Part One: Progress of the Colloquium

1.1. Summary

The Refresher Colloquium was carried out on the basis of the contract Unesco/SC/2363/70, BOC Ref. 20877 dd. 10th Feb. 1971.

The intergovernmental cooperation bases on the Government Agreement between Austria and Czechoslovakia dd. Jan. 23rd 1960, and on a similar Agreement between Austria and Hungary dd. Jan. 15th 1968.

The Geological Survey Organisations of the states mentioned, cooperating with the respective University sections were responsible for carrying out the programme.

The Refresher Colloquium is based on a recommendation of the Prague-meeting of the directors of Unesco-sponsored Post Graduate Courses, April 1968, which considered it advisable, to give former course participants the opportunity, to meet again in Europe for a discussion of trends and developments in their various fields at home and abroad.

The Refresher Colloquium consisted of lectures, discussions, labwork and excursions and also of contributions (lectures) of the participants.

It took place:
in Austria from Sept. 13th to Oct. 1st and from Oct. 21th to Oct. 28th;
in Hungary from Oct. 2nd to Oct. 9th;
in Czechoslovakia from Oct. 9th to Oct. 20th;

21 candidates applied for admission;

17 candidates were selected on May 17th 1971;

3 candidates were selected as alternates;

due to some last-minute withdrawals the final number of participants was 12.

The respective home countries of the participants were Egypt (1), India (4), Indonesia (1), Iran (1), Iraq (1), Pakistan (1), Syria (1), Turkey (1), Colombia (1).

The participants, so far as they did return after their previous course term to their home country, were offered a one-way return ticket Vienna-home country, which was sponsored by an Unesco contribution.

An overall analysis of the programme is summarized by the following:

Layout of programme

Lectures held in:	Austria	Hungary	Czechoslovakia
general themes	7	2	1
specialized themes	6	9	12
Excursion days			
general topics	5	2	1
specialized topics	6	2	4

Specification of lectures	Austria	Hungary	Czechoslovakia
general	6	1	1
megafossils	1		
ostracods	1		
conodonts	2		
bryozoa		1	
larger foram.		1	1
foraminifera	1	3	5
nannofossils	1		2
palynology	1	4	4
diatomology		1	1
Lectures contributed by participants			
general themes	1	1	2
regional themes	11	2	2

The participants were unanimous, in strongly recommending

a) that a similar Refresher Colloquium should be organized again after a 4 years term;

b) that for future colloquia funds should be made available, so that the full tickets home country — Europe — home country could be sponsored.

Although the results of a programme and the meaning of lectures and excursions cannot be documented by the amount of the presentations submitted, we venture to summarize here as the main impression of participants and organizers, that during the 6 weeks programme of the Refresher Colloquium 1971 a compact scientific review was presented by the scientists of the cooperating countries, which was unanimously appreciated by all participants.

The "experiment" of the colloquium, and as such it should be evaluated, is to be considered as a fruitful and recommendable one.

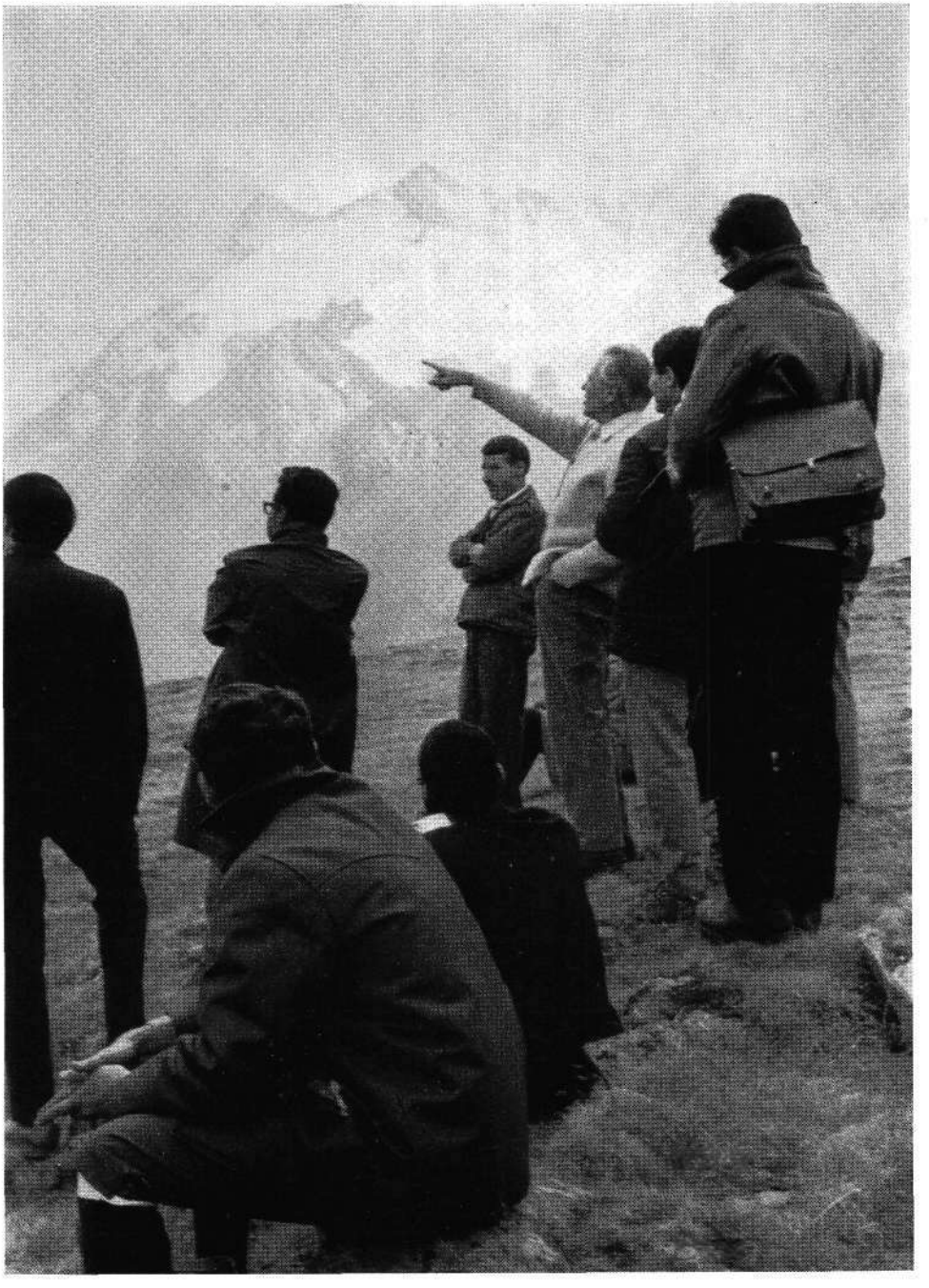
For comments on some worldwide aspects of our course work we might refer to the contribution on page 132 of this report.

Note

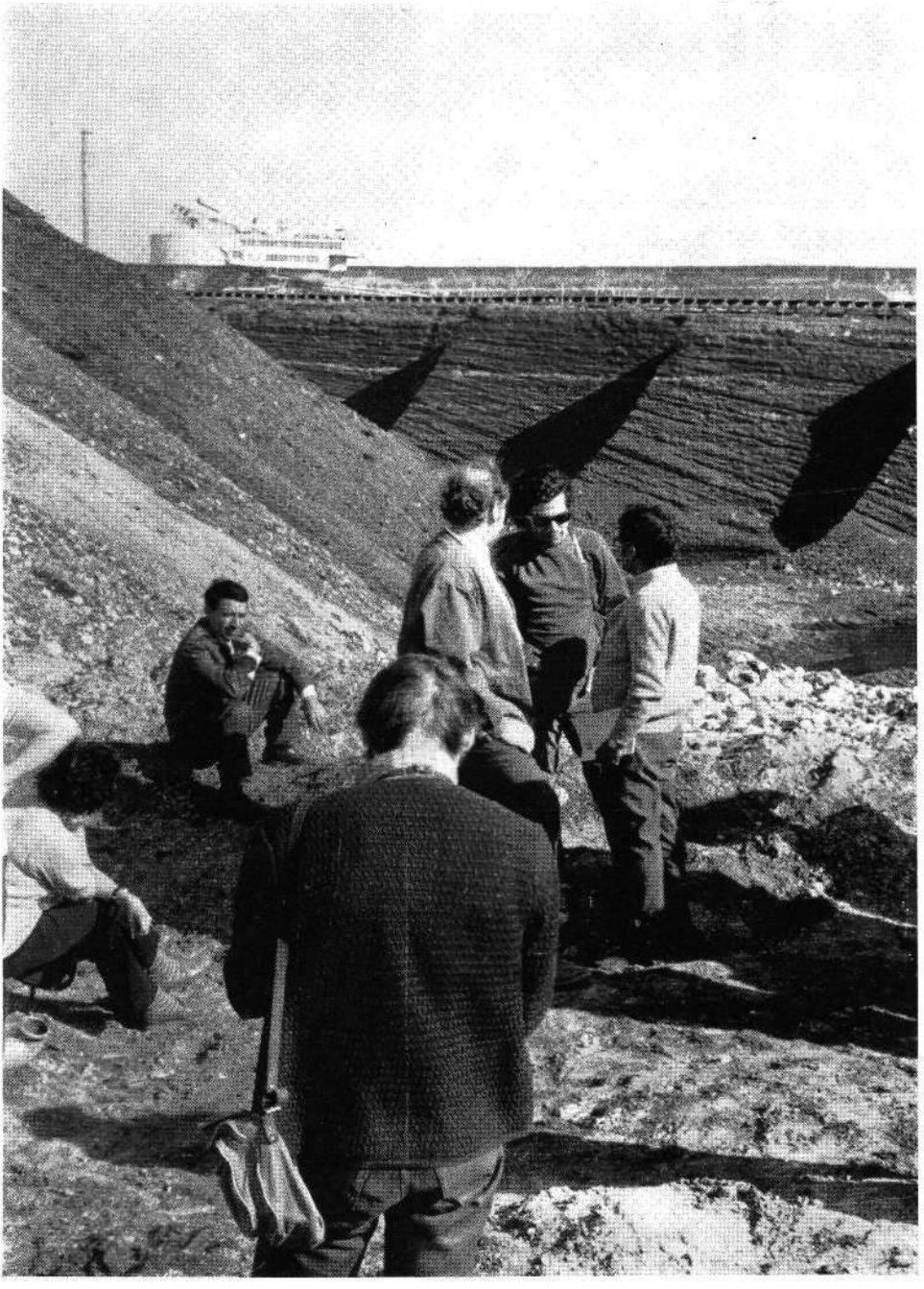
the organisation of the colloquium was in the hands of the following scientists:

M. Hajós, Budapest
E. Hanzlíková, Praha
H. Küpper, Vienna
E. Nagy, Budapest
M. Schmid, Vienna
M. Vanová, Bratislava

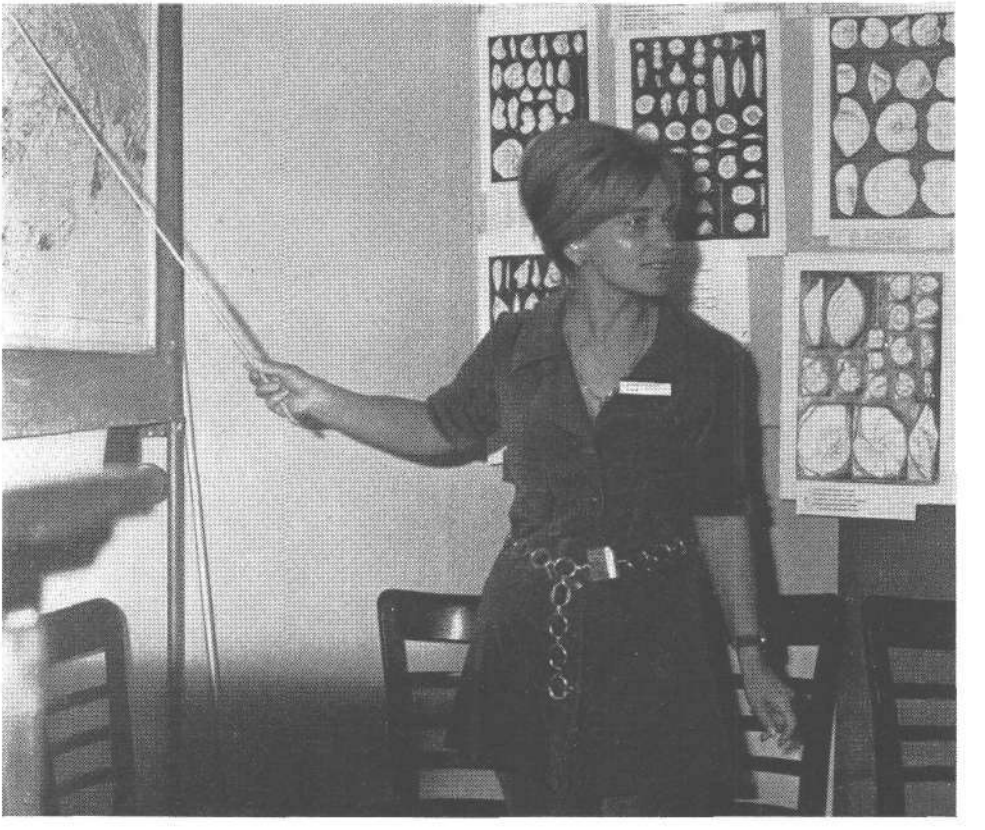
Vienna, May 1972
H. Küpper



Austria: Excursion Sept. 24th, Obergurgl.
Explanation of glacier studies.



Hungary: Excursion Oct. 8th.
Lignite mining, Visonta.



Czechoslovakia: Praha, lectures.

1.2. Review of Recommendations

The participants of the colloquium on many occasions discussed their views and opinions as to the value of the venture with respect to a continuation and its development in the future; organizers and staff were joining this exchange of ideas. The following is a short review of the main suggestions discussed; we have mentioned first the ideas submitted, comments as to the feasibility from the side of the organizers were added, where necessary.

a) The basic, unanimous recommendation was, that a similar colloquium should be organized after a four years term. For the organizers too, the meeting was a stimulating experience. The total amount of work and costs invested into the preparation and preformance of such a "multilateral" venture however should certainly not be underestimated. The fact that the colloquium was organized on the basis of a cooperation between Austria, Czechoslovakia and Hungary contributed essentially towards the scientific and personal spirit of the meeting; for geoscientists it is of paramount importance, to gather experiences outside ones own normal daily working sphere. The "transplantation" of this multilateral concept to other centers inside or outside Europa might be possible, provided that a certain variety of cooperating institutions can provide a diversity of problems and approaches.

b) The second basic recommendation, viz. that of the availability of funds for full return travelling costs and also for covering the costs of the colloquium inside the participating countries, is certainly not the question of geoscience-goodwill alone. It is hoped that a multidisciplinary approach within the geosciences on a multilateral working basis might be considered as attractive in the future by sponsoring governmental and inter-governmental organisations.

c 1) Although for some participating members it might have been not too easy, to obtain leave from teaching or laboratory obligations, many recommended an extension of the duration up to about two months, in order to include the possibility for full determination- or labwork, during which special "problem"-samples on a joint basis could be investigated and discussed.

c 2) Some members suggested to receive the detailed programme of lectures and excursions well ahead of the meeting in their homecountry for a still more detailed preparation. It was pointed out, that a multilateral venture could be better preformed on a more flexible basis, which provides the framework of the programme well ahead, but leaves details open for local, last-minute decisions.

c 3) Funds for publication of scientific contributions should be made available from the outset, was another suggestion. Agreeing that it might be rather difficult in some countries, to get scientific contributions printed within reasonable time, the other side of the problem is, that funds can be

mostly obtained for such subjects only, which are beyond local interest and of lasting working value.

c 4) Some colleagues suggested, that also internationally known specialists ("star specialists") should be invited to lecture at the colloquium. Apart from the fact, that this might involve financial implications, it was emphasized as basic idea of our meeting, to provide an actual impression of the scientific capacity and standing of organisations, which are engaged in problems, coming up during the normal handling of Geological-Survey — and University Institute-problems; of course, one always can invest more and more in a given subject; the present overall working capacity of governmental and university institutions in a group of central-european countries was for all organizers a reality, they were proud to demonstrate.

c 5) That the timing of the colloquium should consider the full European summer season, or even the date coincidence/closeness with/of international geoscience events/congresses, were other suggestions; their soundness admitted, we had to point out, that it was rather difficult anyhow, to find in Europa a suitable date for a scientific venture, involving the presence of a group of scientists, due to the fact, that the timetable of science institutions in Europa is mostly booked out years ahead.

1.3. Working Programme (abbreviated)

Sept. 13th 1971	Arrival of participants in V i e n n a
Sept. 14th/16th	Lectures
Sept. 17th	Excursion Flysch outcrops
Sept. 18th	Excursion area E of Vienna
Sept. 20th	Excursion Vienna—Gmunden Topic: oilsituation alpine foreland
Sept. 21th	Excursion Gmunden—Salzburg Topic: field palynology
Sept. 22nd	Excursion Salzburg—Innsbruck Topic: hydropower dam-site
Sept. 23rd	Lectures
Sept. 24th	Excursion Obergurgl—Rotmoosferner Topic: modern glacier investigations
Sept. 25th	Excursion surroundings Innsbruck Topic: alpine road construction, quaternary
Sept. 26th	Excursion Innsbruck—Lienz Topic: pipeline crossing of the alps
Sept. 27th	Excursion Lienz—Villach Topic: pipeline pumping station and exposures lower carboniferous
Sept. 28th	Returntrip Villach—Vienna
Sept. 29th/Oct. 1st	Lectures and lab work
Oct. 2nd	Travel Vienna—B u d a p e s t, visit Györ
Oct. 3rd	Sightseeing Budapest
Oct. 4th/6th	Lectures
Oct. 7th	Excursion Sümegh—Tihany Topic: mesozoic stratigraphy
Oct. 8th	Excursion Gödöllö—Eger Topic: young tertiary problems
Oct. 9th	Excursion Budapest—CSSR frontier Topic: old tertiary problems

Note: For the excursions in Hungary a printed guidebook was handed out to the participants.

Oct. 10th	Travel to P r a h a with geological explanations
Oct. 11th/13th	Lectures
Oct. 14th	Excursion cretaceous N of Praha
Oct. 15th	Lectures and visits of institutes
Oct. 16th	Travel Praha—B r a t i s l a v a
Oct. 17th/18th	Excursions Carpathians in Slovakia
Oct. 19th	Lectures Bratislava
Oct. 20th	Travel Bratislava—V i e n n a

Oct. 21th/25th	Lectures
Oct. 27th	Visit metro construction office
	Reception Department of Science and Research
	Farewell meeting
Oct. 28th/30th	Participants departure
	End of colloquium

1.4. Scientific Presentations

These are subdivided into three groups; the first covers those, held in Austria, the second, those held in Hungary and the last one those, given in Czechoslovakia, Prague and Bratislava. The presentations given by the participants of the colloquium are added to the first group; the arrangement in the groups is alphabetical; see also index.

1.4.a. Presentations given in Austria*)

Prof. Dr. H. HOINKES, University Innsbruck

Modern glaciology and world water reserves

(theme of lecture and excursion)

Prof. Dr. W. KLAUS, University Vienna

Review of Palynology

(Abstract)

Earth Science and Biology received a considerable amount of contributions by palynologists within the last few years. A number of modern developments should be mentioned, with emphasis to those subjects, which may be of interest and possibly also of practical value to geologists of various specializations. These include pollen preservation, the use of accumulation — rate diagrams as opposed to the classical pollen-percentage diagrams, the application of fluorescence-, cathodoluminescence-, interference-phasecontrast and stereoscan-electronic microscopy. Marine palynology and its various prospects for stratigraphy, sedimentology and environmental geology received close attention. Some trends in prequaternary palynology include new attempts at a palyno-stratigraphy of Triassic, Cretaceous and Neogene, the many applications of palynological studies of saltdeposits, the growing importance to oil geology with basic contributions to palaeogeography, palaeoclimatology and palaeoecology and a computerbased numerical coding system for the description of pollengrains and spores. Palynological data about the origin of the gymnosperms, chlamydosperms and angiosperms are considerable increasing. The annual output of scientific publications on palynological subjects reached 1400 in 1965 and reaches about 2000 in 1970.

Numerous important events, which incorporated palynological subjects or were especially devoted to palynology, occured during the last few years: the Gondwana Symposium in Argentina and South Africa, 3rd Int. Salt Symposium in Ohio (USA), First Int. Symposium on Sporopollen in

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London 1970 and the 3rd Int. Palynological Conference in Novosibirsk 1971; special attention will be given to the Silver Jubilee Paleobotanical Conference Dec. 1971 at the Birbal Sahni Institute of Paleobotany in Lucknow (India). A number of important books and periodicals have been issued during the last few years; e. g.

ERDTMAN, G. (1969): Handbook of Palynology. Munksgaard, Kopenhagen.
KEDVES, M. (1969): Palynological studies on Hungarian Early Tertiary Deposit. Budapest 1969. Akad. Kaido.
KRUTZSCH, W. (1970): Atlas der mittel- und jungtertiären dispersen Sporen und Pollen sowie der Mikroplanktonformen des nördlichen Mitteleuropas. 7 Lieferungen. VEB Gustav Fischer Verlag, Jena, DDR.
MANTEN, A. A (1966): Marine Palynology. Special Issue of Marine Geology, Vol. 4, N. 6. Elsevier Publishing Co. Amsterdam.
NAIR, P. K. K. (1966): Essentials of Palynology. Asia Publishing House, Lucknow.
POKROVSKOYA, I. M. (1966): Palaeopalynologia. 3 Volumes. Leningrad (Russian).
TSCHUDY, R. H., & SCOTT, R. A. (1969): Aspects of Palynology. Wiley-Interscience, New York-London-Sydney.

Dr. K. KOLLMANN, Direktor, RAG, Vienna

New Information on the Microstructure of Ostracods as obtained by means of the Scanning Electron Microscope

(A b s t r a c t)

The study of bodily preserved microorganisms or their skeletal elements in the reflected light has its limits, where a simple light microscope is used, in that the depth of field as required for a three-dimensional view can be achieved only through reduction of the lens aperture at the expense of resolution. The many times greater resolution of the scanning electron microscope permits of reaching into optical ranges, which are beyond the capacity of even the best light microscopes.

The scanning electron microscope lately brought about remarkable successes in the study of recent and fossil ostracods. It turned out i. a., that the features of the pore canal openings show much more variety than had been assumed only a few years ago. Moreover, there was deepened and supplemented also our so far but sketchy information on the surface ornamentation of the shells, of the hingement, and of the central muscle scar pattern on the interior of the shells.

As most of these features are also of special systematic significance, more and more information on the microstructure will furnish also many new vistas as regards phylogenetic relations, above all between those ostracod groups, whose direct relationship with recent representatives has not yet been clarified. In spite of the numerous advantages of the scanning electron microscope, however, both the binocular and the monocular light microscope will keep their place in research work and, chiefly, in routine analyses.

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HAY, W. W., & SANDBERG, P. A. (1967): The scanning electron microscope, a major breakthrough for micropaleontology. — Micropaleontology, vol. 13, no. 44, pp. 407—418, pls. 1—2, New York.

PLUSQUELLEC, P. L., & SANDBERG, P. A. (1969): Some genera of the ostracode subfamily Campylocytherinae. — Jour. Pal. vol. 15, no. 44, pp. 427—480, pls. 1—10.

SANDBERG, P. A., & HAY, W. W. (1967): Study of microfossils by means of the scanning electron microscope. — Jour. Pal. vol. 41, no. 4, pp. 999—1001, pls. 131—132.

SANDBERG, P. A. (1968): A new specimen stub for stereophotography with the scanning electron microscope. — Micropaleontology, vol. 14, no. 44, pp. 489—498, pl. 1, New York.

SANDBERG, P. A., & PLUSQUELLEC, P. L. (1969): Structure and polymorphism of normal pores in cytheracean Ostracoda (Crustacea). — Jour. Pal. vol. 43, no. 2, pp. 517—521.

Dr. H. A. KOLLMANN, Museum of Nat. History, Vienna

Austria's contribution to Micropaleontology

As "Nautilids" FICHTEL & MOLL described fossil and modern foraminifera in "Testacea microscopica". This paper, published 1803 at Vienna, was one of the first on this group of animals. The types of FICHTEL & MOLL could be traced again some years ago at the Wiener Naturhistorisches Museum; first examination showed, that the effect of these old types on foraminiferal nomenclature, strictly using the old names, would certainly involve difficulties.

Nevertheless the great french paleontologist A. D'ORBIGNY thought FICHTEL & MOLL's paper to be the first s c i e n t i f i c treatise on foraminifera. 1846 D'ORBIGNY who first recognized the independence of forams from "Nautilus", described 228 species from the Vienna Basin. This Material was sent to him by FR. V. HAUER who very ealy recognized the importance of foraminifera.

After D'ORBIGNY many papers on Foraminifera were published. Outstanding is the work of A. E. REUSS, who was originally medical doctor in the Bohemian Bilin and 1849 came to Vienna. Besides his work on mollusca, bryozoa and corals he published a large number of papers on foraminifera and ostracodes; his material still exists, but would need a revision.

Besides the work of REUSS a great number of special papers on foraminifera was published at Vienna in the second half of 19th century. One of the outstanding scientific events was the Novaraexpedition (1857 to 1859). STACHE (1864) and KARRER (1864) worked also on foraminifera.

A new epoch of problem-oriented micropaleontological investigation began after World War II. Stratigraphic and phylogenetic work has been done in all fields of micropaleontology.

Reference:

KÜPPER, H. (1959): Micropalaeontology in Austria, past and present. Erdoelzeitschrift.

Prof. Dr. H. KÜPPER

Outline of the world Petroleum Situation as per 1970

part one: framework of world problems

1.1. raw materials, shift in demand pattern, winter-summer
shift in supply pattern, Africa, Near East
mining, shift to politically stable areas, Austrialia, Canada, Indonesia, Brasil.

1.2. agriculture

yield increase:	India	Pakistan
wheat	34%	7%
rice	40%	22%

Mexico wheat increase since 1944 6 ×
E. Borlaugh, Nobel price speech: world food crisis delayed for 30 years.

1.3. environment, world as finite environment, no outside resources

1.4. world population mid 1970 abt. 3,600 Millions
population as a whole will double within 35 years
developed countries will double within 70 years
developing countries will double within 30 years

part two: world petroleum situation

2.1. basic data

	population	oil consumption	oil production
Eurasia			
W Europe	9.9%	26.7%	0.7%
USSR/China	31.5	14.6	16.8
Near East	2.9	2.4	29.5
Mid/Far East	31.7	13.5	3.0
N America	6.3	35.2	25.8
M/S Amercia	7.9	5.8	11.5
Africa	9.8	1.8	12.7
Total	Mill. 3,630	Mill. 2,268	Mill. 2,333

The threefold discrepancy between population maximum and demand-maximum and production maximum is one of the essential features of the present world oil situation (in the above table the respective maxima are underlined).

2.2. major features in modern exploration
Cenozoic exploration
Far East, classical folding, miocene

Australia, fault traps, marginal basins, eocene — lower cretaceous
Adriatic sea, pliocene gliding
Mesozoic exploration
W Africa, continental slope, salt formation, lower cretaceous
Egypt, cratonic fault traps, lower cretaceous-lower tertiary
Andes foreland, classical folding-strat. traps, cretaceous
Palaeozoic exploration
North sea, cratonic undulations and tertiary basins
Alaska, deep seated foreland structures, devonian

2.3. USSR situation
developement of production
1946: oil 21.7 mill/T, gas 4 mrd m^3
1968: oil 300 mill/T, gas 198 mrd m^3
development of production regions
classical Baku, 1870/1920, 97% of total production
Tertiary/Mesozoic Structures, exploration continues
"second" Baku since 1930, west Ural-Volga region
1968 180 mill. T/y
carboniferous basins, all types of structures
biggest oil province, abt 500 fields
"third" Baku since 1965, western Sibiria
lower cretaceous to lower tertiary basin,
sedimentary thickness 2—7 km.
production 1970 30 Mill. T, estimate 1980 230 Mill. T
other major exploration-production provinces
Timan-Pechora, Palaeozoic, 33 fields in operation
Caspi-Taschkent, mesozoic gas province
Pre Caspi depression (N of lake Caspi)
deepest part of european platform, 15—19 km. sediment
salt structures
Baku-Turkmenistan, permian to pliocene structures
marine exploration

Prof. Dr. H. KÜPPER

Outline of the Sea Floor Geology as per 1970

part one: continental shelf and continental slope

1.1. marine geology, not oceanography
replacing old theories: permanence of oceans, C. DIENER, 1890
continental drift, A. WEGENER, 1920

1.2. general setting:
coastal plain

continental shelf
continental slope
• 200 m depth line accepted as
boundary at UN conference 1958
from continental shelf 17% of world oil production
6% of world gas production

1.3. examples of offshore successes:

o l d : Baku, Maracaibo, Louisiana, Persian gulf

m o d e r n : North Sea, Nigeria, Adriatic sea, Australia
New Sealand, Australasia

p a r t t w o : deep sea

2.1. historical-technical developement

until 1950 results from old time dredging
results from refraction profiles
"sediments under oceans must be thin"
1964/65 first drilling vessel after mohole failure
1967/71 Glomar Challenger, first cruise 11. 8. 68.
per 1. 12. 70. 230 holes at 144 sites
58,000 m. drilling
10,000 m. core recovery
deepest water 6140 m.
deepest penetration 985 m.
Gl. Ch. staff: 2 co-chiefs, 4 sedimentologists,
4 palaeontologists, 10 technicians plus crew
cores 6.25 cm. diam, 9 m. length

2.2. outline of features:

	ocean	continent
crust	basic, 6—8 km.	acidic, 35 km.
age	young, 155 mill. y (Jur. limst.)	old, 3.5 bill. y
lithology	thin sediment on basic rocks	complex, sediments, igneous, metamorphic rocks
structure	simple, mid ocean ridges abyssal plains	complex, geosynclines, shields platforms

2.3. mineral resources: unique province-ultra basic ore deposits

primary ore deposits mid ocean, indian ocean Cr, Pt, Ni, Co,
surficial deposits glauconite, manganese, phosphorite/placer
hydrothermal deposits rift zones, Fe, Mn, Sn, Pb, Co,

generally hostile for petroleum and salt formation
except in extension of continental conditions
f. i. Challenger Knoll, 3572 m. oil, gas, Gulf of Mexico

2.4. theoretical framework

central oceanic ridges — mid ocean belts
high temperature convection
earthquake zone on axis
tensional features
thin earth crust
lower density mantle material, peridotite → serpentinite
zones of magnetic orientation parallel to axis
outward spreading 1—10 cm./year

E. L. Gealy 1971/p. 5
"data gathered by the Joides Deep Sea Drilling Project strongly support the theory of crustal accretion along mid-ocean ridges and of lateral spreading of the seafloor away from the ridges. Sediments immediately above basalt basement are younger over the crest of the mid-ocean ridges and, with minor exceptions, are progressively older away from the ridges crests in both the Atlantic and Pacific Oceans."

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F. J. Vine (1971): Sea Floor Spreading Understanding the Earth, p. 233, The Artemis Press, Sussex.

Doz. Dr. H. K. Mostler, University Innsbruck

Conodonts of the Triassic

Triassic conodonts were neglected for a long time mainly because the general opinion was that they could not be used for stratigraphic purposes. In 1958 R. Huckriede issued a monograph on the conodonts of the Triassic, discussing at the same time their stratigraphic value by means of a table of distribution and also pointing to their comparatively lesser value for stratigraphy. As a result the interest in Triassic conodonts slackened down.

Intensified research on Triassic sediments, however, beginning some 5 years ago, showed that an exact study of conodont faunes could well be used for a stratigraphic subdivision of the Triassic.

The Lower Triassic (Skythian) to start with, can be subdivided into 3—4 "zones" (Staesche, 1964). W. C. Sweet's attempted subdivision into 9 zones derived from the study of the Salt Range sediments cannot be supported by the author's own investigations (samples from the Himalaya). A subdivision of the Skythian into 4 zones remains acceptable.

The Lower Middle Triassic (Anisian) can be divided into 2 (MOSHER, 1970) and sometimes into 3 or 4 zones (BENDER, 1967); the Lower Anisian (Hydasp) and Higher Anisian (Illyr), however, can very well be subdivided. An exact delimitation of the Skythian — Anisian was not yet possible; this problem is at present being investigated by the author.

The delimitation of the Upper Anisian-Ladinian by conodonts imposes considerable difficulties. According to MOSHER, 1970, the boundary is defined by the extinction of *Neogondolella constricta* (CLARK). HIRSCH made the attempt to define the boundary quantitatively by means of faunal assemblages; though a clear delimitation of the Anisian-Ladinian is not possible at present. A subdivision of the Ladinian is not yet well founded; it seems, however, that a distinction of 2 zones may be possible.

The delimitation Ladinian-Karnian is clearly defined by the extinction of *Epigondolella mungoensis* (DIEBEL), Karnian itself can be subdivided into 3 zones.

The Norian can be divided into 3 zones (KRYSTYN, 1970). The subdivision is partly based on the appearance of simplified "platform-types" and partly on the appearance of new forms shortly before the complete extinction of the conodonts.

Conodonts die out with the end of the Norian; reports concerning the appearance of conodonts in the Rhaetian (MOSHER, 1970), in the Jurassic (NOHDA & SETOGUCHI, 1967) and in the Cretaceous (DIEBEL, 1956) are either the result of a misinterpretation of stratigraphy or the conodonts were redeposited into these particular series.

Note: A preliminary distribution chart of triassic conodonts was handed out during the lecture.

Dr. R. OBERHAUSER, Geol. Survey of Austria

Excursion to the Dobratsch-Range, West of Villach, Carinthia with comments on general alpine tectonics

The Dobratsch-Range belongs to that part of the Southern Calcareous Alps, which is situated just north of the important Alpine-Dinaric fault separating Alps and Dinarids. The Dobratsch still exhibits the facies of the Northern Calcareous Alps in spite of its tectonic position in the south. The peak of Dobratsch consists of limestones of the Middle-to Upper Triassic transitional beds, rich in corals, calcareous sponges such as *sphinctozoae, hydrozoae,* calcareous algae and abundant problematic organic remains. Megafossils are rare, only gastropods, especially *Chemnitzia rosthorni* HOERNES, are more common. Some finds of cephalopods, namely nautilids, and lamellibranchs (especially pectinids) have been recorded. Foraminifera are very rare, and they are not diagnostic for age determination. The top of the Dobratsch mountain is the type-locality

for a problematic, small tubular fossil: *Lamelitubus cauticus* OTT, and for the thalamid sponge *Vesicocaulis carinthiacus* OTT. Fauna and flora of the Dobratsch is indicative of a reef facies. It was studied in thin slides by OLAF KRAUS and ERNST OTT in 1968. The authors described and photographed the following forms: *Tubiphytes obscurus* MASLOV, *Ladinella porata* OTT, *Lamellitubus cauticus* OTT, *Uvanella irregularis* OTT, *Dictyocoelia manon* (MÜNSTER) and *Vesicocaulis carinthiacus* OTT. The fossil list also includes: *Coelospongia catenulata* OTT, *Girtyocoelia oenipontana* OTT, *Vesiocaulis* aff. *depressus* OTT, *Holocoelia toulai* STEINMANN and big Codiaceae as *Mitcheldeania*.

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KRAUS, O., & OTT, E. (1968): Eine ladinische Riff-Fauna im Dobratsch-Gipfelkalk (Kärnten, Österreich) und Bemerkungen zum Faziesvergleich von Nordalpen und Drauzug. — Mitt. Bayer. Staatssamml., Paläont. hist. Geol., Bd. 8. München.

Prof. Dr. A. PAPP, University Vienna

Global Stratigraphy of the Tertiary

During the last ten years Tertiary stratigraphy has been more and more based upon evolution of planktonic organisms. At present subdivision of the Tertiary rests mainly upon planktonic foraminifera and nannoplancton.

The boundary between the Cretaceous and the Tertiary is characterized by disappearance of Globotruncanas and existence of a „Globigerina-horizon" with *Gl. djaubergensis*, which can be recognized worldwide. Evolution of planktonic foraminifera gives good possibilities for zonation of the Paleocene and Eocene. Besides planktonic forms, larger foraminifera (Nummulites, Assilina, Alveolina a. o.) give evolutionary sequences, which permit zonation of the calcareous marginal facies.

Especially the evolutionary peak in the Middle Eocene offers good possibilities for wide ranging correlations. During the Oligocene evolution of planktonic foraminifera is not characteristic. At the boundary between the Oligocene and Miocene evolution of the genus Globigerinoides begins — which date is often used as definition of the boundary mentioned.

Evolution of Lepidocyclines and Miogypsina gives valuable zone fossils for division of the calcareous marginal facies during the Lower Miocene.

Very important for far reaching correlations during the Miocene is the evolutionary sequence from *Globigerinoides bisphericus* to *Praeorbulina*

and further *Orbulina suturalis*. In the tropical regions evolution of *Globigerinatella insueta* and the group of *Globorotalia fohsi* is important.

The Miocene-Pliocene boundary cannot be defined exactly on a worldwide base, since climatic differentiation is already strongly pronounced.

The boundary Tertiary/Quaternary (Pliocene-Pleistocene) is characterized by deterioration of climate and its influence on the fauna and flora over extensive areas in the northern as well as the southern hemisphere.

Doz. Dr. W. Resch, University Innsbruck

The Pleistocene of the Inn valley/Tyrol

(Abstract)

Pleistocene deposits and the morphological characteristics of the Inn valley in the Tyrol have gained great importance on the stratigraphy of the Quaternary and the paleogeography of the entire Alpine region as well. Four different main glaciations can be traced in the foreland of the Alps, according to their moraine deposits and fluvioglacial gravel beds (ranging from Günz as the oldest over Mindel and Riss to Würm as the youngest member). In the surroundings of Innsbruck the most complete series of Pleistocene sediments in the inner Alpine region are to be found. This area shows three different ground-moraine deposits of separate glaciations and two fossiliferous beds in interglacial and interstadial sediments.

The "Hötting Breccia" located on the slopes and along the foothills of the "Nordkette" North of Innsbruck was deposited in a comparatively warm interglacial period. In the "Geologenstollen" the underlying ground moraine of the Mindel glaciation (classified by some authors as Riss) can well be made out. The breccia contains frequent plant fossils such as imprints of needles of Pinus silvestris and leaf imprints of Rhododendron ponticum found in some outcrops. The "Conglomerate of Ampaß", which is underlain also by ground moraine deposits, is most probably of the same age.

Both breccia and conglomerate are overlain by younger ground moraine sediments and again above these the so-called "terrace sediments" are following, made up by warved clays and silts near the bottom of the sequence and coarse gravel at its top. In a clay pit situated E of Innsbruck (loc. Baumkirchen) pollen grains, wood belonging to different plants and fish remains were found in fine grained sediments. Radiocarbon dates of the (subfossil) wood gave the result of 26,800 and 31,000 before present. The above clays, silts and gravel beds again are superposed by ground moraine deposits which are related to the latest stade of the Würm glaciation due to the fact, that these are showing the formation of recent soil.

Cloncluding from the finding of erratics, the height of glaciation of the Inn valley glacier system in the vicinity of Innsbruck (574 m. a. s. l. = 1,780 ft.) reached as high as 2,400 m. a. s. l. (= 7,440 ft. a. s. l.).

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Dr. M. E. SCHMID, Geol. Survey of Austria

Evolutionary trends in the foraminiferal genus Uvigerina in the Badenian of the Vienna basin

(Abstract)

The zonation of the Badenian was proved by means of the evolution of the benthonic foraminiferal genus Uvigerina and several guideforms were described already in 1953 (PAPP & TURNOVSKY, Jb. Geol. B.-A., *96*). Unfortunately, these guide-fossils sometimes are lacking while other species, occuring throughout the Badenian beds, normally are present in a sufficient number of specimens.

Due to this fact a method was developed recently, demonstrating the evolution of Uvigerina by means of metrical methods (PAPP & SCHMID, Verh. Geol. B.-A., 1971/1). In this study it is shown, that sculptural features may be neglected and the number of specimen restricted too, thus having the possibility to use this method for samples from wells with an often limited material. The features taken into consideration are: the number of chambers and the length of the tests. An average index-number, representative of the degree of evolution, was determined arithmetically for several surface outcrops representing the type-localities of the Badenian zonation. The increase of the indices from the oldest to the younger beds of the Badenian (14.0 to 64.8) was checked and confirmed by the study of well-samples in superposition too. As the main result it is pointed out, that we are able to evaluate the stratigraphic position of Uvigerina bearing beds from the Badenian of the Vienna basin merely by determination of the index-numbers of the Uvigerina populations.

Dr. W. SCHNABEL, Geol. Survey of Austria

Flysch-Problems

(A b s t r a c t)

The expression "Flysch" was first used by STUDER (1827) in the Simmen-Valley of Switzerland, it characterizes rocksequences of sandy-silty nature, which incline to slide when wheathering and usually form soft regions.

Now, 1970, after 10 years of world-wide and intensive discussion no final d e f i n i t i o n o f "F l y s c h" can be given. Flysch-deposits are characterised by grade-bedded series of psammitic — pelitic detritus (turbidites!), which are usually found as remarkable sequences, as for instance the Flysch formations of the East-alpine and Carpathian "Flysch-zone". Due to this thick formation, which inevitably presupposes sedimentation in sinking or deep basins, a certain relation to tectonical events is given. On these criteria petrographers base their definition of Flysch as WIESENEDER (1962), who regards Flysch as a "certain lithofazies independent of any particular period, which has been formed in geosynclinals at any time".

SEILACHER (1958) goes even further when he includes the small amount of mega-fossils and large quantity of trace-fossils and primitive foraminifera in his definition. According to his definition, Flysch has to have a special L i t h o f a c i e s (graded bedding ...), B i o f a c i e s (trace-fossils, no mega-fossils ...) and T e c t o f a c i e s (great thickness originating in lateral basins of geosyncline before or during the first foldings and tectonical movements of the orogen). Frequent association of these given tectonical, sedimentological and biological features at various points of the earth history demonstrates the significance of the flysch concept. Examples intermediate to other facies types are relatively rare and differ from true flysch in either one (tectonically, sedimentologically or biologically aberrant flysch) or two (flysch-like formations) of the three aspects (SEILACHER, 1967).

The clearest answer to the question of the g e n e s i s o f F l y s c h - d e p o s i t s is given by KUENEN & CAROZZI (1953) in their theory of t u r b i d i t y c u r r e n t s. Material, deposited in adjacent areas slides down as a suspension into the deeper sea, where the suspended material settles down according to grain-size and weight, causing graded bedding. If there was not enough energy to transport the whole material in a suspended condition, F l u x o t u r b i d i t e s are formed (partly sliding movement causing incomplete gradation, DJULYNSKI et al., 1959).

The turbidity current forms current-marks into the clay on the bottom, which reveals the transport direction. In the case of the creation of the alpine flysch-zone the direction of material-transport has changed a few times, which for instance was observed by HESSE (1965) for the Bavarian flysch. Besides the organic traces, anorganic s t r u c t u r e s (ripple-marks ...) where present in the clay-sediment on the sea floor, which

can be partly conserved by the following turbidite. The replicas of all structures on the bottom of a layer can be called b a s i c - m a r k s (current marks, ripple marks, organic traces, load casts ...) and must not be confused with i n t e r n a l - s t r u c t u r e s, which occur within a bed and are caused by different density gradient, slumpings ect. The most common phenomenon of the internal structures is the convolute bedding (POTTER & PETTIJOHN, 1963). In polish carpathian flysch SUJKOWSKI (1957) pointed out that on an average every 4000 years a turbidity current must have occured. In the Flysch of the Vienna-woods it was found, that a turbidity current extinguishes the bottom fauna and after that, the new formed floor is reinhabited, beginning with primitive agglutinated foraminifera to more and more specialised forms (GRÜN et al., 1964).

Flysch-formations are found in the alpine geosynclinal as well as in the variscian and older sequences. The flysch-zone of the eastern alps and the carpathians is very typical and well investigated (see references).

Many regions today have sedimentation with mechanism of turbidity currents (Gulf of California ...), their sediments can be compared with "fossil" flysches. (v. RAD, 1968). In the Adriatic sea we know four holocene turbidites (VAN STRAATEN, 1970).

From recent observations we know that turbidity currents occur with such great intensity and violence, that deep-sea cables are cut. The investigation of Flysch sediments, Flysch basins and their origin is thus of immediate economic interest (KRAUSE et al.).

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Dr. H. P. SCHÖNLAUB, Geol. Survey of Austria

Palaeozoic Conodonts

(R e v i e w)

Conodonts are widespread in Palaeozoic sequences. They are the isolated remains of free-swimming pelagic as well as benthonic or even near-shoreliving animals. However, in a recently published paper G. SEDDON & W. SWEET suggested a modified ecologic model for conodonts as small planctonic animals, different species of which were segregated by depth stratification. As the investigations of the last 20 years have shown, these microfossils are due to their rapid evolution very valuable for dating and mapping the beds, in which they locally occur in great numbers.

Conodonts range in size of less than 1 mm up to 5 mm. They are composed of calcium phosphate and can therefore be obtained from limestones through solution of the latter in acetic acid, whereas they will dissolve in other acids, for example hydrochloric acid. They also may be observed on bedding planes of shales or cherts, where they are preserved as moulds or fragments. They may be easily recognized with help of a magnifying glass and sometimes even be determined in the field.

With regard to the morphology of conodonts three principal types can be distinguished: simple, compound (blade-like) and platform conodonts. Simple conodonts are the oldest ones and occur in the upper part of the Middle Cambrian for the first time. They are widespread throughout the Palaeozoic with a great variability. Compound conodonts can be genetically derived from simple ones. They are characterized by lateral processes or denticles in addition to the main cusp of the simple conodonts. Their first occurence is in the very early Ordovician. In various stages they are of great stratigraphic value. The platform types are generally derivable from compound conodonts, in which specific morphologic elements are widened and emphasized. Due to their rapid evolution these types are guide-fossils for parts of the Ordovician and younger systems. Especially in the Silurian and Devonian, as well as in the Carboniferous of North America and Europe conodont-zonations have been introduced on the base of the biozone concept. The worldwide validity of these zones

has often been checked and partly revised by founds of megafossils in the meantime.

During the short review on Palaeozoic conodonts the techniques of conodont research will be studied and then an attempt will be made to determine some important genera of the Ordovician, Silurian, Devonian and Carboniferous by following LINDSTRÖM's key to the conodont-genera.

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Doz. Dr. F. STEININGER, University Vienna

Macro- and Micropalaeontology as a basis of a modern stratigraphy of the Tertiary

The historical subdivision of the Tertiary was based upon marine mollusc faunas and continental vertebrates. This stratigraphy by means of faunal associations is sufficient for subdivision into bigger units, it does not suffice, however, for modern conceptions of a detailed Tertiary Stratigraphy.

A modern biostratigraphic subdivision is based in the first place upon nannoplancton and evolutionary lines of planctonic foraminifera; these are regarded as biostratigraphic indicators of primary importance. They are, however, since climatic zones are already prominent in the Tertiary, restricted to tropical and subtropical regions of sedimentation.

In marginal regions only a few of those planctonic zones are well established. In order to be able to subdivide also intervals between those intercontinental planctonic biozones, local or regional evolutionary lines of various groups of macro- or microorganisms are used, most of them benthonic, in marine as well as in non-marine sediments.

The Central Paratethys is such a region of sedimentation, including marine, brackish, limnic, fluviatile and terrestric sediments. Subdivision of these neogene sediments serves as an example for the manyfold possibilities of modern detailed biostratigraphical analysis, based upon combination of micro- and macropalaeontology.

Dr. H. STRADNER, Geol. Survey of Austria

Nannoplankton Stratigraphy

Plates and excerpts from recent papers dealing with the stratigraphic value and the zonation of nannofossils (coccoliths and discoasters, nannoconids etc.) were distributed and discussed during the lecture.

For more detailed information on the standard Calcareous Nannoplankton Zonation of the Tertiary and the Quaternary the paper by E. MARTINI in the Proceedings of the II. Planktonic Conference Roma 1970 is to be consulted.

At present papers on nannoplankton stratigraphy are in press by THIERSTEIN (Switzerland) and MOSHKOVITZ (Israel). Also see the Initial Reports of the DSDP (Glomar Challenger), especially the reports by the shipboard nannoplankton paleontologist and by DAVID BUKRY (USA).

(See also review on page 132 of this report.)

1.4.b. Presentations by Participants

J. BENDECK OLIVELLA (Participants Scientific Contributions page 53).

BILAL UL HAQ, Stockholm University

Rates of Evolution in Cenozoic Calcareous Nannoplankton

(Summary)

Variations in the total frequency of the cenozoic nannoplankton and the evolutionary rates for coccoliths and discoasters were calculated accor-

ding to the method outlined by G. G. SIMPSON (1953). It was shown, that calcareous nannoflora diversified rapidly during late Paleocene and early Eocene, but underwent a gradual reduction in frequency during the remainder of Eocene and sharply declined during Oligocene and early Miocene, with a slight second radiation in the middle and late Miocene. A comparison with the paleotemperatures shows, that calcareous nannoplankton increase in diversity during the warmer intervals and decrease in diversity during the cooler ones.

Dr. EL DAWOODY, Cairo

Calcareous Nannoplankton Biostratigraphy of Upper Cretaceous and Lower Tertiary Sediments at Gebel Duwi

(referring to the above theme 3 lectures were given in Viennna, Budapest and Praha; they are based mainly on the thesis of the author, 2 volumes 1970, which was circulated and discussed widely among the participants)

H. HONNAPPA, Dept. of Postgraduate Studies and Research in Geology, Manasa Gangothri, Mysore (India)

Ostracoda From the Recent Sediments of Mangalore Harbour Area, West Coast of India

(Summary)

Actinocythereis tumefacentis (LUBIMOVA & GUHA) from bore hole sediments of Mangalore Harbour Area, is represented by a large number of individuals of various dimorphic stages. Besides appropriate sketches, the main features relating to as ontogeny, nature of marginal porecanals, hingeline structures, muscle scarpattern, and taxonomic status of the species, have been presented; the length, height and thickness of the individuals have been measured, and the measurements data have been plotted on a scatter diagram; the nature of the ontogenetic developement has been discussed. The detail observation of the hinge structures of larva and adults revealed the different moult stages. By comparitive study of the shape of carpaces, position of the muscle scars, and the marginal pore-canals, the variations and the similarities within the population have been recognised. The nature of the reproduction has been studied with the help of the ratio of female right and left valves. The nature of surface ornamentation, the internal characters, the ratio of closed to isolated carpaces, the degree

and the nature of pyritization enabled to interpret the ecology and the depositional conditions of the recent sediments of the Mangalore Harbour Area of West Coast of India.

S. A. JAFAR, Department of Geology, Aligarh Muslim University, Aligarh, India

Some Aspects of Relict Sediments off the Coast of Bombay, India and its Bearing on the Pleistocene Sea Level Fluctuation

(Abstract)

The inner shelf sediments of the coast off Bombay, India, are characterized by the presence of a veneer of blueish grey mud (terrigenous) of Holocene age underlain by oolitic calcareous sands (relict sediments of late Pleistocene age). The study of oolitic calcareous sands has revealed, that they were formed at the time of lowered sea level, probably during Wisconcin glaciation, from the evidence of their association with typical shallow water benthonic foraminifera. However, the occurence of calcareous sands at different depths both off the east as well as west coast of India remained a problem; the possibility is not altogether dismissed, that they represent different strand line deposits of Pleistocene epoch. The microfauna associated with oolitic sand is largely exotic and hence cannot be relied upon for paleoecologic interpretations.

DARWIN KADAR (Participants Scientific Contributions, page 58).

Dipl.-Geol. IBRAHIM KHOGA, General Petroleum Company, Syria-Damaskus

Palynological Investigation on Upper-Triassic (Kurashine-Dolomit) deposits of northeastern Part of Syria

(Abstract)

Three cores from the borehole JB. 5, NE-Syria, depth 3150—3200 m. were prepared and examined for their contents of sporomorphs. Four genera were described: *Circulina, Samaropollenites, Caytonipollenites, Ellipsovelatisporites*. These genera appeare in different parts of the world, f. e. in Austria, Saudi Arabia, Malagashi and Russia. The sporomorphs found in core 17 were strongly affected by the dolomitic recrystallisation. The age was given as Upper-Triassic according to *Circulina meyeriana* KLAUS, 1962.

This was the first palynological study in Syria.

D. S. N. Raju

Late Cretaceous and Lower Tertiary foraminiferal zones from different basins of India

(two lectures were given in Budapest and Praha basing mainly on recent publications of the author, e. g. Jb. Geol. B.-A., Sb. 17, 1970)

G. N. Saxena, Dept. of Applied Geology, University of Sagar, Sagar (M. P.), India

The Danian in South India

The question of Cretaceous-Tertiary boundary has almost exclusively been related to the position of the Danian in the Cretaceous — Eocene succession in any area. Whether the Danian is topmost Cretaceous, Lowest Tertiary or a separate unit in itself has determined the position of Cretaceous — Tertiary boundary also. Some workers e. g. Tromp, refuse to recognise any horizon like Danian and are of the view that this term is superfluous and should be dropped. The controversy mostly revolves around the peculiar nature of the Danian fauna in different areas. Diverse opinions have evolved regarding the existence and position of the Danian on one hand, and the validity of the parameters used for correlation on the other. Status of the Danian s. s. in the Trichinopoly and Pondichery areas of the South India is discussed here. Convincing faunal support is not available to prove the existence of the Danian s. s. in these areas. The strata so far referred to as Danian could at the most be uppermost Danian and possibly Montian.

Trichinopoly: The upper part of the Niniyur beds here is regarded as Danian in age on the basis of the discovery of *Hercoglossa (Nautilus) danicus, Cardita (Venericardita) jaquinoti* and *Orbitoides minor*. The presence of *Orbitoides minor* is a definite indication of the Maastrichtian age of these beds or atleast that part of the beds which has them. Sarkar (1968) re-examined the "danicus" from this area and compared them with the type "danicus" and concluded that the so called "danicus" from this area belong to some allied species and not to "danicus". Moreover, "danicus" is found in situ at the base of Ariyalurs (Campanian) at Sudarampet near Pondichery. In Madagascar it is occurring in Campanian — Maastrichtian. In the type area of Danian in Denmark, the "danicus" is always accompanied by *Baculites* and so is the case in the Franco-Belgian basin. But no ammonite is found with "danicus" in these beds in this area. Regarding the evidence of *Cardita (Venericardita) jaquinoti*, a close ally of *Cardita beaumonti*, Rutsch (1936) says that if all the species of *Cardita*

beaumonti of different areas are put together, the range of *Cardita beaumonti* group is much longer and ranges from Maastrichtian to Eocene. All these fossils therefore, do not support the presence of the Danian s. s. in this area. Fossil algae described from these beds also indicate the presence of younger Palaeocene element. These beds, therefore, on the available evidence should not be assigned to Danian, but may belong to some younger horizon.

Pondichery: More work on the microfossils has been done in this area than the previous one. Foraminifera are the most common amongs these. RAJGOPALAN (1964, 1965) made six foraminiferal zones and recognised that the Cretaceous strata continue without interruption into Lower Eocene (Ypresian) in this area. Revising this scheme RAJGOPALAN (1968) concluded that the topmost horizon indicates a Palaeocene age and not Lower Eocene as decided earlier. MCGOWRAN (1968) also points out the absence of Danian and leaves a gap between the *Globotruncana tricarinata, G. gansseri* Zone (Campanian — Maastrichtian) on one hand and *Globotruncani trinidadensis, G. uncinata* Zone (Montian — Thanetian) on the other of the horizons suggested by RAJGOPALAN. This gap, therefore, should represent the Danian. *Heliolithus riedeli,* a very characterstic Thanetian nanno-plankton has also been reported by RAJGOPALAN from these beds.

1.4.c. Presentations given at Budapest *)

Prof. E. NAGY Dr. PH., Dr. Sc.

Micropaleontology in the Hungarian Geological Institute

(Abstract)

There has been done intensive paleontological work since the very foundation of the 102 years old Institute. The pioneer work was started in the field of micropaleontology by M. HANTKEN, the renowned first director of the Institute. In the 20th century, one of the most prominent micropaleontologists was B. ZALÁNYI, who specialized in ostracods.

Presently, 3 research teams of micropaleontology are at work in the Paleontological Department of the H. G. I.: on

— *diatoms* and *coccolithophorids,*
— *pollens* and *spores,*
— *small* and *larger foraminifera* and *ostracoda.*

Altogether 14 micropaleontologists are included in the present staff of the Institute.

*) Hungarian Geological Institute, Budapest XIV, Népstadion út. 14.

Prof. E. Nagy Dr. PH., Dr. Sc.

Aspects of Nomenclature, Taxonomy, Ecology, Cenology, Climatology and Faciology in Paleopalynological Research

(Abstract)

Some methodological aspects of palynological work are discussed, amongst others clean sampling and maceration techniques. The most important part of the palynological work is the identification of forms. Beside morphological identification, biological identification is needed, if possible. This is the basis of any further scientific and practical conclusion. In Hungary, paleoclimatological zones could be distinguished by means of palynological studies.

These and some faciological conclusions including redeposition have proved to be important for industrial exploration work too.

Biostratigraphical information obtained is a serious help for geological mapping done by the Hungarian Geological Institute. Of course, palynological results are evaluated together with those of other micro- and megapaleontological, sedimentological, investigations. Three palynological diagrams display the different possibilities of evaluation.

Dr. J. Bóna, National Prospecting and Drilling Co., Komló

Palynological Practice in the Investigation of Liassic Coal Measures in the Mecsek Mountains (South Hungary)

(Abstract)

Continuous Upper Permian to Upper Cretaceous sedimentation in the Mecsek Mountains comprises two cycles. The second one started with the deposition of a 200 to 1200 m. thick black coal bearing formation of Lower Liassic age.

Pollen studies have contributed essentially to settle the following major problems:

1. Approximate determination of carbonization grade (depending mainly on tectonic stresses).

2. Tracing the Triassic/Liassic boundary. Of 128 forms found in the examined sequence, 38 are indicative of the Upper Triassic only, while 38 — of the Lower Liassic. They never occur together.

3. Distinction of swamp zones: deep swamp, shallow swamp and swamp forest, with direct possibilities of coal measures correlation. This is a very important aid in this area, which is very intensely folded.

4. Establishing an adequate picture of Lower Liassic paleogeography. Some continental floral exchanges have been pointed out with the Rhodopean Continent, while marked differences support the existence of a marine area betwen the area of study and the Bohemian Massif.

Dr. E. Dudich Jr.

Paradoxes and Use of Bryozoa

(Abstract)

A synthetic review of some crucial problems of paleobryozoology is given. Such are: the contradiction between systematics based mainly on features of the soft body and paleosystematics necessarily based on skeletal morphology; a possible interpretation of paradoxical bryozoan anatomy by means of mosaic evolution; the rule of astogeny, reflecting phylogeny in zoarium development; the two-phase phylogeny through the Earth's past, with virence periods displaying strange reiterations and competition phenomena; non-corallian ecology and possibilities of paleocommunity reconstruction based on the principle of actualism. As for the methodological aspect, traditional and up-to-date techniques are enumerated and commented. Finally, references are cited, with particular regard to practical applications in faciology and stratigraphy. As an example, some conclusions drawn from Upper Eocene bryozoan faunulas in Hungary are presented, concerning age, environment and conditions of sedimentation.

Dr. F. Góczán

Comparative Palynology and the Paleoclimate of Bauxite Formation

(Abstract)

The author adopted the concept of E. Vadász (1951, 1956): "bauxite is a particular type of continental sediment which is — independently of its laterite or terra rossa origin — produced by analogous processes from siallitic substances derived from various bedrocks."

A comparative palynological approach is forwarded. As a first step, several maps of recent aluminium enrichment areas are compiled, showing January and July medium temperature, rainfall distribution and sea water temperature data as well as the distribution of climate indicating plants, the ancient equivalents of which can be traced, by means of pollen studies, from Jurassic to Oligocene.

As a second step, these climatic features are compared with maxima of paleoclimatological curves. These have been plotted on one hand from paleotemperature measurements on *Belemnites* and *Nummulites* specimens (oxygen isotope method), and from palynological data, reflecting relative climatic values obtained by the study of continental paleovegetation.

This comparison points out markedly the time intervals of optimum conditions of bauxitization. Accordingly, the majority of bauxite deposits in Hungary seems to have been formed during the Albian.

Dr. M. Hajós C. Sc.

Siliceous Unicellulars. Their Use for Faciology and Biostratigraphy

(Abstract)

The study of siliceous unicellulars is of increasing importance. Particularly so in the case of sediments containing no other kind of microfossils.

In Hungarian Geological Institute siliceous unicellulars are evaluated also from the point of view of applied geology.

Siliceous unicellulars are to be found most likely in acidic tuffs and tuffites, or in diatomites accompanying these.

The composition of these assemblages is controlled by the chemical and physical characteristics of the given water medium. Light, temperature, agitation, chemism of the water are decisive for the propagation of these microorganisms. Changes in these involve changes in both the sediments and the assemblages enclosed.

The most sensitive indicators of such alterations are the diatoms.

Consequently paleobotanical conclusions are based first of all on diatoms. However, for faciological and microbiostratigraphic evaluations the whole assemblage should be taken into account: *Archaeomonae, Silicoflagellata, Ebriida, Diatomea, Phytolitharia, Radiolaria,* accompanied by fragments of siliceous sponges. Chitinous tests of planktonic forms "incertae sedis" of characteristic morphological featurs, also occur; these may be of considerable stratigraphic value.

In Hungary, important diatomites are known to occur in the foreland and in some marginal basins of the Mecsek and Bakony mountains. Their age varies from Liassic through Oligocene, Miocene and Pliocene to Holocene. "Marker species", of short haemeras, may be used for stratigraphic dating the age. In the Tertiary, assemblages can be used even for detailed geochronological zonation and even for longdistance correlation with the neighbouring countries.

Dr. M. JÁMBOR-KNESS

Eocene Stratigraphy of the Dorog Basin based upon Larger Foraminifera

(Abstract)

A chart is presented displaying the distribution of larger Foraminifera in one typical region of the basin, taking into account the lithology and the regional geological setting. In the chronology, the author has adopted the stratigraphic terminology developed by M. HANTKEN (1871), P. ROZLOZSNIK, Z. SCHRÉTER & K. TELEGDI-ROTH (1922), modified on the basis of recent stratigraphic research (L. GIDAI, 1969) and of her own foraminiferological results (M. JÁMBOR-KNESS, 1965).

The recognized *Nummulites* horizons are illustrated according to their position and importance in the sequence. Frequencies (abundances) of the individual species are represented by thickness of the respective line, while vertical ranges by its length. Surface and equatorial section pictures of the species are added, in order to facilitate quick orientation even for specialists of far-away countries.

Dr. M. JÁRAI-KOMLÓDI, L. Eötvös University, Budapest

Role and Importance of Pleistocene and Holocene Palynology

(Abstract)

Qualitative and quantitative analysis of pollen spectra is useful for the reconstruction of the ancient climate and vegetation history of Hungary's different phytogeographic areas.

Alternation of cool and warm periods can be well traced. Some plants turned out to be excellent climate indicators, as shown by numerous examples (e. g., *Armeria maritima, Selaginella selaginoides, Hippophaë rhamnoides, Ribes alpinum, Gypsophila fastigiata, Polygonum bistorta, Koenigia islandica).*

A review of glacial, interglacial and post-glacial vegetation history of Hungary is given, with special regard to flora migrations and relict forms in the Hungarian Central Mountains and on the Great Hungarian Plain.

Colour slides of the characteristic forms have been demonstrated.

It is stressed that the climax vegetation of the Great Hungarian Plain is now forest-steppe, while that of the highlands, deciduous oak and beach forest.

Dr. I. Korecz-Laky

Foraminiferal Studies on Miocene Formations of Hungary

(Abstract)

The Miocene formations of Hungary can be subdivided in detail by means of foraminifera.

The relatively rich foraminifer fauna of the Burdigalian marine clay marls corresponds to that of South Slovakia and of the Eggenburgian in Austria. From the Lower Helvetian, foraminifers abundant in the *Cardium* bearing beds only, being represented very poorly in the lower rhyolite tuff and in the lignite bearing members. On the contrary, the *Oncophora* bearing sands, *Chlamys* sandstones and "Schlier" beds of the Upper Helvetian are very rich in foraminifers. Three biofacies could be distinguished according to the predominance of arenaceous, benthic and planktonic forms, respectively, to the N-NE of the Danube, while to the south, a fish-scale bearing facies is characteristic, with rather scarce foraminifers. This stage is terminated by biotitic, scoriaceous rhyolite tuffs, which are overlain by Lower Tortonian sediments, yielding a very abundant foraminiferal assemblage, characterized by the apparition of *Orbulina* species, and by the predominance of *Lagenidae*, both indicating off-shore environment. The corresponding litoral sediments of "Leithakalk" type, more or less sandy, contain numerous *Amphistegina* and *Heterostegina*. In the Mecsek and the Bakony Mountains, the following fresh-to brackish water member, including brown coal seams, are overlain by Upper Tortonian Corbula and Turritella bearing clay marls, which can be subdivided into three foraminiferal horizons. As a heteropic facies, the "Leithakalk" reappears, which can be distinguished, however, very well from the lower one by means of its different microfauna characterized by *Borelis*, *Peneroplis* and *Dendritina*.

The brackish water sediments of the Sarmatian develop in continuity from the Tortonian, in the same facies. They can be separated by microbiostratigraphic studies only. Within the Sarmatian, several biofacies could be discerned.

Dr. A. Oravecz-Scheffer

Triassic Foraminiferal Assemblages of Stratigraphic Value in Hungary

(Abstract)

After a short discussion of techniques, the most characteristic foraminifer assemblages of the Hungarian Triassic are reviewed. A brief description of the Campilian *Meandrospira iulia* bearing beds of Trans-

danubia is given as well as of the assemblages of the Anisian Glomospira and Meandrospira dinarica bearing beds of the Bakony and Villányi mountains.

The rich Karnian assemblages of the Balaton Highlands, the Northern Bakony and the Cisdanubian Horsts and the microfaunistical features of the Rhaetian Dachsteinkalk formation are discussed in detail.

Attention is drawn to the abundance and stratigraphic-ecological importance of some microscopic echinoderm skeletal elements *(Holothurioidea, Asteroidea, Ophiuroidea).* Some typical species have been illustrated by projection of microphotos.

Dr. M. Sidó, C. Sc.

Biostratigraphic Importance of Cretaceous Foraminifera in Hungary

(Abstract)

Relying, above all, upon the studies on boreholes Sp-1 and Sp-2 at Sümeg, Transdanubia, and on the surface profile demonstrated during the field trip, the author presents an overall picture of the Cretaceous (and partly Jurassic) microfaunistic assemblages of Hungary, with particular regard to their use in chrono- and microbiostratigraphy. The importance of the nannoplankton and of the planktonic foraminifers is particularly emphasized beside the benthic communities, in view of correlation and paleogeographic reconstructions.

The phylogenetic analysis of pelagic foraminifers resulted in distinguishing three major evolutionary phases.

1st phase: Valanginian to Middle Aptian inclusive, characterized by nannoplankton, *Tintinnidae, Radiolarian* assemblages, and as for Foraminifera, by the genera *Hedbergella, Ticinella* and *Globigerinelloides.* Subdivisions can be established by the apparition and disparition of particular species. E. g. the *Globigerinelloides algerianus* Zone characterizes the Upper Aptian.

2nd phase: Upper Albian to Turonian, characterized by the genera *Rotalipora, Planomalina* and *Praeglobotruncana.* Flattened *Rotalipora* appear at the lower boundary of the Vraconian, with the predominance of *R. appeninica.* Inflate, angular forms are characteristic of the Cenomanian, including the zones of *Planomalina buxtorfi, Globigerinelloides eaglefordensis* and *Rotalipora* aff. *greenhornensis.*

3rd phase: Turonian to Senonian inclusive, characterized by various forms of the genus Globotruncana: double-keeled in the Turonian, single-keeled in the Lower Senonian, and conical in the Maestrichtian. Within the Senonian, three zones have been recognized: those of *Globotruncana concavata, Gl. calcarata* and *Gl. mayaroensis — Pseudotextularia.*

1.4.d. Presentations given in Praha*) and Bratislava**)

Eva Benešová

Applied micropaleontology in the Paleogene of Moravia

Paleogene sediments of Moravia (Ždánice Unit) contain macrofossils for biostratigraphical correlations. From other groups of fossils smaller foraminifera are suitable for stratigraphical zonation. Stratigraphical ranges of most of planctonic foraminiferal species and their evolutionary lineages may be correlated with planctonic zones used in worldwide measurement. The benthonic part of all foraminiferal assemblages yields material for studying ecological conditions and for the reconstruction of the development and changes in the sedimentary provinces.

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N. Gabrielová

Plant microremains in crude oil

(Abstract)

Recently, the study of organic microremains has proved to be useful in the solution of problems connected with migration of crude oil and its genesis. These problems have been dealt with by many authors (J. C. Sanders, 1937; K. R. Čepikov & A. M. Medvedeva, 1953, 1960, 1961; A. Horowitz & Y. Langozsky, 1965; C. Sittler, 1955; J. Tomor, 1950, 1964, and others) who studied oils of different ages from important petroleum areas. For obtaining microorganisms from crude oil, laboratory preparation is necessary, which mostly consists in filtration or separation by centrifugation. After a microscopic study, the assemblages of organisms from crude oil are compared with those known from the reservoir rocks.

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In Czechoslovakia, crude oil was for the first time examined in this way on samples from bore Lubná-1. The assemblage of organisms established there fully corresponds to that from the Neogene sediments of the Carpathian foredeep. As it is considered to be autochthonous, the conclusion can be drawn that oil originated there in the Neogene.

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E. HANZLÍKOVÁ

Applied micropaleontology in the Cretaceous of Moravia

(Abstract)

The Upper Cretaceous of Moravia has a complete stratigraphic sequence. It is developed in marine facies. All subsequent substages from the Cenomanian to the Maastrichtian were determined by means of foraminifers. In some partial basins the thickness of sediments is more than 5000 meters, especially in the Silesian Flysch trough. The sediments were zoned according to the pattern elaborated by BANDY (1967) and his ideas based in the evolutive lines of Cretaceous planktonic *Globotruncanids* and *Heterohelicids*. From the ratio of different species of planktonics found in the outer Flysch all the Moravian territory belongs to the transitional zone between the Boreal and the Mediterranean bioprovinces. Flysch biotop does not show any of this pattern. It is explained as a permanently subsiding trough with changeable conditions in the salinity (PH factor) redox potential, clarity of water and other abiotic as well as biotic factors, all of them affected by the huge inrush of terrigenous material, coming from the cordilleras, exotic blocks and from the Bohemian massiv too. This biotope is represented by very primitive foraminifers rarely accompanied by planktonics *(radiolarians)*.

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JITKA HERCOGOVÁ

The Foraminifera and their Significance for the Stratigraphy of the Cretaceous of Bohemia

(Abstract)

Upper Cretaceous sediments of the Bohemian Massif were deposited in a period ranging from the Upper Cenomanian to the Lower Santonian. On the basis of micropalaeontologic investigations it has been possible to distinguish the Upper Cenomanian; the Lower, Middle and Upper Turonian; and the Lower and Upper Coniacian. Only sandy sediments, which did not favour preservation of the foraminifers, were deposited during Lower Santonian time.

According to their stratigraphical significance, the foraminifera can be subdivided into the following groups:

1. Species having no stratigraphical significance, these are found in beds ranging in age from the Cenomanian or Lower Turonian to the Coniacian (*Lenticulinae*, most of *Frondicularia*, *Nodosaria*, *Valvulineria lenticula* [REUSS], *Textularia foeda* REUSS, and others).

2. Species limited only to a certain part of the Upper Cretaceous, mostly to its lower portion (up to the end of Middle Turonian) or to the Upper Turonian and Coniacian.

3. Species which were referred to by F. BETTENSTAEDT (1952) as "Häufigkeitsfossilien". These are of wider stratigraphical range over large areas, but confined to certain stratigraphical units in relatively small areals; as in the Cretaceous of Bohemia.; such a limited stratigraphical range is chiefly due to ecological factors; *Cassidella tegulata* (REUSS), *Vaginulina ensis* REUSS, *Stensiöina granulata* (OLBERTZ), *Stensiöina exsculpta* (REUSS), etc.

4. Index fossils (species) confined to a certain stratigraphical unit:

Cenomanian:	*Gavelinella cenomanica* (BROTZEN),
	Pseudotextulariella cretosa (CUSHMAN),
	Marginulina muelleri REUSS,
	Marginulina aequivoca REUSS, etc.;
Lower Turonian:	*Gavelinella rudis* (REUSS)
Middle Turonian:	*Gaudryina ruthenica* REUSS, etc.

5. Members of phylogenetic series, which are considered by F. BETTENSTAEDT (1960) to constitute the most reliable group; *Neoflabellina deltoidea* (WEDEKIND) occurs only in the Lower Coniacian, whereas *Neoflabellina sphenoidalis praecursor* (WEDEKIND) is known only from the Upper Coniacian of the Cretaceous of Bohemia.

A range chart referring to the above data was handed out to the attendants of the lecture.

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MILADA KAISEROVÁ-KALIBOVÁ

Palynology of the Carboniferous of the Bohemian Massif

(Abstract)

The Geological Survey, Prague, carried out a palynological research in the Bohemian Massif especially in the Carboniferous system. Both megaspores and microspores from the coal seams (of Westphalian B-C — Stephanian age) were studied.

The megaspore investigation in the Plzeň Basin has shown that megaspore studies are a useful aid in local seam correlations.

The results of microspore studies carried out in three main basins of the Central Bohemian Carboniferous complex (Kladno—Rakovník, Plzeň, Mšeno basins) were summarized and stratigraphically evaluated.

Two bore-holes in eastern Bohemia may be taken as examples showing that it is possible to use palynology in determining the age of the rocks containing neither coal nor macrofossils.

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MAGDA KONZALOVÁ

Paleophytoplankton in geological research

(Abstract)

The application of phytoplankton investigation in stratigraphic paleontology is outlined. It involves the preparation technique and the general characteristic of various groups of planktonic microfossils — *Acritarcha, Dinoflagellates,* green and blue-green *algae* — known from marine and brackish-marine sediments. The progress of microplankton-research in the Bohemian Massif in the Upper Proterozoic, Early Paleozoic and Upper Mesozoic is outlined. Particular attention is paid to the most characteristic microfossils, their assemblages and geological occurrence. Practical use in stratigraphy and geology is shown.

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R. Lehotayová, D. Stur Institute, Bratislava

Electron Microscopic Investigation of Calcareous Nannoflora from Neogene Pelites in Slovakia

After mentioning the history of investigation and importance of calcareous nannoflora the lecture dealt with the biostratigraphy of Neogene sediments in the western part of Slovakia.

The age of calcareous nannoflora pelites studied from the localities Vel'ká Čausa, Pôtor, Bajtava, Salka, Semerovce, Lontov, Devínska Nová Ves and Pavlová was determined on the basis of planktonic foraminifers in the most cases; it has become known more completely and precisely with investigation by aid of electron microscopy.

In the last years great stratigraphic importance has been ascribed to calcareous nannoplankton in zonation and interregional correlation.

The earliest sediments concerned in the study under consideration are of Eggenburgian age from the locality Vel'ká Čausa (borehole ČČ-3). From calcareous nannoflora the following are most abundantly represented:

Coccolithus eopelagicus
Coccolithus sp. 1
Coccolithus sp. 2
Microrhabdulus cf. *decoratus*
Reticulofenestra umbilica
Reticulofenestra ovalis
Reticulofenestra cf. *danica*
Zygodiscus diplogrammus

The pelitic sediments from the Modrý Kameň area, locality Pôtor (borehole M-2) belong to the Carpathian. The calcareous nannoflora consisted of the following species:

Coccolithus pelagicus
Discoaster sp. 1
Ericsonia ovalis
Helicosphaera carteri
Reticulofenestra sp. 1 etc.

The most part of the studied material is Badenian (Tortonian s. l.) in age, from the localities Salka, Bajtava, Lontov and Semerovce, with very rich associations of nannoflora. The main component was formed by heliolithic forms; discoasterids as well as rhabdoliths were found sporadically only.

Most abundantly were represented:
Coccolithus cf. *celticus*
Coccolithus eopelagicus

Coccolithus floridanus
Coccolithus cf. *minutulus*
Coccolithus cf. *muiri*
Coccolithus parvulus
Coccolithus ex gr. *pelagicus*
Coccolithus sp.
Cribrosphaerella ? sp.
Cruciplacolithus devinensis
Cyclococcolithus cf. *formosus*
Cyclococcolithus leptoporus
Cyclococcolithus reticulatus
Cyclococcolithus rotulus
Cyclococcolithus sp.
Discoaster challengeri
Discolithina macropora
Discolithina multipora
Discolithina phaseola
Discolithina sp.
Ericsonia occidentalis
Ericsonia ovalis
Helicopontosphaera carteri
Lithostromation perdurum
Microrhabdulus sp.
Microrhabdulus sp. 1
Reticulofenestra dictyoda
Reticulofenestra sp.
Reticulofenestra sp. 3
Rhabdosphaera claviger
Rhabdosphaera sp.
Scapholithus fossilis
Syracosphaera sp.
Syracosphaera sp. 1 nov. spec. ?
Umbilicosphaera cf. *mirabilis*

The latest sediments in the Neogene of the Paratethys, thus also in our country, in which calcareous nannoflora is represented, are Upper Miocene, Sarmatian, in age. So far we have obtained coccoliths only from its lowermost horizon, the horizon with large *elphidia*. Among the forms found in the Sarmatian the following were of greatest importance:

Braarudosphaera bigelovi
Discoaster sp.
Reticulofenestra sp.
Reticulofenestra pseudoumbilica
Discolithina macropora

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Importance of Palynology for Stratigraphy and Development of the Neogene Flora in the Region of the West Carpathians

In the introduction of the lecture a short historical survey was presented from the beginning of the palynological method to its full application for biostratigraphical purposes. Next a general description of the arrangement and structure of pollen grain was mentioned and possible errors and inaccuracies following from application of the palynological method were indicated. On the other hand the possibilities of application of this method in paleoecology, mainly paleoclimatology and stratigraphy, were pointed out. As main contribution for biostratigraphy by aid of the palynological method evaluation of so called standard diagram and pollen grains is being considered. These are treated by evaluation of an amount of sediments of equal age, and serve then as basis for stratigraphy and correlation.

In the next part of the lecture a survey of the results of palynological investigation in Slovakia from the Egerian to the Plio — Pleistocene was presented. Every stage of the Neogene was characterized by the flora with its development of paleoecological conditions in the Neogene of Slovakia.

The development of the climate in the Neogene was not advancing rectilinearly from tropical — subtropical climate towards cooling off. Certain periods of cooling of the climate were alternating with warmer climatic periods. The climate was relatively cooler in the Egerian and Lower Eggenburgian than in the Ottnangian and Carpathian. In the Badenian the climate was subtropical with alternating humidity of the climate. A change in the climate took place in the Lower Sarmatian, when the tropical climate completely retreated and Arctic — Tertiary types of the flora became predominating. In the Pliocene gradual cooling of the climate set in, also reflected in composition of the pollen picture. Wood species became gradually more and more rare and in the uppermost Pliocene herbs of varied associations are most important in the pollen picture.

Z. ŘEHÁKOVÁ

Solution of sedimentological and stratigraphic problems with the use of diatom analysis

(Abstract)

In the past, diatoms were generally recognized as valuable devices for microbiostratigraphic correlation of sediments. Their importance for

age determination and detailed stratigraphic division of sedimentary formations was mostly underrated. However, the possibility of applying the diatom analysis in stratigraphy on a broader scale has recently been proved. The study of stratotypal floras and extensive comparative studies conducted in various countries of Europe, Asia and America, furnished positive results in this respect.

The author has studied qualitative changes of fresh-water diatom associations in various Tertiary and Quaternary sediments on the territory of Czechoslovakia. On the basis of these investigations she defined diatom associations characteristic of individual stratigraphic units and established the complexes of index species.

Every major time interval is distinguished by the evolution of a specific type of diatom flora. The younger the flora is, the smaller is the percentage of extinct species and the closer is its relationship to the recent diatom associations. The diatom associations of the Miocene are very monotonous, comprising few genera and species; the *Melosira* populations predominate greatly over pennate diatoms, which are quantitatively insignificant. In the Pliocene sediments the diatom associations are more varied; the epiphytic and benthic forms of the order *Pennales*, which are characteristic of the Pliocene, increased substantially in number. Compared with the Miocene, the number of extinct species dropped down to the minimum. Quaternary species of diatoms show close relations to the recent ones; the qualitative changes in their associations are more influenced by the climatic fluctuations and the ecological diversity of the habitat than by the age of sediments deposited during this short time interval.

The results have been checked against the published data on the occurrence of fossil diatoms in the continental deposits of Europe; it has been found that they essentially agree.

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Important Foraminifera of the Bohemian Cretaceous

Planctonic and benthonic foraminifera as individual components of the microfossil associations were studied in the Bohemian Cretaceous. Statistical methods were applied in this study. Important species were evaluated in detail. Their study brought some new taxonomic, phylogenetic, ecological, and stratigraphical conclusions.

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Nummulites from the Area of Bojnice, the Upper Hron Depression and the Budín Paleogene around Štúrovo

In the submitted report the biostratigraphy of the Paleogene of the Central Carpathians from the wider environments of Bojnice, the Upper Hron Depression and the Budín developement of the Paleogene in the Štúrovo area was presented, based on larger foraminifers, mainly *Nummulites*.

In the wider environments of Bojnice the basal transgressive lithofacies were deposited from the Upper Lutetian to the Lower Priabonian, the marginal lithofacies in the Upper Lutetian, the flysch lithofacies from the Upper Lutetian to the end of the Priabonian. In the Upper Hron Depression the basal transgressive lithofacies was deposited from the Upper Lutetian to the end of the Priabonian, the sandy-claystone lithofacies in the Upper Priabonian, the claystone lithofacies in the Upper Priabonian too. In the Štúrovo area a thick complex of sediments contained montonous assemblages of Upper Lutetian age. According to their stratigraphic range larger foraminifers were divided into seven assemblages. The assemblages I—V fall into the Upper Lutetian, the assemblage VI falls into the Lower Priabonian and the assemblage VII into the Upper Priabonian. Comparing bioassociations from the wider environments of Bojnice and the Upper Hron Depression with associations from the Budín developement of the Paleogene in the Štúrovo area, the associations from the first two areas were found to contain granular species with massive shells and the associations from the Budín developement of the Paleogene to contain species with simpler shell structure.

The different nature of bioassociations in the Central Carpathian Paleogene in the wider vicinity of Bojnice, and in the Upper-Hron depression and from the depression and from the Budín Paleogene around Štúrovo may be ascribed to their appurtenance to two different paleogeographical sedimentation areas. The supposed connection of the sedimentation area of the Budín Paleogene across the wider area of Bojnice

and the Hornonitrianska kotlina (depression) with the Central-Carpathian Paleogene cannot be documented with nummulite associations. In fact, till the present no nummulite bioassociations have been found as to comprise numerically equal granulated and non-granulated forms.

The occurence of alveolines below the association with *Nummulites gallensis* (HEIM) in the wider vicinity of Bojnice indicates the connection of the Central-Carpathian Paleogene with the epicontinental Paleogene in the Bakony mountains. Here, below the horizon with *Nummulites perforatus perforatus* (MONTFORT) in the horizon with *Assilina spira* (IXth horizon) occur the species *Alveolina elongata* D'ORBIGNY and *Alveolina fusiformis* SOWERBY (G. KOPEK, T. KECSKEMÉTI & E. DUDICH, 1965). The connection of the Budín Paleogene with the central-Carpathian Paleogene across the region of the wider vicinity of Bojnice and Hornonitrianska kotlina (depression) could only be indicated by a sporadical occurence of *Orbitolites* (not yet determined) from the boreholes Mužľa-3 and Obid-6, situated near Štúrovo.