

Collections of the Lunz flora in Graz

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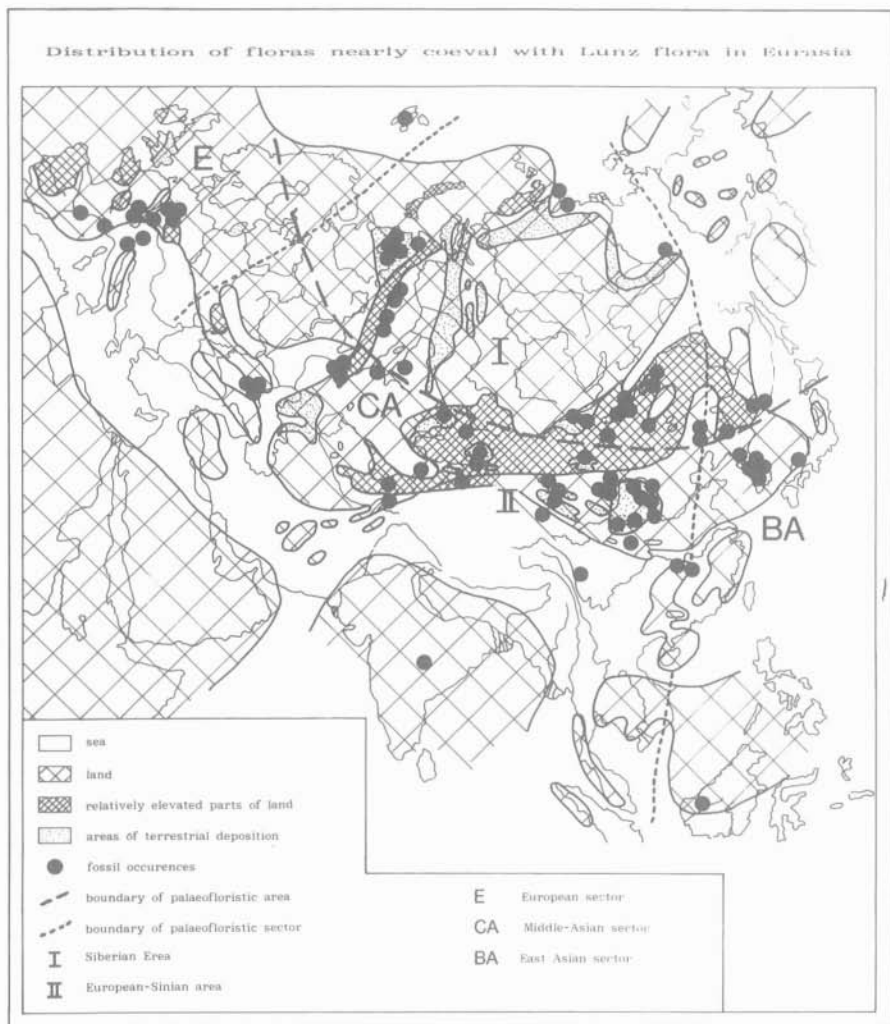
In June 1987 I had the pleasure to make the acquaintance with the collection of fossil plants from the Karnian of Niederösterreichische Alpen in Joanneum. This collection was presented to Joanneum by Prof. F. KRASSER and by the Institute of Botany (University of Graz 1901) in the very beginning of our century and nobody studied it yet. It was exciting to deal with the material which had waited for so long. First of all I would like to thank Prof. W. GRÄF and Dr. R. NIEDERL for such possibility and attention and also L. SCHRÖTTER for her kind help.

The Lunz flora is the most famous and for a long time already the best known flora of the Karnian stage (The Upper Triassic). It was discovered about 150 years ago, and many species of fossil plants were established for the first time in this flora. Later such species were determined also in other floras - by comparing new findings with Lunz plants. The Lunz flora occurs in marine deposits with marine invertebrates. It means that its geological age is exactly known because International Geological Scale for the Triassic (as well for the most part of the Phanerozoic) is based on marine succession. Thus, the Lunz flora may be considered a standard flora. Apart from the Lunz flora we have some other standard floras for the Karnian: the floras from Svalbard, Soviet Primorye and Japan. But the stratotype for the Karnian stage occurs in the Alps and the Karnian in the other regions was established after a correlation with the stratotype by using marine fossils. The direct correlation of plant-bearing beds with the Alpine stratotype is certainly more precise.

This flora was the base for dating of many intercontinental floras of Eurasia and America which had no association with marine fossils: the age of the Upper Triassic floras of the Donets basin, Priuralye, the Urals, Middle Asia, Mongolia, China was established through comparison with the Lunz flora (and with coeval floras of German ba-

sin). The Lunz flora was basic to infer the Upper Triassic age of the North American flora of Virginia, USA, in the end of the last century.

Distribution of floras nearly coeval with Lunz flora in Eurasia



The Lunz flora also was the base for the correlation of German and Alpine facies of the European Triassic. For a long time the question was: which flora from the German basin - Lettenkohle or Schilfstandstein flora - was to be correlated with the Karnian one. Thus the exact correlation of the Triassic of the German basin and the Alps depends very much on the exact determination of the Lunz plants.

The Lunz flora is very rich and diverse, fertile ferns and fertile parts of other plants being most interesting; good preservation of fossils permit to study the anatomy of leaves and spores in situ.

Thus the importance of this flora is due to more precise correlation with the stratotype of the Karnian (in Salzkammergut), a longer history of studies, the original descriptions of many species and possibility of cuticular and palinological studies.

The importance of the careful study of this flora is evident and it is strange that we still have not a complete description of it. There were many palaeobotanists who dealt with this flora but none managed to complete investigations. Only the first paper written by D.STUR in 1885 gave a complete (though preliminary) list of all plants from the Lunz beds, comparison of the flora as a whole with other fossils floras (especially with floras from Basel and Raibl), determination of the age, and palaeogeographical conception. All other papers concern separate plants or plant groups; besides, some specimens (the most interesting from a botanical point of view) were described several times while the most part was not described at all. They gave a distorted picture of the relations of the main plant groups in this flora. Many specific and even generic names are used without any detailed study after preliminary determinations of D.STUR, often after names inscribed on the labels; for many species it is a tradition. But it is clear that such determinations cannot be valid.

W.HAIDINGER was the first to collect fossil plants from Lunz sandstones in 1842. C.ETTINGSHAUSEN in his "Flora der Vorwelt, 1851" gave a first picture of a plant (*Equisetites gamingianus*) from this flora. W.HAIDINGER was right to compare them with the Keuper plants of Württemberg (the German basin). Unfortunately later palaeobotanists H.R.GÖPPERT and F.UNGER referred them to the Lias due to the disorder in fossil plant collections: in one collection there were ones not only from the Lunz beds but also from the Liassic localities. It was D.STUR who explained the difference between the two groups of plants, having first studied the rocks in the museum. Later he confirmed his results by field work in 1863 - 1864. Present investigations are in agreement with STUR's conclusions.

D.STUR considered the Lunz flora to be a flora of peat swamp at the south margin of Bohemian Highland

north of the Central Range. Coeval vegetation of Northern Switzerland (Basel environments) was in the same position to the Central Range as the Lunz one. These two floras are very similar.

F.KRASSER after STUR's death published his diagnoses to fossil ferns from Lunz and short descriptions of other plants without figures. His own work on the Lunz flora consisted of the description of fertile parts of Lunz Cycadophyta with pictures. He dealt with collections of Geologische Bundesanstalt, Naturhistorisches Museum, University of Vienna and from Prag.

R.KRÄUSEL described Conifers and Ginkgophytes from the same collections as well as from Germany and France. He dealt with the more interesting specimens and had no interest in the flora as a whole.

G.NATHORST, R.FLORIN, F.SCHAARSCHMIDT, G.ROSELT described single specimens from Lunz collections outside Austria. J.D.BHARADWAJ and H.P.SINGH collected themselves the remains of fern *Astherotheca* and described it. J.TOWNROW and W.KLAUS investigated "spores in situ" from Lunz plants and R.POTONIE included all figured spores in situ from Lunz plants in his "Synopsis spores in situ". J.LANGER during the war tried to put STUR's collections (Geologische Bundesanstalt) in order and described several species determined by STUR. H.POTONIE, W.KLAUS, S.V.MEYEN figured some of known Lunz plants in their textbooks without or with some comments. There are more than 30 papers which deal with the Lunz plants one way or another. They are dispersed in different editions and it was difficult to receive an image of this flora or at least of its published part.

That's why I prepared an atlas of all figured specimens of the Lunz flora with indications of the place of storage. This atlas is now in Geologische Bundesanstalt, and copies are in Naturhistorisches Museum, Geological Institute of Strasbourg and in Moscow. I have also prepared a paper after the first stage of my study of the Lunz flora which consists of the review of geology, stratigraphy of the Lunz beds, review of all collections, known to me, history of study and problems of systematic and taxonomy of Lunz plants. It will be published in Geologische Bundesanstalt.

The complete picture of the flora under consideration may be compiled from the studies of all its collections and their systematic monographic investigations. The grea-

test collection of the Lunz flora is stored in the museum of Geologische Bundesanstalt in Vienna. It is a collection which was determined by D.STUR and later was shortly described (without pictures) by F.KRASSER. The second place according the quantity of fossils belongs to Naturhistorisches Museum of Vienna. All other collections are smaller. They are at University of Vienna, Niederösterreichisches Landesmuseum in Vienna, in museums of Lunz, Waidhofen, Mödling, Leoben, Innsbruck and in Graz. R. KRÄUSEL who as well as F.KRASSER studied collections in Geologische Bundesanstalt and Naturhistorisches Museum, mentioned also collections in Berlin, Stuttgart, Tübingen, Frankfurt, Strasbourg, Basel. I have seen a collection in Lyon, Dr.H.KOZUR sent me pictures of Lunz plants from Meiningen.

It is very important to make an inventory of all material, to see it with the same eyes and to begin a revision of the flora from the point of view of modern palaeobotany and stratigraphy. During my two visits to Austria (1986 and 1987) I have seen the most part of Austrian Lunz collections. The necessity to study museum material is in our case more important than in many others because nearly all material was received from coal mines which are closed now; natural outcrops are practically absent. Till today I have seen at all 6630 imprints (really there are more imprints because many specimens hide inside many imprints) of fossil plants on more than 2629 specimens. Among them 1026 imprints (294 specimens) are in Joanneum.

There are five collections in Joanneum: the first is marked by 1901 and was donated by the University of Graz. It consists of 39 specimens with 75 imprints on them. The second is marked as "Sammlung von F.KRASSER, 1902" (59 specimens with 216 imprints), the third "Sammlung von F.KRASSER, 1904" (99 specimens with 404 imprints), the fourth: "Sammlung von F.KRASSER, 1909" (46 specimens with 220 imprints), the fifth: "MARKTANNER" (50 specimens with 126 imprints) - see the chart.

The most part of floral assemblage consists of **Cycadophyta**, namely of sterile leaves of *Pterophyllum* type. It corresponds very well to the composition of all collections known to me of the Lunz flora: the percentage of **Cycadophyta** varies from 50% to 70%. In all collections the sterile part consist of no more than 3%. And nearly all fertile specimens of **Cycadophyta** were studied, described and figured whereas sterile leaves were figured only occasionally

List of the Lunz plants in Joanneum

	1	2	3	4	5	All	
Sphenopsida (6%)							
<i>Equisetites arenaceus</i> (JAEGER) SCHENK							
<i>Neocalamites meriani</i> (BRONGN.) HALLE	2	8	13	19	22	64	
Ferns (7%)							
<i>Asterotheca meriani</i> (BRONGN.) STUR	1	5	30	19	12	67	
<i>Bernoullia lunzensis</i> STUR				1		1	
<i>Danaeopsis lunzensis</i> STUR			1	1		2	
<i>Oligocarpia</i> sp.			1	1		2	
<i>Clathropteris lunzensis</i> STUR				2	1	3	
<i>Lacopteris lunzensis</i> STUR						1	
Cycadophyta (70%)							
<i>Pterophyllum longifolium</i> BRONGN. (50%)	45	128	205	81	38	497	
<i>Pterophyllum</i> sp. 2			3	2	1	8	
<i>Taeniopteris</i> sp. (17%)	8	26	62	41	32	169	
<i>Macrotaeniopteris</i> sp.			3	5	3	11	
<i>Anomozamites</i> sp.		7		1	1	9	
<i>Nilssonia sturi</i> KRASSER			1			1	
<i>Bennetticarpus wettsteinii</i> (KRASSER) KRÄUSEL			1	1	1	3	
<i>Cycadolepis wettsteinii</i> KRÄUSEL			1			1	
<i>Haidingeria krasseri</i> (SCHUSTER) KRASSER				3	1	4	
<i>Leguminanthus siliquosus</i> KRÄUSEL et SCHAARSCHM.			2	2	1	5	
<i>Alectrorurs</i> sp.			1			1	
Ginkgophyta (13%)							
<i>Glossophyllum florini</i> KRÄUSEL	15	25	68	16	3	127	
<i>Desmiophyllum</i> sp.		1				1	
Coniferophyta (5%)							
<i>Stachyotaxus lipoldi</i> (STUR) KRÄUSEL	3	14	12	13	9	50	
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	imprints	75	216	404	220	126	1026
	specimens	39	59	99	46	50	294

1 Geschenk Universität Graz, 1901

2 Sammlung KRASSER, 1902

3 Sammlung KRASSER, 1904

4 Sammlung KRASSER, 1909

5 MARKTANNER

in textbooks without descriptions. I think, that there are fewer species of *Pterophyllum* and *Taeniopteris* (*Macrotaeniopteris* also) than it was mentioned in STUR's list. That's why I distinguish now (before revision) only two species of *Pterophyllum*: *P. longifolium* for leaves with nar-

row segments and *P. sp. 2* for all others. As concerns *Taeniopteris* and *Anomozamites* I prefer not to use specific determinations now because of the same reason.

The second place belongs to *Glossophyllum* (**Ginkgophyta**). It's content varies from zero to 13% and it depends on the localities from which the collections were taken. Long narrow leaves of *Glossophyllum* were studied by R. KRÄUSEL. Their systematic position is not quite clear. They have features of Ginkgoales and Pteridosperms at once - in their epidermal structure, and here are no very sure evidences of their connections with fertile parts.

Sphenopsids, ferns and conifers are represented nearly in equal quantities. It is necessary to repeat about determinations of ferns nearly the same as about cycadophytes: it is impossible to give exact determinations - before revision - but I am sure that there are less species than it is in STUR's list. That's why I unite all *Danaeopsis* and *Bernoullia* in one species till revision, and it is possible that in genus *Oligocarpia* I could include some other genera (it is not clear enough if genus *Oligocarpia* itself exists in the Lunz flora). But there are so few representatives of such ferns in Graz collections that it does not change the image of the whole flora. But of course the content of fern genera is very interesting from the point of view of evolution of plant kingdom and I hope that we will do this work in future. It is very interesting also the presence of Dipteridaceae (*Clathropteris*, *Laccopteris*) - the family of ferns which was widely distributed in Europe only from the Norian-Rhaetian and in the Jurassic. In the Far East its representatives are known already in the Ladinian, in the Southern hemisphere in the Karnian (as in Lunz, but less exact stratigraphical position). Investigation of Lunz Dipteridaceae and their relation with south and east fern families can make clear the ways of migration of plants in the Triassic.

Nearly complete absence of Pteridosperms is very strange. In all collections - except Geologische Bundesanstalt - they are absent at all, if Glossophyllaceae is not referred to this group. In Geologische Bundesanstalt collection they are represented by several specimens. In the same time in all other coeval floras Pteridosperms are numerous especially in the continental deposits of inland parts of Eurasia. Also strange is the absence of in other coeval floras very usual conifers as *Voltzia*, *Podozomaites* etc.

Presence of *Stachyotaxus* is also a specific feature of the Lunz flora.

Thus, the first acquaintance with Joanneum collection widens our knowledge on the Lunz flora. This collection shows normal relation between main plant groups in this flora because it consists of fossils which were not specially selected. It could be supposed that F.KRASSER who already begun in 1902 - 1904 to study Lunz plants had not sent the most interesting material as a gift. But those specimens which were the most interesting for him contain the smallest part of the Lunz flora and did not change the whole composition of the flora in the collection of Joanneum.

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