameters and wall thickness in the different gut segments, the sturgeon gut has clearly distinguishable regions, namely: the foregut consisting of the esophagus, proventriculus and ventriculus with the pyloric appendices; the midgut with the hepatopancreas on its outer surface and the spiral valve; then the last segment is the relatively short hindgut.

- Fig. 1: Cross section of the midgut of sturgeon. mu=Mucosa; cm=circular smooth muscle layer; lm=longitudinal smooth muscle layer. Haematein-eosin staining. x100.
- Fig. 2: Cross section of the carp midgut. sm=submucosa; cm=circular smooth muscle layer; lm=longitudinal smooth muscle layer. Haematein-eosin staining. x200.
- Fig. 3: A nerve bundle (asterisks) between the circular (cm) and longitudinal (lm) muscular layers in the midgut of sturgeon. Haematein-eosin staining. x400.
- Fig. 4: A germinal center (arrow) in the lymphoreticular tissue of spiral valve of sturgeon gut. Haematein-eosin staining. x150.



In spite of the conspicuous anatomical differences the histological layers of the gut wall are very similar in the two studied species (Figs. 1, 2) corresponding to the conventional layering of hollow visceral organs (mucosa, submucosa, muscularis and serosa). As a histological speciality, the axis of the spiral valve in the sturgeon was found to contain lymphoreticular tissue with germinal centers (Fig. 4). Our studies were focussed on the myenteric plexus which lies between the inner circular and outer longitudinal smooth muscular layers muscularis (Fig. 3).

The NADH-diaphorase staining revealed perikarya and network of nerves in the sturgeon gut (Figs. 5-9). A number of thick nerves running longitudinally and parallelly with each other were heavily stained (Fig. 5). At places, besides the parallelly running nerves, irregular network of nerves was visualized between the two muscular layers (Fig. 6). Stained perikarya were found along the entire gut evenly but sparsely distributed (Figs. 6-9). They did not form conventional ganglia but sometimes the various cell types gathered into little groups (Fig. 7). Three types of perikarya could be distinguished according to their morphology and size: 40-60 μm large multipolar (Figs. 7-9), 60 μm elongated bipolar (Fig. 7), and cca 20 μm small cells with narrow cytoplasmic rim around the relatively large nucleus (Fig. 7). The staining was confined to the cytoplasm and at a higher magnification its grainy character became well visible (Fig. 9).

Considerably higher number of perikarya and no nerves were stained in the carp myenteric plexus along the entire length of the alimentary tract (Figs. 10-13). The cells were scattered between the circular and longitudinal muscular layers, several of them were solitary (Figs. 11, 13), but small ganglion-like groups of few cells were here also frequent (Fig. 12). The considerably higher density of neurons was combined with smaller size: here the average diameter of larger multi- and bipolar cells was measured around 15 μm (Figs. 11-13), while the average diameter of the smaller cells somewhat below 10 μm (Figs. 10, 12). Sometimes the processes of the neurons were also stained especially those of the bipolar cells (Figs. 11, 13).

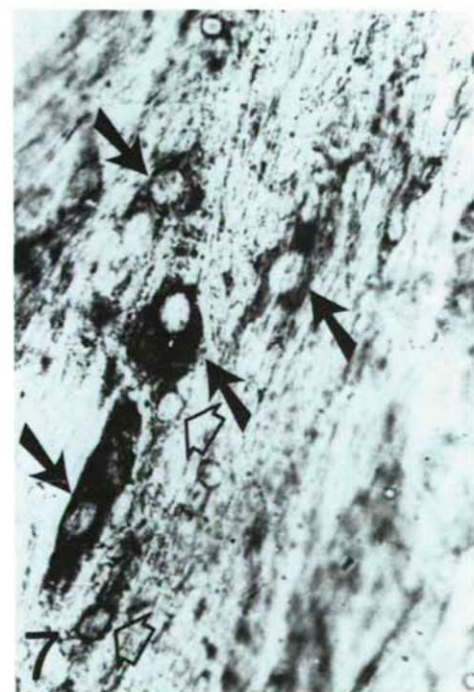
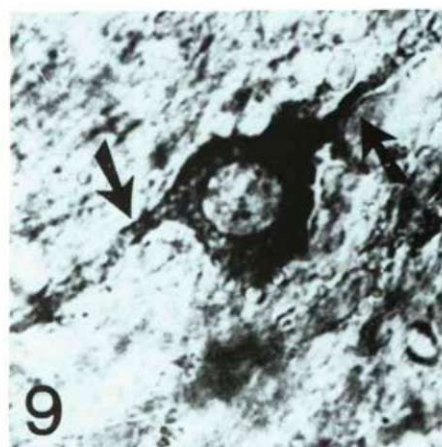
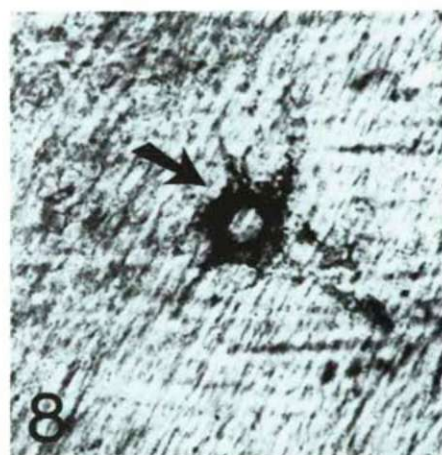
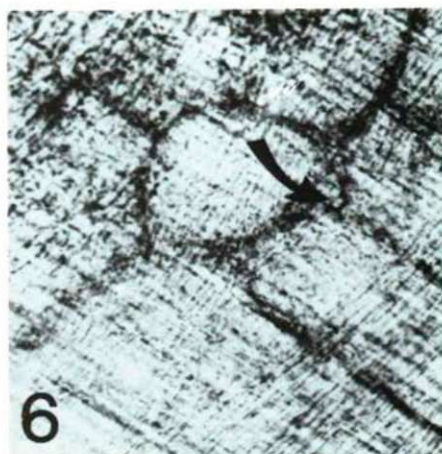
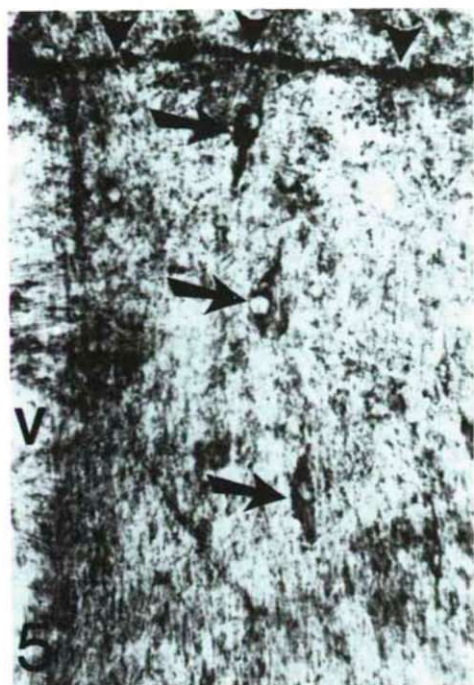
Fig. 5: A row of bipolar neurons (arrows) arranged parallelly with a blood vessel (v) in the sturgeon hindgut. Note the stained nerve (arrowheads, on the top of the picture). NBT/NADH staining, whole-mount prepareate. x200.

Fig. 6: Network of stained nerves with a perikaryon (arrow) at the junction of nerves in the sturgeon hindgut. NBT/NADH staining, whole-mount prepareate. x150.

Fig. 7: Ganglion-like arrangement of large (arrows) and small (open arrows) perikarya in the muscular layer of sturgeon hindgut. NBT/NADH staining, whole-mount prepareate. x40.

Fig. 8: Large multipolar neuron (arrow) in the sturgeon hindgut. NBT/NADH staining, whole-mount prepareate. x450.

Fig. 9: High magnification of a multipolar myenteric neuron with two stained process (arrows). Note the granular appearance of the cytoplasmic staining and the lack of staining over the nucleus. NBT/NADH staining, whole-mount prepareate. x800.



Discussion

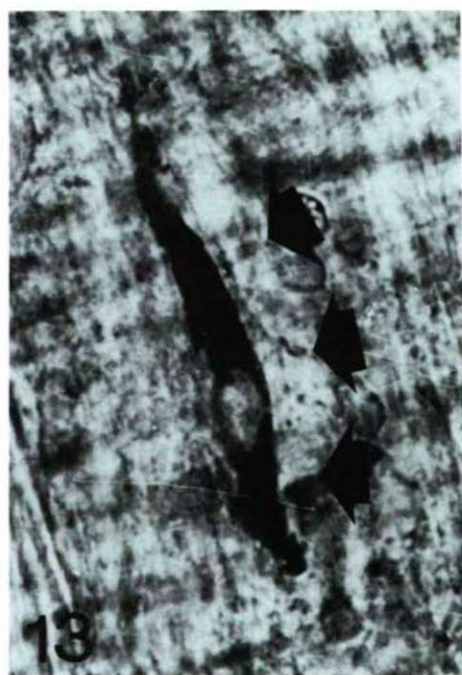
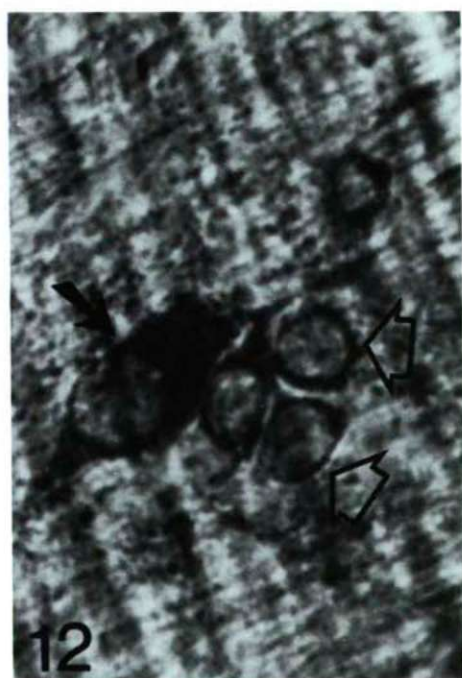
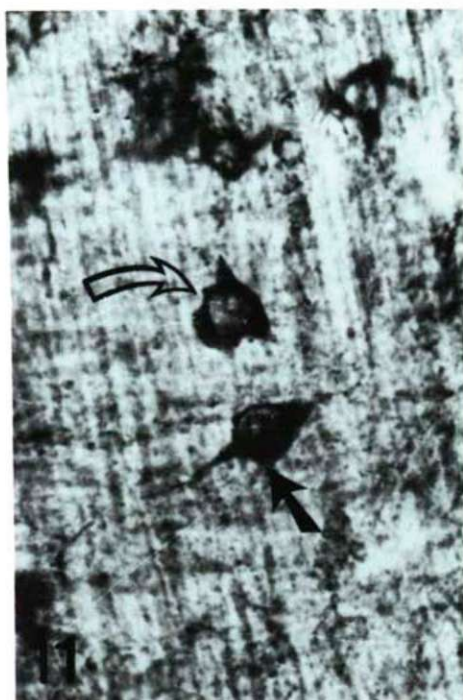
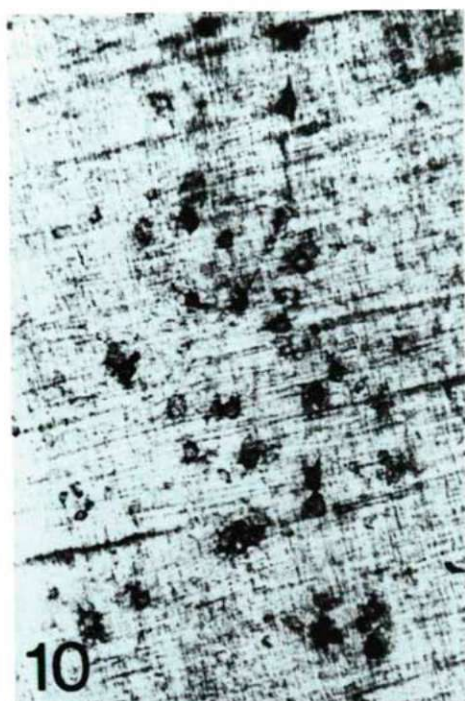
Previous observations (WATSON, 1981) established that the organization of the fish ENS is less complicated than the mammalian one. However it is fairly difficult to draw general conclusions valid for a whole taxonomic group. This is true especially in the case of fish because this group contains cca 25.000 species (HOLMGREN, 1985). This fact also emphasizes the importance of comparative studies even inside one taxonomic group. For this reason we have chosen two fish species belonging to different subclasses for the comparative morphological study of their ENS.

For this purpose the NADH-diaphorase method – staining first of all neuronal perikarya – proved to be very suitable. In previous studies (GABELLA, 1987; HALASY et al., 1988; GÁBRIEL et al., 1988; 1989) this method was successfully used for the description of the general pattern of myenteric plexus and for the study of distribution of neurons in different species, and even for the counting of the neuron-number in various segments of the gut.

The most contradictory data are available on the question of ganglionic arrangement of myenteric plexus in the fish gut. KIRTISINGHE (1940) studying the teleostean indian catfish (*Sacchobranchnus*) did not find ganglia, but solitary neurons in the ENS. BURNSTOCK (1959) found ganglionlike groups of nerve cell bodies at the nodal points of nerves in the ENS of brown trout (*Salmo trutta*). BJENNING and HOLMGREN (1988) studying the occurrence of neuropeptides in the fish gut, made experiments on 33 fish species. They established that there are strong specific differences in the organization of their ENS. GÁBRIEL et al. (1988) published two steps of the phylogenetic development of ganglionated plexus: only the foregut was found to have ganglionated myenteric plexus in the frog and lizard. The well-developed ganglionated myenteric plexus appeared first in the entire alimentary tract of birds during the phylogenesis.

Neither the sturgeon nor the carp ENS showed ganglionic arrangement in our study. The appearance of small nerve cell groups in both species can be evaluated as a preliminary step to a ganglionated system.

- Fig. 10: Characteristic pattern of the distribution of myenteric neurons in the midgut of carp. NBT/NADH staining, whole-mount preparate. x200.
- Fig. 11: A bipolar (arrow) and a multipolar neuron (open arrow) between the muscular layers of carp midgut. NBT/NADH staining, whole-mount preparate. x400.
- Fig. 12: Ganglion-like group of large (arrow) and small (arrowheads) perikarya in the midgut of carp. Note the very narrow cytoplasmic rim around the nucleus of small type cells. NBT/NADH staining, whole-mount preparate. x800.
- Fig. 13: A solitary, elongated bipolar neuron in the midgut musculature of carp. NBT/NADH staining, whole-mount preparate. x900.



Data received with the application of a purely morphological method are not satisfactory to elucidate the function of the intrinsic neurons present in the ENS. Among the multipolar cells very probably both sensory and intrinsic motoneurons are present, while the bipolar types can be associative or interneurons (BURNSTOCK, 1959). The function of the small neurons is even more questionable. Studying the neuron size and number in the rat myenteric plexus GABELLA (1971) raises the possibility that undifferentiated neuroblasts are present even in the adult myenteric plexus and these immature nerve cells are able to differentiate to neurons when required. The small cell-types in the studied fish ENS may represent a pool of immature nerve cells too, and this is the morphological basis of neuronal plasticity characteristic of all parts of the nervous system.

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DIE GESCHICHTE DER ANTHROPOLOGISCHEN KÖRPERWACHSTUMSFORSCHUNGEN IN UNGARN

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Abstract

The author reviews the researches of growth and development of children in Hungary classifying them (according to EIBEN, 1988) into three periods.

The first period lasted till the end of World War I and at that time the collection of data was the main purpose. In the interwar phase, in the second period the investigations extended on the whole country, and became more uniform methodically. The third period lasted from the end of World War II to the present time. This time, the volume of the investigations was growing and data collection performed mainly on the basis of programmes planned in the latter decades.

The investigations were primarily directed by anthropological departments (Budapest, Debrecen, Szeged).

The methods were uniform and rendered possible an international comparison. The results were published also international journals.

In theoretically relation there were studies which investigate the periodicity of growth, effectiveness of acceleration, the menarche, the growth and developmental status of conscripts, the newborns and the sick children.

The total bibliography of these studies was published systematically in the Hungarian journal *Anthropologiai Közlemények*.

Key-Words: growth and development, investigations, Hungary.

Geschichtlicher Überblick

Die Konstituierung, den Beginn der ungarischen Anthropologie rechnen wir von der Gründung des Anthropologischen Lehrstuhls der Budapester Pázmány-Péter-Universität im Jahre 1881 an. Bereits vorher hatten aber schon JÓZSEF KÖRÖSI und BÉLA WEISZ (FÖLDES) 1875 über die Augen-, Haar- und Hautfarbe von 14616 Kindern berichtet. Von da an haben zahlreiche Datensammlungen von verschiedenen Fachleute stattgefunden, die berufen waren, die körperliche Entwicklung der Kinder zu klären. Von der ersten Periode bis zu Ende des II. Weltkrieges haben vor allem LAJOS BARTUCZ, GYÖRGY VÉLI, JENŐ BRAUNHOFFNER, MIHÁLY MALÁN und BÉLA BALOGH Daten über Untersuchungen bei Kindern mitgeteilt.

Wir befinden uns in der glücklichen Lage, dass die Literatur dieser Phase von Beginn an bis 1952 gesammelt vorliegt (ALLODIATORIS, 1958) und uns ausserdem auch kleinere Mitteilungen zur Verfügung stehen (MALÁN, 1947; EIBEN, 1961; FARKAS, 1961).

Nach dem II. Weltkrieg nehmen die Körperwachstumsforschungen einen Aufschwung und vorerst fanden solche in erster Linie an den Anthropologischen Lehrstühlen der Kossuth-Lajos-Universität in Debrecen und dann der József-Attila-Universität in Szeged statt. Anschliessend wurde am Anthropologischen Lehrstuhl der Eötvös-Loránd-Universität in Budapest eine Zentrale eingerichtet, die sich vornehmlich mit dem Wachstum der Kinder befasst.

Die erste moderne longitudinale Untersuchung knüpft sich an den Namen von TIBOR RAJKAI, der im Zeitraum von 1951 bis 1961 und dann von 1961 bis 1971 in Hajdusámson (Komitat Hajdú, Ost-Ungarn) bei insgesamt 178 Kindern (73 Knaben und 105 Mädchen im Alter von 6.5-13.5, bzw. 7-14 Jahren) neun anthropologische Merkmale halbjährlich wiederholt untersuchte (RAJKAI, 1960). In der in West-Ungarn gelegenen Gemeinde Körmend wurden zwischen 1958 und 1988 sehr eingehende, 10jährlich wiederholte Wachstums- und Konstitutionsuntersuchungen an 3-18-jährigen Knaben und Mädchen durchgeführt (EIBEN, 1977a, 1988a). Von 1962 bis 1966 fanden in verschiedenen Niederlassungen des Landes unter Einbeziehung von 100 Versuchs- und 100 Kontrollklassen mit halbjährlich wiederholten Messungen (25 Körpermasse) Untersuchungen an 1756 Mädchen und 2024 Knaben (10-19 Jahre alt) zwecks Feststellung des Einflusses von wöchentlich 4-stündiger, bzw. wöchentlich 2-stündiger Körpererziehung statt (BAKONYI et al., 1969). Darauf folgten zwischen 1963 und 1972 an 105 Kindern in Szombathely halbjährlich Untersuchungen von fünf Körpermassen und zwei physiometrischen Merkmalen (EIBEN, 1972a). Sehr bedeutsam sind die auf Budapester Kinder im Alter von 1-60 Monaten (SÁRKÁNY, 1977) und 0-8 Jahren bezüglichen umfangreichen somatometrischen, soziodemographischen und Morbiditätsuntersuchungen des Anthropologischen Lehrstuhls, des Heim-Pál-Kinderkrankenhauses und des Zentralen Statistischen Amtes - ebenfalls im Rahmen longitudinaler Datensammlung (SÁRKÁNY, 1982).

Ergebnisse

1) ORGANISATIONSFRAGEN

Die 1875 begonnenen und bis zum heutigen Tage durchgeführten Kinderwachstumsuntersuchungen lassen sich praktisch in drei Zeitperioden unterteilen (EIBEN, 1977a, 1988b).

Die erste Phase dauert vom Beginn bis zum Ende des I. Weltkrieges. Die Umweltfaktoren (gesellschaftliche, wirtschaftliche, soziale Verhältnisse), die von

wesentlichem Einfluss auf das Wachstum und die Entwicklung der Kinder sind, waren damals in Ungarn weniger günstige orientieren. Die Forschungen dieser Jahre waren zwar auf die Erfassung, Erkennung der Körpermasse und Merkmale der Kinder gerichtet, sie waren aber nicht aufeinander abgestimmt. Damals gab es in Ungarn noch keine ausgebildeten Anthropologen, so wurden die Messungen hauptsächlich von anderen Spezialisten vorgenommen, die auf anderen Bereichen tätig waren. Diese Forschungen, die eigentlich nur Datensammlungen zu nennen waren, haben dennoch wertvolle Informationen über die ungarischen Kinder geliefert, allerdings waren sie nicht geeignet, als Normwerte für die Körperentwicklung der Kinder unterschiedlichen Alters und Geschlechts verwendet zu werden. Auch methodologisch gesehen entbehrten sie der Einheitlichkeit, so dass auch ihre Verleichstellung schwer lösbar ist.

Das Verdienst der damals wirkenden ungarischen Forscher ist in erster Linie, das sie, indem sie die Wichtigkeit des Körperwachstums der Kinder und die Bedeutung der Datensammlung erkannten, in Ungarn schon sehr früh – vielen anderen Ländern voraus – die Wachstumsuntersuchungen in Angriff nahmen (EIBEN, 1988b).

Die zweite Phase ist auf die Zeit zwischen den beiden Weltkriegen zu setzen. Zu Beginn dieser Periode – und später noch ausgesporchener – haben sich wohlausgebildete Fachleute mit dem Studium des Wachstums der Kinder, wie, LAJOS BARTUCZ, GYÖRGY VÉLI, BÉLA BALOGH und MIHÁLY MALÁN befasst.

Im Laufe diese rund 25 Jahre haben sich die Umweltfaktoren geändert, die Urbanisation hat eingesetzt, die einzelnen gesellschaftlichen Schichten, bzw. Klassen haben sich polarisiert, die das Wachstum der Kinder beeinflussenden Faktoren haben eine Modifikation erfahren. Dies hat jedenfalls ein Studium der körperlichen Entwicklung der jüngeren Altersklassen erforderlich gemacht.

Ausserdem haben sich die Datensammlungen und ihre Wertung auch methodologisch einheitlicher gestaltet. Die Forschungen blieben nicht mehr auf die Hauptstadt begrenzt, sondern sind auch auf Provinzgebiete ausgedehnt und in gewissen Gegenden (wie z.B. in Kaposvár) zu einem regelmässigen Programm geworden.

Aus dieser Zeitspanne stehen uns zahlreiche Daten zur Verfügung und wir können sie – wenn auch nicht in jeder Beziehung – nun schon beim Vergleich mit den heutigen Ergebnissen mitberücksichtigen.

Die dritte Phase reicht von der Beendigung des II. Weltkrieges bis in unseren heutigen Tage.

In den ersten Jahren dieser Periode – etwa bis 1950 – sind die Nachkriegsschwierigkeiten noch spürbar und im wesentlichen setzen in den ersten Jahren jene Forscher ihre Betätigung fort, die bereits auch über frühere Untersuchungen, bzw. Erfahrungen verfügen. Die Hauptfrage in dieser Phase lautet, von welcher Wirkung der Krieg und seine Folgen auf das Wachstum und die Entwicklung der jüngeren Generation war (VÉLI, 1948).

In den 50-er Jahren begannen (vornehmlich in Debrecen) die ausgedehnteren Datensammlungen, die aber immer noch hauptsächlich aus Querschnittuntersuchungen stammten. Sie bezogen sich vorwiegend auf die Feststellung der körperlichen Entwicklung (VIOLA, 1952; FARKAS, 1967), bzw. zu Beginn der 60-er Jahre auf die Klärung des Zeitpunktes des Menarche der Mädchen (BOTTYÁN et al., 1963).

Gleichzeitig muss aber auch erwähnt werden, dass bereits 1951 longitudinale Untersuchungen stattfanden (RAJKAI, 1962) und den Forschungen ein neues Gepräge verliehen.

In den letzten Jahren (von 1981) endlich hat sich die Möglichkeit ergeben, dass im Rahmen gut durchdachter und geplanter Programme mit einer oder der anderen bestimmten Zielsetzung – bei Garantierung finanzieller Unterstützung – auch Datensammlungen grösseren Volumens vorgenommen werden können.

Von diesen ist die Forschungsrichtung mit dem Titel: "Der biologische Entwicklungsstand der ungarischen Jugend in Abhängigkeit von der gesellschaftlichen Struktur und der Lebensweise" zu erwähnen, die vom Anthropologischen Lehrstuhl der Eötvös-Loránd-Universität ausgearbeitet wurde und in die aus der Altersklasse der 3-18-jährigen im ganzen Bereich Ungarns 40 tausend Knaben und Mädchen einbezogen wurden. Die sich auch 18 Körpermasse und einige Umweltfaktoren (gesellschaftliche, wirtschaftliche, soziale Lage) erstreckende Datensammlung wird uns die Möglichkeit bieten, ein Bild über die körperlichen Entwicklungszustand der ungarischen Jugend zu erhalten (EIBEN, 1987; EIBEN und PANTÓ, 1981).

Das zweite Forschungsprogramm ist mit dem Titel: "Vergleichende Untersuchung der pubertalen Beziehungen der Akzeleration unter Berücksichtigung der biologischen und gesellschaftlichen Faktoren" gestartet und wird vom Anthropologischen Lehrstuhl der József-Attila-Universität unter Mitwirkung der anderen Institutionen ausgearbeitet. Das Hauptziel dieser Forschung war, die den Reifungsprozesses der Mädchen beeinflussenden Faktoren kennenzulernen, um unter Aufdeckung der Zusammenhänge einen konkreten Plan für die sexuelle Erziehungsarbeit in der Grundschule erarbeiten zu können. Die Datensammlung ist abgeschlossen und hat – auf das ganze Land ausgedehnt – Auskunft über annähernd 30 tausend (vorwiegend 10-18-jährige) Mädchen und 22 tausend Knaben geliefert (FARKAS, 1988a). Die 34 Informationen umfassende Datensammlung ist mittels computergestützter Analyse geeignet zur Einholung weiterer neuer Informationen.

Die Ergebnisse der in letzter Dekaden durchgeführten Forschungen sind die neueste Standarden für das Körperwachstum (EIBEN und PANTÓ, 1987; FARKAS, 1987a) und das Menarche. (FARKAS, 1988a).

Wie also ersichtlich, laufen die Forschungen nach dem II. Weltkrieg auch weiterhin entweder auf kleinere Kindergemeinschaften, oder den neuerscheinenden Ansprüchen gemäss schon auf die gesamte ungarische Kinderpopulation ausgedehnt. Die Zielsetzungen der Forschungen werden immer mehr von dem

praktischen Forderung bestimmt, dass die Normen des Körperentwicklungsstandes der ungarischen Kinder festgesetzt werden müssen, denn obzwar uns bereits neueste und zuverlässige Daten zur Verfügung stehen, finden in der ärztlichen Praxis dennoch die amerikanischen Daten aus dem Jahre 1940 Anwendung (Pädiatisches Vademekum, 1975).

Aus organisatorischer Sicht war in dieser Periode ausschlaggebend, dass im Anthropologischen Lehrstuhl der Budapester Eötvös-Loránd-Universität OTTÓ EIBEN seine früher durchgeführten Körperwachstumsuntersuchungen fortsetzte und sogar auch ein dafür geeignetes Laboratorium und eine Arbeitsgemeinschaft ins Leben rief. Darüber hinaus hat er durch Abhalten von Vorträgen an ausländischen Veranstaltungen und Organisierung von Kongressen in Ungarn zur Bekanntgabe, zum Bekanntwerden der ungarischen Ergebnisse beigetragen.

Einen neuen Aspekt bedeutete es auch, dass am Lehrstuhl der Budapester Universität Körperbau-Forschungen begannen, als deren Ergebnis eine grössere Studie erschien (EIBEN, 1972b, 1977b). Diese neuere Forschungsrichtung erwies sich als effektiv und auch an der Budapester Universität für Körperkultur gestaltete sich die Körperbauforschung der Schüler, bzw. Studenten immer intensiver.

Von den 1960-er Jahren an laufen auch am Anthropologischen Lehrstuhl der Szegeder József-Attila-Universität Körperwachstums-Untersuchungen. Diese sind in erster Linie auf die Südliche Tiefebene beschränkt und bezwecken einerseits somatometrische Datenerhebungen bei einem umfangreichen Kindergruppen und andererseits eine Feststellung des Zeitpunktes der Menarche und ihrer Zusammenhänge. Da aber das andere Hauptforschungsgebiet des Lehrstuhls die historische Anthropologie ist, ergibt sich hier keine Möglichkeit zur Einleitung umfangreicher longitudinaler Forschungen, obwohl der Lehrstuhl auch an derartigen Datensammlungen mit teilgenommen hat.

Bis zu einem gewissen Grade ist es eine bedauerliche Tatsache, dass die Kinderwachstumsforschungen der Debrecener Universität in den Hintergrund geraten sind, wo doch in der früheren Epoche Debrecen das Zentrum dieses Forschungsgebietes in Ungarn war.

Zusammenfassend kann man also sagen, dass im Verlauf der letzten 100 Jahre nicht nur die organisatorischen, sondern – im Rahmen der Möglichkeiten – auch die materiellen, bzw. finanziellen Voraussetzungen für die Forschungen erfüllt, realisiert sind.

2) METHODOLOGISCHE FRAGEN

Um zu vollwertigen, zum Vergleich geeigneten Ergebnissen kommen zu können ist es natürlich auch erforderlich, dass die Forschungen auch in methodologischer Hinsicht der Kritik standhalten.

Von diesem Gesichtspunkt ist vor allem die dritte Entwicklungsphase hervorzuheben (von 1945), als mehrere Studien erschienen, die berufen waren,

gerade die methodologischen Probleme zu bereinigen. Nachdem sich auch mehrere Biologie-Lehrer den Wachstumsuntersuchungen angeschlossen hatten, schien es indiziert, die Methoden der Datensammlung und der Auswertung auch für jene Mitarbeiter in allgemeinverständlicher Form herauszugeben (EIBEN, 1961; DEZSÓ, 1964; HEGEDŰS und EIBEN, 1970; EIBEN et al., 1971), die sich nicht als Hauptberuf mit der Erforschung des Wachstums der Kinder beschäftigen. Es ergab sich auch die Möglichkeit, unter Berücksichtigung der Empfehlungen des IBP ausführliche methodologische Universitäts-Skripten herzustellen (FARKAS, 1972a).

Darüber hinaus konnten auch neue, praktischere Verfahren bekanntgegeben werden in Verbindung mit der Wertung des Höhenwuchses (RAJKAI, 1962), der Berechnung des Kaup-Indexes (EIBEN, 1960a), der numerischen Errechnung des Median (FARKAS, 1975) und dem Gesichtspunkt der Probenauswahl (FARKAS, 1968b).

Sehr erleichtert wurde die Lösung der Probleme in Verbindung mit der Auswertung durch den Umstand, dass zahlreiche statistische Fachpublikationen erschienen, aus denen sich besonders die jüngeren Forscher die moderne biometrischen Verfahren aneignen konnten.

3) PUBLIKATIONSMÖGLICHKEITEN

Die Ergebnisse der Kinderwachstumsuntersuchungen werden von den ungarischen Forschern nach Abschluss der einzelnen Datensammlungen möglichst bald veröffentlicht. Obzwar diese Mitteilungen in sehr zahlreichen und sehr verschiedenen Zeitschriften erschienen sind – in Ungarn wie auch im Ausland – wird ihr Überblick doch dadurch erleichtert, dass die Bibliographie der ungarischen Anthropologie – vielleicht hinsichtlich des Fachgebietes in einzigartiger Weise – regelmässig erscheint. So können sich die heimischen, wie auch die ausländischen Fachleute aus diesen Zusammenstellungen informieren (FARKAS und DEZSÓ, 1965; FARKAS, 1966, 1968a, 1969a, 1972b, 1973; FARKAS und MARCSIK, 1976, 1978, 1983, 1987-88; FARKAS et al., 1981).

4) THEORETISCHE BEZIEHUNGEN

Die Forschungen haben darauf hingewiesen, dass auch bei den ungarischen Kindern eine Wachstumsperiodizität zu beobachten ist, die aber nicht mit der STRATZ'schen Einteilung vereinbar ist. Aufgrund der Untersuchungen in Körmend ist zwischen dem 6. und 7. Lebensjahr eine allgemeine intensive Wachstumsphasen zu beobachten, dem eine langsamere Wachstumsperiode folgt. Das zweite allgemeine intensive Wachstum entfällt in die Zeit zwischen dem 11. und 12. Lebensjahr und eine alles bisherige übertreffende Wachstumsintensität macht sich bei den Mädchen zwischen 13.-14. und bei den Knaben zwischen 14.-16.

Lebensjahren bemerkbar. Im Alter von 18.-19. Jahren ist dann das Längenwachstum nur mehr minimal (EIBEN, 1962).

Die Periodizität des Wachstums haben mehrere Autoren mit Daten belegt (EIBEN, 1963). Sie stimmen darin überein, dass diese intensive Zunahme nicht bei allen Körpermassen gleichzeitig erscheint (RAJKAI, 1970) und auch aufgrund der Querschnittuntersuchungen ist die Periodizität nachweisbar (FARKAS, 1967).

Die andere Hauptfrage hängt mit der Akzeleration zusammen.

Die Messungen der Stellungspflichtigen haben bewiesen, dass das 10-jährliche Wachstum der zwischen 1872 und 1945 gemusterten Jugendlichen 8 mm, jenes der nach 1945 gemusterten aber 18 mm betrug (VÉLI, 1967). Die Urbanisation, die Verbesserung der hygienischen Verhältnisse, der Anstieg des Lebensstandards der breiten Volksschichten (am wenigsten bis 70-er Jahren) dürften diejenigen Faktoren sein, die hierzu beitragen haben. Dieser Akzelerationsprozess ist aber ein fluktuierender, periodische, sein Beginn ist bei den 1860 Geborenen zu beobachten (KÁDÁR und VÉLI, 1974). Die Daten der Stichproben lassen die Feststellung eines früheren Zeitpunktes nicht zu, dennoch hat es den Anschein, dass als gesellschaftlicher Faktor die Befreiung der Leibeigenen, bzw. Fronbauern angegeben werden kann. Das durchschnittliche Wachstum pro Jahr macht 0.0788 cm aus (VÉLI, 1954).

Eine weitere theoretische Frage ist, ob wir von einer Akzeleration, bzw. sekulare Trend sprechen können. Die ungarischen Autoren stimmen im allgemeinen darin überein, dass wir nicht von einer Akzeleration, sondern eher von dem Aufhören der Retardation sprechen können (VÉLI, 1971). Dies bekräftigen auch die neuesten Daten, denn z.B. im Falle des Brustumfanges gibt es schon Gebiete, wo eine Durchschnittszunahme den früheren Daten gegenüber nicht besteht (FARKAS, 1983a, 1983b).

Auf die Probleme des Pubertätsalters hatte eine zwischen 1959 und 1961 durchgeführte Untersuchung bei insgesamt 7000 Mädchen zur Feststellung des Menarche-Alters aufmerksam gemacht (BOTTYÁN et al., 1963). Der damaligen Datenaufnahme nach betrug der Landesmedian 13.23 ± 0.021 Jahre. Es stellte sich auch heraus, dass in Ungarn von Norden nach Süden, bzw. von Osten nach Westen fortschreitend das Menarche-Alter steigt; in Transdanubien steht es in Korrelation zur geographischen Verteilung der Pigmentation. Auch beim Menarche-Median ist ein Abnehmen wahrzunehmen. Dieses ist aber in den verschiedenen Landesteilen nicht gleichen Ausmasses und auch in ein und demselben Gebiet hat seine Intensität in den letzten Jahren nachgelassen (FARKAS, 1988a), d.h. der Akzelerationsprozess ist auch im Falle dieses Merkmals verlangsamt.

Die Forschungen in Verbindung mit der Menarche haben im wesentlichen die ausländischen Erfahrungen bezüglich der Koinzidenz von Menarche- und Geburtsmonat (EIBEN und BODZSÁR, 1970; FARKAS, 1971), der Saisonalität (FARKAS, 1964, 1988b; FARKAS und SZALAI, 1989), der Geschwisterzahl, des elterlichen Berufs, usw. (EIBEN, 1972c; BODZSÁR, 1975; FARKAS, 1980, 1988a)

unterstützt. Der Nachweis einer neuen Korrelation konnte zwischen meteorologischen Daten und Menarche-Median erbracht werden (FARKAS, 1979).

5) SPEZIELLE FORSCHUNGEN

Die sehr vielseitige Untersuchungen von 10% der 1955 geborenen Stellungspflichtigen (NEMESKÉRI et al., 1983) hat das Augenmerk auf Probleme in Verbindung mit der körperlichen Entwicklung der Jugendlichen gelenkt (Mangel an Training und Kraft).

Über die Körpermasse der Neugeborenen sind nur wenige Mitteilungen erschienen (EIBEN, 1960b); ebenso gelten als Ausnahmen Studien in Verbindung mit der Gonadenreifung der Knaben (DEZSÓ, 1965; EIBEN und PANTÓ, 1984), dem Vorkommen des Mongolenflecks (FARKAS und BÚS, 1977), der Entwicklung der sekundären Geschlechtsmerkmale (JÓNÁS et al., 1968; FARKAS, 1969b; BORSOS et al., 1976; BODZSÁR, 1982; DÓBER und KIRÁLYFALVI, 1988) den Kopf- und Gesichtsmassen der Kinder (EIBEN, 1967; NYILAS, 1980; FARKAS und NYILAS, 1988), dem somatischen Entwicklungsstand der Facharbeiter-Schüler (EIBEN et al., 1979; BAKONYI, 1984; FARKAS, 1987b), dem Körperwachstum der Schüler von Schulen mit Musikunterricht (KOKAS et al., 1967), bzw. dem Zusammenhang zwischen dem Fluoridgehalt des Trinkwassers und dem Wachstum (FAZEKAS et al., 1984). Praktische Fragen werfen die sich mit der Sexualbeziehung befassenden Forschungen auf (FARKAS, 1976).

Auch Fragen betreffs Krankheiten und Körperwachstum sind an die Tagesordnung gesetzt worden (EIBEN et al., 1974; SZILÁGYI 1965, 1968; GYENIS und SIMON, 1974; BUDAY, 1987).

Studien über das Hautleistensystem im Rahmen verschiedenen Stichproben hat SZILÁGYI (1965, 1968) und GYENIS (1975) angestellt.

Auch diese Aufzählung zeigt, dass ausser den Forschungen, die sich auf einige Charakteristika des Wachstums der Kinder erstrecken und eine Wertung des Entwicklungsstandes anstreben, die ungarischen Forscher des Körperwachstum auch im Zusammenhang mit anderen Faktoren untersucht haben.

6) DIE ZENTREN UND PERSPEKTIVEN DER FORSCHUNGEN

Die sich im Lande mit dem Körperwachstum beschäftigenden wirken teils an anthropologischen Lehrstühlen (Budapest, Szeged), oder sind in nicht ausgesprochen anthropologischen Instituten tätig (z.B. Universität für Körperkultur, Krankenhäuser, Kliniken, usw.).

Als das eine Zentrum kann das Lehrstuhl für Anthropologie der Eötvös-Loránd-Universität in Budapest bezeichnet werden, wo sich drei Anthropologen unter Anleitung von Professor OTTO EIBEN mit dem Körperwachstum befassen.

Eine weitere Einrichtung, wo ausgedehntere Forschung betrieben wird, ist der Lehrstuhl für Anthropologie der Szegeder József-Attila-Universität.

Nicht nur mit Kinderwachstum befasst man sich an der Universität für Körperkultur, doch ist die Datensammlung eine sehr umfangreiche.

Daneben sind jene Forscher zu erwähnen, die sich nicht berufsmässig mit Wachstumsproblemen befassen, teils Ärzte (DÓBER und JEGES, 1986), teils Lehrer.

Ein Institut, wo Fachleute ausschliesslich für auxologische Forschungen ausgebildet werden, gibt es in Ungarn nicht; gewöhnlich schliessen sich Fachleute mit biologischer Grundbildung derartigen Forschungen an.

Zusammenfassend sei nur noch erwähnt, dass die Probleme und Ergebnisse, die mit den Körperwachstumsforschungen in Ungarn zusammenhängen, hier natürlich nur in grossen Zügen umrissen werden konnten. Den sich besondere für diese Fragen Interessierenden möchten wir die Bibliographien empfehlen, aus denen laufend Informationen über die ungarischen Forschungen, bzw. erscheinende Mitteilungen eingeholt werden können, und aus diesen wiederum über die Forschungsergebnisse.

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INVESTIGATION OF BILATERAL NON-METRIC TRAITS IN A SAMPLE FROM THE 10TH CENTURY

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Abstract

Non-metric traits are thought to be under genetic control, and therefore they have a great importance in population comparisons. In this paper data are presented on the frequencies of some bilateral traits in a sample from Sárrétudvari-Hízóföld (Hungary). The problem of differences in side frequencies and the dependence between sides for traits also were examined. It is found that generally in the sample there is no significant difference in the frequencies of traits between the two sides. However in most cases these traits show significant side dependence.

Key-words: historical anthropology, non-metric traits, side dependence, bilateral occurrence.

Introduction

Since non-metric traits are thought to be under genetic control (BERRY, 1968), they are considered as possible elements in the construction of biological distance measures between osteological samples (BERRY, 1974a; SJØVOLD, 1973).

Many of these traits are bilateral, they may appear on both sides of the skeleton.

The purpose of this study was: (1) to present data on the occurrences of some of these bilateral non-metric traits, (2) to study the differences in side frequencies, (3) to examine the independence of occurrence from side to side.

Materials and methods

Data were collected from a sample of a 10th century cemetery from Sárrétudvari-Hízóföld. For this investigation this sample consists of all ages and both sexes. Although the expression of many traits appears to be influenced by age, sex and the incidence of other traits (HERZOG, 1968; CORRUCINI, 1974), these factors should not influence the level of bilateral asymmetry, if they are strictly under genetic control, age, sex and trait independence should affect both sides equally (TRINKAUS, 1978). Ten traits on skulls and 11 on the postcranial skeleton were taken into consideration (Table 1.). In order to

calculate frequencies of occurrence the method proposed by GREEN et al.(1979) was followed, so the side was used as a unit.

The side dependence of the traits was assessed by means of the chi-squared statistic. The data were arranged in a two-by-two contingency table:

		Right side	
		Present	Absent
Left side	Present	a	b
	Absent	c	d

Table 1. Incidence of non-metric traits

Traits		%
Cranium		
Fronto-temporal articulation	7/123	5.69
Epipteric bone present	6/111	5.41
Ossicle at asterion	48/205	23.41
Parietal notch bone present	44/251	17.53
Lambdoid ossicle present	211/243	86.83
Parietal foramen absent	139/299	46.49
Foramen spinosum open	34/187	18.18
Posterior condylar canal patent	127/169	75.15
Anterior condylar canal double	60/297	20.20
Condylar facet double	3/234	1.28
Atlas		
Transverse foramen incomplete	8/198	4.04
Anterior notch	1/210	0.48
Posterior notch	60/209	28.71
Posterior foramen	22/214	10.28
Posterior bridge	16/236	6.78
Lateral bridge	2/224	0.89
Articular facet	17/234	7.26
Scapula		
Acromial bone	8/133	6.02
Suprascapular foramen	4/108	3.70
Humerus		
Septal aperture	45/287	15.68
Calcaneus		
Anterior calcaneal facet double	115/305	37.70

Table 2. Chi-squared values and side to side correlation for 21 traits

Traits	a	b	c	d	r	χ_1^2	χ^2
Fronto-temporal articulation	1	1	0	36	0.697	1.000	18.486
Epipteric bone present	1	0	1	28	0.695	1.000	14.483
Ossicle at asterion	5	11	12	27	0.005	0.043	0.001
Parietal notch bone present	7	9	10	54	0.275	0.053	6.050
Lambdoid ossicle present	92	5	3	3	0.392	0.500	15.863
Parietal foramen absent	45	25	14	15	0.148	3.103	2.183
Foramen spinosum open	1	10	6	20	0.163	1.000	0.986
Posterior condylar canal patent	37	6	4	1	0.052	0.400	0.131
Anterior condylar canal double	8	20	11	57	0.141	2.613	1.919
Condylar facet double	1	0	1	97	0.703	1.000	48.995
Atlas							
Transverse foramen incomplete	2	1	2	74	0.558	0.333	24.619
Anterior notch	0	1	0	93	-	1.000	-
Posterior notch	16	15	6	53	0.485	3.857	18.899
Posterior foramen	3	8	6	74	0.216	0.286	4.242
Posterior bridge	4	5	3	95	0.465	0.500	23.089
Lateral bridge	0	2	0	98	-	2.000	-
Articular facet	3	7	2	96	0.386	2.778	16.065
Scapula							
Acromial bone	1	1	1	41	0.476	0.000	9.977
Suprascapular foramen	1	0	0	30	1.000	-	31.000
Humerus							
Septal aperture	15	10	3	104	0.653	3.769	56.293
Calcaneus							
Anterior calcaneal facet double	45	11	3	78	0.790	4.571	85.472

$a+b+c+d$ = total number of possible cases

χ_1^2 is the chi-square value for side difference in trait frequency

χ^2 is the chi-squared value for side to side dependence

r is the side to side trait correlation

The test statistic was:

$$\chi^2 = \frac{n(ad-bc)^2}{(a+b)(a+c)(b+d)(c+d)}$$

According to GREEN et al. (1979) the chi-squared statistic in showing the difference between the frequencies of the sides was:

$$\chi_1^2 = \frac{(b-c)^2}{b+c}$$

The critical χ^2 value at the 0.05 significance level with one degree of freedom was 3.841. The formula calculating the correlations was:

$$r = \left[\frac{(ad-bc)^2}{(a+b)(a+c)(b+d)(c+d)} \right]^{1/2}$$

Results

Table 1. presents the data for the frequencies of traits. The most frequent traits are the following: lambdoid ossicle present (86.83%), posterior condylar canal patent (75.15%) and parietal foramen absent (46.49%). The most rare are: anterior notch (0.48%), lateral bridge (0.89%) and condylar facet double (1.28%).

Tests for differences between side frequencies (Table 2.) show a significant difference (at the 5% level) twice for the postcranial skeleton. The anterior calcaneal facet double and posterior notch were significantly more frequent on the left side. On crania we could not find any significant difference between side frequencies. Table 2. present the data for the test for independence for the 21 bilateral traits in this sample. Significant dependences (at the 5% level) are found for five traits on the cranium and nine on the postcranial skeleton. Observed correlations are positive for all of these traits and range from 0.005 to 1.000. The correlation in the case of suprascapular foramen (1.000) is unrealistic and may due to the low number of observations. A relatively strong correlation, between sides in the manifestation of the trait, can be found in the following cases: anterior calcaneal facet double (0.790), condylar facet double (0.703), fronto-temporal articulation (0.697) and epipteric bone present (0.695).

Conclusions

Our conclusions are as follows:

1) In most cases there is no significant difference in the trait frequencies between the two sides.

2) From 21 examined traits 14 show a significant side dependence. A relatively strong correlation can be pointed out in this sample. This may confirm the hypothesis of a genetic basis that may realises the bilateral manifestation of traits (BRASIL-GUALANDI et al., 1989), while environmental stress factors may cause the unilateral appearance.

The importance of the study of both skeletal sides before drawing any conclusion concerning the genetic or acquired nature of traits is therefore emphasized.

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SPONDYLARTHROPATHIES IN AVAR AGE HUMAN REMAINS

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Abstract

During a paleopathological examination aiming at the research of articular diseases, 518 human skeleton remains belonging to the Székkutas-Kápolnadűlő cemetery (Hungary, territory east of the river Tisza) of late Avar and Sarmatian period have been analysed. We have found traces of spinal diseases in 116 (31.3%) cases out of 371 adult skeletons. In the majority of cases (109) we have registered osteochondrosis vertebrae, spondylosis deformans and spondylarthrosis. In two cases, signs of seronegative spondylarthritis have been detected. We have assumed that among the infectious lesions vertebral tuberculosis have been found on two skeletons. The occurrence of DISH seems to be revealed in four cases. The definition of help of the illnesses has been carried out by the morphological and radiological method.

Key words: paleopathology, Avar period, arthropathies.

Introduction

During the evolution the human spine has suffered significant changes. The extent of its mechanical load and its function have undergone important modifications due to the longitudinal supporting role of the vertebral column. The main difference compared to animals can be found in the sacro-iliac joint and the lumbo-sacral transition. From a phylogenetical point of view, the human spine is far less developed than the limbs showing significant differentiation. That is what explains the numerous variations and the susceptibility to diseases (OLÁH, 1987).

The aim of the present research program is to define and to diagnose spinal diseases of a human population of a historical age. The survey is part of the program relating to the anthropological and paleopathological examination of skeleton remains of the Székkutas-Kápolnadűlő cemetery of late Avar (8th century) and Sarmatian period and an overall 3-year research program entitled "Articular lesions in historical anthropological series".

Materials and methods

The 555 graves of the Székkutas-Kápolnadűlő cemetery of late Avar and Sarmatian period were uncovered between 1965 and 1986 under the direction of KATALIN NAGY archeologist of the Tornyai János Museum of Hódmezővásárhely (NAGY, 1982). The subject of the anthropological and paleopathological analysis consisted of 518 human skeletal remains (the greater part of which being uncomplete) uncovered from 555 graves.

The determination of sex and age at death carried out with traditional methods used in historical anthropology (FARKAS, 1972; LIPTÁK, 1980; MARTIN and KNUSSMANN, 1988). In the case of adult skeleton remains we managed to carry out the age estimation with an accuracy of 10 years. The skeleton remains have classified follows: group Inf I.:54 (10.4%), Inf II.:52 (10.1%), Juv.:41 (7.9%) and 371 adult skeletons (71.6%) for latter, see details in Table I.

During the macroscopic morphological examination of spinal lesions, we have analyzed the remains of 371 adult skeletons of the Avar period – as we have not found any lesion on infant and juvenile skeletons previously. For more problematic cases, particularly for complicated differential diagnose, we had to apply X-ray analyses. On skeletons showing the signs of osteoporosis, the extent of the disease has been determined by using the Barnett-Nordin biconcavity index (OLÁH, 1987).

Discussion

The description of spinal diseases can be found in most of the general paleopathological studies, from the early period of paleopathology to nowadays (PALES, 1930; WELLS, 1964; DUTOUR et al., 1989). However, the interpretation of these works meets some difficulties. Cases described some 20-25 years ago as ankylosing spondylitis would probably be considered today as ISH (ORTNER, 1988). Not only the existing and the historical populations or our prehistorical ancestors, but also a great number of the different vertebrates (e.g. the Dinosaur) suffered from spinal diseases (PALES, 1930).

During the paleopathological diagnosis of the arthropathies – and among them the diagnosis of spinal diseases – the main task is to define the nature of the morphological changes (erosive, proliferative), the pattern of dispersion, other pathological features, the sex and age of the skeleton. The next step is the radiological analysis of the remains, which helps to make comparison between the fossil material and the clinical cases (ROGERS et al., 1987; and ROGERS's personal comment). During the examination, we intended to carry out the diagnostics and the classification of the spondylarthropathies taking into consideration the above mentioned criteria.

1. DEGENERATIVE SPINE DISEASES

The degenerative lesions of the spine is as frequent as the arthrosis deformans of the joints. The degeneration takes place in the course of the senescence or due to

other metabolic effects. The degeneration takes place under a continuous mechanical microtraumatisation of the vertebral disc that results in osteological consequences (KORONDI and ZAHUMENSZKY, 1988; GÖMÖR and BÁLINT, 1989; GREGG and GREGG, 1987.)

Out of the 371 adult skeleton remains of Székkutas, 109 showed signs of degenerative spinal disease. For breakdown by sex and age: see Table I. It shows clearly that the lesions become more frequent with the growth of age, and as to the breakdown of sexes, males are predominant.

Table I.: Breakdown by sex age at death of the remains

H: healthy

D: diseased (remains showing degenerative spine diseases)

N: total number of adult skeletons (371)

Sex Age at death	Male		Female		Undet. sex		Total n				Diseased (%) in the ratio of age groups
	H	D	H	D	H	D	H	D	H	D	
20-30	12	5	37	2	4	-	53	7	14.3	1.9	13.2
30-40	51	15	48	17	3	-	102	32	27.5	8.6	31.4
40-50	49	25	39	7	4	-	92	32	24.7	8.6	34.7
50-60	35	17	25	7	2	1	62	25	16.7	6.7	40.2
60-	12	8	12	4	8	1	32	13	8.6	3.5	40.7
Undet. age	6	-	5	-	19	-	30	-	8.2	-	-
Total	165	70	166	37	40	2	371	109	100.0	29.3	-
Sex rate(%)	44.5	44.7	10.8	100.0							

There have been many attempts to determine the types of degenerative lesions according to their stadium. The 5-grade classification of CHAPMAN (1972) does not enable us to classify the degenerative changes and other proliferative alterations of the spine, and we consider it rather artificial.

According to the present pathological and radiological knowledge the degenerative lesions of the spine can be classified in three groups:

- *Osteochondrosis vertebrae* (Fig.1.): The pathological changes effect not only the discus but also the subcondral bone which can result the sclerosis of the surface of the vertebral body. Degenerated nucleus pulposus often changes place: Schmorl-hernia can be produced.
- *Spondylosis deformans* (Fig.2.): Proliferative bone changes can be seen at the margins of the vertebral bodies (spondylophyte). Fibrocartilage at the rim of the joint ossifies and becomes contiguous with the joint margin.
- *Spondylarthrosis*: Intervertebral joints are also affected by the degenerative changes (OLÁH, 1987).

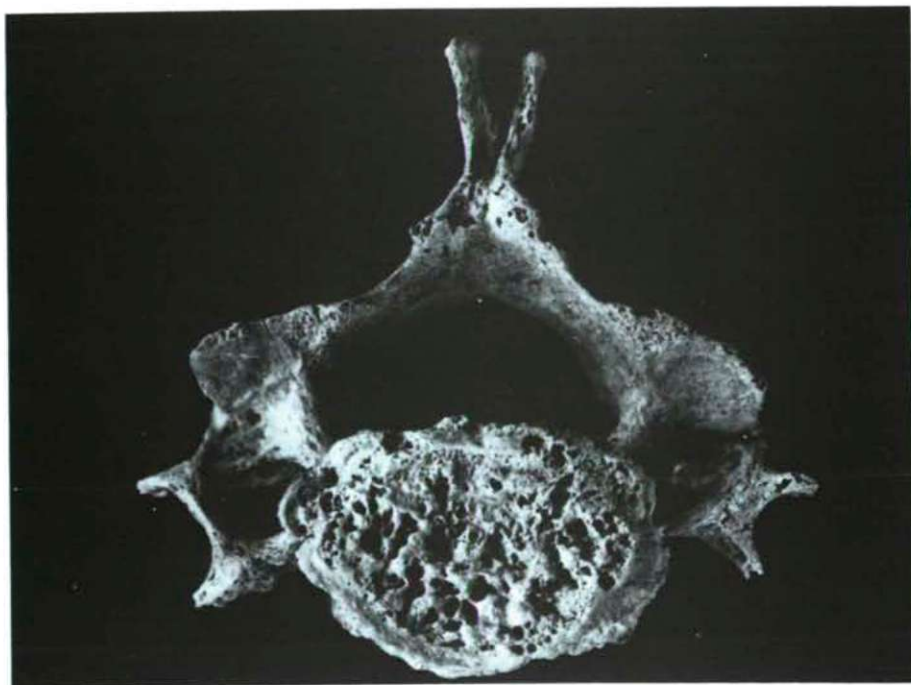


Fig.1. Osteochondrosis vertebrae on a cervical vertebra. Finding Nr. 8840, grave Nr. 326. Male, 60- years of age

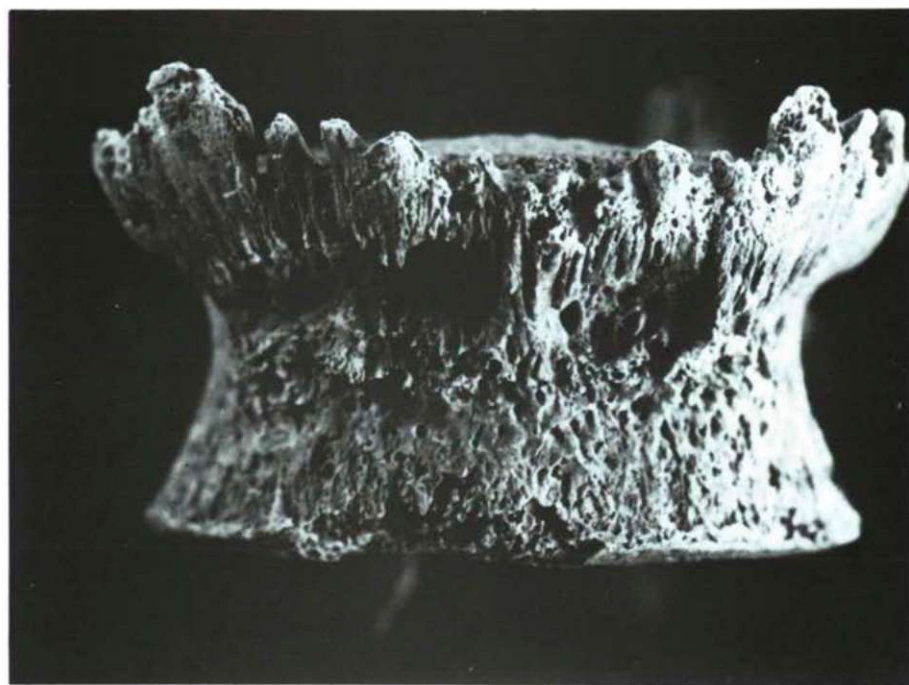


Fig.2. Spondylosis deformans on a lumbar vertebra. Finding Nr. 8870, grave Nr. 356. Male, 40-50 years of age

We have carried out examinations on 109 skeletons showing degenerative spine disease in order to determine the predilect regions. Instead of the expected 2725 vertebrae we were obliged to work with only 1617 (58.5%) and instead of the 109 sacrum 86 (78.9%) were available. 669 vertebrae (42.3%) and 44 sacrum (51.1%) belonging to these skeletons have been affected by more or less serious alteration.

We can state on the basis of the data that the degenerative disease is a general process affecting a great number of vertebrae. As the three above mentioned categories are based on quantitative (consequently chronological) differences (rather than on aetiological ones), it is quite understandable that often we have found examples of each category on the different spinal regions of one skeleton.

46 skeletons showed osteochondrosis vertebrae, and 20 out of them with traces of Schmorl-hernia. While this type of lesion was more frequent on the thoracic vertebrae, more serious spondylosis or spondylarthrosis has developed on the lumbar and lumbo-sacral region.

In some of the cases, the prearthrosis-factor causing secondary degenerative lesion could have been identified:

- *spondylolysis*: 3 cases (*spondylarthrosis*);
- *sacralisatio*: 5 cases (*spondylarthrosis*, *sacro-iliitis* in 2 cases);
- *luxatio coxae congenita*: 1 case (*spondylosis def.*);
- *scoliosis*: 1 case (*spondylosis deformans*).

We have found two cases of spondylarthrosis with serious ankylosis:

- 1st case: female skeleton, 40-50 years of age (finding Nr. 11553, grave Nr. 292): serious spondylarthrosis on the vertebrae C4-C7. Ankylosis of the vertebral bodies of C6-C7;
- 2nd case: male skeleton, 40-50 years of age (finding Nr. 8912, grave Nr. 399): spondylarthrosis on the C5-C7, T8-T12, L1-L5 spinal segments. Ankylosis of the vertebral bodies and the intervertebral joints of C5-C6.

2. SERONEGATIVE SPONDYLARTHROPATHIES

The seronegative spondylarthropathies (SNSA) is a collective term initiated in the rheumatological nomenclature during the last decade. The most important diseases belonging to SNSA are the ankylosing spondylitis, psoriatic arthropathy, enteropathic arthropathies and reactive (postinfectious) arthritises (e.g. Reiter's syndrome). Lesions have been detected not only on recent and historical human populations (KRAMAR, 1980; HORVÁTH and FORGÁCS, 1984; ROGERS et al., 1987) but also on remains of Primates (LOVELL, 1990).

There are two cases out of the series where we seem to have found seronegative spondylarthropathie. The exact definition of the diseases was not possible because of fragmentary material, lack of clinical symptoms and the possible differences of symptoms between individual cases (GÖMÖR and BÁLINT, 1989).

- 1st case: male skeleton, 40-50 years of age (finding Nr. 5791, grave Nr. 67) fragmentary skull and skeleton. Pathological alterations: Bywaters-Dixon type syndesmophytes between L3-S1, ankylosis of L4-L5. Small joints are also affected (Figs.3-4.);

T4-T12: arthritis in the small joints with decreasing intensity upwards; C5-C6: small joints affected by arthritis; Slight proliferative sacro-iliitis on the right side; Erosive arthritis on the atlanto-occipital, left shoulder and right sternoclavicular joints;

Erosive-proliferative changes of MTP and PIP joints; Several tarso-matatarsal ankylosis;

Bilateral proliferative changes of hip and knee joints; Ossification of entheses on both ulna and hip bone.

The presence of syndesmophytes and the ankylosis between vertebral bodies, the erosive-proliferative arthritises and ossification of entheses, the ankylotic

symptoms of tarso-metatarsal joints led us to assume the occurrence of SNSA (ROGERS, 1988; GÖMÖR and BÁLINT, 1989).



Fig.3. Seronegative spondylarthropathie. Finding Nr. 5791, grave Nr. 67. Male, 40-50 years of age

- 2nd case: male skeleton, 30-40 years of age (finding Nr. 5802, grave Nr. 80), fragmentary skull and skeleton. Pathological alterations: complete ankylosis of 4 (Fig.5.) and 2 other thoracic vertebrae in the intervertebral joints. Syndesmophytes on the fragments of vertebral bodies. The ossification of the costovertebral joints and ligaments can be seen on the radiograph (Fig.6.).

The bodies of the lumbal vertebrae cannot be evaluated; but an extensive osteopytosis of the posterior joints was observed.

Slight bilateral sacro-iliitis and proliferative changes of the right carpo-metacarpal joint are present.

On the fragmentary remain we could not carry out a satisfactory differential diagnose. On the basis of the above mentioned criteria we consider that the case belongs to the SNSA group (ROGERS and WALDRON, 1986).

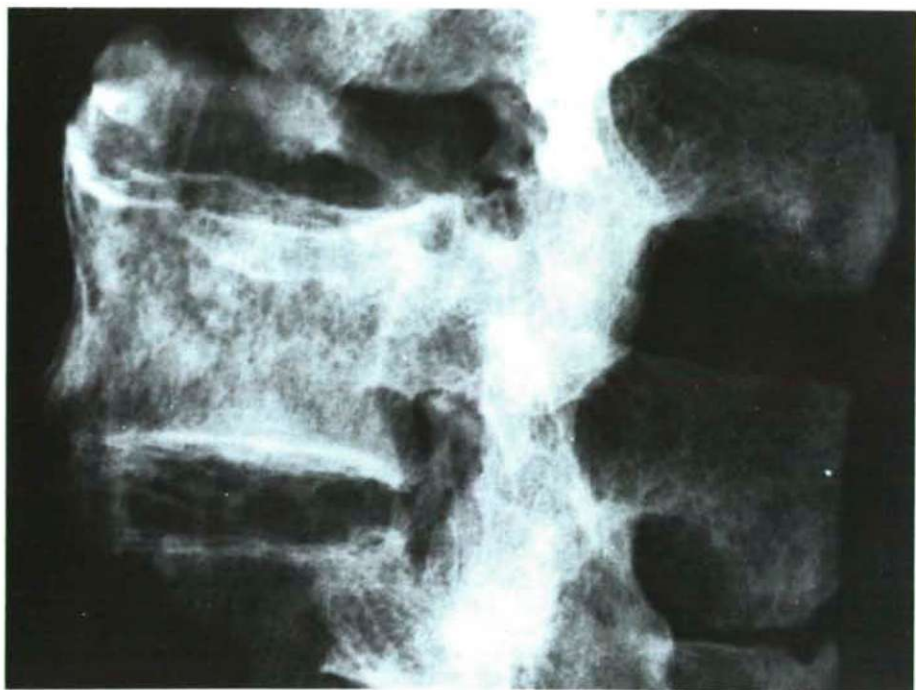


Fig.4. Radiograph of the vertebrae seen on Fig.3. Finding Nr. 5791, grave Nr. 67. Male, 40-50 years of age

3. INFECTIOUS SPONDYLARTHRISES

This group involves cases with joint inflammation caused by microorganisms. Osteomyelitis is the result of introduction of pyogenic bacteria into vertebrae by hematogen dissemination or by direct affection. It causes pain and fever, and the recovery goes together with a massive ossification and fast ankylosis (BENDER, 1987).

Vertebral tuberculosis is an extrapulmonary form of the postprimer tuberculosis. The pathological process caused by the *Mycobacterium tuberculosis* or *M. bovis* is spreading from the primary center of infection to the bones with hematogen dissemination (BÉLÁDI et al., 1987). The tuberculous process erodes the cortical surface and slowly extends into the anterior portion of the vertebral bodies. Collapse of one or several vertebral bodies with remaining vertebral arches and spinous processes leads to a sharply angular gibbus (POTT's disease) (ENDES, 1983; BARTA, 1986).

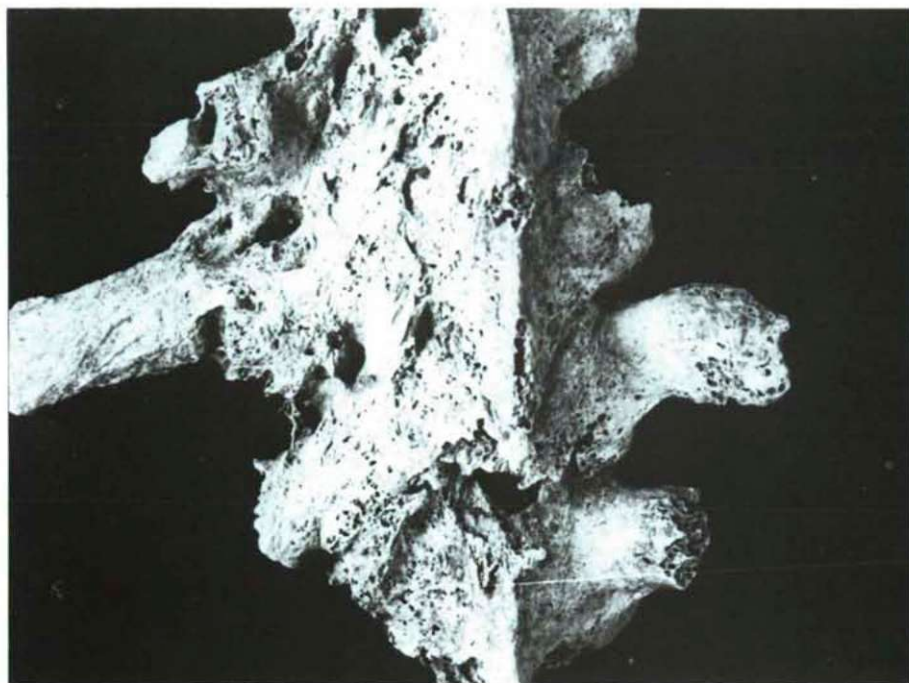


Fig.5. Ankylosis of thoracic vertebrae. Finding Nr. 5802, grave Nr. 80. Male, 30-40 years of age

The paleopathological description of the symptoms of the tuberculose is known from the beginning of the century mainly due to the activity of MOODIE (in: JANSSENS, 1970).

Presumably we have found spondylitis tuberculosa in two cases. Their more detailed description is as follows:

- 1st case: male skeleton, 40-50 years of age (finding Nr. 5784, grave Nr. 60). Formation of POTT-gibbus between T10-L1 with atrophy of the vertebral bodies; fusion of T11-T12.

- 2nd case: female skeleton, 30-40 years of age (finding Nr. 8857, grave Nr. 343). Sharply angular kyphosis between T4-T8 with attenuation and destruction of vertebral bodies; ankylosis of T5-T6. (This case is very similar to the tuberculous symptoms of the remain (Nr. NMIC28680-715) described by BENNIKE (1985).

The common characteristics of the two cases are that the tuberculous spondylitis involved vertebral bodies in the thoracic spine and healed with gibbus without massive new-bone formation.

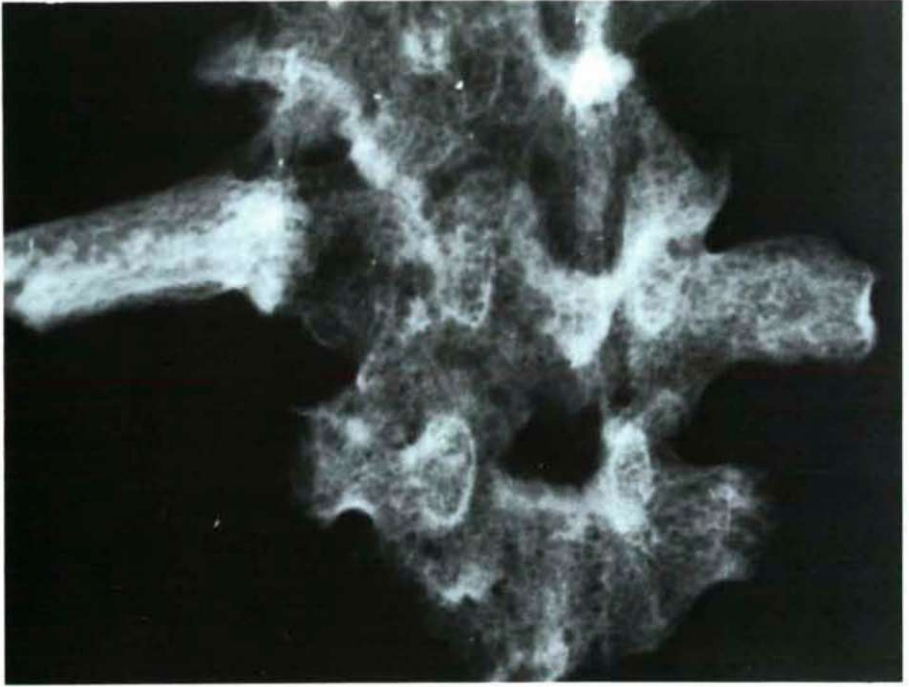


Fig.6. Radiograph of the vertebrae seen on Fig.5. Finding Nr. 5802, grave Nr. 80. Male, 30-40 years of age

4. DIFFUSE IDIOPATHIC SKELETAL HYPEROSTOSIS (DISH)

The disease is characterised by the regional ossification of the anterior longitudinal ligament and by the extraspinal manifestations of new bone growth in ligaments, in tendinous insertions or in cartilage. Common sites include the linea aspera, olecranon, iliac crest, ischial tuberosity, trochanters, patella and calcaneum. The ossification of the costal and laryngeal cartilages is also possible (ROGERS, 1982).

According to some authors (BENDER, 1987; KORONDI and ZAHUMENSZKI, 1988) the DISH is quite common among males of today's population (over 50 years of age). In classic DISH the vertebral bodies may be ankylosed, but the disc spaces are normal and the facet joints – in the absence of other pathology – are almost always normal.

The first typical example of the disease in skeletal material has been described by ROGERS in 1980 and it can be found rarely in the paleopathological literature

(BRUINTJES, 1988). This can be explained by the fact its differentialdiagnose is a rather problematic field (MORLOCK, 1986).

During the examination of our Avar age remains, we have not met classical, serious cases. In four cases, we have found lesions of lighter stadium:

- 1st case: male skeleton, 30-40 years of age (finding Nr. 5824, grave Nr. 102). Ossification of costal cartilages and the insertions of the Achilles tendom into the calcaneum. Early hyperostosis between T10-L3. Early DISH is possible.

- 2nd case: male skeleton, 50-60 years of age (finding Nr. 8289, grave Nr. 155). Ossification of costal cartilages and several entheses (lig. patellae, lig. interosaeae metatarsae, tendo calcanei). Slight hyperostosis between T3-T10. Slight DISH.

- 3rd case: female skeleton, 50-60 years of age (finding Nr. 8348, grave Nr. 220). Ossification of costal cartilages, hyperostotic changes on the surface of the arch and symphysis pubic, hyperostosis between T1-T6, ankylosis of C6-C7. Medium stage of DISH.

- 4th case: male skeleton, 40-50 year of age (finding Nr. 9543, grave Nr. 482). Slight hyperostosis between T4-T12, incipient ossification of ligaments. Calcaneal spurring, massive new bone formation on the surface of the patella, symphysis pubic, iliac crests, ischial tuberosities. Medium stage of DISH is possible.

The aetiology of DISH is not clarified at present, it is always considered to be the side effect of diabetes mellitus (FORGÁCS, 1982; KORONDI and ZAHUMENSZKY, 1988).

Conclusions

During the morpho-pathological examination of the human skeleton remains belonging to the Székkutas-Kápolnadűlő cemetery of late Avar period, we have come to the following conclusions:

1. *The composition of the population:* During the determination of sexes and ages at death it has been revealed that the number of skeletons belonging to the groups Inf.I. and Inf.II. is smaller than the values of similar archeological periods. This is explained by the great extent of fragmentary skeletons of infant remains – it is very possible that only few of them are still for archeological purposes after 1200 years.

Within the adult population, the extent of deseases of young women can probably be explained by the greater extent of mortality at childbirth of that time.

2. *Spondylarthropathies:* No lesions have been detected on infant and juvenile skeletons. As to the adult remains, the pathological cases of the spinal joints are more frequent than the diseases of the other part of the skeleton, all together.

Out of 116 rheumatic spinal lesions, we have found lumbal vertebrae suitable for measurement in 87 cases, therefore we have defined the biconcavity factor on the

basis of these. In 37 cases (42.5%) the value of the calculation was less than 80%, which is considered pathological by the rheumatological literature (OLÁH, 1987; GÖMÖR and BÁLINT, 1989). It is worth mentioning that the osteoporosis and the spinal lesion are so strongly associated.

The degenerative spinal lesions are the most frequent pathological lesions. 109 cases represent 29.3% of the adult population. This is similar to the values of other series of the Avar period, and there is no significant difference compared to the results of the wide-spectrum swiss neolithic and medieval series (KRAMAR et al., 1987). During the classification of the degenerative spinal lesions, our intention was to eliminate the weaknesses of the previous methods. Although, the fact that we have found explicit arthrosis of the small joints without any sign of osteochondrosis or spondylosis deformans, seems to demonstrate that the two processes are not necessarily developing parallelly with each other. The different degenerative pathomechanism of the hyaline-cartilaginous (diarthrodial) and fibrocartilaginous intervertebral joints are already mentioned in the literature (LOTT et al., 1987).

The fact that males are more frequently affected emphasises the role of the mechanical factors in the course of the process.

Less frequent spinal lesions – vertebral tuberculosis, SNSA group, DISH – are not suitable for statistical analysis due to their low frequency. Their frequency is satisfactory in the case of seronegative spondylarthropathies (KIRWAN, 1988) and vertebral tuberculosis (GLADYKOWSKA-RZECZYCKA, 1982) showing similarity with the data of the literature, but the frequency of DISH in inferior (MORLOCK, 1986). Beside the fact that we deal with fragmentary material, the reason of the above mentioned problem is that early stage and atypical cases cannot be separated from more general spinal lesions.

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Short Communication

EFFECTS OF pH AND NITRITE ON POTASSIUM AND PHOSPHATE UPTAKE
AND GROWTH OF RICE SEEDLINGS

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In most soils NO_2^- is usually negligible, but certain environmental (stress) conditions, e.g. waterlogging, some soil-applied herbicides, heavy metals, high pH, may lead to an accumulation of NO_2^- in the soil solution to concentrations which are toxic to plant roots (HAYNES and SHERLOCK, 1986; MARSCHNER, 1986). This prompted us to study the effects of factors influencing the toxicity of NO_2^- in rice seedlings.

The investigations were carried out on rice seedlings (*Oryza sativa* L. cv. Dunghan shali) grown in nutrient solution in the presence or absence of NO_2^- . The composition of nutrient solution was as follows: NaNO_2 from 0.01 to 5.0 mM, KH_2PO_4 1.0 mM, Na_2HPO_4 0.5 mM, CaCl_2 0.5 mM, MgSO_4 0.5 mM and micro nutrients as described earlier (ZSOLDOS et al., 1986). Ion uptake was followed via tracer techniques under controlled conditions. All experiments were carried out with three parallel samples (20 seedlings in each group) and the data given below are averages. The main results are as follows.

Even at a concentration of 0.1 mM, NaNO_2 inhibited K^+ and H_2PO_4^- uptake and growth of seedlings (Figs 1. and 2.). The inhibitory effect of NO_2^- differed considerably between the nutrients and was also different for the roots and shoots. The toxic effect of NO_2^- was strongly influenced by the H^+ ion concentration of the outer medium. A decrease of the pH in the external solution led to an increased inhibitory effect of NO_2^- on both the ion uptake and the growth of seedlings. It is noteworthy that the root hairs are unusually sensitive to NO_2^- treatments.

The results obtained suggest that the lower the pH in the root environment, the higher the uptake of NO_2^- by the roots, resulting in an inhibition even at low concentrations of NO_2^- which are otherwise non-toxic to the roots of seedlings.

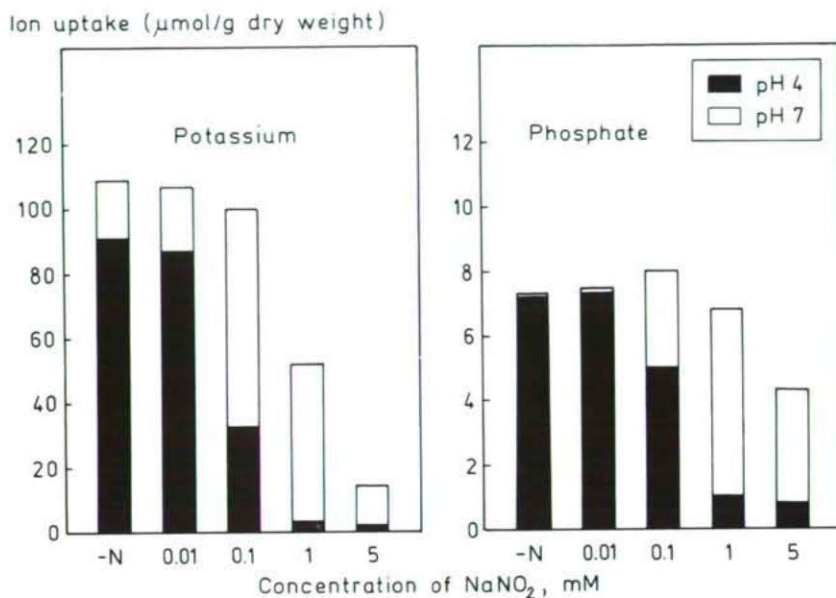


Fig. 1. Effects of pH and increasing NaNO_2 supply on the K^+ and H_2PO_4^- uptake of roots of 7-day-old rice seedlings grown in 0.5 mM CaSO_4 solution in the absence of NaNO_2 . Uptake solution: 1 mM K^{86}RbCl + 0.5 mM CaCl_2 + NaNO_2 or 0.5 mM $\text{KH}_2^{32}\text{PO}_4$ + 0.5 mM CaCl_2 + NaNO_2 . Uptake time: 1 h. Each value is the mean of 3 replicates. SE did not exceed $\pm 8\%$.

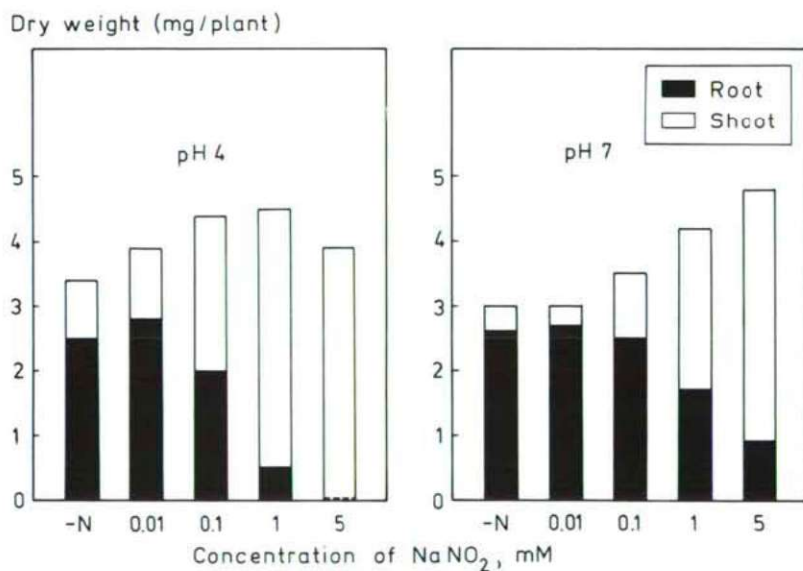


Fig. 2. Effects of increasing NaNO_2 supply on dry weight of 7-day-old rice seedlings grown in nutrient solution. Otherwise as in Fig. 1.

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Short communication

HIGHLY ORGANIZED BIOPOLYMER STRUCTURES FROM THE ECTEXINE
OF THALICTRUM FLAVUM L.

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(Received: February 28, 1990)

On partially degraded exines biopolymer structures in Å dimension were established by TEM method. Using the modified Markham rotation method a quasi-crystalloid basic biopolymer skeleton in the exine was established (KEDVES 1988, 1989). Sub-units of the exine in nanometer dimension were described in several papers of ROWLEY et al., and by SOUTHWORTH; for example: ROWLEY et al. (1980), SOUTHWORTH (1986). To establish the different levels of organization of the sporoderm an attempt was made (KEDVES, 1989). Beside the solvent method we started to use the high temperature effect, too (cf. SENGUPTA and ROWLEY, 1974).

20 mg pollen grains of *Thalictrum flavum* L. were heated at 100 °C for 2 hours, on 20 June, 1988. After heating 1 ml 2-aminoethanol was added to the pollen material. Length of time: 24^h, temperature 30 °C. For TEM: post-fixation with OsO₄ aq. dil. embedding in Araldite (Durcupan, Fluka).

On the TEM pictures, highly organized biopolymer structures in nanometer dimension were observed (Plate I, fig. 1-4). These structures are similar or identical with the model of ROWLEY and FLYNN (1968), and FLYNN and ROWLEY (1971), cf. ROWLEY et al. (1981). Helical structures and regularly arranged points with strong electron affinity were observed. These points may be identical with the "crossover points" of ROWLEY et al. (1981).

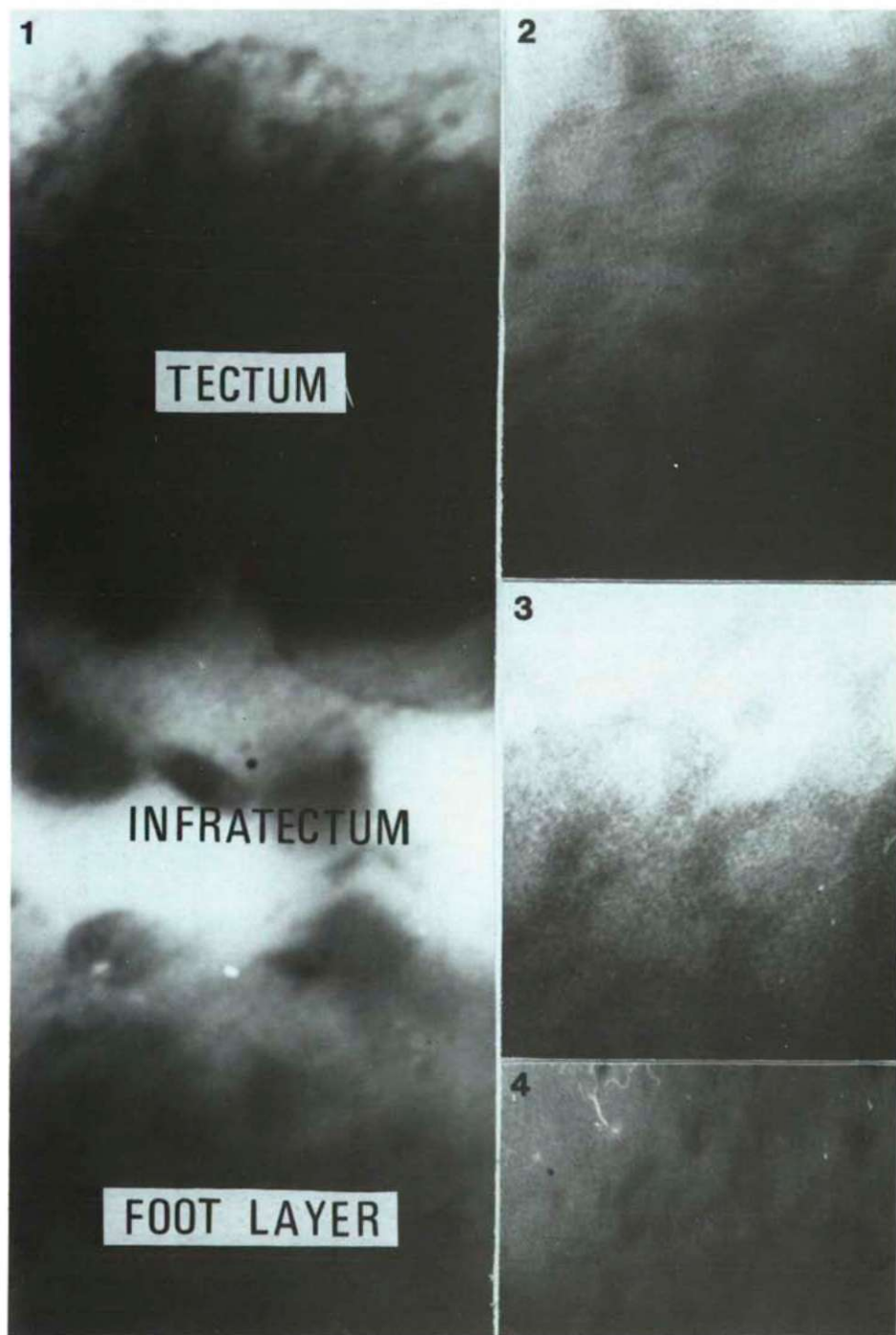
It seems that the solvent and the oxidizing method combined with the high temperature effect may be one way to get more data on the highly organized biopolymer structures of the sporoderm. As regards the heating we need to emphasize that after heating the sporopollenin becomes more aromatized; BROOKS (1971). Following POTONIÉ and REHNELT (1971) during the fossilization process the same alteration was established.

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Plate I

- 1-4. *Thalictrum flavum* L., collected from the Botanical Garden of the University by Dr. L. TÉCSI on the 20 June 1988, after experiment No 285.
1. TEM picture of the ectexine, negative No 0107, x50000, well shown are the biopolymer structure in the tectum. No similar organization in the infratectal and foot layer.
- 2,3. Magnified part from the biopolymer structure of the tectum, negative No 0107, x250000.
4. Highly organized biopolymer structure from the tectum, negative No 0106, x50000.



Short communication

INVESTIGATIONS ON RECENT MONOSULCATE GYMNOSPERMATOPHYTA
POLLEN GRAINS

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(Received: February 28, 1990)

The first data about the high temperature effect on the recent Angiospermatophyta pollen grains were published previously (KEDVES and KINCSEK, 1989). A large research program was started with different basic concepts of investigations including all spore and pollen types (iso-, homo-, heterospore, different kinds of gymnosperm and angiosperm pollen grains). Several papers are under publication or elaboration. Within this program, the recent Cycadales are very important. Dr. P. VORSTER (Dept. of Botany, The University of Stellenbosch, Rep. of South Africa) was kind to send pollen material from several species of the genus *Encephalartos* for our investigations. We express our sincerest thanks. The pollen samples were frozen at -20 °C. The aim of our first investigations was as follows.

1. Study of the pollen grains without staining or other kind of preparation.
2. Investigation of the morphological changes of the pollen grains after staining, acetolysis, and high temperature effect.
3. The qualitative and quantitative data were evaluated statistically.

Regarding the basic morphological concept of the recent monosulcate pollen grains, especially Cycadales, see the papers of AUDRAN (1970), AUDRAN and MASURE (1978), CRANWELL (1952), ERDTMAN (1965) and XI and WANG (1989). Our first previous and basic establishments are as follows:

1. The pollen grains of the genus *Encephalartos* LEHM. without stain or other kind of preparation are nearly isodiametric, and heteropolar. On the proximal pole (PP) a more or less isodiametric field is surrounded with a light line of the thinning of the tectum. On the distal pole, a characteristic colpus (or sulcus) occurs. (Plate I, fig. 1-5).

2. Occasionally, we have observed trichotomosulcate forms (Plate I, fig. 6-9) which in general are not characteristic for the monosulcate gymnosperm pollen grains. These pollen forms have also evolutionary significance, see for example the paper of KHAN (1976). Generally on the basis of our recent knowledge this

morphological characteristic feature occurs at the monosulcate angiosperm pollen grains, e.g.: *Palmae*.

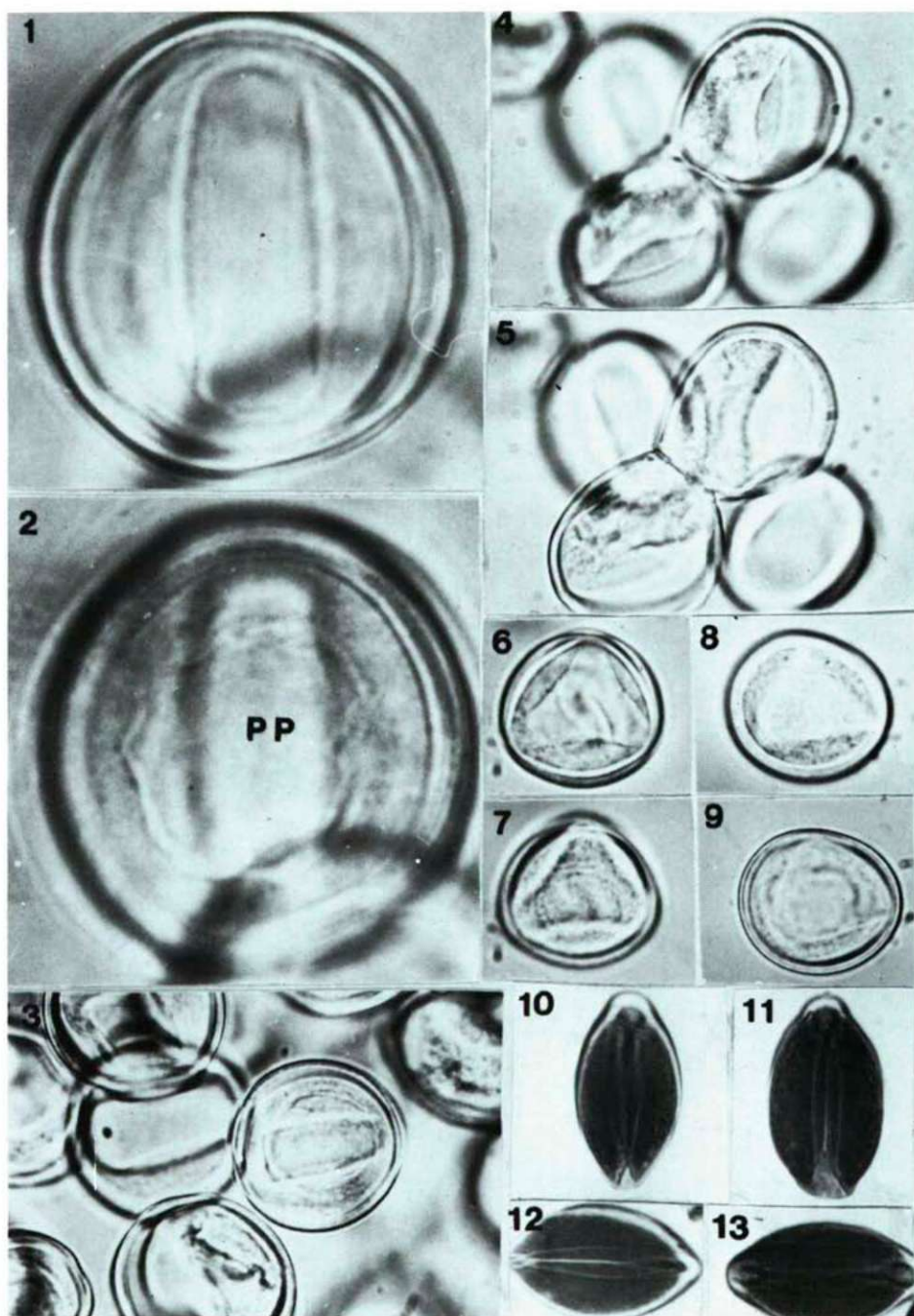
3. As an example for the high temperature effect on these pollen grains see figs. 10-13 on the plate I; *Encephalartos transvenosus* STAFF et BURTT DAVY. Well shown are the early morphological characteristic features of the fossil mostly mesozoic "monosulcate" pollen types, cf. POTONIÉ (1962).

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Plate I

- 1,2. *Encephalartos caffer* MIQ. x3000.
3. *Encephalartos transvenosus* STAFF et BURTT DAVY x1000.
- 4,5. *Encephalartos lehmannii* ECKLON x1000.
- 6-9. *Encephalartos humilis* VERDOORN x1000.
- 10-13. *Encephalartos transvenosus* STAFF et BURTT DAVY, experiment No 722, x1000.



Short communication

**ABOUT THE SUPPOSED SKELETON OF SÁNDOR PETŐFI FOUNDED
IN SIBERIA**

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Received: June 5, 1990

The famous Hungarian poet SÁNDOR PETŐFI was born in 1823.

According to historical sources he was killed in action at Segesvár in 31st July 1849. Legends were told of his burial place. One of these suppositions says that he wasn't killed at Segesvár but he was taken prisoner and carried to Siberia.

Notwithstanding that this legend is still not reinforced an unofficial expedition carried out an excavation in Barguzin (in the Buriat Republic, U.S.S.R.) in order to find the skeleton of SÁNDOR PETŐFI.

The place of excavation was pointed according to the story of the Soviet engineer Vinokur.

In 17th July 1989 a skeleton of Euroid type was brought to light from the grave no.7.

One of Hungarian anthropologists (I.KISZELY) thought that the skeleton belonged to SÁNDOR PETŐFI owing to sufficient criticism.

In his report he referred to the identification of two American (C.SIMPSON and B.LATIMER) and a Soviet (A.BURAEV) anthropologists, but they never said that the skeleton is that of SÁNDOR PETŐFI.

The committee of the Hungarian Academy of Sciences (two experts in forensic medicine, two anthropologists and an archaeologist) studied the skeleton in Moscow between 5th and 11th January 1990.

The established sex ratios of the skeleton parts (by the method of HARSÁNYI, ACSÁDI and NEMESKÉRI) are the following:

1.metric data of skull	-0.31
2.morphologic data of skull	-1.11
3.metric and morphologic data of skull	-0.74
4.metric data of the postcranial bones (except pelvis)	-0.50
5.metric data of pelvis	-0.84
6.metric data of the postcranial bones	-0.72
7.morphologic data of the postcranial bones	-0.60

8.metric data of the complete skeleton	-0.63
9.morphologic characters of the complete skeleton	-0.93
10.82 metric resp. morphologic characters of skeleton	-0.71

We mention that among 82 observed characters 45 were feminine, 22 indifferent and 25 masculine.

As the comparison shows, the finding can be determined as woman in every respect and the identification is fundamentally wrong and false.

At last we can conclude that the skeleton found in Barguzin in grave no.7 can't be identify with that of SÁNDOR PETŐFI!

Thesis of dissertation for candidate degree

**COMPARATIVE MORPHOLOGY OF THE NEUROMUSCULAR JUNCTIONS
IN THE ALIMENTARY TRACT OF SOME INVERTEBRATE AND
VERTEBRATE ANIMALS**

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Introduction

The concept of the distinction of the enteric nervous system (ENS) as a third division of the autonomic nervous system was raised by LANGLEY (1921). He first realized the specific autonomic function of visceral organs merely modified by the sympathetic and parasympathetic influence. He suggested the separation of the ENS from the sympathetic and parasympathetic nervous system on the basis of:

- its relative independence of the central nervous system
- the presence of complete reflex arches in the gut wall
- the extremely high number and diversity of enteric neurons.

Recent fine structural studies (GABELLA, 1972; 1981; FURNESS and COSTA, 1980; GERSHON, 1981; BURNSTOCK, 1986) showed that the ultrastructure of the ENS resembles more that of the central nervous system than the other parts of the peripheral nervous system.

Cytochemical and pharmacological studies proved that the intramural neurons of the alimentary tract contain a large variety of neurotransmitters and/or neuromodulators just like the neurons of the central nervous system.

Since experiments have been carried out mostly on mammals, we decided to study the ENS of some lower invertebrate and vertebrate species for a comparative morphological analysis. Besides an overview of snail, insect and fish ENS, a special attention was paid to the fine structure of the enteric neuromuscular junctions playing a key role in the motility of the gastrointestinal tract.

Our questions were:

- What forms of neuromuscular junctions are to be found in the enteric muscular layers of the studied invertebrate and vertebrate species?
- What kind of vesicle populations are characteristic of the axon profiles taking part in the enteric neuromuscular junctions?
- What are the neurotransmitters and/or neuromodulators present in those axon profiles?
- How does the transmitter release take place?

- What conclusion can be drawn from the comparison of our results with those received on mammals?

Materials and methods

Adult specimens of snail (*Helix pomatia*), locust (*Locusta migratoria*), cockroach (*Periplaneta americana*), sturgeon (*Acipenser ruthenus*), carp (*Cyprinus carpio*) and tench (*Tinca tinca*) were used.

The applied methods were:

1. *Light microscopic embedding and staining*: after fixation in 4 % formaldehyde or Bouin fixative tissue blocks were embedded in paraffin, 7-10 μ m sections cut and stained with haematein and eosin.
2. *NADH-diaphorase method*: for the visualization of nerve elements gut segments distended with Krebs solution, treated with Triton X-100 were incubated in a reaction mixture containing NBT and NADH (GABELLA, 1967). Gut segments were then fixed in 10 % neutral formalin, whole mount preparates of the muscular layers made, and mounted on slides in glycerine.
3. *Light microscopic localization of AChE*: a modified version of KOELLE and FRIEDENWALD (1949) method was applied on whole mount preparates.
4. *Light microscopic immunocytochemistry*: STERNBERGER's preembedding immunoperoxidase method was applied to whole mounts for the localization of proctolin, serotonin, dopamine (antisera kindly donated by MANFRED ECKERT), GABA, and FMRFamide (antisera kindly donated by PETER SOMOGYI).
5. *Electron microscopy*: for the study of the fine structure of the enteric neuromuscular junction tissue blocks were immersed in, or perfused with 3 % glutaraldehyde, or Karnovsky-fixative, embedded in Durcupan ACM, double-stained with uranyl acetate and lead citrate. Ultrathin sections were cut and studied in JEOL 100 C, or Tesla BS 500 electron microscope.
6. *Electron microscopic detection of AChE*: the method described by TÓTH (1977) was applied for the detection of cholinergic motor endplates in the striated musculature of fish alimentary tract.
7. *TARI method*: for the visualization of exocytosis profiles of non-synaptic transmitter release tissue blocks were incubated in a medium containing tannic acid (BUMA et al., 1984), then treated as described in point 5.
8. **QUANTITATIVE DETERMINATION OF BIOGENIC MONOAMINES AND AChE**: The amount of adrenaline and noradrenaline was determined by ANTON and SAYRE (1962), the amount of dopamine by SCHELLENBERG and GORDON (1971), the 5-HT was determined with the fluorimetric method of SNYDER et al. (1965). The AChE-activity was measured by ELLMAN et al. (1961).

Results

The innervation of the gut musculature of *Helix pomatia* morphologically resembles the mammalian myenteric plexus in several respects. The alimentary tract has a smooth muscular layer rich in nerve elements and intrinsic neurons. The neuromuscular junctions are similar to the mammalian autonomic close contacts. Three types of axon terminals (T1: containing 200 nm dense ellipsoidal granules; T2: containing 100 nm dense-core vesicles; T3: containing 250 nm granules with grainy matrix) establish close contacts with the smooth muscle cells in the gut wall of snail. Besides the similarities essential differences were revealed: in the snail ENS no

synapses are present in the neuropil; the majority of the myenteric neurons are unipolar; the neurons do not form ganglia; the number of morphologically distinguishable axon profiles is lower than in the mammalian ENS. With the help of TARI-method we could prove that non-synaptic transmitter release takes place both in the neuropil and myoneural close contacts. Exocytotic transmitter release was detectable even if the distance between the nerve and muscle was considerable.

Anthropods representing a different phylogenetic line have a different way of innervation in their alimentary tract. The exclusively cross-striated enteric musculature receives both synaptic and non-synaptic (close contact) innervation. Two, morphologically different axon terminals establish synaptic neuromuscular junctions (T1: contains 50 nm agranular vesicles together with 130 nm granules; T2: 50 nm agranular vesicles are in it together with 200 nm moderately electron dense granules). Four types of axon terminals with very diverse vesicle population establish close contacts with the striated muscles (T3: containing 130 nm electron dense granules; T4: with 150 nm strongly electron dense granules; T5: 150 nm strongly electron dense granules and 50 nm agranular vesicles; T6: 120 nm dense-core vesicles). Intramural neurons were found in the hindgut of locust by means of NADH-diaphorase method. Their sensory or motor character has not been proved yet.

The alimentary tract of the studied fish species – representing the beginning of the vertebrate evolution – is built up by similar histological layers like that of mammals. The tunica muscularis is built up by circular and longitudinal smooth muscle layers. In the tench striated muscular layers are attached to the smooth smooth ones till the border of midgut and hindgut. This is a peculiarity restricted to this species, its physiological role has not been clarified yet. Both types of muscular layers are innervated by the same nerve. plexus. The majority of the myenteric neurons are multipolar. They do not gather into ganglia in the studied fish species. The nerve-smooth muscle junction is the autonomic close contact, the nerve-striated muscle contact is the motor endplate. Its morphology differs from that of mammalian motor endplates: the finger-like infoldings of sarcolemma are not present. Morphologically three different types of varicosities are to be found both in the myenteric plexus and nerve-muscle junctions (T1: 40-50 nm pleomorph agranular vesicles and 100-120 nm dense-core vesicles; T2: 200 nm dense granules; T3: 40-50 nm agranular vesicles).

Biochemical measurements proved the presence of norepinephrine, epinephrine, dopamine and serotonin in the gut of each studied group. In the snail and carp serotonin was found to be present in highest amount, in the locust the amount of dopamine was the highest.

Serotonin and dopamine was detected by immunocytochemistry in the snail gut, both in the nerves and intrinsic perikarya. Nerve fibres showing FMRFamide-like immunoreactivity were also present in the snail gut. Varicose nerve fibres of locust hindgut showed serotonin-like and proctolin-like immunoreactivity. A GABA-

ergic groundplexus was revealed in the carp gut by immunocytochemistry. The presence of AChE was also detected in nerves and intramural nerve cell bodies in different regions of snail and fish gut. The activity of AChE was measured significantly higher in the tench fore- and midgut, than in the hindgut, or any gut segments of the carp. The higher enzyme activity can be related to the presence of striated muscular layers.

Summarizing our results, we contributed to the understanding of the evolution of the ENS with some new morphological data. Our results provide structural basis for further functional experiments.

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