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PALEONTOLOGY AND DIALECTICS

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with 19 figures

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Contents

1 Introduction

Motto

In this book the usefulness of Dialectical Materialism will be discussed. In this context it is irrelevant whether dialectical materialism is regarded as right or wrong, good or bad.

During fifty years the author asked questions to nature and received expected answers. His main object was the discovery of hitherto unknown fossils, a work, he had been trained for by his teacher Johannes Weigelt. Two suppositions are manifest in this work of discovery: firstly, the work had to be founded on the then available fossil record. The non-appearance of a certain taxon in the fossil record would be the positive indication of this taxon in nature, hence an object of my endeavours. The work had to be maintained in regions with logistic difficulties at a minimum, with abundance of artificial or natural exposures and with exposed sediments, which would be the matrix of the fossils to be expected. Secondly: the work had to be sufficiently different from kindred work undertaken by contemporaries; otherwise a discovery would not belong to oneself. Hence, methods demanded independence of mind and results would often be either unexpected (*Kuehneosaurus* ROBINSON 1962) or their evidence would conflict with present day theory (Morganucodon, see chapter 3, *Paulchoffatia* HAHN 1969). The position of the author in this society as a nonconformist can be deduced from his work during five decades.

To achieve his results the author did not work ceaselessly, nor did he make sacrifices. When he became a teacher, he generalized from his special experiences; instead of finding new specimens, he taught methods how to find new specimens. These methods, tactics and strategies of palaeontological fieldwork together with their performance in the laboratory, are inter alia subject matter of this book.Their application brings success.

The book also deals with the social relevance of palaeontology. This is an outcome of the writers personal fate: first an impact was suffered - expulsion from university and political prosecution. This was later turned into an advantage: travel and work in Denmark and England and later in western

Europe; the concept of the alien effect arose. Finally the experience was generalized as a system, fit to be taught and applicable all over the world.

With increasing age the writer noticed the dialectical nature of life-processes: in his life, in the history of his science, in the society he and his science are embedded, and in the history of life which he has studied. Expressing this in print, reveals palaeontology's social relevance. The book can help the reader to regard his scientific activity as socially relevant, that is, to form these ideas on and to the performance in society. In fact, the palaeontologist can be conciousness-forming - i. e. "bewußtseinsbildend".

Wherever this book is read, it will necessarily lead to success in palaeontology. As the book makes use of dialectical materialism, the reader is subjected to dialectical theorems, practice and argumentation. Hence by becoming a successful palaeontologist, he also becomes a person who does not need to suffer his fate, but who is fitted with the theoretical tools to analyse and to discern his social substrate. This is the explicite intention of the writer.

The book is witness to the theorem treated in chapter 2. In a limited way it aspires to a usefulness germane to books which make use of the synthesis between two hitherto unrelated subjects. Th. Kuhn (1962) called them "paradigma-forming science" compared with 99% of all scientific work, being "normal science". Once such book is issued, science is no longer the same. The whole outlook of the respective science is changed. Ethnology became thus changed by Fr. Engels when brought into relationship with materialist economy: "Der Ursprung der Familie". Archaeology became thus changed by V. G. Childe when brought into relationship with Marxism. Childe's numerous books on the subject are paradigmatic.

The book was written when the author suffered acutely from a feeling of dissatisfaction regarding his science. Palaeontology today seems to lack a relevant relationship to society. The stratigraphical reliance and the applicability of fossils has been worked out long time ago. The contribution of palaeontology to the theory of evolution is negligible, measured on the relevant biological secondary literature, for instance in school books. The palaeontologist's "daily bread" is the "determination" of new fossil specimens according to morphological similarity with objects previously made known by means of more primitive tools and outdated concepts. To name these new fossils according to obsolete rules and thereby neglecting the fact of evolutionary change seemed to the writer absurd, unsatisfactorily and devoid of sense, though acknowledged by the majority of palaeontologists, with the exception of a few micropalaeontologists. As a result, few ambitious and intelligent youths are likely to enter palaeontology.

To remedy this situation palaeontological evolutionary research is brought into relationship with dialectical materialism. The chapters have at their beginnings a theorem of dialectical materialism, followed by presentations of examples from palaeontology or other earth-sciences, where such theorems are realized or have become evident. Chapters 4 and 5 have at their subject matter the evidence, that life evolved dialectically.

The purpose of this book is twofold: firstly, it is expected that the new relation will be of advantage to palaeontology; secondly, as it is evident to the writer that biological and social evolution have taken place according to dialectical principles, it is expected that this factum will give a new impetus to the study of both - hence it will be also of social relevance.

A subject matter of palaeontology is the presentation of evolutionary change through the geological times. This task cannot be accomplished with an antiquated and outdated reference-system, i. e. that of C. v. Linné. The task cannot be fulfilled because palaeontology has never embarked on the one possible way out of this dilemma, to new statements, to more insight: viz by the relation-formation to neighbouring sciences. If one searches in these sciences for the elucidation or simply for the descriptions of change one finds a picture as in palaeontology: For instance the science of mental communication describes the different languages, but not their relation to the "Praelingua", the animal signal. The science of writing is - in respect to the origin of writing, in a slightly better position, but it regards memory, writing, printing and "dating" as separate phenomena and not as different forms of information storage. We have to take recourse to the social sciences, to find an analysis of change.

In the capitalistic society however we find here a phenomenon which hinders the objective dealing with change: the taboo, a means of protection , not for society, but for the ruling class of this society. The taboo serves the maintenance of the ruling classes claim to the rule of this class and embraces religion, sex, politics, monetary matters, and the distribution of power in a society. Above all, the taboo embraces the theory of social change, which is here and in the following pages called dialectical materialism. This theory is a tool, fit for the negation of class rule. The taboo has embraced the teaching of the greatest modern thinkers, Marx, Darwin and Freud, and the teaching of Marx is still tabooized in West-German universities. Nevertheless we find us today in a world situation, where one part tries to found its dealings and existance on marxism, whereas the other part tries to act and to think on antimarxistic lines. The position of the author is a favourable one, as he can with impunity and immunity try to proceed to the coupling of palaeontology and marxism. If we begin to soak palaeontology with dialectical materialism, the social structure of our substrate is not likely to be challenged. The author does not aspire to a chair in the U. S. A. nor in the F. R. G. In this book the usefulness of dialectical materialism will be discussed. In this context it is irrelevant whether dialectical materialism is regarded as right or wrong, good or bad.

The coupling of marxism and palaeontology is the first attempt, a first experiment. The reader has to regard it as such and has to concede to the author his very weak position. If the reader gains a little of insight, of contradictions resolved and of methods, useful to himself, he ought to be content. The author knows about his shortcomings. There is little he can offer. 50 years of experiences in practical palaeontology cannot make good to compensate an only elementary knowledge of genetics, zoology and botany, mathematics and philosophy. After 1979, when this book appeared, Lewins and Levontin (1985) issued "The Dialectical Biologist". It is to be expected, that both books will supplement each other.

In this book the author takes here and there recourse to "historical constellations"; his contacts with science and with scientists and his curriculum vitae have been determined by factors, which occur singly in many persons, but combined in only a very few. They have led to successes in palaeontology and they have led to the writing of this book. The historical constellation of the author led him, to see some phenomena with different eyes, than his contemporaries and co-speakers of the German language. He aspires not to find his views tomorrow to be true, but - so he hopes - that some biological problems are discussed with more clarity, more objectivity. Unavoidably this paper also covers even some part of philosophy. The author knows that there are many books, proving or disproving the unity of the world, or the existance of God. Readers of such books are invited to regard the relevant opinions of the author as vulgar or lacking in depth. To the author they seemed to be sufficient. He accepted the Chinese "will do", where, effort and outcome have to meet. Only if his arguments are found to be wrong or insufficient, he invites correction by philosophers. For the scientific practice of the author, the five dialectic-materialistic theorems here presented have been sufficient. To many readers, which adopt the five theorems, they will be sufficient. Within a short time, the author hopes, they will be insufficient.

Simple population statistics demonstrates, that the width of variation is a function of the number of individuals. Owing to little internal selection pressure, inside of a dwarf population and under special historical constellations, the author sees the picture of German palaeontology. Among the German-speaking palaeontologists, he observes retardive behaviour, which is criticized by German biologists. A consequence is the little appeal of palaeontology to youth. If this retardive tendency is maintained in textbooks of palaeontology in both parts of Germany, he does not see danger for the science as a whole, but danger for the science inside the German language. To maintain, that palaeontology is a wonderful science, able to answer crucial questions to our time and life, has to be stated. It has to be maintained that palaeontology has to contribute essentials to the science of evolution.

In this book the author has even to apply his criticism where the critized author is still among us. Where his arguments are better than those of his opponents, he feels pity with them. They could have used them and saved the author much work. Where the arguments of his opponents are the betters, he hopes to offer better arguments in future. Part of the world of learning in

Germany suffers since 1848 in being unable to see lifeprocesses as analytical and dynamical. The reason is easy to find. If the analysis is directed to the origin of the class of the Mammalia, one may proceed to the origin of the class of the Bourgeoisie in Germany: In 1849 the Bourgeoisie formed an alliance with the feudalism against the proletariat. Hence German bourgeoisie reveals negation of progressiveness, negation of ratio, negation of humanity, but class ideology, racism, wishful thinking and expecting and hoping for catastrophies. The book is a conscious antidote to this kind of thinking.

Often the reader will find opinions used by the author but not properly cited. The author has regarded such opinions as commune bonum, being witness to the quality of such ideas, which, originated in one brain, become independent of it and are soon the property of all.

The author has not read "all", which could be read, relevant to his subject. If he would have tried, the book would not yet have been completed. He is of the opinion, that an impact on the consciousness of interested readers can be made only with fitting means at the proper time. According to the cited Chinese word, it was not his aim to write a book in most passages correct and unassailable, but a useful book, contributing to discussions of today. The Chinese "will do" applies to the five theorems. In the given context they will suffice. Only simplicity allows to bring test-cases and to deal with them in such fashion, that they can immediately be useful. This book on dialectical materialism and palaeontology is - I hope - not the last of its kind.

One vindication of the author's twenty years of comfort and opulence, is this book. He aspired to have used his freedom and his opportunity to have produced blue-prints of problems of tomorrow. In his youth the monopoly of learning by the ruling class was a fact. He met in his life many men and women, much better qualified, to work scientifically, than himself, but unable for financial reasons, to study. To their memory, this book is dedicated. They would have performed this task earlier and better.

The ruling class of capitalistic society cannot deny the dialectical nature of the biosphere, without making a laughing stock of itself. The application of dialectical materialism as a tool to proceed in theory and practice in the anthroposphere, is however tabooized. Where there is no border, a sham-border is erected, for irrational, not justified reasons. Political acting man is invited to trample down such sham borders. The limitation of his activities is only dialectical.

This book is based on the thoughts of the author's teachers, on his experience and on literature. Two authors are relevant: A. N. Sewertzoff and G. G. Simpson. If Sewertzoff's book: "Morphologische Gesetzmäßigkeiten der Evolution" would have been issued in English and in 1941 instead in 1931, it would be today the bible of neodarwinism. What I try with great effort to say, with bad and modern words, Sewertzoff writes 40 years earlier. The preposition of Sewertzoff are 30 years work of a school, active in Embryology and "Entwicklungsmechanik". The starting basis of Simpson is conventional systematics of fossil mammals. These conditions are relevant for both. Simpson betrays the static, he uses pairs of concepts, for instance Tachytely and Bradytely, horizontal versus vertical systematics etc; Sewertzoff looks at phenomena, relevant to Simpson's pairs of concepts not as an either - or, but as two points on a curve, from absence to presence, from the negative realm via zero to the positive realm. The role Sewertzoff's book plays in modern slavonian literature is significant.

It is a truism, that after a paradigma forming book has been issued, the world of the respective science is a new one. This book is an augmented translation of the edition of my book of 1979. At that time and before, when I was engaged in writing the book, meteoric events of global size, were not heard of; my argumentation, regarding the deficiency of the fossil record, did not take into account any global catastrophies. Doubtless, the global events are relevant to the fossil record, but doubtless remains the fact, that we have not at all sampled the fossils in a satisfying measure. Daily, increasing numbers of new taxa are discovered, anywhere during the Phanerozoic.

Marking on a Mercator map of the world the new described taxa of the last twenty years, the evidence is obvious: Central Europe and the east and the west of North America are the centres of new taxa, are the centres of palaeontological activity. The rest of the world lags behind. Hence the lesson of this book is still patent, globally.

1.2 Acknowledgements

Dr Th. Schlüter and Rolf Kohring have done all the computer-work. Hence my thanks to both of them.

2 Relation-formation between hitherto unrelated phenomena.

2.1 Theorem: Phenomena are not to be viewed or considered in isolation, but in connection with others, having a relevant relation with them.

The chapter deals with the scientific method and procedure. In the annex is given a glimpse on the relation-formation in the non-human biosphere.

Though the theorem resembles a common-place, it is easy to reveal the importance and usefulness of it during scientific procedure. The examples which I present from my own work, happened before I realized their dialectical-materialistic nature. Only one example, the discovery of Mesozoic fossil resin, containing an arthropod fauna, was performed as a direct consequence of the application of the theorem. If the examples are not taken from my own work, it can be taken for granted, that no conscious relation existed between the relationship-former and his science and dialectical materialism. This is paramount for our first example and its performer - William Smith -, who acted before Hegel developed scientific dialectics. The aim of the following examples is an analysis of the intellectual processes, which lead to new relation-formation. Hence it eases future relation-formation.

It is obvious to myself that teaching relation-formation is profitable, is demanded and is not performed in ordinary lectures or courses on palaeontology.

That it is not at all commune bonum to embark consciously on relation-formation, coupling is brought to the mind of the reader by two examples in the appendix of this chapter: the invention of the ophthalmoscope and the otoscope. Both tools revolutionized their respective field of medicine and both could have been developed 50 years earlier, if the relation-coupling which led to their invention, would have been consciously sought for. The avoidable suffering of millions of eye- and ear- patients is proof for the relevance of relation coupling not being realized. Once the methodology of relation-coupling is understood and trained, it can be executed without being forced upon the acting person by necessity, accident, opportunity or bottleneck.

Optimally relation-coupling is a means to unavoidable success. Once the theorem has proven its value in scientific procedure, it applies to dialectical materialism, of which this theorem is an integral part.

2.2 Relation-formation and series-formation

Two kinds of relation-formation are here considered: firstly the newly formed relation of two phenomena: in one step is the new partnership achieved, the creation of the unexpected new. Examples are the invention of stratigraphy, the alien-effect and in the appendix the application of processes from physics and medicine. Secondly it is the series-formation of homologous phenomena. Series-formation is the tool to reveal of well known phenomena essentially new aspects and characters. Examples are the discovery of Mesozoic arthropod-bearing resin and the series of fossiliferous slate of the epizone. In the first case the new is revealed with a single act of relation-formation and the intellectual process is then finished; what follows is the application of the new insight, it is normal scientific work. In the second case the gain in new insight is dependant on the numbers of the series. The more members, the more parameters are rationally revealed in the series; the safer the prognosis, related to a new member of the series and the smaller the mass of unknown, unexpected and rationally not comprehensible items.

The insight gained from one member is applied to all members of the series: the longer the series, the greater the amount of feedback. The feedback from the newly found members increases the value of any member of the series already known.

It is almost impossible to determine in advance the region, where finally relation-formation ensues. Before Torell (chapter 3.9) found glacial polish and and glacial pots on the Muschelkalk of Rüdersdorf near Berlin, he was unaware that his knowledge of the arctic glacial phenomena would have any relevance to the refutation of the drift-theory. Before I had discovered in England and Wales Mesozoic karst, with fissure- and cave-fillings, I was unaware that the meagre knowledge I had of continental Tertiary karst phenomena with vertebrate remains, would be of relevance in the process of the discovery of numerous localities of small fossil tetrapods.

If necessity, bottleneck or economic duress leads to the attempt of relation-formation, the discussion with an interested scientist of another subject is imperative. The locally active worker is mostly immobile and can only rarely proceed to series-formation. This applied for instance to R. Opitz (1932), who gave the best account of the famous Lower Devonian fossil locality of Bundenbach without knowledge of another one. Until his untimely death in world war II he lived as a schoolteacher there.

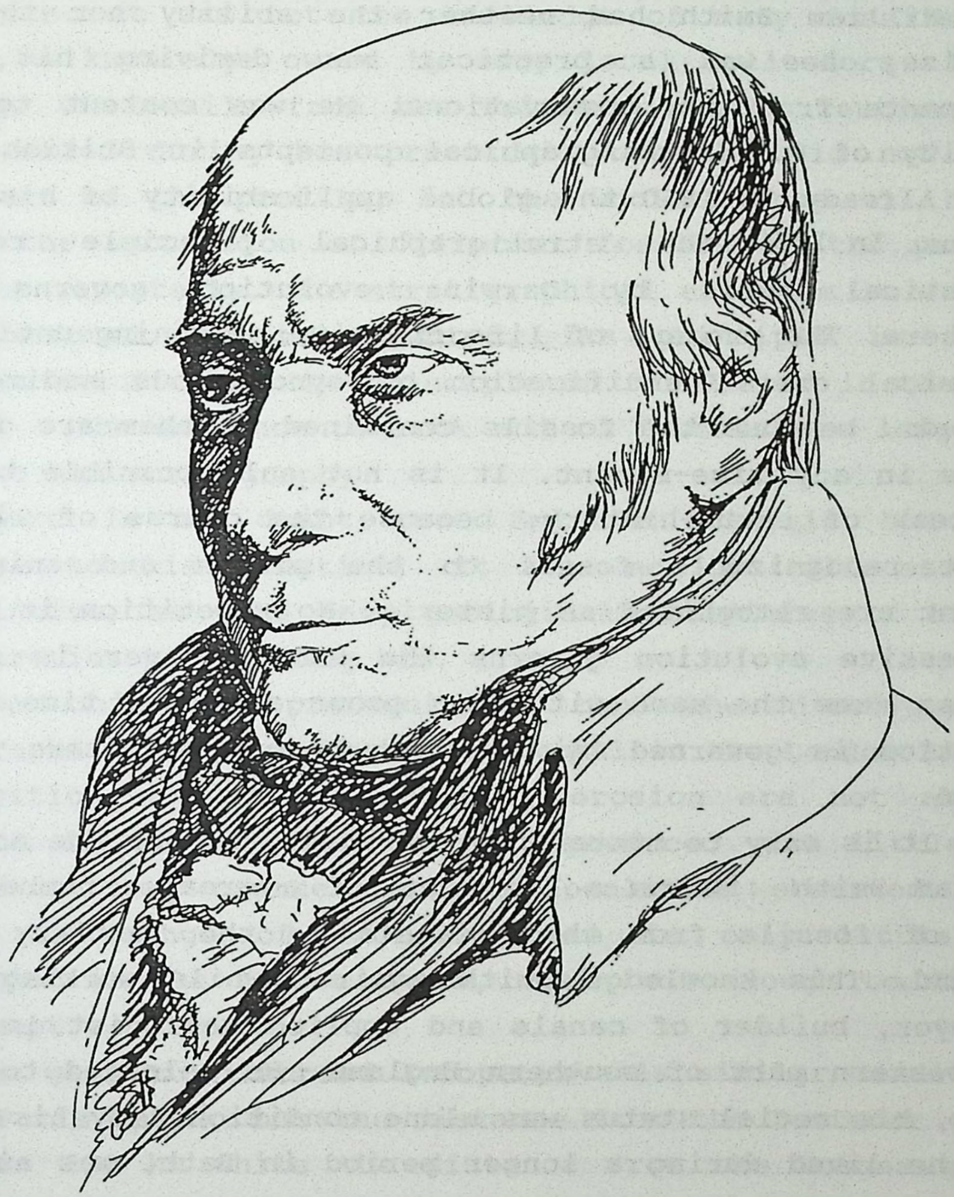
2.3 William Smith and the invention of stratigraphy. Fossils in relation to space and time.

Previous to 1800 geology as a science did not exist and persons thinking about fossils had to do this only with a systematic reference-system, stratigraphy not existing. William Smith (1769 - 1839) is the founder and discoverer, nay, the inventor of stratigraphy and hence with good rights the father of geology.

20 years after his discovery when stratigraphy was already commune bonum, one began to speak of the science of geology. Geology began to be taught in universities, national geological services were inaugurated and the first geological maps published. The achievement of William Smith is the classical case of relation-formation. The newly discovered phenomenon is only badly called "stratigraphy". The new word does not say anything on the documents of life of the past - the fossils - and their relation to the vertical sequence of sedimentary rocks.

Nicolaus Steno (1638 - 1687) formulated the law of superposition of rocks. He concluded that spatial relations tallied with temporal relations; of two superimposed rock masses, the lower would be the older and the upper would be the younger.

The stratigraphical principle allows the worldwide chronological identification of sedimentary rock by means of the fossils found in them. Synchronous are not rocks of similar petrographical and lithological composition but those with the same content of fossils. The title of one of William Smith's papers reads accordingly: "Discovery of constancy in the order of superposition and continuity in the courses of British strata with



1 William Smith (1769 - 1839), originator of stratigraphy. After a picture by Fourau, redrawn by P. Berndt.

the peculiar mode of identifying them by organized fossils embedded".

William Smith had neither the ability nor the desire to theorize, he was a practical man deriving his theoretical statements from own observations. He was content to prove the validity of his stratigraphical concepts in British sedimentary rock. Already in 1850 the global applicability of his concept was obvious. In 1859 the stratigraphical principle received its theoretical basis by Darwin: evolution governs the whole biosphere. The process of life from its beginning until today is a historical one. Identification of synchronous sedimentary rocks succeeds, because the fossils contained in them are different and unique in any time-moment. It is not only possible but necessary to speak of earth-history, because the course of life from the oldest recognizable fossil to the plants and animals of the present are recognized as historic. No repetition is possible but progressive evolution governs the whole. Never in a historical process does the same situation occur a second time, because the situation is governed by a multitude of parameters resulting in change.

It is easy to muster the prerequisites for the achievement of William Smith :it was a knowledge of a greater number (more than 200) of fossils from the Triassic to the Tertiary of southern England. This knowledge Smith aquired while working as a land-surveyor, builder of canals and applied geologist in the central and western part of southern England. He belonged to the working class, his social status was alone conditioned by his achievement. That he lived during a longer period in Bath, was augmentive for the success of his discovery.

The stratigraphical principle was discovered by a man knowing the whole rock sequence mentioned, traversing it on many routes repeatedly and finding the same fossils in the same relative position in the same expected spot. This applied to William Smith, who travelled extensively on horseback. From the Triassic of West England yielding to him no fossils, to the Tertiary of the east, he traversed the rock profile of middle and southern England very often. Dividing this profile into 20 units there is no exception to the sequence of fossils in the profiles encountered. The fossil-sequence is similar in all regions from Yorkshire to the south coast.

Which qualifications did William Smith possess, which his contemporaries lacked ? It was not the knowledge of a great number of fossils. It was not the knowledge of many fossils from one stratum, a knowledge owned by many local collectors. It was the knowledge of fossils from the Triassic to the Tertiary, aquired and assembled during his practical work. He did not observe a small part of the profile, but the whole. Above all he did not observe the succession of different fossils in the profile once only, but repeatedly. The stratigraphical evidence is surmised, it is conjectured, it is expected, its principle is applied in prognosis and finally the principle is formulated in the abstract. In short - the sequence of rock and of fossils was long enough to reveal to him stratigraphy.

There is no doubt that Smith's analysis had immediate relevance to his practice; it was not at all esotheric or contemplative, as were many geological activities of his wealthy contemporaries patronizing him.

The objective prerequisites for the discovery of the stratigraphical principle are optimal in the London Basin. Nondeposition and interformational erosion are not absent, but would not disturb a first concept, produced with little evidence and with a very coarse grid of localities observed. The same applies to change of facies. There is only little tectonic deformation in the London Basin, again not enough to disturb the new concept.

The geological map of Europe reveals similar conditions only in the Paris Basin, but the distance from the Dartmoor granite to London is 250 km while the distance from the Vosges granite to Paris is 350 km.

A discovery by relation-formation - as stratigraphy - could only be realized under optimal conditions. If the evidence less than optimal, for instance on the Russian Platform, the discovery is not made. In case the evidence is more than optimal, that is when different parameters cloud the simple picture, the discovery is made more difficult; it would ensue later in time - or the clouding effect would inhibit the discovery. In the case of William Smith such clouding effect would be a nappe or a lying fold. The repetition of part of the fossil sequence in the vertical or a repetition in reversed sequence would have inhibited the discovery of stratigraphy at the time-moment when it happened.

We can now generalize and utter a warning: to formulate a new relation-formation or to formulate the antithesis to the thesis, only sufficient evidence is required, not "all" evidence. If a potential relation-former musters more than sufficient evidence, he is not in the optimal position between complete lack of relevant evidence and the maximum of evidence, and he is in general disqualified to form the relation-coupling. Originally the steam engine was even constructed without a safety valve!

Mendel, after formulating the laws of heredity with *Pisum*, was induced by Nägeli to choose as a second object of his studies *Hieracium*, without being aware of the apogamy of this taxon. Obvious for us, today, the evidence did not corroborate the evidence furnished by *Pisum*. Mendel, most likely, was shaken in his belief of the general validity of his laws of heredity. The evidence of *Hieracium* was detrimental to, not furthering genetics.

The person forming a new relation (KUHN 1962, p. 89) is either young or a beginner in the subjects which he is about to put into the new relation. It means that he knows of both subjects very little. He requires only those elements of the two subjects which are relevant to the relation-coupling, or a person, supplying him with knowledge of one subject relevant to the relation-coupling.

Example: To widen a bottleneck while handpicking a phosphatic grit from the locality Holwell in Somerset, yielding *Haramiya*, I used acetic acid to break down the calcareous component of the grit. Prof. A. Brammal gave me this advice. One third of the grit which previously I had to handpick completely was now broken down before handpicking, reducing this time consuming work by one third (KÜHNE 1946). The relation-coupling to ore dressing was the crucial step forward.

The relation builder cannot afford to know the wrong programme of his two subjects; of the right programme he must have only sufficient knowledge to build the relation. He must possess the greatest amount of freedom; he acts better if provided with independent means and not in a responsible position.

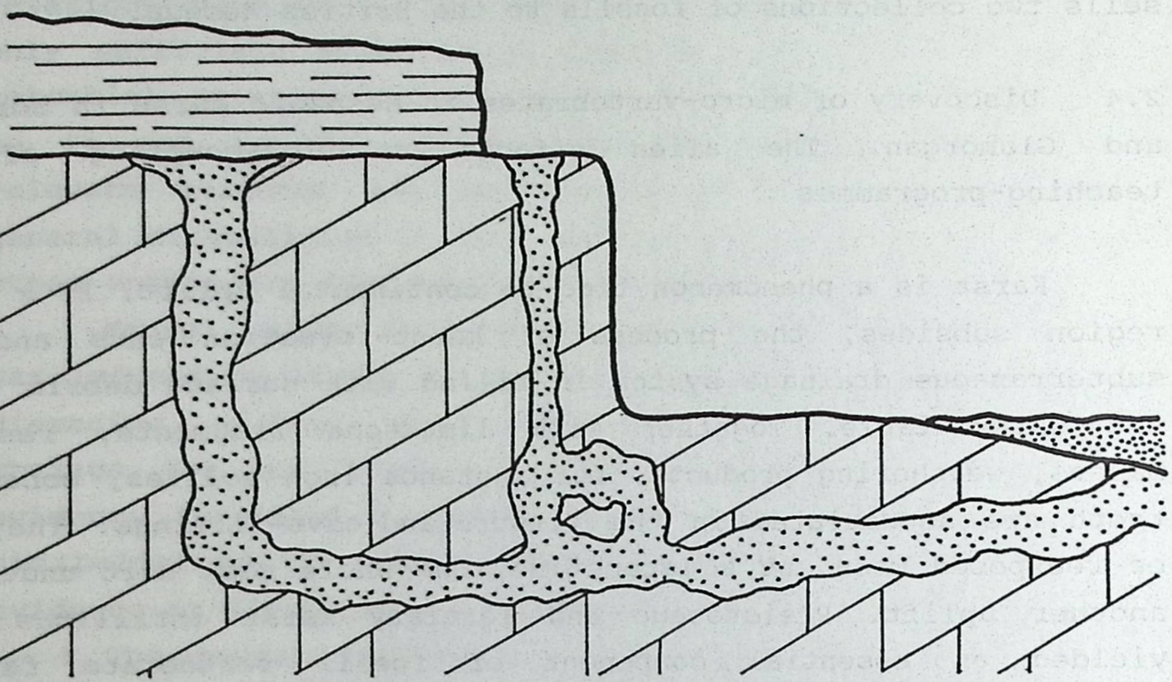
With the act of integration of relation-coupling the two elements concerned gain a new value. Before the inauguration of stratigraphy, fossils are objects in the cabinets of the mighty. They serve to create awe, they do not convey knowledge; from the moment of inauguration of stratigraphy fossils are object of academic teaching, they even gain market value: William Smith sells two collections of fossils to the British Museum.

2.4 Discovery of micro-vertebrates in Mesozoic karst in Somerset and Glamorgan. The alien effect; relation-coupling of two teaching-programmes

Karst is a phenomenon tied to continental uplift. If a karst region subsides, the process of karst-formation ends and the subterraneous drainage system is filled with surface debris up to the water table. Together with limestone fragments, residual masses, weathering products, for instance iron oolites, bones and teeth are accumulated in the fissure-and-cave-fillings. They may be reexposed when, at a later time, the whole rock unit undergoes another uplift. Pleistocene and Tertiary karst infillings have yielded an essential component of fossil vertebrate faunae. Vertebrate remains from karst deposits are to be found generally in disassociated condition. In karst faunae rich in taxa, the correlation of postcranial elements to the taxa founded on dentitions, is small or nil.

Karst is a global phenomenon. Hence the search for fossil vertebrates in karst can be maintained globally. If geology-textbooks in all languages transmit the kindred information, the discovery of Tertiary and Mesozoic and even Palaeozoic Karstic bone-deposits will mount, will be the rule, not the exception. And consequently the knowledge of small fossil tetrapods will mount too. In consequence the present picture of practically only large fossil tetrapods will come to an end and the true picture, a world of small tetrapods will appear.To the known Mesozoic karst deposits yielding tetrapod remains, discovered since 1979, have come Triassic at Jarovice, Poland, in Devonian limestone, and a Triassic occurrence in the Spessart mountains, in Permian limestone. In both cases I do not have autopsy.

The first task, after a karst fissure with bones is discovered, or be made known by accident, is the prospecting for the fossil field in which the first discovery is a part of. The following task is the determination of a gradient in the fossil field - from the isolated occurrences far in between to the region of densest occurrence. The locus axiomaticus of fossil bone in karst is a linear region, the outcrop of hard limestone covered by



2 Fissure fillings in pre-Tertiary strata. Where old limestone is exposed under a younger sediment, karstic features, dating older than the sedimentary cover, and younger than the reexposed old limestone, are testimony of a terrestrial phase in the Mesozoic. Exposure of fissure fillings is ephemeral and only in artificial exposures.

younger deposits. This is the region of most quarries for economical reasons and the region of the best preservation of karst phenomena.

In the 19th century the means to gather Tertiary mammalian remains from fissure fillings was their collecting as a by-product during the dressing of the fissure sediment to recover oolithic iron ore or phosphate (e. g. Quercy in France). So is the production of limestone from cave fillings in the pre-Cambrian Cape-Dolomite instrumental for the discovery of *Australopithecus* by Robert Broom.

The discovery of karst infillings is bound to artificial exposures. If these are lacking, there is practically no possibility to discover the small occurrences. Karst infillings are generally composed of soft rocks, softer than the bedrock of limestone and get scooped out by erosion. Karst infillings older than Tertiary are rare. Besides less than 20 localities in Somerset and Gloustershire in England and Glamorgan in Wales which are not older than Keuper and not younger than Liassic, I know of few other occurrences. Previous to 1945 Mesozoic fissure-fillings have been discovered in England and Wales four times. The discoveries were made by four different people at different times who did not communicate. The discoveries were isolated phenomena. The discoveries were made between 1840 and 1945, they were made by local geologists. The four discoveries were made by accident. They were not due to a planned prospecting activity. The principle which governed the existance of fissure-fillings of each of them remained unknown. The four fissures discovered are:

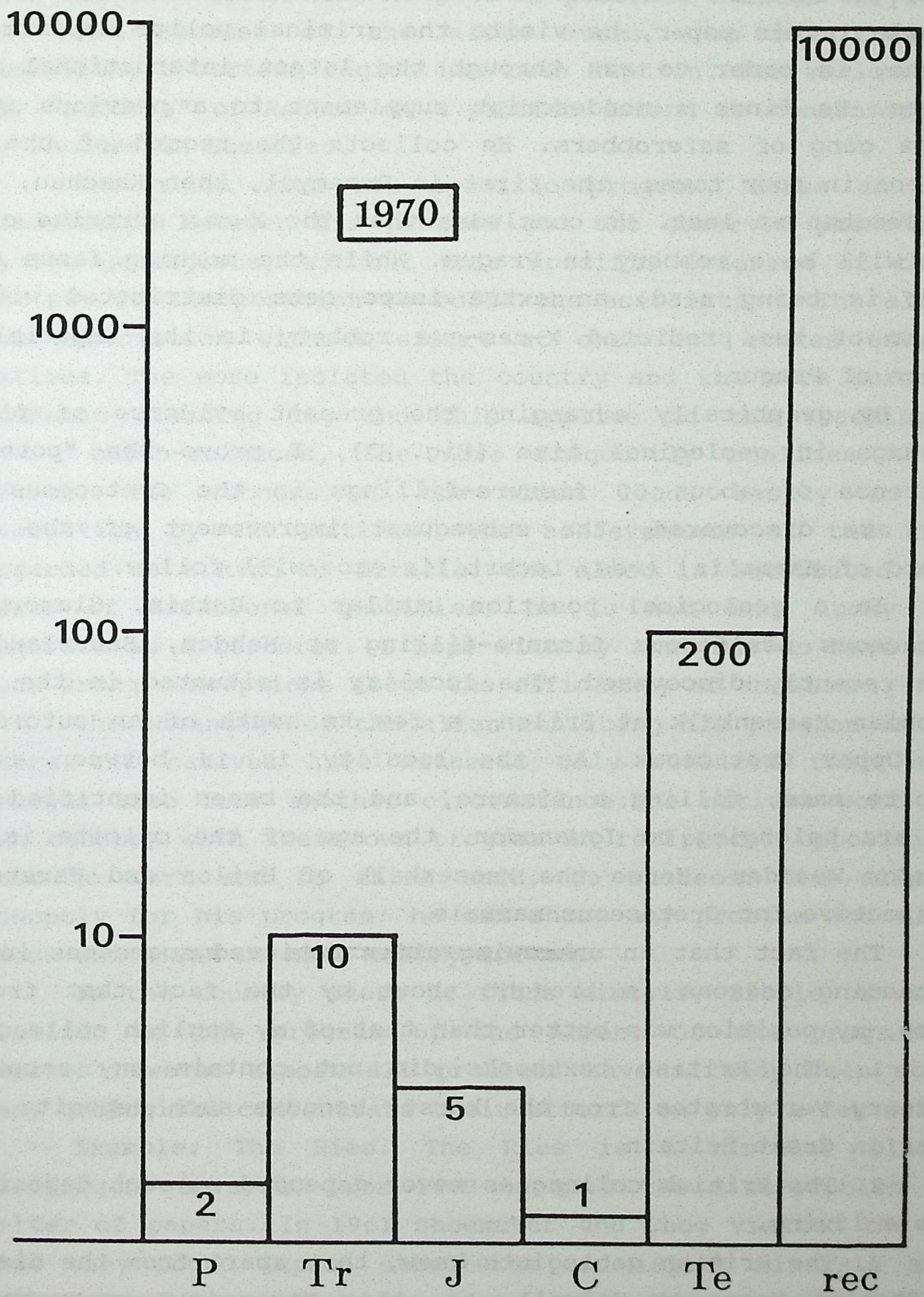
Pre 1840: Durdham Down in the city of Bristol, by Riley and Stuchbury; Triassic.
Pre 1867: Holwell near Frome, by Charles Moore; Rhaetic.
Pre 1939: Slickstone quarry near Cromhall, Gloustershire, by Hudson; Triassic.
Pre 1945: Ruthin quarry, Glamorgan, by T. M. Thomas; Triassic.

The writer had only knowledge of the existence of the fissure-fillings yielding *Haramyia* at Holwell near Frome when he began work in Somerset in January 1939. The work differed in no way from the one performed by Charles Moore in 1850 (KÜHNE 1946). However, the work at Holwell was not profitable enough to induce me from abstaining prospecting for a better locality. Contrary, there was a strong tendency to modify the work at Holwell or to substitute it (see the inhibitory role of the small success, this chapter). Hence a new locality had to be found by prospecting the region around Holwell. The prerequisites for this work were the following:

1. In order to safeguard our existence as emigrants in England I depended on the success to procure unknown or rare fossils and to bring them on the market. Hence my efforts were those of a professional and not those of an amateur.
2. Experiences and observations with salvaging and preparing vertebrate fossils in the Geiseltal near Halle from 1931 - 1933.
3. Autopsy of a collection of vertebrate fossils from the Quercy phosphorites which were exhibited in the geological institute at Halle and which had been bought by J. Walther, many decades ago.
4. Long and intensive discussions with fellow students on salt solution and lignite formation.
5. Autopsy of sterile fissure-fillings in the Muschelkalk west of Halle.

Under these conditions and reservations the *Oligokyphus*-locality "Mendip 14" at Windsor Hill near Shepton Mallet, Somerset, was discovered in September 1939, at the second visit (KÜHNE 1956). In 1945 the two localities were discovered which have yielded *Kuehneosaurus* (ROBINSON 1957): Emborough and Cheddar. 1946, after an analysis of the Somerset evidence, it was deduced that Glamorgan, having identical geological structures to Somerset, would yield a similar crop of vertebrate bearing fissure-fillings. Hence the work was transferred to Wales. The locality Ruthin, previously and independently discovered by T. M. Thomas, was found and exploited (ROBINSON 1957). The evidence of Rhaetic triconodont and symmetrodont teeth in the Duchy quarry near Bridgend (KÜHNE 1950) was the start for the spectacular success of K. A. and D. Kermack, especially in the Pant quarry and in at least five neighbouring localities.

While I revised this text for the English translation, I arrived at a prediction only by combining the available evidence under a new point of view. The prototype for this sort of creative



3 Fissure fillings in geological time. Between the Triassic/ Jurassic fissure fillings and the numerous Tertiary ones, a deficit of about 50 Cretaceous fissure fillings is noticed.

associations is Egon Erwin Kisch in "Jahrmarkt der Sensationen" 1957, p. 127. In a vain search for a subject matter of a X-mas-article in his paper, he visits the criminal police department in Prague, in order to run through the latest international police cables. He finds a nondescript supplement to a previous warrant for a gang of saferobbers. He collects the record of the gang's actions in four towns, the first in Przemysl, then Kaschau, Olmütz and Teschen at last. He concludes that the X-mas surprise of this gang will be a robbery in Prague. While the morning issue of his paper is being read, an extra issue gets distributed with the report of the predicted X-mas-eve robbery in the Imperial Post Office of Prague.

By graphically arranging the present evidence of fissure-fillings in geological time (Fig. 3), I prove the "potential" existence of about 50 fissure-fillings in the Cretaceous. When they are discovered, the subsequent improvement of the fossil record of Mammalia, Aves, Lacertilia etc. will follow.

In a geological position similar to Ruthin, Glamorgan, a Cretaceous ossiferous fissure-filling at Nehden, Sauerland, has been recently discovered. The locality is situated in the Middle Devonian Massenkalk at Brilon, a few km south of an outcrop of the Upper Cretaceous. As the locality is in between a mined calcite mass, filling a fissure, and the bones identified up to now are belonging to *Iguanodon*, the age of the calcite is older than/or Wealden. Hence the Massenkalk of Brilon and Warstein is prospective for Cretaceous mammals.

The fact that an unknowing alien achieved successes in three succeeding seasons is brought about by the fact that from the start, my position was better than that of my English colleagues.

1. The British textbooks did not contain any account on Tertiary vertebrates from the karst, because such deposits do not occur in Great Britain.

2. The British colleagues never depended on such deposits, to make a living.

3. The British geologists knew, that apart from the discovery by Charles Moore at Holwell, no other Mesozoic vertebrates from fissures had been found.

The results of my work in the south of England and Wales are to be found in the literature, but little is revealed about the prerequisites of this work and the little steps, which let to it. This has been given here as good as possible - after 45 years.

The success of the alien stems from the breakdown of isolation, a certain region has been kept in, for various reasons. The "success" of *Rattus* on a pacific island is commensurable with my success in Somerset.

The alien with his specific program, forms an immediate association between his program and the observed phenomenon. The native geologists, without this specific programm of the alien, are not in the position to build the association. The alien forms the association without effort at once and evokes envy by the natives. The more isolated the country and the more parochial its academic training is, and this applies to the teaching of all the earth-sciences, the more frequently realizes the alien-effect. The success of the alien leads easily to a wrong evaluation by the natives. The achievements of the alien are regarded as a kind of miracle. The alien is attributed with some sorts of irrational qualities; he is not only lucky - he is regarded as a sorcerer. I hope with my analysis to have rectified such wrong conceptions about the efficiency of an alien.

The advantage of the alien realizing his program in a region where the natives have hitherto only realized their own, emerges also from another circumstance:The natives work in their own country with their own program in reciprocal opposition, they have to work and to think hard, to succeed. The alien has a monopoly for his program; he can chose any problem and will chose those which can be most easily solved.

In the country where he finds himself, little or nothing is realized of the program of the alien. Of the program of the natives however almost all problems have already been solved and many geologists concentrate their efforts on only a few subjects.

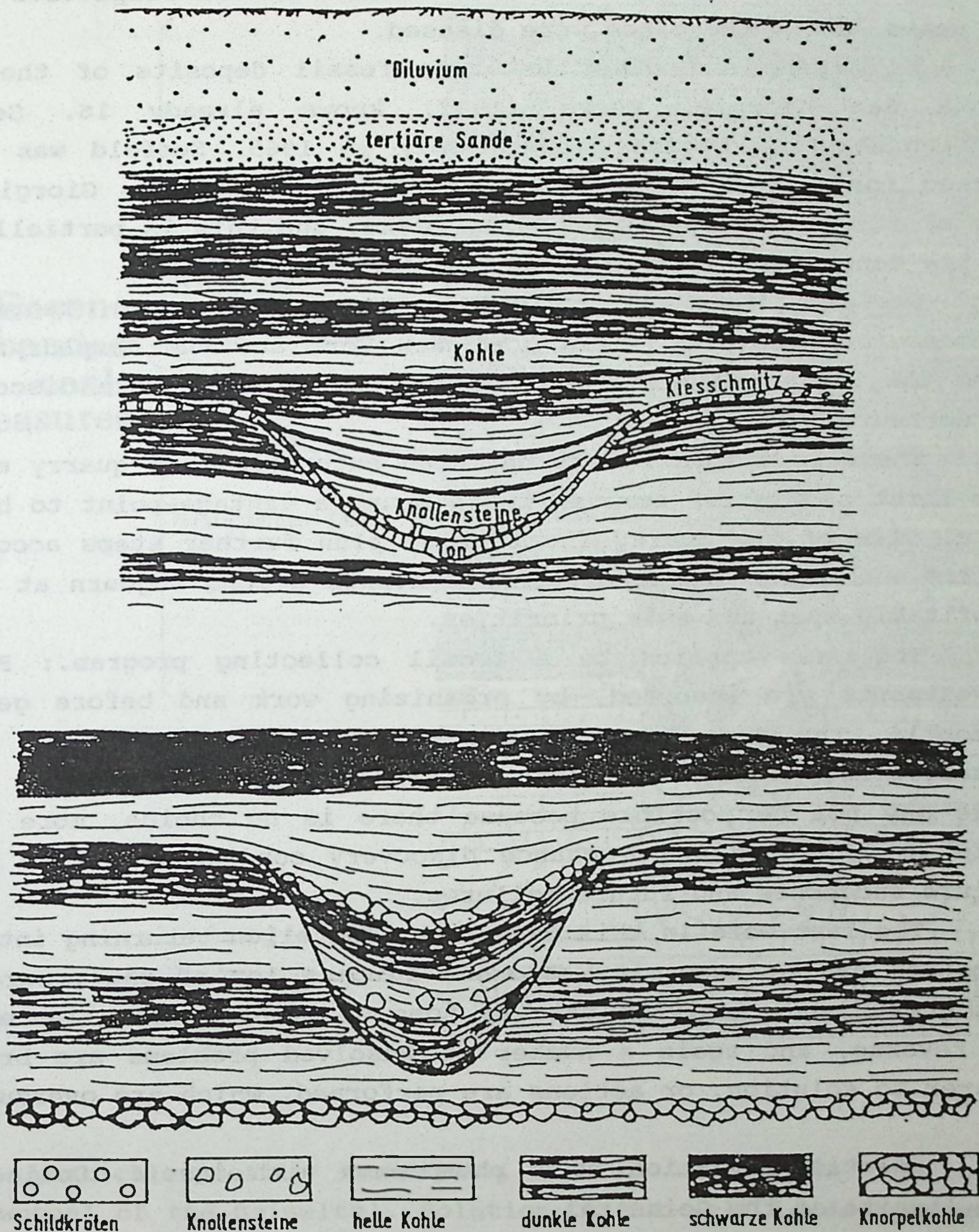
Example: The Ries. The Ries is a circular plain round Nördlingen, Bavaria. From 1800 to 1961 the Ries-problem evoked a welter of papers. In 1961 Shoemaker and Chao visited the Ries. At once they found impact structures and impact minerals and hence solved the Ries-problem in a paper of a few pages. The Ries is an impact crater of a meteorite, it is not volcanic, and it is nothing else. The solution of the Ries-problem has been an anticlimax; when it happened, the Ries-crater became one of many already well known phenomena, it was not very particular, irksome, miraculous or fascinating. The Ries belongs to a series of cosmopolitic phenomena.

On a smaller scale the same applies: the instruction in any geological department is specific. If a member shifts into another department he is in a position to solve at once some problems which - in this department - are "left over" problems. The newcomer's program allows him to be associated with some of those problems, the other members of the staff are "betriebsblind", i. e. they suffer under "shop-blindness", and the newcomer solves the problem. The alien effect is the relation-formation of two programs; it is the importation of a program into a region , from where it was hitherto excluded.

The analysis allows us to see the nonrealisation of a discovery in a new light: the alien possesses those programs, which qualify him to form at once new associations. However, he lacks those items of programs in the land where he finds himself, which hinder or forestall this association-formation. Hindering program-items are wrong teaching programs or yearlong experienced failure to solve a problem with limited means and/or insufficient tools.

A hindering factor of great importance is success and particularly little success. This applies not only to the inhibition of a potential relation-formation. Small success can consume the personal or financial resources of a researcher, especially in "small sciences". Small success after long endured absence of any success is easily overvalued by the scientist. As a consequence, lack of further prospecting may ensue. Such omission will give the next-comer a chance, to have in the very field of activities of the alien more success than he himself had. In such a case the alien is only a pioneer, an initiator. Inhibitory are often borders, beyond which the scientist is not allowed to work.

The potential of the geological departments under Weigelt in Halle, Wurm in Würzburg and Peyer and Kuhn in Zürich was consumed in the fossil collecting work in the Eocene lignite of the Geiseltal, the Miocene lignite of Viehausen and in the Ladinien sapropelite of Monte San Giorgio in Tessin. During decades work was maintained and yielded excellent results, but much better chances at other localities and better chances to succeed were not even thought about. The historical situation in the early thirties of this century would have allowed magnificent work in the



4 Salzmann's interpretation of earth-falls in the Eocene browncoal of the Geiseltal as washouts. From Salzmann 1914, Figs 5 & 6.

Mesozoic lignites of the Iberian Peninsula, in France, Germany, Austria and the Balkans. Wherever I visited the respective mines 30 years later, the mines were disused.

Of alpine and other Mesozoic fossil deposits of the type Monte San Giorgio, Deeke (1927) knows already 16. Seefeld (Norian/Rhaetic) became disused only in 1965. Seefeld was never worked for fossils in a systematic way as Monte San Giorgio nor any of the 16 localities named by Deeke, and this is partially due to the concentration of work on the Monte San Giorgio.

Seefeld has only yielded one species of tetrapods. *Icarosaurus* from the Triassic of New York and the *Ramphorynchids* from the Norian of Cene near Bergamo (WILD 1979) were discovered by amateurs.

There is a rule how to begin an excursion in a quarry area . The first step after arrival is to mount a vantage-point to have a total view of the quarry in order to plan further steps according to the available exposures. This prevents a long sojourn at a non profitable spot and sets priorities.

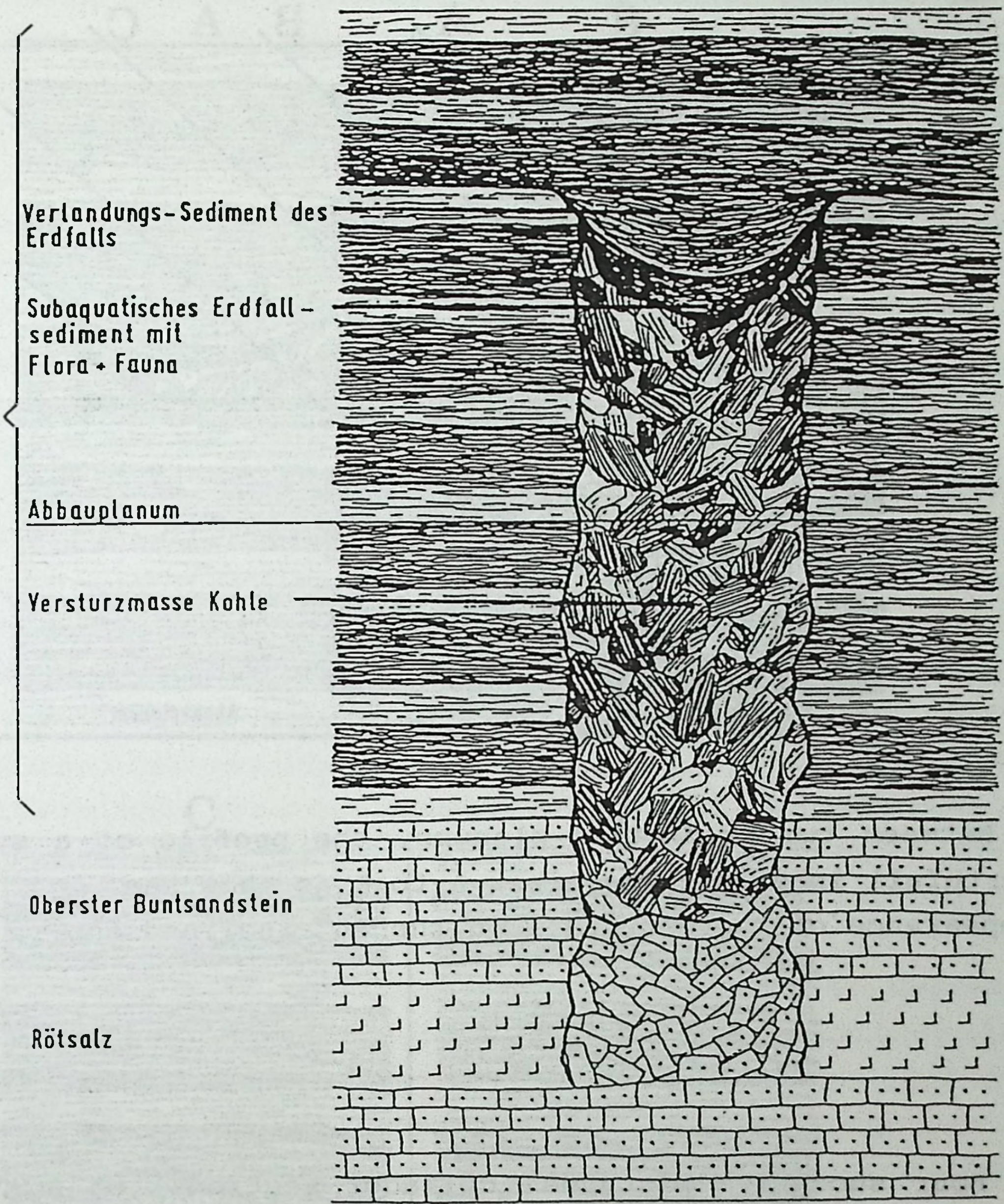
The same applies to a fossil collecting program.: Before investments are incurred, by organizing work and before getting immobile, the supervisor of the program has to know the whole fossiliferous region in order to make the optimal choice. Often this may not be possible because there is no choice, more often this is neglected and a chance discovery conditions future work, future successes and future failures.

The last word in this paragraph: The alien returning into his homeland has by necessity absorbed quite a lot of the program of his guest land. Applying this at home he creates the alien-effect in reverse, and again a number of unsolved problems are brought nearer to solution, or actions are performed, which are overdue.

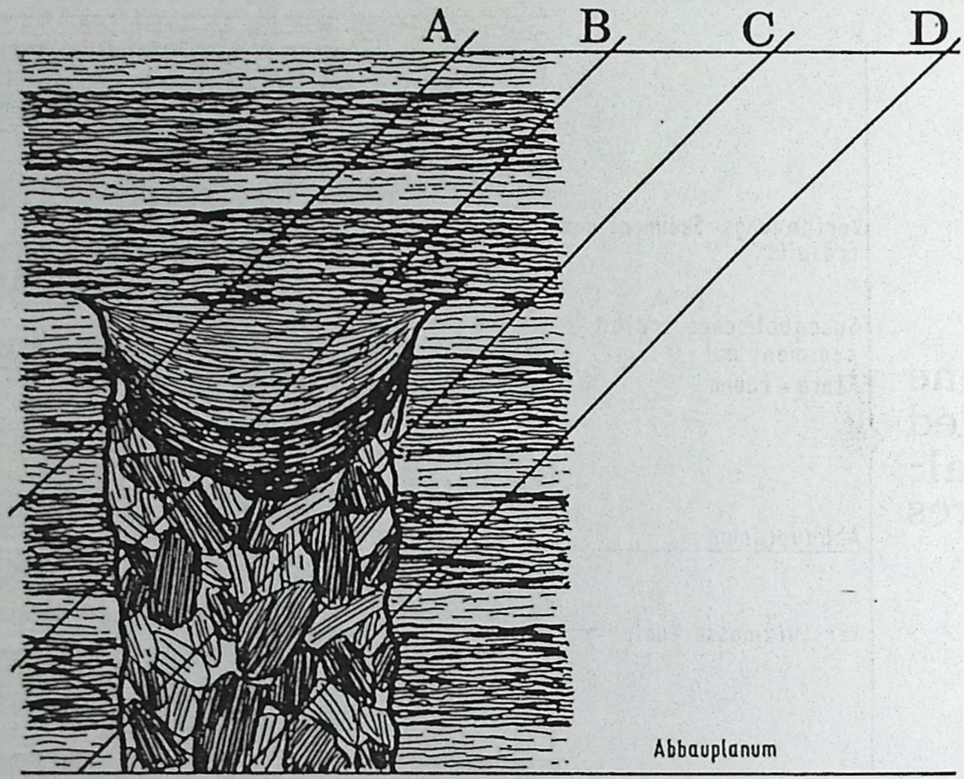
2.5 Relation-Formation of a phenomenon with itself. Dolines in the lignite of the Geiseltal

The fossil deposits in the Eocene of the lignite of the Geiseltal are either sapropelites in dolines or black-coal-deposits in shrinking ponds. Smaller or larger subsidences lead to semipermanent water-bodies on the surface of the actively growing lignite mass and are regions of reduction in a general milieu of oxydation; consequently carcasses are preserved in them.

Eocene banded coal-measures



5 Vertical profile through a filled doline in the banded browncoal of the Geiseltal. Solution of Röt-salt leeds to caverne-formation. At a dark-band-time of the browncoal, the cavern-roof collapses. On the surface of the moor, a mini-lake developes. At its bottom, the earth fall sediments bear vertebrate fossils. Soon the lake is overgrown and is filled with dark-brown coal.



6 Between two production-planums, the profile of a synsedimentary earthfall is drawn. The lines A to D do show the appearance of the earthfall on the 45^{o} inclined cut.

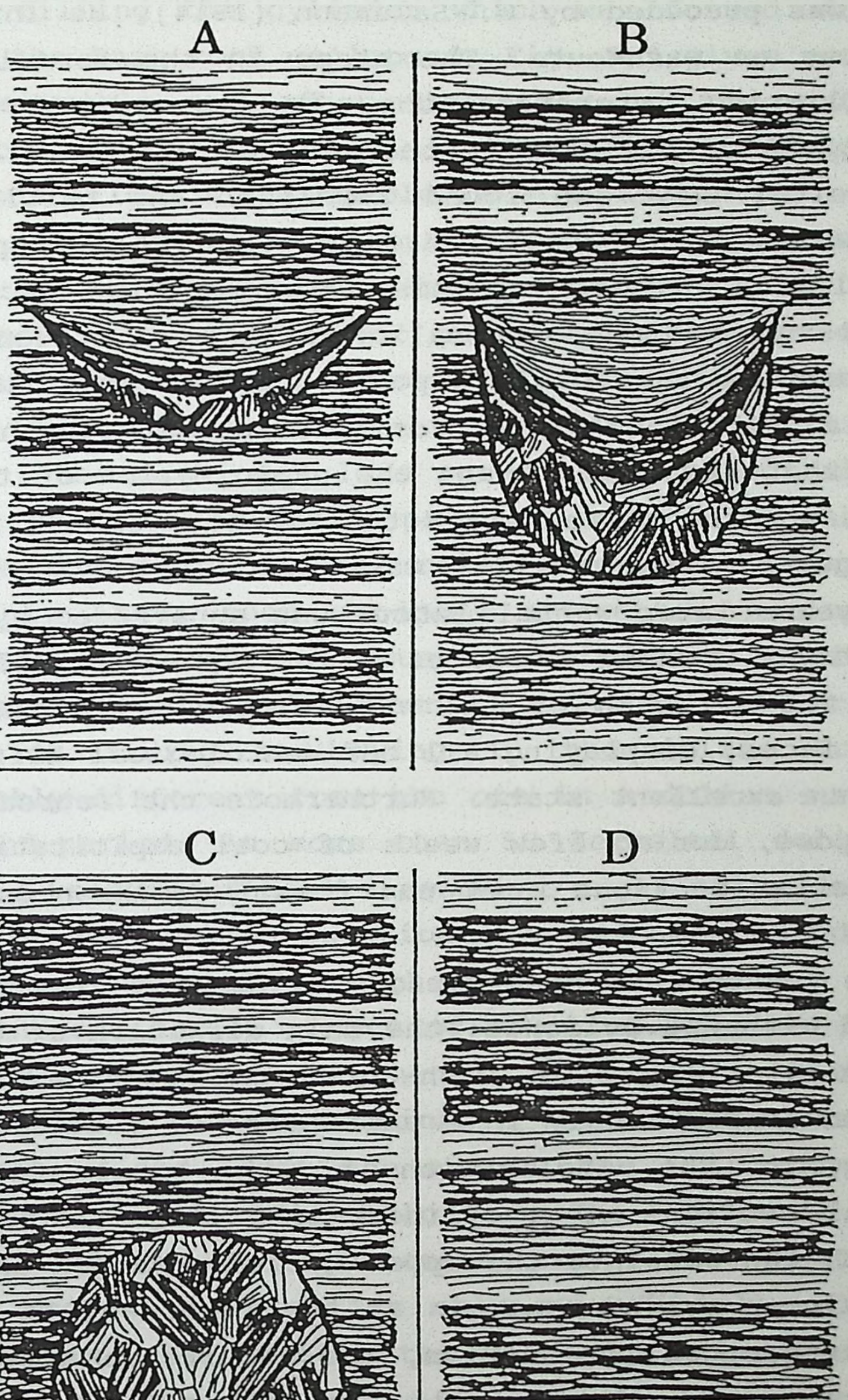
7 Four succesive pictures (cylinder sections) of a synsedimentary earthfall.

A. The two earthfall-sediments are exposed, from above downwards: dark brown coal, when the lakelet is overgrown. Below, the earthfall sediment. Underneath.: breccious coal fragments, fractured during the collapse.

B. The same three sediments, at a later stage.

C. Only the breccious coal-fragments are to be seen.

D. On the 45^{o} inclined cut, only breccious coal is exposed, the rest of the earthfall is exposed on the horizontal production-planum.


A
B
C
D

The interpretation of the small fossil-occurrences as dolines in 1930 was preceded by W. Salzmann (1914). He interpreted these occurrences as wash-outs. The steps in the formulation of these two conflicting interpretations, is the subject matter of the following pages: Salzmann is the real discoverer of vertebrates in the Geiseltal coal. He found *Lophiodon* and turtles in sediment bodies, which he drew (Fig. 5) and which he interpreted as wash-outs. Salzmann arrived at this interpretation because he easily discerned the sedimentological differences between the coal and the sediment of the fossil deposits, but he was unable to discern the spatial relations of the fossil deposits with the coal.

In the time of Salzmann the exploitation of the coal was by hand. The working surfaces and the exposure of the fossil deposits was irregular. Observability was also impeded by the coal being wet. 15 years later manual labour was superseded by baggers. Long and straight working surfaces were exposed, inclined about 50 Degrees. The lowering of the water table below the coal, led to dry coal faces, displaying all sedimentological differences of the coal in an excellent state. Furthermore the retreating coal face would expose, during afew weeks of coal exploitation, sequential cuts - serial sections - of the fossil occurrences, Salzmann had described as wash-outs.

The sequence of observations allowed an interpretation, more in accord with the evidence: the main direction of the occurrences is not horizontal as in wash-outs, but vertical. This vertical phenomenon consists only in a small part of fossiliferous deposit. According to the inclination of the coal face, sequential elliptical sections of a cylinder-like body became visible. They began with the cut into the upper cylinder-margin and ended at the opposite lower cylinder-margin at the lower end of the coal face. During further coal production, the occurrence appeared as a disc on the lower coal platform, if the latter was wind blown and free from coal dust.

From top to bottom the following layers of the occurrence were observed:

1. Black coal, deposited under wet conditions when the doline-pond was already overgrown.

2. The subaquaceous pond deposit with ample sapropelite, leaf coal, vertebrate fossils, syngenetic minerals like quartz and pyrites and well preserved stratification.

3. The doline sediment: tightly packed breccious coal fragments filling the cylinder which was formed when a solution cavity in the base rock collapsed. Fig. 5-7 gives sections as they became observable one after the other in the course of a few weeks. Not one section showed all three layers. Singly, not one of the sections allows a reasonable interpretation.

The series of all sections, brought into the correct spatial relation allows only one interpretation, the interpretation offered above. In 50 years of palaeontological practice, I never observed a comparative phenomenon. The stratification of the Geiseltal coal shows dark and light bands; the light ones are rich in bitumen, the dark ones less so. It is assumed, the light bands have been produced at dryer periods, the water table relatively low, the amount of subsidence relatively small. The dark bands on the contrary, have been produced at wetter periods, the water table rather high and the amount of subsidence relatively big. If the doline happened to sink down at a light band period, the fauna caught - or living and dying in the doline must have been significantly different from the one in a doline sunk down during a dark-band-period. As more than 50 Geiseltal dolines have been excavated a relevant faunal assessment ought to be done.

What I have called relation-formation on the preceding pages, is the connecting of two phenomena to solve a problem. The association is likewise an act of coupling. The new is not coupled with something outside the thinker, but with his content of his memory (i. e. "Bewußtseinsinhalt"). Associations are formed instantaneously and adapt the new to the old; they make the new understandable with the help of the old, if no complete congruences of the two phenomena are realized. If association joins two phenomena which are only superficially alike, error is the consequence. The greater the knowledge, the greater the value of the association.

2.6 Asides:

2.6.1 The invention of the ophthalmoscope by Helmholtz. Coupling of physics and ophthalmology

I cite from from the biography "H. von Helmholtz", vol. 1, by L. Königsberger (My underlining and my translation). H. in a letter to his father, loc. cit. p. 133.: "I have made an invention which possibly will be of great value to ophthalmology. It was latent, as it did not require more knowledge of optics than I had aquired on the Gymnasium; it beats me why other people and myself were so blockheaded not to find it." And p. 143, Helmholtz in a review of his medical-physiological papers: "The invention of the ophthalmoscope has been of great importance to my career. To myself I explained my success in the following terms: fitted , by good fortune, with some geometrical understanding and with physical knowledge, I was thrown among the medical people; here I stepped upon virgin ground of great fertility. My occupation with life-phenomena on the other hand led me to questions and new points of view which were not germane to pure mathematicians and physicists."

I deem it most unlikely that the physical curriculum of the Potsdam Gymnasium of 1835 contained items, not already known since the turn of the century. Thus the theoretical basis for the construction of the ophthalmoscope was latent at least 50 years, when Helmholtz went to his construction by coupling optics to ophthalmology. The second part of my quotation gives the proof: The presence, the availability of two programs, the physical and the medical one, in one head and at that time, was so rare, that it did realize only once. If the person in question was thrifty and enjoyed a long life, he could only be successful. The British mathematician Babage constructed the ophthalmoscope three years before Helmholtz, without succeeding, having it used by the medical profession.

2.6.2 Adaptation of Greenough's binocular microscope to otology. The development of the otoscope.

Since 1892 the Greenough stereoscopic microscope (here called "binocular") is available and has been adapted to serve as a tool in many technical and scientific fields. As an example where the binocular was a prerequisite for a new science, I mention micropalaeontology. It could be surmised that from zoology - which I assume to be the original place of the binocular - the application of this instrument spread to other fields, whenever a desire for a solution of an optical problem arose. But not at all! Though in the watch industry and in otology such desire must have been manifest, even before the binocular was invented, one records considerable delay of the coupling of this instrument with new fields of application.

Since 1892 the binocular is available. C. Zeiss produced it since 1904. Already in 1911 it is in part instrumental for a Nobel prize: A. Gulstrand received the medal inter alia for the adaptation of the binocular to ophthalmology. But only in 1921 is a monocular (sic !) microscope being used in the operation of a rabbit's ear by C. O. Nylén. The two cases are not strictly homologous. Since the invention of the ophthalmoscope in 1849, the optical observation of the eye by means of optical instruments, has been commune bonum. As the ophthalmological diagnosis yielded more and more useful information, the better the optical instruments became. The optic observation of the outer ear on the other hand ends at the opaque eardrum; behind this curtain are hidden those structures affected and to be observed. Without an opening of the middle ear, an optical inspection of it was impossible.

Hence the otoscope had to be from the beginning a tool for otic surgery, not for otic diagnosis.

Nylén and Zöllner, on my request, to state reasons for the delay of the development of the otoscope, called upon the danger of sepsis and a lack of means to meet this danger before the invention of antibiotica. The spectacular success of the otoscope is indeed chronologically joined with the antibiotica. This however does not solve the patent contradiction, that from 1921 to 1945 ear operations were performed without an optical aid, which later would have been a malpractice. The otoscope could have been developed in 1911 or 1921 just as well as it was developed in 1945.

Nylén wrote to me: "As far as I know, I was not aware of Gustrand's binocular for ophthalmology. At the time when I started these ear operations, I was 29 years of age and first a specialist in ear, nose and throat." It emerges clearly: A relation between the two relevant fields of medicine did not exist.

2.7 Reasons for the non-formation of relations, of coupling

One cannot comprehend, one cannot assess the negative evidence, viz. the lack of relation-formation, of coupling. This is only possible after the relation has been formed and the condition under which this has happened, has become known. The process can be analyzed regarding the historical situation , the causing problem demanding its solution, the available tools, the social position of the perpetrator etc. The importance of such analysis is obvious: to succeed, it is essential to search and to find latent couplings which can easily be realized.

2.7.1 Morgan neglects old German basic research on *Drosophila* anatomy

Before the concept of "chromosomes" had been created by Boveri in 1910, the structures, later identified as the giant chromosomes in the salivary glands of *Drosophila* had been described by BALBIANI in 1881. Later the gonads forestalled the salivary glands! In a brisky developing science like genetics, not even one person ran through the pertinent literature for 22 years, until this was done in 1933 by E. Heitz, H. Bauer and T. S. Painter.

2.7.2 Lack of selection pressure in small science

Isolation of microvertebrate elements, especially scales and teeth from limestone by means of acetic acid is an acknowledged technique since 1945. But already in 1845 the prerequisites were well known. The coupling between phosphatic vertebrate remains in limestone and acetic acid, breaking down the limestone and liberating the vertebrate remains was latent. Actually the coupling was performed after 1945. Apparently the forces leading to the coupling were not strong enough earlier. About 1935 F. Brotzen and W. Gross isolated Lower Devonian scales and teeth , used in their research, by means of hammer and pliers; their n was less than 100. After 1945 Gross used an n of about 10,000 objects, isolated with acetic acid. His results were quite different especially in quality.

2.7.3 Even the small success is in accord with the principle of economisation

If the small success is sufficient in competition, and if the big success in this case is only feasible by means of coupling, the latter will not be realized. In technology the principle of economisation plays a crucial and a dialectical role: It fosters with great speed improvement of efficiency of apparatus, of safety etc. It leads immediately to stagnation of further developmental expenditure, if superiority is achieved. With great efforts, expensive developmental research and work, and with great initiative and expensive patents an apparatus is developed. When its products emerge out of the red numbers, the production becomes profitable and from this moment onwards, any inducement for further development is out of the question, especially if the apparatus has the protection of a patent.

With other words: The principle of economisation does not lead to an optimum under stabile conditions. Greater investment, greater effort in research is realized not if it is possible or feasible but if it is necessary, and only then.

Example 1: The Swiss watch industry introduced the binocular only in between 1940 and 1950. Up to this moment other improvements in watch making were sufficient to cope with competition and to safeguard profits.

Example 2: The copper ore of Outokumpu in Finland was exploited from 1915 onward. Elementary mercury is present. Only after 1970 when ecological considerations gained importance, roasting was abandoned. Now about 1035 kg mercury per year were not blown into the Finnish air, but were recovered, cutting Finland's mercury importation to nil.

Finland is rid of the hygienic load of 1 ton of mercury per year in its air and the social product required to import mercury could be used for the importation of social relevant and later useful ideas.

The by-product of mercury was only to be recovered by the new dressing and smelting process; it did not arise during the old oxydation process. As copper production was profitable, there was no economic compulsion for the winning of the mercury in order to improve the profit.

The unconditional and unreserved application of the principle of economisation led to the lowering of the national health, to the waste of a nonrecoverable nonferrous metal and to a drain on the national finances.

2.8 Series-formation

Work of a successful investigator is characterized by a high degree of feedback and a great amount of coupling, in respect to a phenomenon being the subject matter of her or his research. The successful investigator does not produce a number of papers on unrelated subjects, that is, he does not produce many papers of a tyro, but produces a series of papers in which the last is definitely an improvement on the last but one, because of the greater amount of feedback. He works economically. Consciously or unconsciously he will proceed by series-formation. In the negative: work will sooner or later be canalized; as such, that phenomena which cannot be associated, cannot be comprehended. Another negative result of canalisation: The investigator is said to write lifelong on the same items.

Example: From 1950 to 1970 I collected the data of about 100 localities in the Jurassic and in the Cretaceous, prospective for small tetrapods. From 1970 onwards, I collected the data of localities prospective for resin and arthropod faunae in the resin. I was surprised to find among the resin localities some, which had been known to me before, as prospective for small tetrapods. One of these is the Turonian lignite of Ajka in Hungary, the only locality which up to now yields an autochthonous resin with an arthropod fauna and which has yielded to me teeth of a crocodilian.

The beginner cannot build series. Of the phenomena which he studies, only a few lend themselves to series-formation. For him, it will be essential to prefer in his research those phenomena, which will lend themselves to series-formation.

The palaeontologist can easily proceed with series-formation. The acknowledgement of similar phenomena at different geological times and different localities is series-formation par excellence. In palaeontology it is more difficult to find a unique phenomenon than phenomena which occur several times in geological time.

As long as a discovery of hitherto unknown fossils is still an acknowledged activity of palaeontologists, the knowledge of the methodology of palaeontological discovery can only be advantageous. That was not only valid for the writer, but will be valid in the future too.

To proceed from the special case which is met by accident and opportunity, to series-formation, abstraction is required: Generally valid parameters have to be searched for and have to be found.

2.9 Fossil resin

The collecting of resin of palaeontological relevance is an activity one has only recently done systematically. Fossils in Baltic amber have been described all over the world; there is nothing easier than to proceed from a palaeontological department, say in Belfast or in Cairo to the nearest jeweller, selling amber articles and to request amber-arthropods. Either the desired Diptera or spiders are on stock or can be ordered to be delivered inside a week.

Baltic amber arthropods are represented in all palaeontological teaching collections, represented by quite untypical specimens, viz. well displayed, in a rectangular , fully transparent and polished block. Their rôle in such collections is one of curiosities. Palaeontologists do not cope with amber insects; they are overtaxed when attempting to analyze a complete insect. Zoologists describe amber insects, as these are the only palaeontological objects acceptable for zoologists. The arthropods of Sicilian amber - simetite - have been described mainly in Catania. The Upper Cretaceous resin fossils from Cedar Lake in Canada have been described mainly in Canada. The arthropods of the amber of the Dominican Republic and of the Peninsula Chiapaz in Mexico (Oligocene to Miocene) have until recently only been described from scientists of North American universities, although the resin is known since Columbus.

Thanks to the dominant rôle Baltic amber plays in commerce - or - in the negative - the strictly local rôle of all other amber occurrences, fit for jewels - all palaeontologists know Baltic amber - but this is the subconcept, not the concept the arthropod yielding fossil resin.

There has been in the past hardly any research for relevant resin occurrences not used nor fit for jewellery. As a result there is hardly any record of Chelicerata and other terrestrial arthropods between the Upper Carboniferous and the time of the Baltic amber. The Carboniferous record stems from brackish concretions from Illinois and the British Midlands. The deficit of the record gains relevance if it is understood that the lacking taxa are obligatory members of resin faunae; and if it is understood how easy it is to procure Mesozoic fossiliferous resin, from which the respective taxa can be obtained If coupling exists between zoologists demanding the Mesozoic faunae and geologists, programmed to procure a rather ubiquitous accessory component of clastic rock viz. fossil resin, arthropod faunae will play an essential part in the palaeontology of arthropods in the future.

Insect wings are common in fresh water, brackish and littoral sediments with preserved stratification. In the Triassic and the Jurassic there are a number of well known localities. However, the first Cretaceous record of Lepidoptera dates from 1970 (MACKAY 1970), from Canadian Maastrichtian resin. The rediscovery of the Lower Cretaceous Lebanon resin is a thrilling story brimful with accidents, neglected opportunities and final success (SCHLEE 1970).

The research on this subject by and under W. Hennig at Ludwigsburg revolutionized resin-research. While we observed the daily changing aspect of the phenomenon "resin arthropods", we decided to apply series-formation to it. Soon it became obvious that almost every resin contains an arthropod fauna - if the single resin-pieces have at least a weight of about 1 g - and that resin from gymnosperms can be expected down to the Devonian (SCHLÜTER 1978). Any newly discovered Mesozoic resin is to be expected to yield an arthropod fauna, provided a minimum of at least 200 g resin is available.

The appeal of amber insects is enormous to a palaeontologist, who is otherwise working lifelong with fragments of elements. Where else do we find in palaeontology oviposition, copula, parasitism, prey and predator ? Where do we find a "Habitusexemplar" displaying the distal element of the extremities, the different elements of the genitals and the bristles. The rule in resin preservation is the exception in any other medium fossilizing animals of the past.

How does one locate and find Mesozoic (and subsequently Palaeozoic) resin occurrences ? By questioning, by reading the literature, by collecting indicators for the presence of fossil resin and by contact with resin consumers. Resin is used as a raw material for jewellery, formerly and rarely as raw material for laquers, as incense, for fire lighting, natural antiseptic wound plaster and to fix stone implements in the wooden handle.

The demand for amber in the jewellery industry is very great and is, since Roman times, monopolized by the Baltic amber. It is unlikely to find today a new source of jewellery amber, because the material is well displayed on any "Lesedecke", it is very conspicious and it has been used as ornament since the Neolithic. As the subsidiary functions of amber are met with by many different products, there is little chance to find even small mines with only occasional production not yet known.

Obviously it is the geological surveys and the geological institutes, where information on non-ornamental amber is housed. The material is sampled by geologists in the hope, that it might yet be used commercially. Amber research in the USSR and the discovery of several amber deposits all over the world recently, indicate that of palaeontological important amber one may not need more than 100 kg. Though the Lebanon amber is still the oldest, yielding arthropods, it is to be expected that even Devonian fossiliferous resin will be discovered in future.

In 1970 I questioned only in Lisboa and in Caen and we received positive answers and saw the samples. At Caen we received the locality name Bezonnais (SCHLÜTER 1975). From there we proceeded to Durtal and Fouras (the two former localities are clay pits, Fouras is a spot in the littoral). The indicators for fossil resin are:

1. Clastic soft rock, sandy clay, fine sand, cross bedding
2. Ample lignite as pebbles and as small allochthonous seams.
3. Lignite drilled by Teredo etc.
4. Rock devoid of lime.
5. Rock rich in pyrites.
6. If present, a brackish water fauna with few taxa of Lamellibranchiata and/or Ostracoda.

From this emerges, that amber-yielding rock in general is not exposed in nature in the temperate zone, but may be in the littoral.

Here again I apply the "Kisch-trick". By accident two samples of pyritized fossils covered by liquid paraffin stood on my writing desk. One from Herne Bay Thames estuary, London clay, consisting mainly of fruits, the other pyrites impregnated wood from the Cenomanian of Fouras, at the Atlantic coast of France. The Fouras locality yielded resin in situ. Fouras is also prospective for amber loosely found on the beach. The Herne Bay pyrites covers as a dense metallic-green "Lesedecke" the foreshore, immediately under the permanently slipping London clay. Fossilized wood, Teredo-drilled is the only other frequent fossil. None of the pyrites is found in situ.

The two localities are now put into relation. Pyrite is common to both, the resin is - up to now - only proven at Fouras. The prediction is made that genuine London clay resin is liberated from its rock at Sheppey and Herne Bay, transported and somewhere deposited. The prediction does not produce London clay resin but makes the existance of it feasable ("denkmöglich"). The task is now to find theoretically the locus for the London clay resin and to search for it along the shore of the Thames estuary. Another prediction: Some of the wellknown Norfolk amber may be London Clay resin.

Of eight occurrences of fossiliferous resins with arthropods we posses eight, autopsy of the occurrences of five; five localities are Mesozoic, three Tertiary. It is obvious that the next locality which we shall discover, or which we shall visit, will be put into relation with those already known. If we find there all seven indicators, different ones, or less than the seven mentioned, the value of the indicators changes by 1/8. With feedback we increase the certainty to find the resin.

2.10 General features of series-formation

A series of localities yielding amber-fossils or useful minerals or for instance sources of information etc. proves its value if the researcher can pick from it the most fitting element. If this is done the worker does not live from "hand to mouth", but he can choose and select from a number of options, where after the prospecting phase the production phase will take place.

The research worker has the greatest satifaction from series-formation, when he can induce another worker to take over part of his program. This is of importance where the builder of the series is not in the position , in order to choose the optimal element, to transgress political or financial borders.

If another worker pilfers the work of the series-builder, the latter has at least the satisfaction that the pilferer, in order to produce, had to use the other's intellectual property. The object, which is stolen, prooves its value by this fact.

The student can do not better than write his first paper on an element in a series. He will realize what amount of scientific matter he has received from his predecessors working in the series. He will realize that he will not start from the bottom, but enters the subject already at a high level. He can assess his own and better results compared with those of his predecessors - and - by feedback he can find and dissolve contradictions left by his predecessors. In case his work is the tenth in the series, he may contribute to the whole series even 25%, by feedback. That is, illuminating each of the nine previously worked elements of the series.

If the first worker on a serial object relies on opportunity and accident, the last worker in a long series lacks these factors, they do not condition his work. The prognosis for future work is conditioned by his work.

2.11 Slate of the epizone

Unless the preservation of fossils in slate is excellent - usually by pyritisation - they are not discovered, or expressed in the negative: very few fossil occurrences in slate are known. In central Europe, slate is used in roofing and slate fossils have a market, hence Bundenbach, Glarus, Wissenbach etc. have yielded faunae and specimens from these localities are well known. If, on the other hand the slate is not worked, a market for its fossils does not exist, there may be in a geological survey collection one poor specimen, sufficient to indicate the stratigraphical age of the rock. The number of badly sampled slate-faunae must be enormous, speaking from my own experience.

At the end of this chapter, I describe a series of four slates of the epizone, two have been exploited in the past, one has been discovered as a natural exposure in a mountain, free of vegetation. The fourth is still unknown, due to be discovered soon, but it is a Late Precambrian slate, with a fauna of macrofossils without mineralized skeletons, comparable with the fossils of the Burgess-pass-slate.

The first element: Oligocene; Matt near Glarus, Switzerland. The fish-slate of Matt is no longer exploited. On the heaps are to be seen thousands of square meters of bedding planes, clean and free from vegetation. Thousands of square meters of bedding planes do not reveal a single fish. Every bedding plane reveals the indication for turbidite and flysch. The size of the loose slate exposed in the heaps is at least ten times the size of the fishes from Matt. The visibility even of unprepared fish on the bedding planes is good. It is obvious that all exposed fishes have been collected from the surface of the heaps, since the exploitation ended - if such fishes were once available! The lack of isolated fish-bones is absolute. There are at Matt only whole fishes. Long fishes, for example *Lepidopus*, are often embedded in a broken condition, the long trunk ends either with a fracture, or the trunk is angulated. The fauna consists of fishes, apart from one bird and two turtles. There are no invertebrates nor plants. Faunistically and biostratonomically the evidence indicates unanimously death and embedding of nectonic animals during the event of a turbidite.

The second element: Lower Devonian. Bundenbach, Eifel, Germany. There is no longer exploitation for slate at Bundenbach. The lithology is in many respects similar to Matt, but the many and crucial indicators for turbidites are missing. The bedding planes, as in all slates are preserved and exposed. Authochthonous benthos is lacking, benthonic organisms are present as fossils. Traces of organisms are not entirely lacking (Seilacher and Hemleben 1966). Biotope and thanatope are seemingly not identical. Lamellibranchiates, gastropods and corals are rare, graptolithes are missing. The interpretation of Bundenbach as a distal turbidite seems to me the one with the greatest probability, though a number of contradictions remain.

The third element: Middle Cambrian. Burgess Pass, Mount St. Stephen, British Columbia. Situated between limestone series, the

Burgess Pass is today (Piper 1972) regarded as a turbidite. The fauna is exceptional, because of fossils with a non-mineralized skeleton. The fossils have been embedded intact. Between the settling sediment and the organic matter of the animals no chemical reaction took place, for instance there are no concretions; the fossils are preserved as films. The turbidite was sterile.

Matt and Bundenbach have been slate workings with slate production and additional fossil gathering for more than 100 years. The sediments of the Burgess Pass are exposed in the mountains. Little talus is present, the discovery is due to Charles Walcott and his sons. The qualification of Walcott as fossil collector was extraordinary.

The fourth element: A late Precambrian slate. This element of the series is again an unfolded turbidite; it is not worked for roofing or building material; it is badly exposed on a mountain slope, in a region free of vegetation, and talus formation is poor. There is no chemical weathering, bedding planes are not covered by lichens. The non-mineralized fossils form films without reliefs. The fossils are observable only by their gloss and luster. Because of an angle of about 2^o between bedding plane and slating plane, many fossils are partially hidden in the rock; that is, they are not completely exposed on the bedding planes.

Considering the small number of the worlds field geologists, who have an autopsy of material from the Burgess Pass, it is not at all striking, that since 1911, the year when Walcott discovered the fossils of the Burgess Pass, no second comparable occurrence has been discovered. (This is - 1990 - no longer strictly true. The fossil field around Walcott's Phyllopod Bed has been discovered by Desmond Collins; In Yunnan the locality Chengjiang has been discovered with a good Burgess fauna, but slightly older. Also from the Lower Cambrian has been discovered in Northern Greenland a Burgess Pass Fauna though not in slate.)

On the other hand, there must be literally thousands of slate deposits, which have been observed, have been mapped and have not revealed their fossil treasures, because the field geologist is - during his training - not programmed to slate fossils.

With this analysis of material and social conditions, the existence of such slate deposits is made feasible - now it can become a program - and my optimistic prediction is made: such

Locality	Matt near Glarus, Switzerland Miocene	Bundenbach Eifel Germany Lower Devonian	Burgess Pass Brit.Columb. Canada Middle Cambrian	not yet discovered Latest Precambr.
Epizonal metamorphism	+	+	+	+
No folding or liegende Falten	+	+	+	+
Shistosity parallel with bedding plane	+	95 %	+	95 %
Bedding planes preserved	+	+	+	+
Fauna	few taxa,no authochth. or allochth. benthos	many taxa fauna from several biocoenoses	many taxa benthos and necton	many taxa
Preservation of fossils	only compl. animals,no skeletal elements	ditto	ditto	ditto
Preservation of fossils excellent	+	+	+	+
Chemical relations sediment/ carcass	Pyritisa-tion	Pyritisa-tion	no relation	no relation
Preservation of non-mineralized matter	+	+	+	+

occurrence will be discovered in the five years after this book is in print.

2.12 Relation-formation in nature

This subject matter is not germane to the theme of this book. It may be mentioned here to give the reader an impetus, to begin to think along this route. Life in isolation without substrate, without biotope, without biocoenosis, without biological equilibrium, without homoeostasis, without evolution does not exist, is not feasable. Life means the complex interrelation of elements of the organic and the inorganic world. Ecology is the science of biological relation-formation.

The more parameters are involved in the formation of an ecosystem, the older it is, the more homoeostatic it is, the more stable it is, in respect to the possibility of change and the less it is capable of selfreparation.

If the evolution of an ecosystem has taken hundreds of millions of years, its injury and final destruction may be the affair of decades. In this respect the old and stable ecosystem compares with the synorgan. Size of an ecosystem is the most important parameter. The optimal size of an ecosystem is situated between the minimal and maximal size. That the minimally-sized ecosystem is lacking a great number of parameters, that it is deficient in homoeostasis, in stability, and that it is extremely vulnerable, we know well, because life on land and in caves has been studied already for decades and lends itself to ecological analyses. Maximally-sized ecosystems do not lend themselves to analyses.

The concept of world government does not only exist in science fiction, it implies a maximally-sized human ecosystem. The dialectical processes in the ecosystem "world government" are totally unknown.

3 Hegel's Triad

3.1 Motto: "All through history, scientific procedure by science officials is by addition of kindred elements. The stalactite-like results gain unwieldy and grotesque forms. The perpetrators of such procedure offer a rigid resistance to even the most trivial change (Robert J. Mayer in "Kleine Schriften", Cotta, 1893, p. 250 - my translation).

Examples:

1. Goethe in a letter to Merck, referring to the refusal of Sömmering, to print Goethe's discovery of the os intermaxillare in *Homo*: "A scientist of profession, I deem it likely, to disavow his five senses."

2. Kühne and Schlüter 1985: Crowson does not describe a larva of a Thysanoptera from the Devonian of Rhynie, because he cannot imagine and accept the existance of winged insects already in Devonian.

3. The Jurassic mammal *Endotherium*, a representative of the Theria, cannot be of Jurassic age nor belonging to the Theria. So B. Patterson 1956. Otherwise, the Lower Cretaceous mammals from the Trinity-Sand would loose much of their significance as being "the oldest" Theria.

4. Brecht in the Play "Galileo": Galileo tries vainly, to demonstrate in his telescope to court-astronomers the satellites of Jupiter. As satellites of a planet do not exist in the minds of the court-astronomers, they refuse to look through the telescope.

3.2 Dialectic-materialistic theorem

Any kind of evolution proceeds dialectical, not additive; that is, by the creation and the solution of contradictions. In Hegel's diction any thesis creates its specific contradiction - viz. the antithesis. The result of the relation between thesis and antithesis is the synthesis. The classical example of Hegel's triad stems from Marx: capitalism - thesis - creates unavoidably organized labour - the antithesis. The social, economical and political battle of both, the class war (Klassenkampf) ends in socialism, the synthesis. The antithesis is not a result of voluntary action of a few (demagoges, seducers of the youth etc.), it is brought about, it is created by the thesis; it is causally related to the thesis.

3.3 Example from the history of society

Social evolution does not proceed continuously but dialectically. The impact of a capitalistic class on its society creates its antithesis. The capitalistic social structure requires "middle men" between capitalists and workers. They obtain insight into capitalism but are not supposed to participate on the surplus value. Sooner or later the middle men organize themselves and claim part of the surplus value. In case the claim is refused by the capitalist class, a revolutionary situation may develop. Dialectical is the unavoidable creation of contradictions. In our case it is the creation of an intermediary group between capitalists and workers. Dialectically may be the cyclical or structural depression. Dialectically may be the senselessness of human existance which in capitalism is governed exclusively by the unrestricted law of economisation. Material and ideological weakening of the ruling class in times of depression may lead to local or general revolution, to the overthrow of the ruling class, to the extinction of its ruling doctrine and to the ascendance to power of the hitherto exploited class. Between the destruction of the old ruling structures and before the inauguration of the new governing structures, viz. during the dialectical combat, the revolution happens.

The replacement of any scientific theory by a new one, happens dialectically. The symptoms during the process of change are commensurable with the above mentioned ones.

There is no scientific procedure without a theoretical concept. There is no research which is not problem-solving. As this is so, theories-albeit poor ones - are created on the smallest evidence and are soon obsolete, they do no longer cover accruing evidence, their application creates contradiction and the dialectical creation of a new theory ensues.

3.4 Examples from the history of Geology

The following two examples illustrate the mode of theory creation and of theory destruction. Given is the permanent increase of palaeontological documents. Evidence which is gathered after the formation of the relevant theory may or may not be covered by the theory. In the latter case this leads to contradiction. The contradictionary evidence leads either to the modification of the theory or to its destruction.

The amount of contradictionary evidence which can be carried by a theory may differ very much. There are cases where theories are broken by one item of contradictionary evidence, for example Lyell's drift-theory (see chapter 2.2) and Heim's contraction-theory. In other cases the formation of anti- and synthesis is a long drawn-out affair.It is a combat between old and young ones, between the many and the few. No abrupt revolution may ensue, but slow replacement.

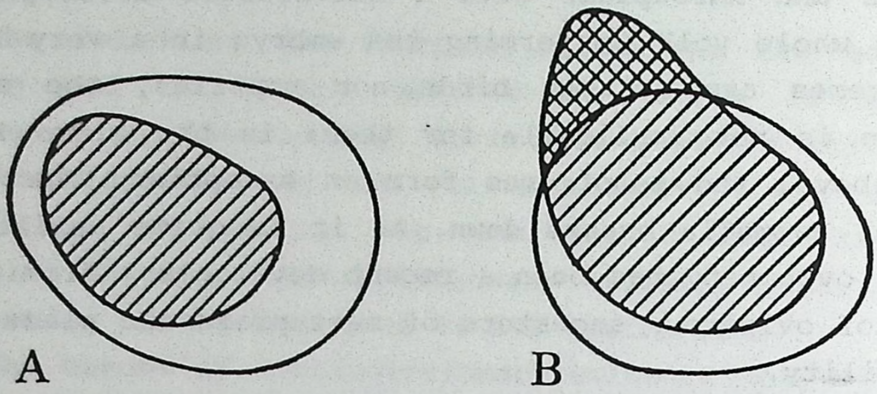
The theory of constancy of the taxonomic units leads 1759 to the "Systema Naturae" of Linnaeus. This theory is refuted by Darwin, about 100 years later. Nevertheless the Linnean system remains in use. Phylogenetic theory and typological practice do not yet create a contradiction. Another 100 years elapsed until W. Hennig created the explicit theory of phylogenetic systematics (HENNIG 1950 and 1966). In the largest field of systematic zoology, in entomology, at about 1935, the most able representative of systematic entomology, was no longer willing to comply with a system, which did not fulfil his needs. And the revolution was triggered off, still growing in momentum today.

As second example I discuss the impact of the discovery of the monotremes and of the precursors of the mammals in the Mesozoic. The Linnean system creates so called obligatory categories, such as phylae, classes, orders etc. The class Mammalia is defined in the following way: Members of the class Mammalia are homoeothermous, viviparous, lactating, their skin is covered by hair. Implied is the general applicability of this definition. Caldwell's telegram to the section of zoology at the meeting of the British Association for the Advancement of Science at Montreal (2nd of september 1884) is the classical theory-breaker: he states: "Monotremes oviparous, ovum meroblastic." (Meroblastic is the embryological development in birds and reptiles by means of a germinal disk in a rather large egg. Placentals and Marsupials have a holoblastic development of the ovum. The whole yolk is forming the embryo in a very small egg). If monotremes are neither birds nor reptiles, the above given definition is not applicable for them; in the class Mammalia as defined above, the monotremes form an exception. The typological concept of Mammalia breaks down. As it is quite unlikely, that a status of oviparity has been a recent development from viviparity, the fact of oviparous ancestors of marsupials and placentals gains in probability.

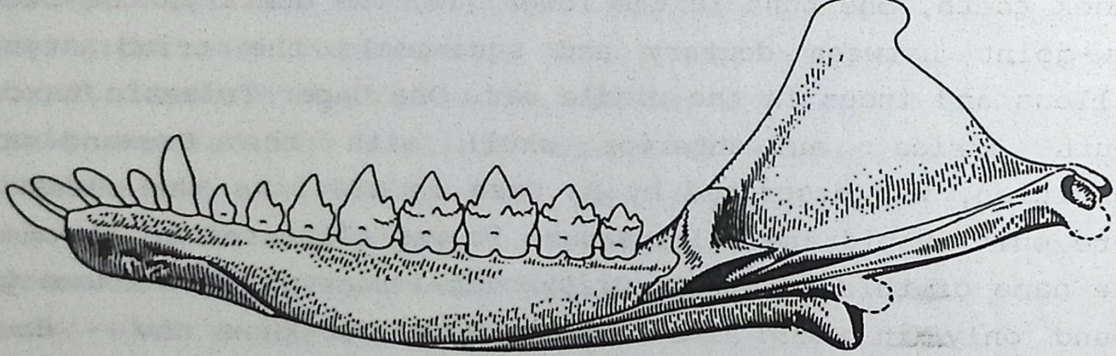
The area in which the old definition is still valid, is restricted by the new discovery. The process of phylogenetical change from an oviparous to a viviparous condition becomes feasible. The contradiction between the old definition and the new evidence, furnished by the monotremes, must lead sooner or later to a new theory of the origination of the Mammalia.

The same applies to palaeontology: As the Linnean definition was not applicable, being founded on soft structures, an accessory definition was given: Mammalia posses multicuspid and multiramous cheek teeth, one bone in the lower jaw, the dentary; the secondary jaw-joint between dentary and squamosal; the triad: tympanic, malleus and incus in the middle ear. One Upper Triassic taxon from South Africa, an anterior skull with the Pre-and-maxillar dentition, was described by R. Owen in 1884. As the cheek teeth were multicuspid and multiramous, it was allocated to the mammals. The name of this fossil is *Tritylodon longaevus*. The lower jaw was found only in 1939; its dentary - as we know now - does not articulate by means of the secondary jaw joint, the dentary does not possess a condylus mandibularis. The dentary possesses - as in the therapsids - a deep sulcus cartilaginus meckeli, housing the articular, the angular and the prearticular, and the jaw-articulation is by means of the primary jaw-joint, viz. by the articular and the quadrate.

Here again the applicability of the above given and old definition was no longer possible. The recent oviparous monotremes had their fossil counterpart in *Tritylodon* with "mammalian" teeth and a "reptilian" jaw. It remains to find out the systematic position of the tritylodontids. They as well as the monotremes could not be fitted without creating contradictions into compartments, conceived before they became known. The immediate



8 Evidence and theory. A. The evidence (hatched) is covered by the theory (white). B. Additional evidence, later available, reaches beyond the theory. The areal of controversy is crosshatched.



9 *Morganucodon watsoni*. An Upper Triassic taxon from the lineage Therapsida/Mammalia has two functional jaw-joints. Laterally the secondary one between Dentary and Squamosal, medially the primary jaw-joint between Articular and Quadrate. In a static taxonomical system, *Morganucodon* is a contradiction. (Quadrate and Squamosal not figured. From Kermack et al. 1973).

consequence from the new fossil evidence was a phylogenetical one. There is a time-span approximately around the Triassic/Jurassic, where mammals originated and when the today used definition of Mammalia is inapplicable. Exactly as it happened during the French revolution, when neither Kingdom nor Republic existed, so at the Triassic: the concept of Mammalia could not yet exist, but many taxa which had embarked on the route to the mammals existed, and they have been found.

Such considerations negate the Linnean system. According to it, there cannot be an animal neither reptile albeit therapsid, nor mammal.The resistance against this softening up of the Linnean system is well nigh paramount.

> Van Valen (1960, p. 310) suggested a way out of this calamity: Without autopsy he doubted the existance of the functional primary jaw joint in the tritylodontid *Oligokyphus*, though it had been described at length four years previously (KÜHNE 1956).

In 1958 two taxa are known with multicuspid and two rooted cheek teeth and a condylus mandibularis. The primary jaw-joint however was still in existance and formed another jaw joint medial to the primary one. The respective taxa are *Morganucodon* KÜHNE 1949 and *Kuehneotherium* KERMACK 1968, and the docodontids in the Jurassic. At that time I wrote (loc. cit. 1958, p. 232-233, my translation): "the existance of the primary and the secondary jaw joint in *Morganucodon* prooves the actual phylogenetical unity of therapsids and mammals. It is this fact which allows to destroy the dividing-line between therapsids and mammals. What was once said to be a macroevolutionary event, is now known to be a process, spanning several tens of million years by several stations. The connection of Therapsida and Mammalia is now a factum. The "type Mammalia" is an artifact, brought about by objective historical conditions, which are an affair of the past and without taking into account the palaeontological evidence." In 1968 (p. 79), at another occasion, I wrote: "There is no longer a borderline between man and animal." In a chronological determined phase, the transition from animal to man takes place and hence drawing a borderline is nonsensical. Prof. O. H. Schindewolf answered (1969, p. 17): "W. G. Kühne recently issued the opinion, that no borderline existed between animal and man; there could not be a "first man". He obviously neglects the fact, that we cannot proceed in our scientific activity without borderlines." The author who indulged lifelong in typological compartment creation, is unfit to comprehend or to conceive the long process of the origination of a large taxon, even if the relevant evidence is available !

However, the typologists are subjected to empty the beakers of bitter evidence, which contradicts their concepts, down to the dregs. Romer (1969) described the South American Middle Triassic therapsid *Probainognathus*. This taxon has multicuspid and one rooted teeth and a secondary jaw-joint medial of the primary one. Instead of seeing the therapsid-mammal phenomenon as a continuum, as a lineage, a younger generation of typologists is presently going to invent new class-criteria, to save the sinking ship. Barghusen and Hopson (1970) write (my underlining): Therefore, additional criteria must be used, to separate those animals which on the basis of their phylogenetic relations, we wish to call mammals, from those, which we wish to retain in the therapsids."

What had been - up to now - hardly considered to be important, is now designated to lead the typologists out of the dilemma: the diphyodonty. But alas, the two authors see already a time when even this crutch has become useless, because newly discovered evidence will evermore suggest the existance of a lineage between therapsids and mammals and will negate increasingly the concept of a borderline between those two taxa. "But because the dentary-squamosal contact had a multiple origin, its use as the sole criterion for determining what is a mammal has a serious drawback. It does not distinguish between those Late Triassic groups which were terminal lineages within the cynodont radiation. Hopson and Cromptom have suggested that the presence of a diphyodont pattern of tooth replacement and possession of cheek teeth of a characteristic pattern be added to the dentary-squamosal contact as criteria for diagnosing what is a mammal. As knowledge of early mammals improves, other , perhaps better characters can be added to or substituted for those. The problem of mosaic acquisition of these characters will complicate the issue as the record documenting the transition becomes increasingly complete, but we shall also be in an increasingly better position to select the most biologically significant criteria separating the two classes."

Here is nothing at stake. There are no social implications in respect to the origination of the Mammalia. Nevertheless one prefers the procedure which is castigated by Robert Mayer (see motto of this chapter), instead of taking recourse to the only successful procedure: Breaking the old theory and applying the phylogenetic systematics which covers more evidence, and incorporates a smaller number of contradictions. We formulate and summarize: Taxa which have been recognized as elements of a lineage are arbitrary, are non-existing in nature and hinder - by arbitrary borderline-creation - the recognition of the lineage. Such taxa are superfluous and unnecessary, they are relics of a predarwinian time. The only feasible of such taxa, created long ago, are the deficiencies of the fossil record, the gaps in the record which happen to surround such taxa by gaping ignorance. The more the gaps are closed, the more taxa there will have to be and the more borderlines are created between the defined taxa; borderlines where definitions are invalid. Such typological systems during the time of evidence-increase gain in unwieldiness, in inapplicability and in nonsense.

3.5 The creation of contradiction in examples from literature

SHAKESPEARE (Hamlet II, 2): "Though this be madness - yet there is method in't!"

SHAW (1964, p. VII): ..."paleontologists have largely been content to expend their energies in ever more complex nomenclature which becomes ever less relevant to anything but its own ends."

JEPSEN (1948, p. 2): "Naturalists, in recognizing that the names of species represent stages of continuous processes, which have no natural limiting dimensions, are confronted with a persistent and unsolved philosophical problem of how to use static symbols, to present elements of a virtual continuum. The time has arrived to face some of the semantic difficulties in natural science."

The second series of examples to dialectics in palaeontology is related to the problem typology versus phylogeny: commented quotation from palaeontologists: A. S. ROMER (1966, p. 4) writes:

" Two types of classification are possible - vertical or horizontal. Under the first system each family or other unit comprises all members of a known line from its first beginnings to its end or to modern times; the cleavages between lines is carried down to the very base of the evolutionary tree. But when, for example, forms are discovered seemingly ancestral to two families or closely to both, their inclusion in one or the other seems improper. Under such circumstances the best solution seems to be a horizontal cleavage, the erection of a stemgroup, including the base, from which the longlived later families have been derived." Compromise in science however is unfeasible. A taxon does not have more than one position in phylogeny and hence in phylogenetic systematics. To raise to a principle a makeshift-solution, does not lead to the solution of the problem, but to the creation of a multitude of pseudoproblems. The same author (1940, p. 181 writes: "Increasing inability to give precise group definitions is a sign of palaeontological progress." He wrote: "Given is the permanent increase of palaeontological documents." What Romer calls "palaeontological progress" is the increase in documents, which is but a function of the civilisation of the world. I think it legitimate to rewrite Romers's sentence thus: "The applicability of definitions to higher palaeontological taxa, is indirectly proportionate to the knowledge we have about them." With other words: Typological practice melts proportionate as palaeontological evidence increases. "Group-definitions" are a symptom of ignorance. G. G. Simpson writes regarding this problem, and I quote: "In a formal classification it is always necessary, to make a compromise between vertical (cladus) and horizontal (gradus) limitation of taxa." This is a suggestion, about as good as for a teacher to teach and write on thesis and antithesis and to claim credibility for both, by his auditory/ clients/ hearers. It testifies complete ignorance of dialectics, it propagates for convenience-sake and for conformisms-sake in science, where it does not belong. On p. 104 of his book "Life of the past" (1953), Simpson took an even more drastic position: "In case of such successive species or other units a continuous intergardation through time often exists from earlier to later species. Then a purely arbitrary line must be drawn between the earlier and the later species. ... It is like having a piece of string grading from blue at one end to green at the other. We decide to classify it into a blue piece and a green piece, and so we cut in the middle. We have separated bluer and greener parts which existed as realities, but the separation is arbitrary, and just where we made the cut one side is the same as the other."

It is necessary to test such statements for its contradictions. Simpson is convinced, that classification cannot express phylogeny. Classification can be based on phylogenetical evidence. This is obsolete (HENNIG 1966) - classification can express phylogeny!

It is untrue, as Romer and Simpson pertain, that any classification has to compromise between a horizontal and a vertical one. Taxa are not subjective and classification cannot be achieved by means of a compromise. A grade can only have justification in classification until it is replaced by one or several cladi. Between a compromise one is forced to incur by theoretical considerations and the expressed statement that this is a temporary makeshift, one has to distinguish. Simpson's ribbon, blue on one end and green on the other, is not a ribbon given to an important scientist. Simpson is subjected to a compulsary behaviour, he has to cut the ribbon. It is good thing that he does not instigate others, to use the scissors too. To say it quite plainly, I leave the ribbon intact. Those who like to cut, are welcome to do it, those who do not like to cut, will do so. Those who have marched the way into the future, will be revealed quite soon. Thus we start work and try to objectivate fossil taxa according to phylogenetical systematics wherever this is indicated or possible today. The evolutionary process is not a ribbon which has to be cut into bits. If Simpson would start to cut into two pieces a more valuable and more integrated object, for instance the Bayeux tapestry, he would be a vandal, whose criminal activities we would have to forestall. We have to part from traditional practice, we have to find out about its origin , and we have to ascertain its applicability today. If we come to the conclusion, to dispense with the old practice, this alone may mean progress in science.

It is conceivable that at a certain moment in the history of palaeontology, classification of fossils was the only essential task. Erik Stensiö and D. M. S. Watson have both produced an imposing work in which classification plays only a minor role.

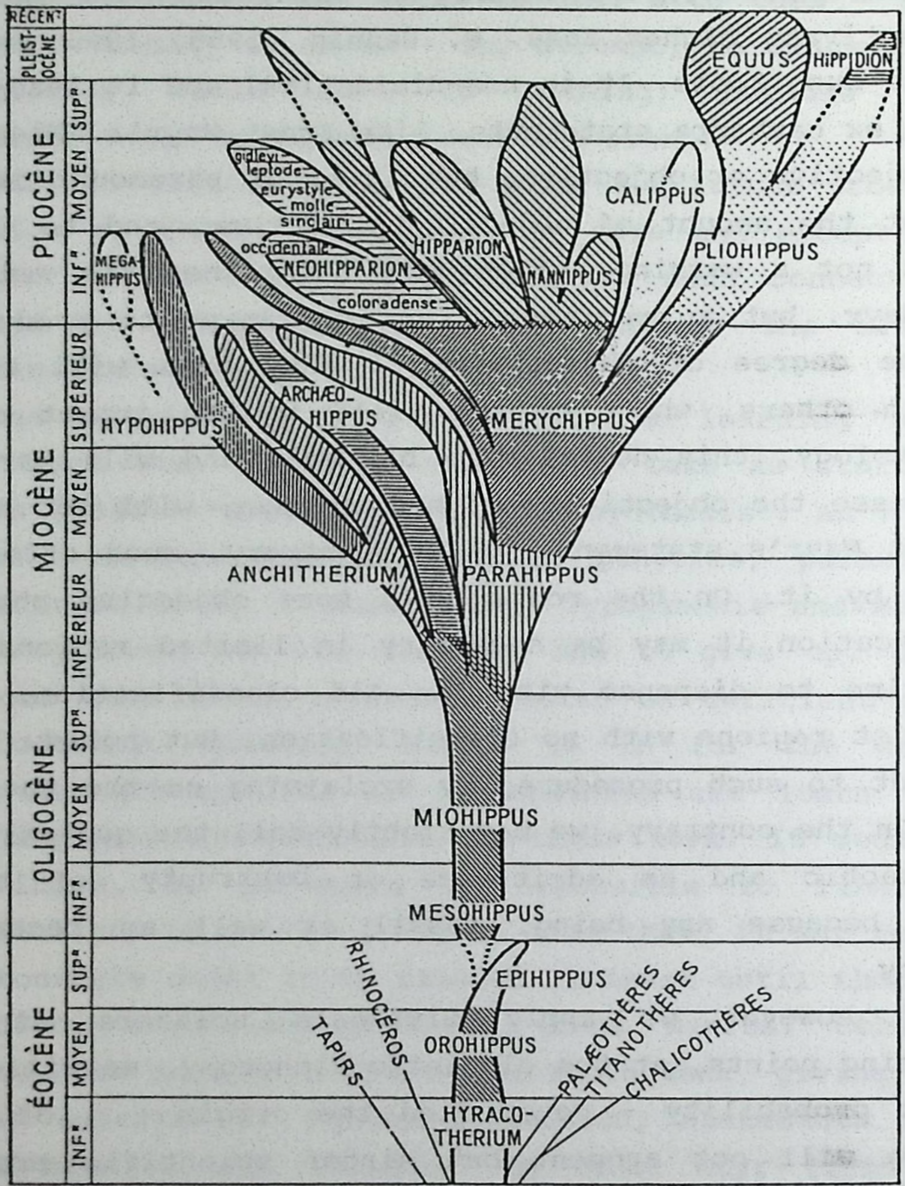
If all creatures once living would be available as fossils, and we would possess the tools to deal with them - and we would feel the necessity to do so - any attempt, to classify any fossil typologically would come to nothing, because phylogenetic systematics would be possible from the start.

What is written here is a model for future procedure. Today connection of fossil hypodigmata is more the exception than the rule. But to work on and to increase such connections is not augmented by compartment-formation, but by the elucidation of trends in lineages.

The well founded and large complex of learning "Neodarwinism" is now more than 40 years old, if we take as starting date J. Huxley's (1942): "Evolution, the new synthesis". As a result of a fruitful relation-formation between genetics, palaeontology and many other sciences, Grossmutation, Typogenesis and Macroevolution came to grieve. The old diehards had to give up. Often it was found out that their arguments rested on deficient evidence and anthropocentric thinking. Harder it is for the dissidents of today. The protagonists of neodarwinism are loath to tell us, where they see contradictions in their work. It would be a poor neodarwinism, if it would be impossible to find the innate contradictions of it. If I try to find them, it may be argued that such procedure ought to be stopped at least until the protagonists have died, acknowledging their great merits. Others, on the contrary, see in such activity meritable work, giving the premises and the material of future discussion, statements and results. "Animal species and evolution" by Ernst Mayr (1965) is one of those books, forestalling the desire to write another. If one has formulated a thought and is convinced that it is rather well formulated and in a new context giving new information , one will find it, better formulated, in Ernst Mayr's book. I had to read many pages and had to look rather hard, until I reached p. 437. From this page I quote: "The delimination and ranking of the higher systematic categories is essentially subjective and should not be made the basis of evolutionary theory." Here my comment: Obviously Ernst Mayr feels uneasy. Of course, if it would be true what Mayr asserts, his warning would be reasonable and a good one. But if the higher categories are "essentially subjective", what are the lower ones ? And if one sees objectivity only in the lower - the species - is it not a chaos if we can arrange them only on subjective criteria, into genera, families etc. ? But if Mayr's assertion is wrong, the warning is vain. But Mayr lacks a method to objectivate higher taxa. W. Hennig (1950, 1965 and 1966) has given us such tools. It is non-dialectical and it leads to nothing to make ex cathedra statements, like Ernst Mayr's. Higher taxa are not subjective or objective, but it is of paramount importance to find out the amount of objectivity of them, and to increase it. This is not a warning, which only underlines the self-esteem of Ernst Mayr, but a programme , an incitement to productive work. Soon the degree of objectivity of many taxa will be increased while in others, which do not yield to the impact of a modern palaeontology, this degree will be small and will hardly change. To increase the objectivity of higher taxa, will not be augmented by Ernst Mayr's statement. On the contrary, such efforts will be impeded by it. On the route to a more objective phylogenetical classification it may be necessary in limited regions and for a short time to dispense with the old classification. Then there will exist regions with no classification. But nobody has a right to object to such procedure, by exclaiming on the then impending chaos. On the contrary, we may rightly call the quotation of Ernst Mayr chaotic and an admittance of bankrupty of the Linnean system, because any being, fossil as well as recent has its phylogeny.

If however we apply Simpson's scissors at the most interesting points, at the cladistic dichotomy, we will - with the greatest probability - never find the origin of the higher taxa. We will not augment but hinder scientific progress (see chapter 4.4, *Watongia*).

The North American horse-lineage became known very early; the gaps in the fossil record are very small, the documentation is very good. Stirton's diagram of 1940 incorporates in it 25 genera. The transition between 6 genera is well documented, it is now available between *Miohippus* and *Parahippus*, *Merichippus* and *Hipparion*, *Anchitherium* and *Hypohippus*. Already in 1935 Colbert wrote (p. 155): "Moreover, careful studies of the Upper Tertiary genera of America have shown that *Hipparion* is pretty certainly derived from *Merychippus*. There is a gradual and perfect gradation in the teeth, skulls and skeletons from the advanced species of *Merychippus*, typical of the Upper Miocene into the most primitive species of *Hipparion*, typical of the lower Pliocene of



10 The phylogeny of horses (from Stirton 1940). Already there existed three zones, where the allocation of a new specimen to one taxon was impossible because the known evidence was continous between two taxa.

Northamerica. <u>This transition is in fact so well graded that the question of a dividing line between the genera assumes an academic aspect.</u>" What is an academic aspect ? Are there other aspects in the concepts of Colbert ? I am forced to interpret Colbert's statement: Colbert has gained the conviction that maintenance of the two generic names is only for formalism's sake. Optimistically he calls this formalism an "academic aspect". But according to the rules of nomenclature there is the obvious demand that any fossil has to have a species name and a generic name. If in the here mentioned cases such procedure is impossible, there exist three zones of contradiction: a fossil cannot be allocated unequivocally to one Linnean taxon. If in a system, the system-conforming procedure is inapplicable, there exists a system-breaking situation. Here is the antithesis to the Linnean system.

If I ask today palaeontologists, specialising in ammonites, whether the knowledge of ammonites tends to greater integration or to lesser one, the unequivocal answer will be, for greater integration. From a phylogenetical point of view, this will mean that taxa which previously existed, systematically isolated, are today phylogenetically connected by transitional forms. When yesterday a phylogenetical scheme was avoided because the evidence did not allow a reasonable statement, there may be today several and in due course it will have to be found out, which scheme of several incorporates the greatest amount of probability and is riddled with the smallest amount of contradiction.

That today's picture of the phylogenetical relationship of ammonites will be obsolete tomorrow, because of new discoveries, new interpretations and new tools, is implied.

Roland Brinkmann in 1929 and 1937 did research on species-formation in *Cosmoceras* and *Leymeriella*. He was very fastidious in respect to the characters of his material. The material had to have the following characters:

1. It had to come from a series of sediments of approximately 10^6 years duration. 2. The taxon to be considered, is uninterruptedly present in the choosen rock-series. 3. The rock-series can easily be subdivided; any division ought to contain more than 50 specimens which can be measured. 4. A fauna rich in specimens but poor in the number of taxa is preferred.

The palaeontologist notices that quite a number of characters are not required, which - generally - are very desirable and make together what is called "a good fauna". For instance good preservation, a fauna rich in taxa, the presence of young and of old specimens. The character "unidirectional morphological change" from the bottom to the top of the rock series is not required, as Brinkmann was convinced, that such a change would be revealed by his research, if his methods would be fit, to show it. This would not be the case if Brinkmann would have choosen a gastropod or a lamellibranchiate, both renowned for the slowness of their phylogenetical change. In 1937 Brinkmann demonstrates - though without quantification - the lineage from *Desmoceras keilhacki* to *Leymeriella tardefurcata*. Furthermore, Brinkmann (1937, Fig. 3) demonstrates the cladistic dichotomy of *Leymeriella schrammeni* into *Leymeriella akuticosta* on the one hand, and *Leymeriella schrammeni* into *Leymeriella tardefurcata* on the other.

As always, if a lineage gets worked at, and some elements of it have been known previously, the old taxonomy is in contradiction with the newly found evidence. Brinkmann (loc. cit., p. 15) writes: "As the zonal indicators are elements of a lineage, zones and subzones follow each other up the zone of *Leymeriella regularis*. Actually however they overlap, as the artificially created subspecies do occur for a distance side by side. This is so because it is impossible to reconciliate the application of genetical and of systematical principles of subdivision in a lineage with great variability. Though a population of a lineage is genetically homogenous, it has to be subdivided into several species and subspecies because of the considerable morphological difference due to variability."

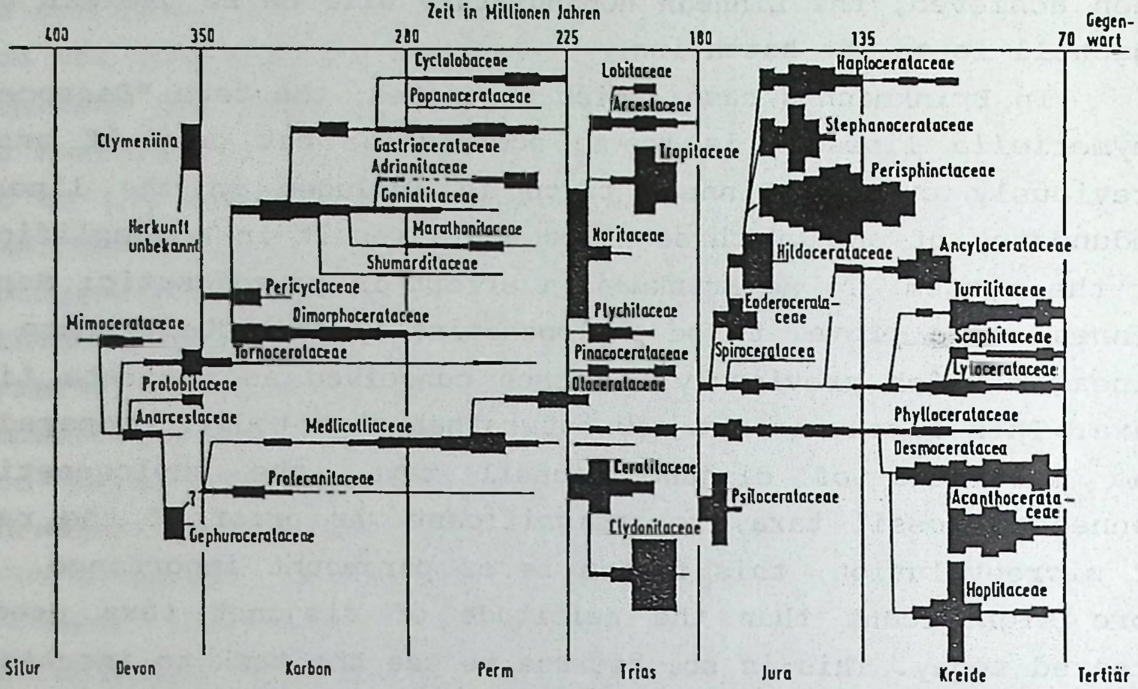
In 1937 it was compulsory for Brinkmann, to separate systematically extreme values of one population. I doubt this compulsion will be existing in future. I believe it is an essential biological statement to regard a fossil hypodigma as being a genetically homogenous unit which it is nonsensical to subdevide systematically, irrespective of the morphological difference of its members. Once, when 50% of the fossil taxa will be connected phylogenetically, the Linnean nomenclature of fossils will be discharged because its use is less than its abuse. Weigelt posthumously wrote in this context (1959, p. 235): "The Linnean species concept is useless in palaeontology."

To negate today the application of Linnean taxa in palaeontology is nonsense. All efforts however have to be centred on the task to increase the degree of integration of existing palaeontological taxa. When a certain degree of integration has been achieved, the Linnean nomenclature will be so useless as the eggshell is to the hatchling.

In Brinkmann's case, which we quoted, the term "*Desmoceras* - *Leymeriella* lineage" is to me acceptable; but only if another, previously created Linnean taxon is included in the lineage a redundancy of one of three names would result in a simplification of the system. To me Brinkmann's effort is paradigmatic: Separate Linnean taxa prove to be phylogenetically connected. There exist lineages which previously had been conceived as separate Linnean taxa. This factum is not new but rather rare today. Compared with the multitude of disjunct fossil taxa, the phylogenetically connected fossil taxa are insignificant. As proof of the reality of microevolution, this factum is of paramount importance. It is more significant than the multitude of disjunct taxa used and created today. This is so, because we see the task to increase the number of phylogenetically connected taxa, while we decrease the number of disjunct ones. Brinkmann's papers on *Cosmoceras* and *Leymeriella* have been followed by others. Fortunuately - from the point of view of the writer. Because if they would have been the only ones, one could still interprete the lineages of *Cosmoceras* and *Leymeriella* as exceptions to the general picture of ammonite-evolution or, as really prophetic papers in the sense of Mendel's *Pisum*-paper, which gained relevance only 40 years after publication, during the ringing in of modern genetics.

To conclude from Brinkmann's work on evolution and taxonomy I quote from him (1929, p. 231): "If it is intended to devide the phylogenetic multitude of a lineage into systematic units, this can be done only arbitrarily. It is irrelevant into how many parts the lineage is cut." It cannot be made out with all consequences and with all probability what Brinkmann meant with this confrontation. It might be a misinterpretation, if I point to Hamlet. After the *Leymeriella*-paper Brinkmann changed over to different subjects, which seemed to him more profitable. The same happened during the productive phase of Serge von Bubnoff and Hans Closs.

Sequel: To create a nova species in a recognized lineage is nonsense and leads to contradictions. If the moment of cladistic dichotomy has been found, the creation of a nova species is



11 The phylogeny of ammonites (from House 1963). Though each of the 44 taxa is depicted as related to another, parental one, the scheme does not permit a specimen to be put between two taxon. This typological scheme forces the author to put a specimen into one of the two.

indicated, even if the noticeable differences of the two cladi are minimal.

To keep to ammonites, I criticise now the "dendrogram" presented by House (1963). This drawing (Fig. 11) claims to depict the phylogenetic relationships of all 40 superorders (.....aceae) of ammonites. Between these 40 taxa there are hair-lines, almost horizontal, which intend to indicate the ancestral taxon from whence the daughter taxon originated, respectively where House expects its phylogenetical connection. The origin of Stephanocerataceae is - for instance - to be sought in the genus *Erycites* in the Hildocerataceae.

The evidence for origin of one taxon in another, is of course quite different: It is either lacking, it is a mere suspicion, a surmise, or it may be as well founded as in *Erycites* (mentioned: Vol. L, p. 267 in Treatise of Invertebrate Palaeontology). This cannot be expressed in House's drawing (Fig. 11). The presentation of the origin of taxa is quite formalistic. Due to theoretical considerations: "Any taxon has to have an ancestral one." Reality and its presentation in the drawing are in conflict. Continuity, Intergradation as phylogenetical connection are not presentable in House's drawing. What is the system like, which any ammonitologist has to adhere to; what is the legitimization of taxa, everybody is invited to "create" anew, provided he adheres to the rules of nomenclature.

I make use of two old established genera, *Aulacostephanus* and *Rasenia*. I cite Ziegler (1962, p. 8): "O. F. Geyer (1961) und B. Ziegler (1958, 1962) gilt das Auftreten eines glatten Externbandes als Unterscheidungsmerkmal zwischen der - mehrere Untergattungen umfassenden - Gattung *Rasenia* und *Aulacostephanus*." The long-time ago extinct ammonoids are helpless and cannot protest. There was no chance that a consensus would form on the issue. The two authors have - bona fide - decided what to do with nature, and for 20 years nobody has been wondering.

As the reader knows many more of such examples, the author does not like to offer more of them. The author does not regard the criticised phenomena , procedure etc. as scientific. In the quoted examples the author's use in a certain context, e. g. the adjective arbitrary, essentially subjective, academic etc. They live under the figment to divide when the criteria which prescribe division are no longer available. Such activity leads to a lost war, to a bankrupt business, to the breakdown of society, to a professor without audience and to a professorship marked down as not to be renewed. Is there another natural science as palaeontology, where obsolete subject matter is propagated without immediate punishment by withdrawal of funds?

The dentist, not using local anaestesia, has no patients, the palaeontologist teaching veritable nonsense, gets pensioned when reaching the age limit.

The older a nomenclatorial system is, the smaller are the gaps in the evidence and the greater are difficulties to "determine" a fossil. The demand, to determine nomenclatorially any fossil, breaks down, if we deal with a hypodigma of normal variability and this is brought into relation with a single holotypus. The selectivity depends on the amount of knowledge already available. For instance on the number of recognized homoeomorphs. Lineages can be subdivided only arbitrarily. Elements of a lineage can be determined neither vertically nor horizontally - in a hypodigma. Taxa above the species are subjective, unless they are located in a cladogram between two dichotomies. There are no obligatory or non-obligatory higher categories. The number of categories to be used, is the number of proven dichotomies.

3.6 Examples from evolution

If we try to recognize the Hegelian triad in nature, and keep to palaeontology, we have to rely on the interpretation of geological evidence. Our statements are conclusions, inferences, suppositions. According to the presently available consensus we do not find very simple evidence contradicting a very simple theory. In biological evolution dialectical features are not only exclusively historical but cannot be observed in the presence. They are also far more complicated than happenings of social evolution; distinctness, clarity will be lacking. The phase of dialectical formation of the antithesis, to a previously established theory is paralelled in biological evolution by the cladistic dichotomy. From it may derive the ecological replacement of a taxon. More frequently however is the extinction, if a taxon comes into contradiction with its "Umwelt". Extinction is the rule in face of the inability to realize dialectical change. Recent model-cases illuminate the historical processes: Analysis of a number of nematodes (OSCHE 1966), which, from a saprobal biotop, to an endoparasitic one, forming a series, give an analogy, to historic biological change. Osche finds (loc. cit. 1966, p. 121) terrestrial and endoparasitic nematodes. But besides those two groups, he finds the nematodes of the saprobal milieu, which live in cow-dung, in high temperatures and in an almost oxygene-free substrate.

The nematodes of the saprobal milieu are not only a plausible link between the two groups mentioned above. If one envisages the origin of endoparasitic nematodes, the nematodes of the saprobal milieu are an obligate link between the two groups. They pass the "Osche-door", they pass the anagenetical critical distance, the transition from quantity to quality.

The mangroove-dweller *Periophthalmus* gives us an example, how we may envisage the origin of the Devonian tetrapods. *Periophthalmus* is an inhabitant of the mangroove-zone of the old world, but he does not reach into the hinterland, owing to the presence of very able country-dwellers, living there since the Devonian; the country is no free space. The silurids and the eels are capable of a short sojourn on land.

Of many manifestations of the cladistic dichotomy, we bring here only the one, resulting from aromorphotic evolutionary change, enabling the bearer to live in a new biotope. The cladistic dichotomy resulting from ecological replacement, will be dealt with in chapter 5. The cladistic dichotomy has, as a presupposition the division of the genepool. The division can happen abiologically. We observe such divisions in disjunct distribution, for instance in *Limulus* or in *Tapirus*.

On the periphery of the region of the genepool, biological or a-biological division of the genepool can happen. If the genepool belongs to a partly subterraneous or terrestrial taxon, then the underwood is the periphery of the biotope. The evolution of a muscle-and-bone apparatus, allowing the movement in the vertical in both directions and the long jump, may be instrumental to the division of the genepool. Thus a taxon has evaded its terrestrial enemies. During this process, the organ for protection, defence, flight and perception being functionless, can be reduced (this is Ideoadaptation) or - more rarely - can find a new function ("Funktionswechsel"). The physical and the psychic condition of the semiarboricole part of the taxon, does not fulfill in all respects the demands of arboricole life. It moves in smallest steps to an equilibrium. As the taxon evades its terrestrial enemies, it exposes itself to the arboricole enemies. Success or failure of the new semiarboricole subtaxon will depend on the historical situation, where and when it evolves and the possibilities of change, it can offer. Change of the way of life may bring into existence a minute discrepancy between reality and possibility. The terrestrial heritage inhibits the achievement of full arboricoly. The taxon lives in a condition of tension and reacts with phyletical change. In our example, starting from Triassic, terrestrial, insectivorous, nocturnal forms, the arboricole condition is reached by forms like *Loris*, *Nyeticebus* and *Perodicticus*, inhabitants of the highest realms of the virgin forest, slowly moving, climbing, frugivorous and insectivorous, diurnal.

The origin of mammals from therapsids has already been dealt with. The change of the dentition during 250 x 10^6 years, is today pretty well known. Higher metabolic rate and homeothermy go subsequent with change of teeth and dentition, resulting in chewing. The reptilian swallowing is past ., is no longer in existance. Drastic reduction of tooth-substance during the change from polyphyodonty to diphyodonty and additional consume of tooth-substance per time unit are the price for chewing and the conditions for lactation. The unavoidable consequence of the origination of mammalian life, is the small size - less than 1.5 kg weight -, and the short length of life, being annual during 100 million years.

The further consequences of large or even gigantic size can be envisaged: no digital toilet because of hooves. Increase of size, no longer subterraneous protection - the largest digger is *Orycteropus* -, no climbing, no jumping; and drastic reduction of the number of the young ones and density of inhabitants in a unit of space.

Dialectically are coupled the homeothermy with the fur, the fur with the toilet function, the toilet function with the toilet organs, the change to social toilet when toes become hooves, or to automatic toilet. Toilet being only one example, where the interdependence is obvious.

The consequently evolving contradictions are consequently solved by dialectical change - or the contradiction cannot be resolved and extinction follows.

The change in social or biological evolution happens, where the expense is least, the minimal parameters are involved and where a similar situation is realized several times, soon after another. The chances of iteration are given and a first occasion being unsuccessful, can be followed by a successful one.

Our example of the evolving arboricoly of the mammals is historical. The potentiality to become arboricole exists until this status is achieved. Later a similar step in respect to physiology, anatomy and morphology is doomed because this step does not open a free biotope, but one, already inhabited.

The origin of the tetrapods is limited to a linear biotope, the shore of waterbodies, not well oxygenated, rich in rotting vegetation. Here the lung is a requirement of aquatic existance.

Tetrapody (ROMER 1957) allows originally the transfer from one waterbody to another, nocturnal and on wet lowland. Subsequently the connection with water vanes and with amnion and allontois even reproduction can be realized outside the water. Dustfilters are only developed, when locomotion allows the visit of dry country. The same applies to an axial skeleton, carrying the body above the substrate.

Homeothermy is the key to mammalian genesis. The existance of the marsupial bone in all mammals but the placentals suggests ovipary and maternal care for the young. The timespan from egglaying to independence from paternal care is passed in a den. Mesozoic mammals live temporarily subterraneously. The den isolates the inhabitants from high temperatures, enabling incubation; increased breeding temperature of the female is the consequence of a well protected, isolated kindbed. Life in the dark den allows microphthalmy, nocturnal foraging is indicated. The incubation warmth of the mother allows nocturnal foraging, no torpor limits her nightly visits. This is the case with all reptilian mammal-enemies and is an essential condition, allowing the inhabitation of the uninhabited niche of the nocturnal ground of virgin-forest - as soon as homeothermy is homozygous in both sexes.

The hypodigma of *Oligokyphus* from Somerset (KÜHNE 1956, p. 82, 87, 112) is in accord with these ideas. Juvenile elements are so rare, that this fact suggests the stay of the juveniles in the den. Such is the case with *Ornithorhynchus*. The young leave the den four months old.

3.7 Typology of the innovator

Dealing with dialectics of evolution and evolutionary science, a discourse on active persons is germane. If we see our task in the display of a dialectical phenomenon, the initiators have to be pictured: the initiator, the revolutionary and the resisting conservative. Both are likewise engaged in the historical process of change.

Fuhlrott and Virchow: Johannes Carl Fuhlrott (1804 - 1877) identified a skeleton of a hominid as a Pleistocene man. The skeleton was found in an opened cave-filling in a Devonian limestone quarry, in the Neandertal near Düsseldorf. Virchow, asked to state his opinion, regarded the Neanderthaler, as the skeleton of a male, old aged and a member of a family-group, more civilized than nomad or hunter, and certainly not of Pleistocene age.

Mendel and Nägeli: The chances of Mendel receiving recognition for his botanical papers during his lifetime were minimal. Mendel's biographer, H. Iltis (1942) delivers a picture of a youth, growing up in utter poverty, talented in only a few subjects, that is, he miserably failed in many subjects. Working as a mature cleric in complete isolation, accepting his election as prior as a godsend, which brings him into not ending conflicts and divides him entirely from botany, where he excelled.

Nägeli - as everybody else - does not understand Mendel's paper "Versuche über Pflanzenhybriden", but recognizes the quality of Mendel's experimental skill; this alone he tries to use to himself. He is engaged with the problem of reproduction of the composite *Hieracium*, a case of contradiction in the Linnean system. Only 30 years later, the apogamy of *Hieracium* is discovered, which solves the problem. Nägeli did not solve the problem, not even with the help of Mendel. But for Mendel, his experiences with *Hieracium*, could only lead to the conviction, that the rules, he derived from the hybridisation of *Pisum* were, for the second example, not confirmed.

The life of Mendel shows exemplarily that an antithesis - here the proof of the material nature of heredity - only in the small timespan of about 10 years, brings fruit to its author. If the antithesis is formulated earlier, nobody understands the new ideas, if the antithesis is 10 years later, it is commune bonum, the thesis of today.

To uphold the antithesis is life endangering, or at least detrimental for one's career, especially if vested interests or ideologies are involved.

The work of Copernicus was published posthumously. Giordano Bruno becomes victim of the inquisition. Semmelweis succumbs to the Viennese medical clan. Schleich is ostracised by the congress of surgeons in 1892. To formulate the antithesis, it is not necessary to refute all statements regarding the thesis. D. M. S. Watson (1953) outlining the evolution of the organ of hearing, proves that macroevolution does not have any part in it. To him this proof is sufficient, to regard macroevolution as an artefact. All cases of so called macroevolution are interpretations based on lacking evidence. Any living organ has to change - to develop - while fully functioning, that means evolution of a synorgan takes place in smallest steps.

T. S. Kuhn (1962, p. 89) notices that theory-breakers and innovators are only those who are either young or new in the respective science. For both is the same valid: they observe the contradiction in one, or in a few cases and this is for them sufficient to formulate the antithesis. The antithesis is not formed by accumulation but by change of principle. We can call the change of principle the "Andersen-effect". H. Ch. Andersen in his fairy-tale "The King's new robes", describes a gang which suggests to the King and his court, that they produce good robes for the King. The gang however receives the money for his presumptive work, does not a stroke and spreads the story, that the new robes of the King can be seen only by the "illuminated". As everybody will belong to the illuminated, everybody "sees" the new robes.At a festivity, the King presents himself to the public in the new robes - in fact in his underwear. Only a little one exclaims: "But the King wears only his underwear!" With these words the taboo is broken, the King disappears, to dress himself properly, the gang flies. The child does not know the social taboos of his society and breaks them at the first occasion. The taboo is so weak to break down at the first occasion.

Whenever the discussion leads to a substitution of the old by the new, the dialectical process leads to brutality. Both opponents arrive at a tragic situation: The theory-breaker finds himself in front of an unpenetrable phalanx of massive resistance, and dispairs. During his lifetime his achievements do not gain social relevance. But Mendel and Semmelweis are not more deplorable than the authority. Asked for a judgement, it is incapable for a just judgement and may have retrospectively an insight to the perniciousness of it. In both cases the dark-zone is enormous, but larger for the latter. The lesson from this discourse: The theory-breaker, an "oppositional", a "non-conformist", has to try, to conform with society on some parameters, to be accepted. The authority has to entertain greatest tolerance and has to act according to the rule in-dubio-pro-reo. In face of the NEW, there cannot exist an authority, this has the juror to accept.

In the next case, the authority has an even greater responsibility. I refer to a case, where the theory-breaker does not realize the relevance of his work. This is frequently so. The formulation of the antithesis requires quite a different character, than the application, the realization of it. Rarely one and the same person are fit to fulfill both functions.

Example: Photoelectrical ore dressing was developed by Sortex Ltd., London, after great successes with fruits and seeds. The research work has an aim, to deal with larger grainsizes at greater velocity, that is, to increase the passage of ore-weight. By sorting according to colour-differences, of gypsum, calcite, baryte and quarz, the efforts by Sortex-research are of greatest relevance. In some cases, the most modern procedure - photoelectric ore dressing - came to substitute even the most ancient procedure: handpicking. I approached Sortex, to take on the sorting of small samples of minerals, containing microvertebrates. Speed would be negligible, size would be required down to 0.5 mm and selectivity of the highest order would be required. A 1 1/2 page paper went into print in the Proceedings of the Geological Society of London. But the editor deleted the three sentences of methodological relevance, which I bring here: "Once more this is a case where the new method did not realize inside the main field but at its periphery, that is, where system-immanent resistance is at a minimum. Microvertebrate palaeontology is for practical purposes an insignificant part of micropalaeontology. The introduction of photoelectric separation is however initiated here, because the costs of handpicking make here a considerable part of total expenses, while in industrial micropalaeontology these costs are insignificant." This example illustrates the aversion to think in the abstract in geosciences. The red pencil of the editor transformed the case into an isolated one, to a "discovery" instead of into a model-case.

3.8 Routine and association

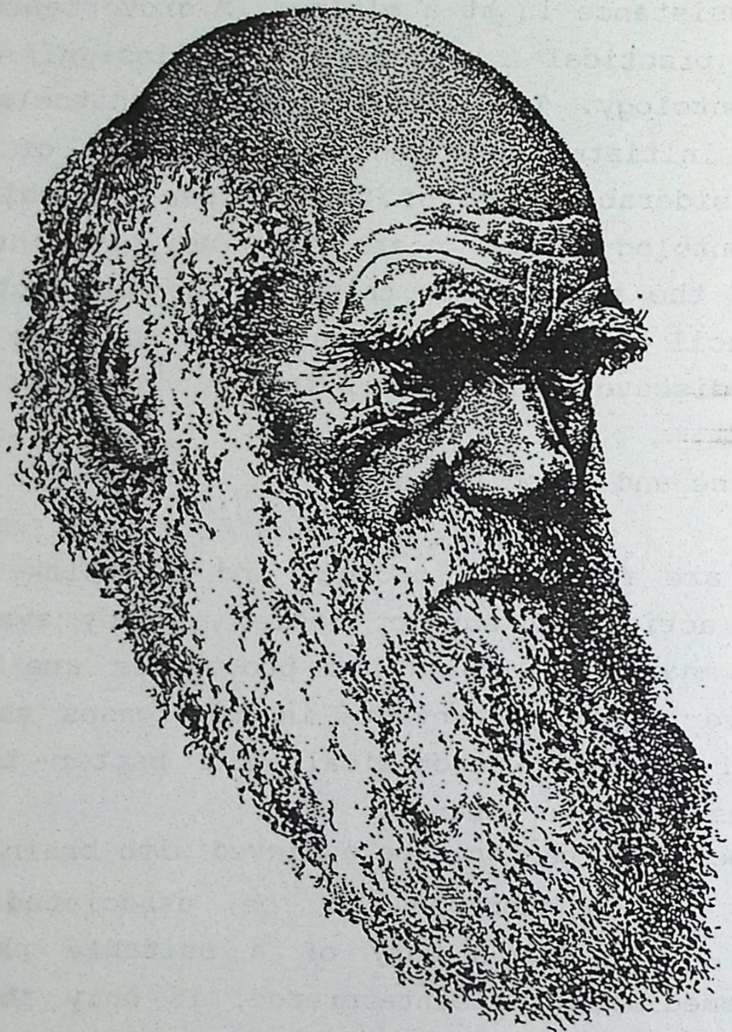
Both are means, to produce and to think economically, to bring into action all subject matter already available. They are auxiliary means, no scientific procedures are possible without them. However, routine prevents in many cases the application of the optimal method. Uneconomical, but better is the choice of procedure as the case demands.

Association can only be achieved with brain content already available. The phenomenon to be associated is identified immediately, with the memory of a suitable phenomenon. It is however, immediatedly misinterpreted, if only the wrong template is available in the memory. The really new has nothing to be associated with.

In 1954, I see in the Pyrenees eggs of dinosaurs. I associate them with algal concretions! The only character of both is their spherical form. In my first term, 1930, I see in the Muschelkalk of Rüdersdorf upright conical objects - I associate the stylolites with - belemnites!

3.9 Test-cases I: Haldane's *Equus*, Darwin's *Voluta*, Torell's Rüdersdorf, the Ries

1. I had the great fortune, to work on the same floor with J. B. S. Haldane at University College, London. Easily, he produced examples, drastical and to the point. As an excellent test-case of theory-breaking evidence in palaeontology, he spoke about his colleague D. M. S. Watson: "A genuine *Equus caballus*, fossilized in the coal-measures would be instrumental to drive D. M. S.



12 Charles Darwin (1809 - 1887). The Founder of Evolution-theory.

Watson to commit suicide." With other words: A single fossil would falsify stratigraphy as a well founded empirical science, would falsify the lifework of his colleague. It would even be instrumental to discuss anew all biological theory - if it would happen.

2. The student Charles Darwin in 1831 is visited at his father's home in Shrewsbury , Shropshire, by Prof. Sedgwick. I cite from Darwin's autobiography (my retranslation from the German): Darwin: "A short talk, I had with him, made a big impression. Visiting a gravel pit near Shrewsbury, a worker told me, having found a large slightly worn *Voluta*, a tropical gastropod. As he was not willing, to sell the specimen to me, I was convinced, the shell being actually found by him in the pit. Recalling these facts to Sedgwick, he replied - doubtless correctly - the specimen must have been thrown into the pit, quite recently. He added, if this *Voluta* would have been genuinely embedded in the Pleistocene gravel, it would be the greatest misfortune to geology, as it would falsify all theory on the Pleistocene. These gravels belong to the Pleistocene, and in later years I did find in them broken arctic lamellibranchiates. I was at that time of Sedgwick's visit surprised that he was not enchanted by hearing of a tropical *Voluta* near the surface in the middle of England.

Nothing but this *Voluta* brought home to me the fact, that science means synthesizing facts to derive from them general conclusions."

If quite recently a complicated and controversial complex of evidence has found a satisfying theory, the upholder of this theory does not like at all a spanner in the works. Hence the amazement of Sedgwick and the immediate denial of the validity of the evidence, as there was no proof about the provenance of the *Voluta*, but only hearsay.

3. In the early 19th century, the sediments of the north European lowlands had been problematical. I cite from K. Gripp (1964): "from 1835 onwards, the drift-theory of Charles Lyell was regarded as valid in respect to the origin of the youngest sediments of the North European plain. Lyell visited Denmark and northern Germany. The distribution of sand and gravel

there, and the presence of marine molluscs in them, convinced Lyell that Scandinavia was ice-covered, the southern foreland however being covered by the sea, the melting Skandinavian icebergs had deposited their moraine-material. But on November 3rd, 1875, the Lutine-bell rung for Lyell's drift-theory. This day, the Swedish zoologist, geologist and arctic researcher O. M. Torell lectured in Berlin on the glacial deposits around Berlin. The Berlin geologist Berendt had shown to him the same morning glacial striae on the Triassic limestone of Rüdersdorf, 30 km east of Berlin. Hence an inland glaciation had covered northern Germany at least down to Berlin. Torell had experience with glaciers on rock as well as on soft ground. Hence he was qualified to interpret the North European sands and gravels as deposits of an inland glaciation." The less a theory is based on real facts, the easier it is to refute it.

4. During 200 years the Ries in Bavaria was an enigma and many authors produced many theories about its origin. In 1961 the two Americans Shoemaker and Chao visited the Ries; they found impact-structures and impact-minerals and left, leaving a short manuscript. The Ries is an impact-crater created by a meteorite. The Ries problem was solved.

3.10 Test-cases II: Refutation of unproven assertions

A special case of Hegel's triad, being frequently encountered in geological science, is the refutation of wrong assertions, based on lack of evidence. Negative evidence can be valid only after a long time of vain effort, to produce positive evidence. The said assertions are however generally issued at the beginning of relevant research. G. Cuvier: "L'espece humaine n'existait point dans les pays oú se decouvrent les ossements fossiles, á l'epoque des révolutions qui ont enfuiser os." - "Amber arthropods do occur only in the Baltic." - "Small tetrapods are lacking in the Jurassic and in the Cretaceous." - "Ossiferous Karst-fissures do exist only in the Tertiary."

This and similar statements result from lack of effort, to go and to collect. Or to a statement of lack of the mentioned comodities, before relevant research has begun. Such assertions provoke their refutation. The refutation has the advantage, to be factual, to be irrefutable, being based on material evidence.

3.11 Conclusion

The subsequent steps of the formulation of the antithesis are the following:

1. Observations: observations of a contradiction. There is evidence, not in accord with the ruling theory.

2. Play: Informal, as a hypothesis, as an experiment, a statement gets formulated, which includes exceptions from the ruling theory. A small radical minority are the functionaries of this play. As fools, they can claim fools-freedom, as youths they can claim child's protection, as seniles they are unassailable.

3. In small peripheral regions, one allows the application of the antithesis. The number of acknowledged exceptions grows. The number of persons - in accord with the antithesis grows.

4. Coexistance: Old, established ones, authorities uphold the thesis, the representatives of the antithesis are numerous. The antithesis is applied in practice. Representatives of the antithesis receive honorary doctorates and medals.

5. Victory: The upholders of the thesis have died. Perseverance is the main feature, demanded by the protagonists of the antithesis. Only rarely is the antithesis immediately accepted.

4 Quantity and quality

4.1 Dialectic-materialistic theorem

If quantity changes continuously, new qualities appear abruptly

4.2 My teacher Johannes Weigelt taught a sequence of increasing value of palaeontological material. The sequence reads: New - Good - Much. If a fossil is new to science, this would be a subjective statement, as a higher taxon would doubtless be available to enclose this novum. The description of a nova species would be, to a not negligible amount, symptom to the authors puerile mind. Such authors would entertain the opinion, to raise their prestige, by creating as many nova taxa as possible. Weigelt's opinion on the creation of nova taxa was very critical. In the process of creating a new species only pettifogging obtained, which by certain other palaeontologists was, regarded as "obligate". This would be from begin to end formalism and had nothing to do with the biology of fossils or the history of life. A good fossil would yield more information than merely a new one. Hence it would be better. But the anecdotical nature of even a good but single fossil would be borne out. The specimen of *Xenusion auerswaldae* yields only fragmentary and deficient information, which is innate to it. Only if a fossil in great numbers is available, if the n of in hypodigm is at least binumeral, it would suffice Weigelt's demands. Only such material would allow to apply all techniques, all processes, to gain relevant data. Only such material would allow to assess the variability, the ontogenetic growth, sexual dimorphism, habitus. ecology. Without such results, palaeontological work, on the respective taxon, would be senseless, it would be an activity not to be taken seriously by society. To arrive at a phylogenetical statement, only a great number of specimens would be adequate.

4.3 Conditions of material, phylogenetically interpretable

Since 1859, when Darwin's origin of species appeared, it is usual in palaeontology, to describe and to arrange the material phylogenetically. It is obvious, such an attempt does not yield a genealogy or even a herdbook of the past. For instance: To get for each million of years of the Jurassic and the Cretaceous material of the Mammalia, 80 localities from different stratigraphical levels would be required, but we have at present about 20 localities from 12 levels.

To base our phylogenetic statement on the evidence from all continents, the minimal number of 80 localities had to be multiplied by 5. If, since the discovery of the first locality of Mesozoic mammals - about 1850 - new methods had been invented, they would have to be applied on all locations, previously discovered. Only such step would safeguard, that rare faunal components, having evaded the first exploiters of the locality, could be collected, thereby improving the ratio of salvaged specimens to the unknown number of those actually being present at the locality.

Phylogeny means, to construct, to postulate the most intimate relation between fossil and recent - or amongst fossil beings, viz. the genetical relation. In systematics, however, the palaeontologist proceeds, up to now, typological, basing his written statements on morphological resemblance and the Linnean system of static, God-created taxa.

If we embark on the task of creating phylogenetic relations between taxa, the origination of one taxon from another has not only to be discussed, but the system has to be fit, to allow the expression of phylogenetic relationship. But already in 1943 Weigelt wrote: "The Linnean species-concept cannot be applied in palaeontology". Measured according to this sentence, the present practice in paleontology is "neanderthaloid". The lists of synonyms grow in length, the search for lectotypes requires more and more time, while the old holotypes get more and more unavailable, due to loss, destruction and decay. Thus the palaeontologists get more and more similar to Jonathan Swift's "scientists", see "Gullivers Travel" third part, chapter 5. The Cynic Swift, canon in Dublin cathedral, castigates his society. In "Gullivers Travels" "Scientists" have found out, that talking shortends ones life. Hence, in order to communicate, they load themselves with a great number of cards, being written with all required concepts - and with a great number of objects - up to capacity. They communicate by showing each other cards and objects.

If we set the task, to arrive at a phylogenetic statement the material has to allow it. A comparison will illustrate the case. Through about 10 million years, we compare a larger taxon with a film. We notice the essential dissimilarity of the dendrogram from palaeontology and the film. In the dendrogram a number of dichotomies, similar to the branching of a river in his delta, produce from one lineage, two independent ones. The film however, shows an uniform run from beginning to end, without dichotomies. The different actions of different actors can only realize one after the other, not beside each other. The film consists of a sequence of frames; for the dendrogram, a larger or smaller number of samples are available, Simpson's hypodigm . A hypodigm compares, with reservation, to a portion of a recent population, that is representative of one taxon in a time-moment. The smallest hypodigm consists of a fraction of one; for instance it contains of one tooth, one conodont, or one spine of an echinoderm.

The minimum representing a film is one frame. This single frame does not inform on the course, the run of the film but only on the subject matter of it. To reveal unequivocally the action, the plot of this film, I estimate about 1000 frames to be necessary.

To construct through 10 million years the dendrogram of a larger taxon, the required material does not exist, when the collection of the material begins. The minimum of one specimen, allows a static statement about the essence of this specimen. If, at a later time the hypodigm has an n of 200, qualitative and quantitative variation can be extracted from it. This hypodigma cannot be identified with the first described, single specimen. If numerous hypodigms are available from one region in stratigraphical order, a number of cladistic dichotomies can be determined, down to the million of years, when this happens. In other cases - by extrapolation - the time of cladistic dichotomies can be ascertained. Statements on the evolutionary course of the taxon between the two dichotomies would be possible. With increase of material, the degree of resolution would grow, until the taxon's phylogenetic fate in time is determined. Further addition of material might allow statements on the taxon, where, at the beginning of the research, nothing was known.

From the single specimen to the n hypodigm , the difficulties and the expenses mount. To procure numerous hypodigma of minimal size is easy in palaeontology, it realizes early , and often in the history of palaeontology, but procuring the maximum of a taxon's lineage is rarely done, is slow and late in the history of this science. Hence, at the material minimum, with the degree of integration at a minimum, typological description can apply without creating at once contradictions. Thus the area where typological systematics creates only contradictions are small and their numbers are small. However, they are present and their number mounts, absolutely and relatively. Thus, the field where phylogenetic systematics is applied is the micropalaeontology where great abundance applies and subjective statements are immediately proved by the practical application. Proof that this is actually the case is given by the dispense with so-called obligatory nomenclatorial categories. "Georgsdorf III, 22. VII. 1939" is more fitting micropalaeontological practice than "*Pseudoflabellina* cf. *atavus* (Müller) nec Schulze". Before typologists begin to reflect the evidence, the palaeontological practice is established: Wherever it is feasible, lineages or short distances of lineages are used for stratigraphical determination. The reason: They are more often available than reliable "guide fossils", and the degree of resolution is better.

Micropalaeontological practice uses suitable objects. To try to prove lineages, was executed already before 1870 by Waagen on slavonian *Viviparus*.

Macropalaeontology depends on numbers of specimens infinitisimal smaller than the number in micropalaeontology being the rule. The number of hypodigms may be considerable in macropalaeontology but lacking are series of hypodigms in stratigraphical sequence, as they are available from drilling chips or from drilling cores.

We can observe: From the single element, e. g. isolated spines, scales etc. to the complete fossil, to the hypodigma and to the lineage, the effort to procure it rises. But as n enlarges, the integration mounts, viz. the degree of temporal, spatial and phylogenetic relationships. The revolution in palaeontology, the formation of the antithesis phylogeny contra typology happens before our eyes and in our profession. A threshold is passed in a sector of palaeontology, the old principle of order gets useless and new, unexpected statements become real.

4.4 Description of the lineage of *Gaudryina*

The inestimable psychological advantage of micropalaeontological practice is the fact, that of the material of any taxon large numbers are generally available.

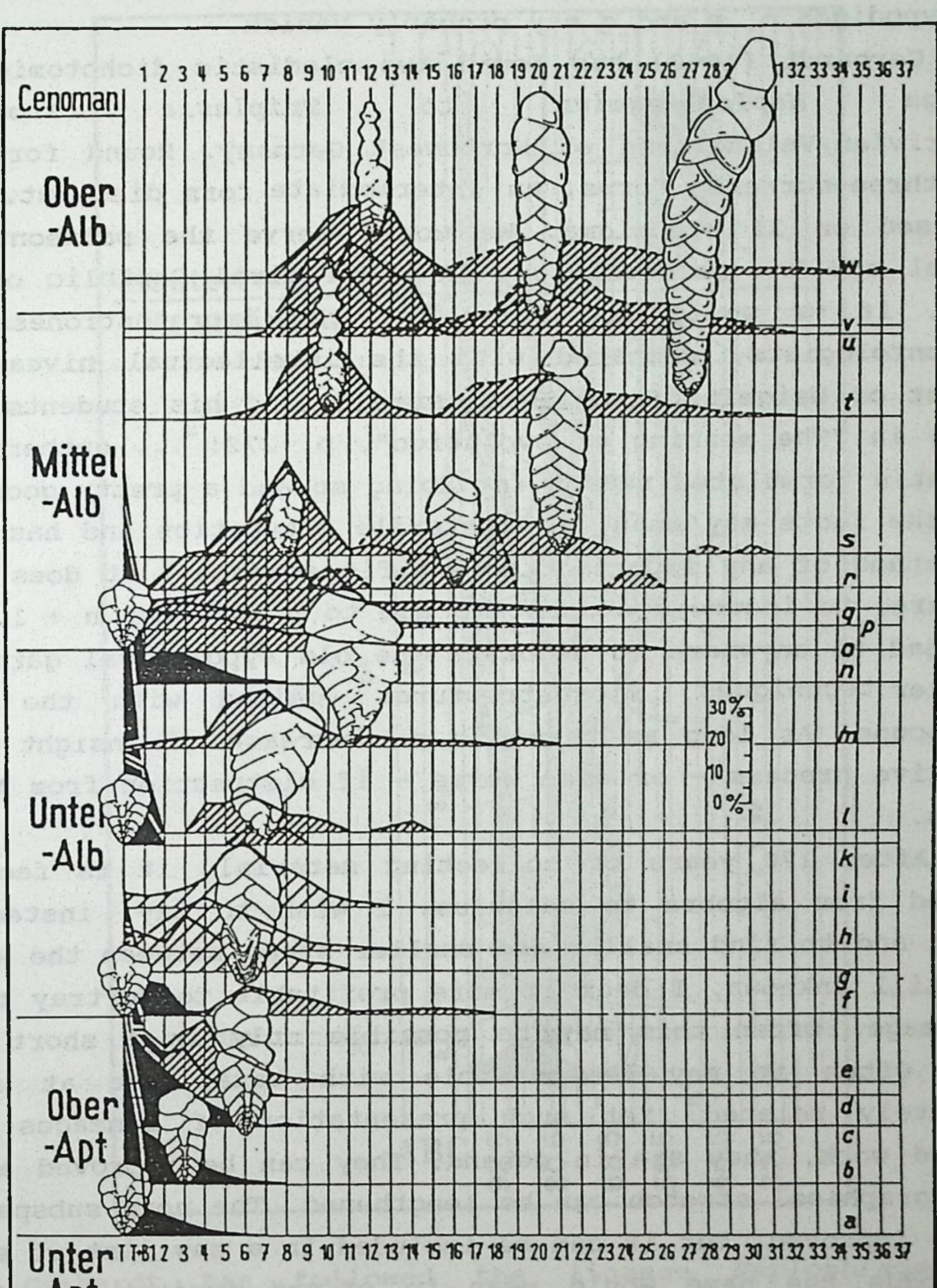
A single specimen is never collected, observed and described, but a polymorph hypodigm with variation. Simple objects, fossils, where few parameters undergo numerical change, easily observed and measured are subject of the first lineage research. The evolution which has been shown by Grabert (1959) in 17000 specimens from 22 hypodigms of *Gaudryina* is maintained in two parameters:

1. Increase in two-lined cells, decrease in three-lined cells.
2. Increase in size.

The paper by Grabert - her doctoral thesis - displays those traits of classical work, which lead an idea to acceptance. The basis is the analysis of simple, numeric characters. Genetics, in 1865, or in 1900 is initiated with the inheritance of *Pisum*. Trivial characters are subject matter of the analysis, round or wrinkled seeds, red or white flowers. They are those characters, which in a non-analytical approach, remain unobserved or are neglected. Mendel and Grabert deal with quantitative manifestations of simple characters in time. Mendel studies the parent-, the F1- and the F2-generation of *Pisum*. Grabert studies the lineage of *Gaudryina* within 7 million years.

Mendel does not observe or describe greater or smaller similarities, and the part of Grabert's paper, containing boring and practically useless "description", does not contribute to Grabert's achievements, but it is lip-service to the referees of her thesis, which were unable to see the evident value, this piece of work represents.

We would not serve B. Grabert and the initiator of her work, Franz Bettenstaedt, well, if we did not point out the weaknesses of her work: Material of Grabert's work derives from the north west of the Federal Republic of Germany. Hence it is a small segment of the world history of the genus. It is to be expected, that the world history of *Gaudryina* will show a more complicated



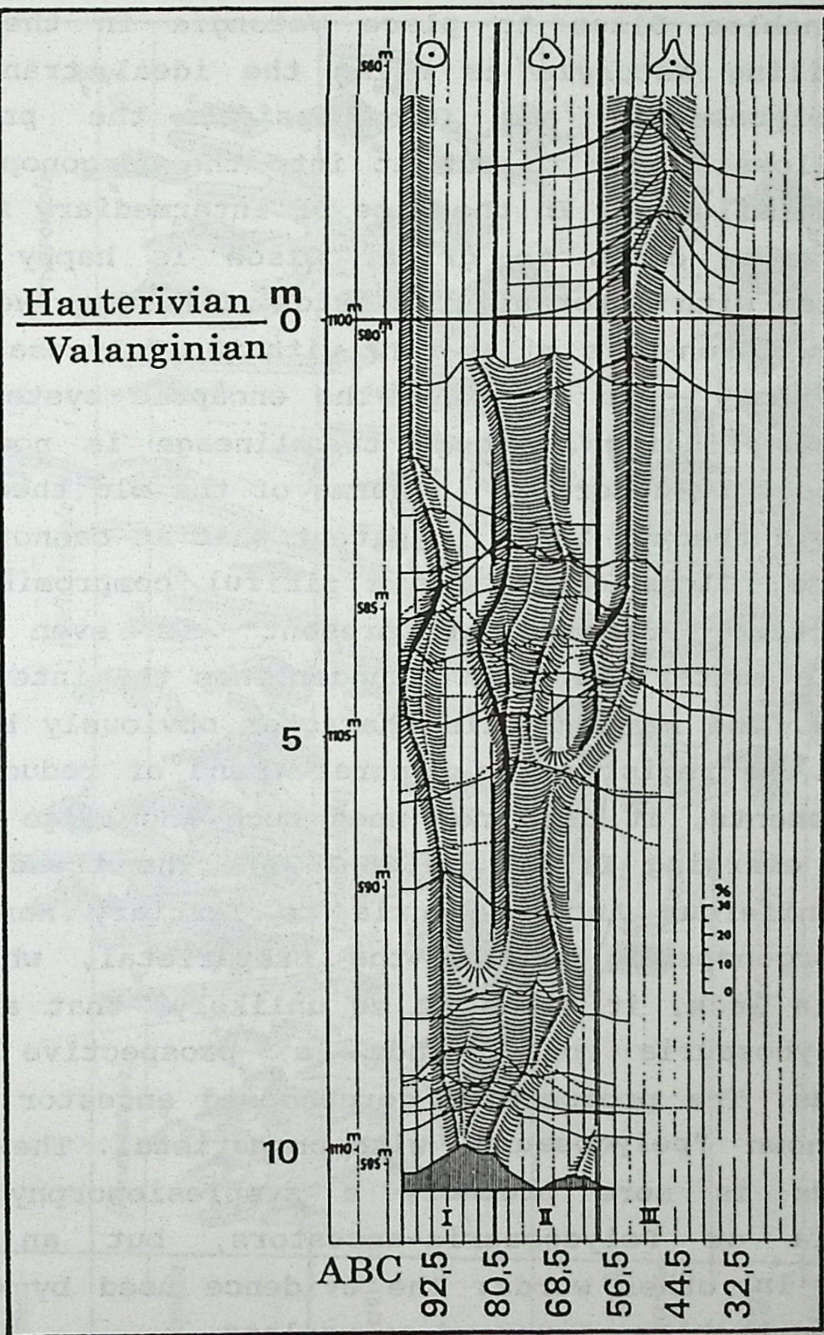
13 In the West German Lower Cretaceous, the lineage of *Gaudryina* to *Spiroplectinata* lasts 7 million years. B. Graberts work was based on 22 hypodigms and 18000 specimens. Each hypodigm is put into a horizontal system of 37 units, of the number of two-lined cells. Black are hypodigms which do contain also entirely three-lined cells. The youngest hypodigm with three-lined cells is "n" from the uppermost Lower Albian.

picture than the northwest-german one. The extreme variability of the hypodigms o, p and q may probably vanish.

Gerhardt (1963) has found two cladistic dichotomies in the lineage *Haplophragmium* to *Triplasia* from the Hauterivian/Valanginian of Northwest Germany. Round forms change into three-cornered forms, an intermediate form dies out. The work is based on 31 hypodigma. We would serve the palaeontology in general and the palaeontology in the Federal Republic of Germany badly, if we would not point out the impretentioness of the palaeontologists, compared with the intellectual niveau of the student of Weigelt, Franz Bettenstaedt, and his students. Simpson (1950) in "The meaning of evolution", p. 272: "... gathering facts without a formulated reason for doing so and a pretty good idea to what the facts may mean, is a sterile occupation and has not been the method of any important scientific advance." It does not lead anywhere, to induce a student to add to n taxa the n + 1. It does not lead to anywhere to decorate the old typological garment with computer techniques, microstructures gained with the electron microscope. As long as there is no increase of insight into the evolutive process - or even worse - if distraction from this task ensues.

After 170 years of collecting material, it is feasible to proceed from algebra to calculus. I wish to say, instead of to search and to find smaller and smaller steps between the known and the still unknown, I deem it more profitable to portray trends in a lineage. Often this may be possible only in a short span of time. Often it may be possible with taxa, not at all very intimately related. Yet such presentation of lineages is the desired work, they are in demand. They can be improved and their stratigraphical stretch can be lengthened. The nova subspecies can not be improved, but it can be included in a new list of synonyma; to subdue the name would mean to offend against the "code of honour" of the palaeontologists - until the pseudolegalistic pettifogging demands more work than the presentation of the history of life in geological time and finally, palaeontology dies on its own contradictions - like the scholastic.

A warning example: Olson (1974), p. 36, describes from the American Upper Permian the tetrapod *Watongia*, an intermediary between Pelycosauria and Gorgonopsida. The only gorgonopsid apomorphy is described by Olson. It is lacking in the older

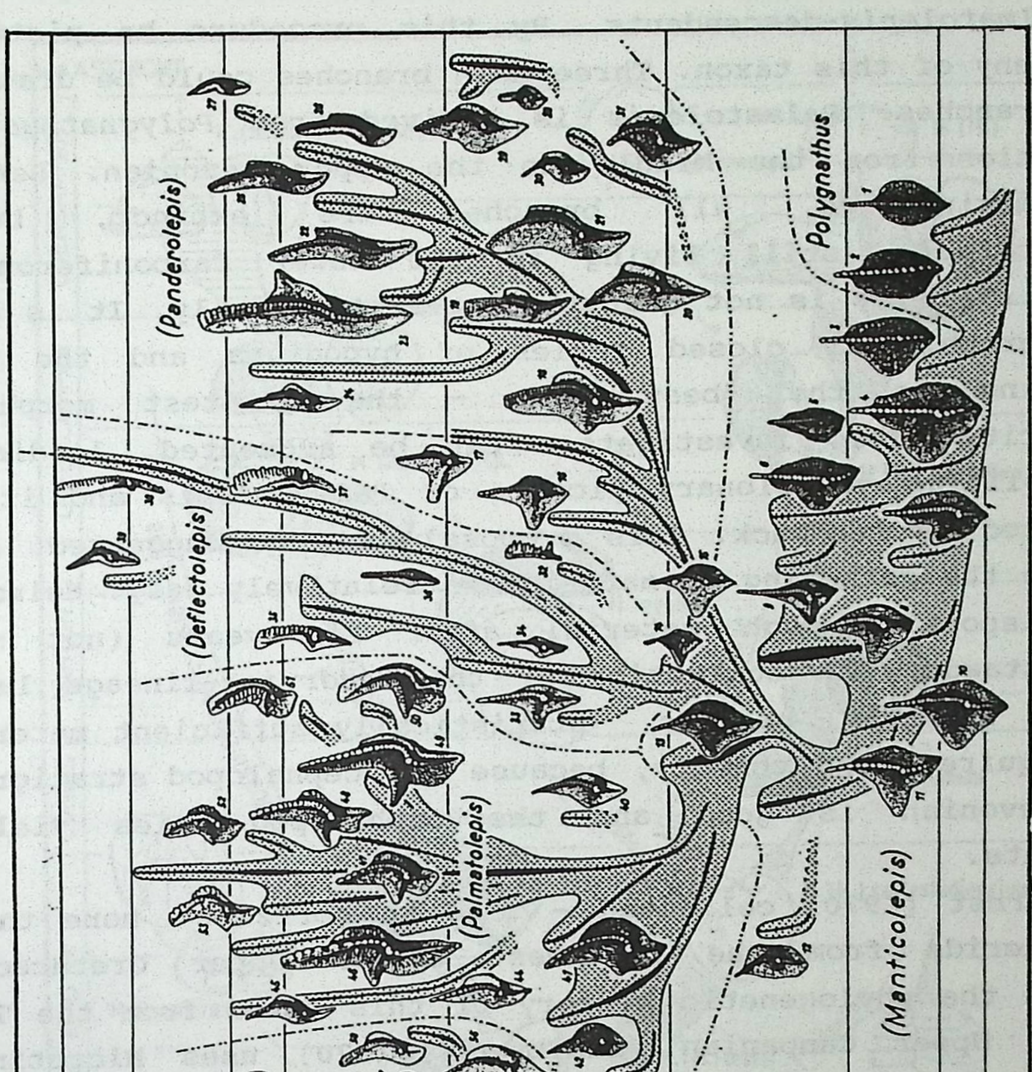


14 H. Gerhardt has followed the lineage *Haplophragmium* to *Triplasia*. 40 hypodigms with 4300 specimens were used.
The evolving three cornered transverse section is depicted. After two cladistic dichotomies and the extinction of an intermediary branch just below the Valangian/ Hauterive, the lineage is divided into the conservative branch with round transverse section and the progressive one with three cornered transverse section. The round form, rolling on the substrate and the three cornered non-rolling form are now genetically divided, no future change is observed.

pelycosaurs and it is present in the younger gorgonopsids. This evidence enables Olson to place *Watongia* in the gorgonopsids; instead hailing *Watongia* as being the ideal transitional taxon between Pelycosauria and Gorgonopsida, the praeparietal of *Watongia* allows Olson to put it into the gorgonopsids, to solve "an annoying dilemma". In the face of intermediary fossil taxa the encaptic system comes to grief. Olson is happy to solve his pseudoproblem with a formalistic trick. Otherwise we would have to define a new taxon of similar rank with the Pelycosauria.

The theory - in our case the encaptic system, cannot cope with the new findings. Though the lineage is now closed, this fact can not be described in terms of the old theory. Instead to break the old theory, if it is patent that it cannot cope with the new evidence, Olson entertains a pitiful compromise. To rely on the character "Praeparietal present" is even for Olson a questionable matter. Because he underlines the intermediary nature of *Watongia*. The meaning this character obviously has, Olson does not reveal. To register the general trend of reduction of dermal cranial elements, it does not need much knowledge (GREGORY 1951: "Evolution emerging II", p. 1668-1671). The trend is maintained from Carboniferous Anthracosauria to Tertiary Mammalia. If the younger gorgonopsids possess the preparietal, which the older Pelycosauria lack, it seems to me unlikely, that among the today known Pelycosauria one finds a prospective ancestor of gorgonopsids. The prospective gorgonopsid ancestor will be an up to now unknown "pelycosaur" with preparietal. The preparietal of gorgonopsids is more probably a symplesiomorphy with unknown Pelycosauria or Pelycosauria-ancestors, but an apomorphy, a neomorph. In other words: The evidence used by Olson to solve the annoying problem, I regard as useless.

Stratigraphy and phylogeny of taxa, by means of lineages, is today the exception from the typological procedure, but it is practised. The three examples Helms (1961), Fahlbusch (1964, 1970), Ernst (1972), which I bring now, are quite new. Though Helm's *Palmatolepis* has been created in 1926, conodonts previous to 1950 are in their "prehistory", their stratigraphical applicability is nil. But after the inauguration by Kockel in 1953 of the successful conodont-stratigraphy, enough material was amassed in six years, that the synthetic picture of Fig. 15 could be integrated. Gauged on the well established cephalopod-



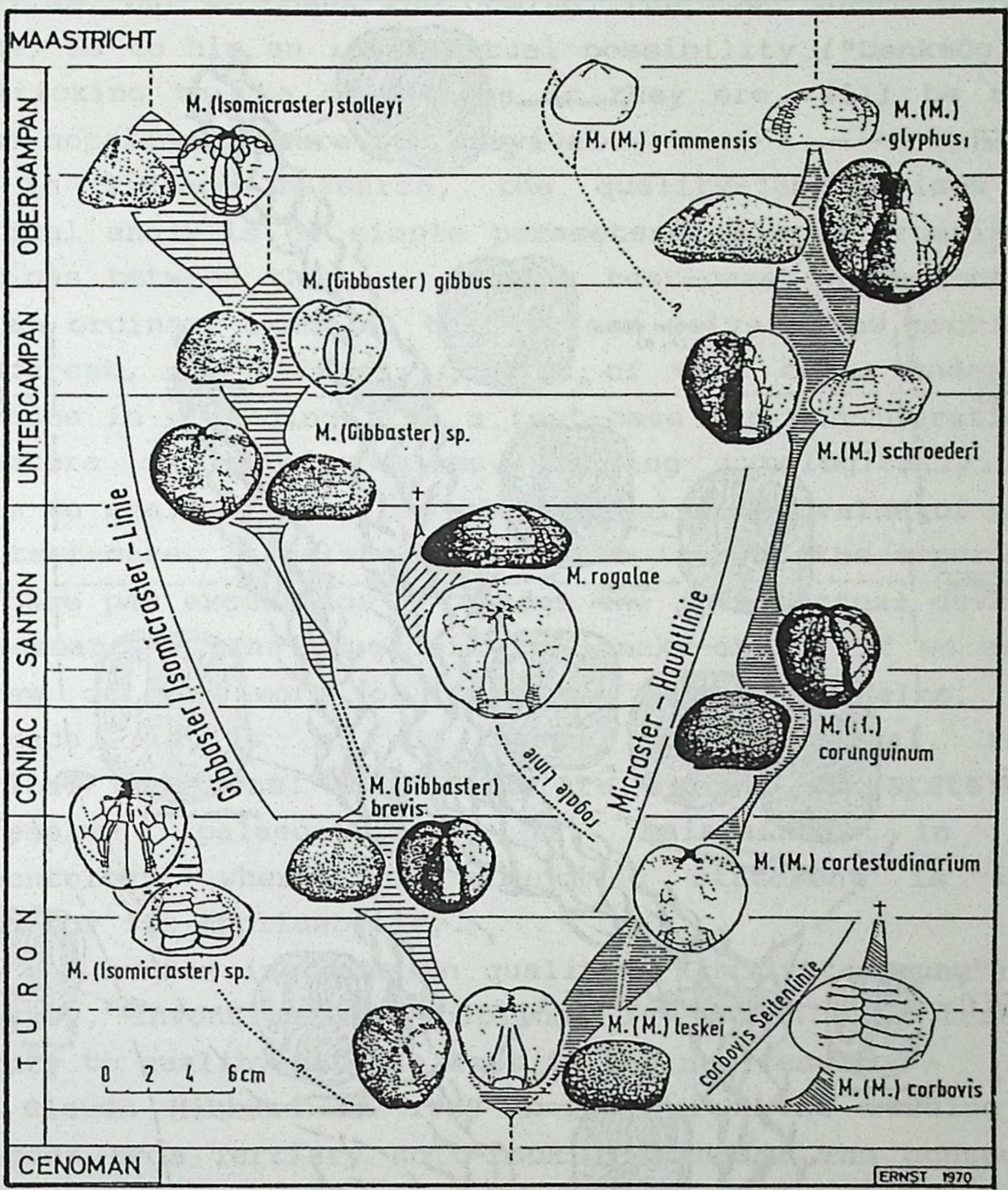
15 Phylomorphogenetic scheme of the conodont *Palmatolepis* in the Upper Devonian. Thanks to the reliable stratigraphy of goniatites and clymenias, Helms analysed 62 varieties stratigraphically and morphologically. Thereby depicting the phylogenetic evolution of the supertaxon *Palmatolepis*. The picture is based horizontally on the morphological best fit and vertically on the proper stratigraphical position.

stratigraphy, Helms arranged stratigraphically and morphologically 62 *Palmatolepis*-descendants. By this procedure he pictured the phylogeny of this taxon. Three main branches could be drawn and 18 side-branches. *Palmatolepis* is derived from *Polygnathus* at the transition from the Middle to the Upper Devonian. Before the Wocklumeria-stage, all branches are extinct, but for *Deflectolepis*, still living in the Lower Carboniferous. The method of Helms is not quantitative-statistically. It is based on stratigraphically closed series of hypodigms and the grouping according to the "best fit" - the greatest morphological similarity. This investigation can be augmented, leading to a cosmopolitian evolutionary picture of *Palmatolepis* and it can be corrected by feedback. This proposal is here suggested, firstly, because the gathering of material is relatively easy. Helms had at his disposal enough material after six years (not so with Bettenstaedt, the collection of the *Gaudryina*-lineage lasted 20 years). Secondly, because statistically sufficient material was not required, and thirdly, because the cephalopod stratigraphy of the Devonian is good and the cephalopod facies yields the conodonts.

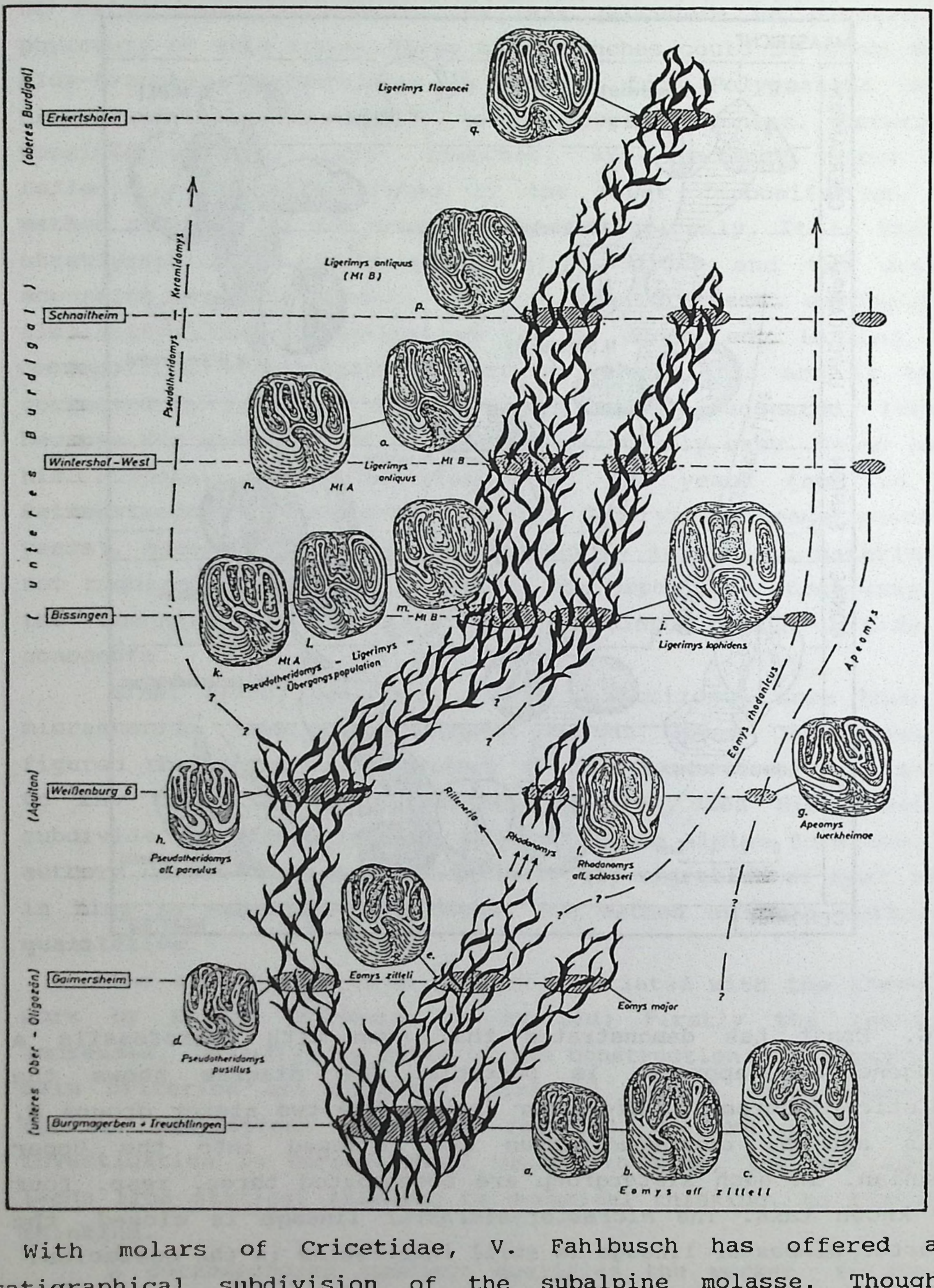
Ernst (1970) collected - true to horizon - more than 2000 micrasterids from the northwest German Upper Cretaceous and figured the phylogenetic history of this taxon from the Turonian to the Upper Campanian. Fahlbusch (1970) uses Microtines to subdivide the Middle Tertiary Molasse of the Alpine foreland. Both authors cannot utilize quantitatively the migration of mean values in time in subsequent hypodigms. The method of both authors is qualitative.

The aim of this kind of work, initiated with the *Kosmoceras* work by Roland Brinkmann is twofold: Firstly the resolution increases. Secondly, by means of the construction of lineages, the main criterion are longtime, directed general adaptations, not special adaptations of "guide fossils". As the object of the investigation is morphological change in time, the new approach leads from statical thinking to dynamical thinking, to historical thinking.

A corresponding approach qualifies the worker to see his social milieu not static but dialectic-materialistic . It qualifies him to make his social milieu transparent; it can even lead to the possibility, to see his social milieu as one of



16 G. Ernst has demonstrated that even with macrofossils a phylogenetic approach is possible. His diagram shows the cladistic dichotomy of *Micraster leskei*. The two sister groups *M. brevis* and *M. cortestudinarium* are followed into the Upper Campanian. In each sistergroup are accomodated three, resp. four long known taxa. The *Micraster-Micraster* lineage is closed, the *Micraster-Gibbaster* lineage is still interrupted in the Coniacian.



17 With molars of Cricetidae, V. Fahlbusch has offered a stratigraphical subdivision of the subalpine molasse. Though provided with only 8 subalpine and 4 West European hypodigms, he succeeds in the synthesis to demonstrate 2 cladistic dichotomies.

thousand presences. If this is the case, he is unfit to hail dead formalism, but welcomes the coming, the new. Survival by means of change, is to him an intellectual possibility ("Denkmöglichkeit"). Any sticking to the conditions as they are, will be regarded by him as hopeless measure for survival.

In lineage research, the quality-jump arises from the numerical analysis of simple parameters, simple organisms, simple relations between them, as in a test-case. A test-case differs from an ordinary example, that it can solve a few problems. It is transparent, not diffuse. Critics of test cases underline their ignorance in demanding from a test-case the consideration of many parameters on many problems. Arguing typologically, they are unable to analyse , nor can they conceive the value of an analysis of a test-case. In palaeontology, the lack of the experiment - the test-case par excellence - impedes the intellectual development of the researcher. The prognosis is make-shift. If we ask for the problem of the work of Grabert, Gerhardt, Helms, Ernst and Fahlbusch, it is in all cases stratigraphical, related to practical questions. Hence, we are allowed to state: the most progressive palaeontology is maintained in practical palaeontology, where the scientific statement is immediately tested for its applicability.

The sudden increase in quality ("Qualitätssprung") due to a discovery, invention, or coupling, is legion. The transition of quantity to quality materializes in the new result.

Claude Hibbard in 1928 began with the washing of small tetrapods from Tertiary soft-rock in Kansas. The consequences in Tertiary, Cretaceous and Jurassic cannot be assessed. The gathering, the collection of thanatocoenoses of vertebrates is now a reality. The study of small tetrapods gains momentum. In the Mesozoic, when mammals are very small, Hibbard's method has revolutionizing effect. Hibbard's achievement is not mentioned in Romer (1950: 50 years of American palaeontology). Though it is the only method which from America gets world wide recognition by being adopted. Here, I give it ample room. Too late, from 1953 onward. Hibbard's method was "taken in". Of all things, one has given it a new name: "Underwater screening", and Hibbard's name subdued.

What a pioneer's achievement is, is shown in Hibbard's letter to me, dated 20. IX. 1961

THE UNIVERSITY OF MICHIGAN
MUSEUM OF PALEONTOLOGY
ANN ARBOR

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September 20, 1961

Dr. Walter Georg Kühne
Freie Universität Berlin
Geologisch-Paläontologisches Institut
Altensteinstrasse 33
Berlin - Dahlem
Germany

Dear Professor Kühne:

Please pardon the delay in answering your letter of July 23, that arrived while I was in the Field. I returned last Wednesday (September 13) and have been working my way through three months' mail. Our classes started today in the University.

The washing method was a "Brain child" of 1928. I originally included how the method was developed in my paper on the washing method, but Dr. Kellum, Director of the Museum, removed it from the article since he considered it was not scientific.

I was raised on a farm and greatly interested in Natural History, also hunting and trapping. I made money to buy clothes while in grade school and high school by trapping fur-bearing mammals. To be a successful trapper or hunter one must study animals, their ways and habits. I always wanted as a boy to hunt large game in Africa; this was impossible.

I entered the University of Kansas in the Fall of 1926. I learned that if I could get on as a member of the expedition to collect fossils, that I could help find fossil "Rhinos", camels, etc. In the spring of 1928 I got my chance to go as cook for Mr. H. T. Martin, curator of vertebrate fossils at the Museum of Vertebrate Paleontology, University of Kansas.

One of the greatest days of my life was when we left Lawrence, early in June, 1928, for the Middle Pliocene Beds in northwestern Kansas. I had cooked in cafes since September, 1926, to earn money to go to the University. Cooking for the Professor and three students was of no concern. We were going to collect fossils.

Mr. Martin had located a quarry (Edson Quarry) in Sherman County, northwestern Kansas, in 1924, and worked it again in 1926. The quarry was located in stream channel sand and sandy silt. Martin and Adams published a paper in 1929 on "A new Urodele from the Lower Pliocene of Kansas. Amer. Jour. Sci. 5th ser., Vol. 18, No. 102. The salamander was Ambystoma kansensis.

In those days the overburden (top soil and other matrix) above a fossil horizon was removed by a plow, scraper, and a team of horses. In 1926, when Martin returned to the locality he found on the quarry dump from the fossil horizon (fine sand) many parts of a salamander skeleton. He picked some of these up and saved them and took them back to the University. Dr. Adams' mother lived in Lawrence where the University of Kansas is located. When Dr. Adams visited Lawrence to see his mother, he always came to the Museum since he had worked his way through college in the building. He became interested in the small bones and studied the specimens. He also requested that Martin get more of the material in 1928.

When we arrived at the quarry in June, 1928, my job was to set up camp, arrange it, cook and do dishes. Martin hired a rancher (farmer) with a team to remove the overburden. I hurriedly set up camp and went to the fossil quarry. It turned out no student could drive a team (Horses) or handle a plow or scraper. So I not only became cook but I ran the plow and scraper. We worked hard and got the overburden off. The next day I finished dishes and camp work and rushed to the quarry to find for myself a Rhino and Camel.

I was greeted by Martin with a pair of tweezers and told to carefully go over the quarry dump of 1926 and to pick up every piece of small bone. I worked about 1½ hours that forenoon and 2½ in the afternoon. There was no shade; one crawled around in the hot sand on their knees or lay on their belly (stomach) picking up vertebrae, etc. By this time I was well acquainted with the rancher, so I asked him if he had any old pieces of screen wire. This is used on doors and windows to keep insects out of the house. He said he did and I asked him to bring 3 or 4 large pieces the next morning. I said nothing to anyone about my idea.

The next morning he drove past camp to get to the quarry and left the pieces of wire. That morning I did not go to the quarry but got everything in top shape at camp (a good dinner and supper organized). After dinner I rushed with the dishes and then took the camp truck with 4 or 5 gunny sacs (Burlap bags) that hold from 100 to 150 pounds and went to the quarry to fill them with fossil-bearing sand. Mr. Martin saw the truck coming and got excited and left the diggings to meet me and see what was wrong. I explained I was going to load up the sacs with sand and use the screen which I had shaped into baskets and take the sand to a buffalo-wallow about 2 miles away and wash out the bones. "Buffalo-Wallows" are places where the American Bison would dust (wallow) in the dirt to get rid of flies. They developed holes from 12 inches to over 2 feet in depth and from the size for one Bison to larger ones that would hold a number. In the rainy season these holes filled with water. A "buffalo-wallow" is a depression generally filled with dust but an excellent toad (Bufo) pool in the (rainy) wet season.

I placed a shovel full of fine sand containing the fossils in the basket like structures and set them in the water in the "Buffalo Wallow". I then lifted and lowered the screen in the water. All of the fine sand passed through the screen leaving chiefly fossil bone. These were vertebrae and bones of salamander, frog, toad, bird, and rodent jaws. That afternoon I got enough small fossils to fill a kitchen match box (2½ inches by 2 inches by 5 inches in size.). When Martin and the students returned from the quarry that evening I had supper on time and had my whole summer laid out, planning to wash for fossils. That night Mr. Martin said, "What did you get?" I showed him. His eyes opened wide. He said, "My God!! You have enough small fossils for all of the museums in the world." My world of collecting small fossils vanished. The next day I began digging for three-toed horse, camel, and Rhino.

I fully realized at that time 50% or more of a fauna went into a quarry dump and vowed I would collect small fossils if I could ever get the chance.

In 1929 we worked all summer on part of a Columbian mastodon and spent over $2000.00 for lumber, freight, etc. In 1930 Curtis Hesse was in charge and we collected horses and camels. In 1931 I spent most of the summer collecting Recent vertebrates, but I got a month or better to collect fossils and we recovered snake, bird, rodent, and large mammals. Large vertebrates were a headache and expensive.

The University of Kansas ran no field trips in 1932, 1933, 1934, or 1935. I personally paid for the little field work done in 1932 and 1933 out of my own pocket by working at .35 (cents) an hour for the Museum. In 1934 and 1935 I worked for the United States National Park Service. I joined the staff of the University of Kansas in the Fall of 1935. It was during the depression years. Instead of the $2000.00 for the summer field fund I got $300.00 for field work. The University considered it so low I would not go to the field. We left as soon as school was out in June of 1936 and returned late in August. We lived off the land. We shot or caught our fresh meat and bought only what we had to buy. I realized I could not collect large fossils or remove overburden, so we turned to hand labor of sifting for fossils.

My whole plan was to return to the Edson quarry of 1928. We did but it was destroyed. If you check the 1929 papers of Adams and Martin, also Wetmore and Martin, 1930, "A fossil crane from the Pliocene of Kansas", you will find that no locality nor county is given.

Childs Frick and the Sternbergs are still alive. When I was a student in 1929, I was present when Martin told George Sternberg, now alive and at Hays, Kansas. "George, I have known you and your father for years. You know as well as I do, blood is thicker than water. If you ever go into Edson and Rhino Hill quarries, I will shoot to kill". George said, "Now Martin, you know me. I will never go in".

I, as a stupid graduate student, listened to Alex Wetmore, who insisted that the Cope and Marsh days were over and I must publish with my master's thesis the location of Edson Quarry (Hibbard, "Two new genera of Felida from the Middle Pliocene of Kansas", Trans. Kans. Acad. of Sci. Vol. 37, pp. 239-248. 1934."

We arrived at Edson Quarry to find it gutted by George Sternberg for Childs Frick. Martin had died the spring of 1931. I at once took this up with Wetmore who hired Sternberg about six months each year to collect for the U.S. National Museum. Wetmore stopped Sternberg from working other quarries but his own. This had been the Sternberg practice for two generations up to this date. To the present no one knows what Frick has from this quarry or many others he has vultured in this country.

During the depression I turned entirely to sifting and washing for the smaller fauna associated with the larger vertebrates since I had only from $300 to $350.00 for summer field funds. Much of the credit goes to Harry Jocob, an engineering student who insisted on washing for the recovery of mollusks that I was trying to pick by hand. The washing of matrix containing mollusks also contained remains of fish, amphibians, snakes, lizards, birds, and mammalian jaws.

We also recovered snail (molluscan) eggs and oögonia of chara.

In our collecting we never left, but always removed large fossils, but by the time all matrix around a large fossil which was dried and washed, there was never enough time to remove too many yards of dirt a year by this practice.

I was always interested in the entire flora and fauna, also the conditions under which they lived. I had two questions I asked myself. "What lived and how, and under what kind of climate?"

I must admit much of my work has been entirely for my personal information. I have wanted to know what and why?

My work has been ridiculed in the past: Some have often said it will only work locally in a certain part of Kansas, but not in Nebraska and the rest of North America.

We spread out about 300 hand towels to place the wet concentrate upon after washing. When dry we pick off the fossil vertebrates with tweezers. I have showed slides of our work and the older vertebrate paleontologists stated, "What are the diapers for? (A diaper is the cloth of an infant).

Regardless it has taken a new generation to recognize the value of washing for small vertebrates. Malcolm McKenna started in our fossil camp and washed fossils until he learned our process and method.

Malcolm McKenna is a highschool classmate of Dwight W. Taylor. Dwight was a member of my field party in 1950 at the time McKenna visited our camp. Dwight Taylor (1960), "Late Cenozoic Molluscan Faunas from the High Plains", states, "Fossils collected at this original locality and exploration of the Meade County region in general subsequently have produced almost an overabundance of paleontological riches." U.S. Geological Survey Professional Paper 337.

In the fall of 1943, Mr. Elmer S. Riggs, curator of vertebrates, Field Museum of Natural History, Chicago, Illinois, then retired but now living in Oklahoma with his son, went to western Kansas with me to collect fossils. We found the camel quarry (See: Geol. Soc. Amer. Bull. Vol. 60, Upper Pliocene Vertebrates from Keefe Canyon, Meade County, Kansas.) Riggs, an old dinosaur collector, was after large bone. We finally divided the quarry and when he finished gutting and chopping out his one-half, he went home (to Lawrence). He chopped up all small bone, and Manuel Maldonado made the statement that if a bone was not 18 inches long with teeth, it was not a fossil. This fitted Rigg's definition perfectly. I had two boys to help us part of one of the three summers we worked the quarry. We could not wash but we sifted the sand (about 10% of the throw-away matrix, and we doubled the fauna.

Riggs got very angry; he said, "Hibbard, you are not a vertebrate paleontologist. No one knows about you. What you collect are "Small potatoes", in reference to the small fossils. The students had him in an uproar. One would shout, "I have a small potato with 3 teeth", another, "I have a small potato with one tooth", meaning a small jaw with 3 or 1 tooth. We doubled the fauna by sifting the sandy from the quarry. What would it have been if we could have washed it.

The American Museum; Harvard, Yale, and Princeton do not believe a new method or a new idea can be developed outside of their walls. See Romer, Alfred S., 1959, Jour. Paleontology, Vol. 33, No. 5, pp. 915-926. (Vertebrate Paleontology, 1908-1958).

The younger vertebrate paleontologists realize that more fossils were left in the old quarry dumps than were ever recovered. They also realize the value of micro - or small vertebrates - and the invertebrates; all of these help to complete the story of the past.

I just had a letter from Malcolm McKenna; during June and July this summer they washed 170 tons of Cretaceous matrix containing remains of mammals. He has had a most successful summer.

My interest in the ostracods and mollusks was to get as complete a picture of the environment of the region as possible. Most of the vertebrate paleontologists consider my conclusions concerning past climates and habitats as guesses and not based on facts. They consider paleobotany as the only basis for constructing past climates and that it is impossible to do so from vertebrates.

Regardless it has been a lot of hard work and a pleasure. We shall see a new generation of students with far more fields of interest to study and vertebrate paleontology shall begin to take its place in science.

Sincerely,

Claude W. Hibbard

Claude W. Hibbard

CWH/hm

4.5 Examples from the biosphere: transition from quantity to quality

In water, with growing weight, the supply of the organs with O_2 is via the surface of the body and by means of gills. On dry land , O_2 supply is, by tracheae and by lungs. From breathing by means of gills, transition to tracheae and to lung breathing exists. No transition exists between tracheae and lung-breathing. Size limitation is manifest in diffusion-breathing and in tracheal breathing. With both modes not more O_2 can be absorbed than the body surface or the number of stigmata allows. As the demand for oxygen rises to the third power with growing body-weight, but the body surface only with the second power, insect-life is limited to a body-weight of not more than about 100 g. The enlargement of body-surface is prohibited in a flying insect. With other words: A biological service- oxygen -supply - sets the limits to a phenomenon: body size. The quality of size limitation is a function of the quality of gasexchange. Miniaturisation leads to the reduction of the heart. In recent echinoids we observe the number of radials without considering any relationship.

Taxon	*Podophora*	*Echinus*	*Echinocardium*
Number of radiols	300	1500	15000
Function	Protection in the breaker zone	Active protection spines. Stilts	Auxiliary function for breathing when submerged. Micro-radiols as Macrocilias

In adaptation to the breaker zone, the rock substrate and the littoral and sand substrate, the number of radials increases. The radials of *Podophora* protect from crushing, under the pavement of radials, gasexchange and nutrition go on, undisturbed by external forces. The radials of *Echinus* or *Diadema* are protective organs and stilts. The clavulae on the fascioli of *Echinocardium* are - as in *Podophora* - essential organs for gas-and-nutrition-exchange (KÄSTNER 1963, p. 1284, Fig. 1102 B).

In many Amphibia and Reptilia the increase of elements in the vertebral column implies a change of quality. So long as the vertebrate column has not exclusively locomotory-or-strut-function, a fluctuation between both functions is feasible. If the column serves exclusively as locomotory organ, the extremities vanish and the number of vertebrae increases. The tetrapod moves - another time - after his Pre-Carboniferous fish life - by wriggling - with still increasing number of vertebrae, the body executes more than one wave. A swift locomotion, without extremities arises in *Ophidia*, *Caecilia* and *Apoda*. Increase of neck vertebrae occurs in Plesiosauria and Eolacertilia, when in the aquatic milieu, static restrictions, which govern terrestrial life, do no longer apply.

If a senseorgan is serviced by sensory epithelium, its function is directly depending on the number of the cells of the epithelium. For instance, in the labyrinth of the helix; its lengthening allows a greater scope of acoustical waves to be perceived.

4.6 A drastic case is the neopallium. In *Erinaceus* it weighs 3.5 g, cerebellum and bulbi olfactores weigh together 1 g. In *Homo*, the neopallium weights 1200 g, cerebellum and bulbi olfactores weigh together 150 g. Cell size and kind of cells are the same in *Erinaceus* and *Homo*. The social unit of *Erinaceus* is only the oldest, the most primitive, between the mother and the litter. Teaching happens only during adolescence, by prohibition and permittance. The social unit of the Madagascar lemurs is the small horde. The degree of interdependence by means of acoustic signals is unknown to me. Baboons social unit is a rigidly organized large horde. Instruction and signalizing happen lifelong. The stock of acoustic signals is large. Social life of the baboon horde is based on the weight of the neopallium of 160 g. With 1000 g neopallium, conceptual thinking, abstraction and language begin. The selection-advantage, coupled with these activities, is obvious: The outcomes are work and the division of work, in all an amount of integration, which does not exist among animals.

The neopallium of *Homo sapiens* is conditioned by the pelvic tissues, which, during birth, allow to passage of a very large head. This head being balanced on the vertebral column does not hang on it. The neopallium of *Homo sapiens* with 13 billion neurons is only of potential value. This is patent, when we observe the culture of *Homo sapiens neanderthalensis*, and of Savages which, with a similar brain capacity as ours, lack states, do not have a social product, hardly division of labour and their minute social units display little integration.

The localisation of the oldest states in the alluvions of the subtropical and the moderate zones betrays the principally new feature. The unspecialized *Homo sapiens* exists in the small horde in the pessimum. Only in the optimum, state-formation is initiated. Where irrigation is available without work by man, the quality of the soil guarantees an agricultural product, greater than the needs of the social unit demands. Since the accumulation of the social product, there is incentive to plunder for the tribe and incentive of the small state for slavery of imprisoned plunderers. The first social product has as a dialectical consequence the class-state. Protectors and distributors of the social product do not partake in its production.

I am not in the position, to entertain reasonable ideas for the gigantic brains of elephants and of whales, serving unknown functions.

The mental faculties of *Homo sapiens* are not the result of genetically most difficult rebuilding and newbuilding. In less than 5 million years the brain capacity rises from 500 to 1500 cm^3. Compared with this, is the time span from the first secondary jaw joint in the Middle Triassic to the first pantotherian lower jaw - without Meckelian groove and without depression for the coronoid in the Aptian -, ten times as long. Today we count a much longer time, perhaps in 50 years, if forms like *Crusafontia* are possibly known from the Kimmeridgian, and the peramurids teach us, how fast the formation of a synorgan can happen. Nevertheless, enlargement is phylogenetically easy and quick, a synorgan develops slowly and with detours and - the brain of *Homo sapiens* developed in a short time. In cultural history enlargement of numbers, of dimension and of speed, yield classical examples for the transition of quantity into quality.

The enlarged gun, the cannon, does away with castles, as an instrument of suppression, rebellion and organized extortion. Fortresses have to be newly constructed. They even have to be built in different topographical positions as at times without fire-arms. A parasitic social structure, the robber-knight vanishes as the cannon rises as a war-instrument.

The speed of communication techniques leads to large governmental units, where they could not exist previously. The present European countries are based on the horse as a means of communication.

Books and writing exist for about 4000 years. Up to 1450 it served class-rule. The book was rare and expensive. It was the monopoly of the alphabets, the carrier of tradition, mediating between ruler and ruled. The written book did exist only in limited editions. Easily it could become extinct, with the loss of its information. Since printing, the amount of stored information rose tenfold, the price of printed books was lowered to 1/10 of the price of the written books. From 1450 onwards the ruling class was no longer in the position to practise the monopoly of learning, learning became potentially available to all, and the monopoly of learning, practised by the ruling class was potentially broken. Information and manipulation of thought was a possibility - bothways. The vatican censorship - the index - was printed since 1559. Though newspaper, poster and the mass-edition of pamphlets are printed. The book, the extracerebral memory, multiply the knowledge available to the individual. Man can be intellectually productive, even with a bad, an untrained memory. The greatest chance of mankind, exists - latent - since 1450, and I wonder why we are ignorant as we are. The printed book enables anybody to make transparent - to himself - social phenomena. But the reality of the control of the own social existence is still a desideratum of mankind. The means of this control are available in printed books ; the utilisation of their content is, I predict - the matter of a few decades, in the optimal region. In this optimum, it will occur and after a short starting phase, will in a triumphal procession engulf the whole globe.

4.7 Rôle of consciousness in the history of society

A by-product of these thoughts is a contribution to the problem of "Bewußtseinsbildung", the formation of consciousness. Can the formation of consciousness be socially effective? Can insight be a social factor, or is this exclusively the mode of production?

I think both, production and consciousness, are depending on each other, reciprocally condition each other.

Every civilisation demands learning, knowledge, and the learned demands imperatively the congruence of his existence and his consciousness. It cannot be enjoyable to betray ones own learning by working in institutions - for instance newpapers - which have their raison d' être in the covering, the veiling of social conditions and social processes. Exactly the censor, the denouncer, the snooper is an objectionable occupation.

Repression, the builder of consciousness encounters by the ruling class, demonstrates that he is feared, hence the forming of consciousness must be socially relevant.

5 Evolution is progressive

Motto: Evolution and extinction are correlates

5.1 Dialectic-materialistic theorem

"Evolution is progressive", this theorem is of great general applicability. As it has validity in both biological and social evolution, its formation not only results in an increase of knowledge but it is consciousness-forming. The theorem is the guiding principle, foremost in regions of the biosphere, where the fossil record is deficient. It is applicable, where a trend in the observable morphological change is not yet obvious. Last not least the principle is relevant to the work of the palaeontologist himself: His science is subject to progressive evolution.

Human and non-human evolution do not reveal progression in all its manifestations. In the history of life, we do not only observe the origination of new forms of life, generally more efficient than the related and older forms, but evolutionary stasis. Extinction, the inability to cope with external change by means of adaptation, is manifest. Today's life is the outcome of 600 million years of survival, accompanied by extinction. Those extinct forms are a thousand times more numerous than the surviving ones.

Cultural history displays a similar picture. Cultural evolution has its antithesis in the fading of small and large cultures. Cultural stasis at a low level is reality, compared with more integrated cultures. It is the means to study the cultural history of the last 200000 years, together with archaeological documents.

5.2 Difficulties encountered when dealing with progressive evolution

The consciousness of the person doing historical work, is conditioned by his material existence ("Das Sein bestimmt das Bewußtsein."). The material existence determines the qualification to observe, or not to observe, progressive evolution. The consciousness of the bourgeois scientist is not only conditioned by his subject matter, but also by the cultural substrate into which he is integrated. In the face of cultural decline, worldwide conflicts, the manifest inability of the ruling class to resolve social problems, the researcher is conditioned to deny progressive evolution. A person living in the wake of revolutionary success of his class, may be incapacitated to observe anything but progressive evolution.

The member of the bourgeoisie in western Europe is historically in a hopeless situation. He is unable to concur with the negative consequences of late capitalism, and he is unfit to do away with them. Socialist thinking surrounds him everywhere; he adopts it, if it is not tabooized or penalized. But social progress is coupled inseparably with the abolition of the bourgeoisie as a ruling class. This event has to be delayed. A means to delay it, is - in the realm of the formation of consciousness - to negate progressive evolution and to present it as ambivalent (ZIEGLER 1972, p. 92-93). Such wrong presentation is maintained in the books which are consciousness-forming.

To point out the progressive nature of biological evolution, is the social duty of the biologist. It corresponds with the observable reality - it is true. To know about route and vector of evolution is pace-making for the analysis of the biologist's position in his class. It is pacemaking for the social revolution.

5.3 Progressive evolution in prehistory

Progressive cultural evolution is manifest and generally acknowledged, when larger time-spans are observed. Even before 1824 the Dane Christian Thomsen was able to formulate the "Three period system" of prehistoric culture; it is the sequence of Stone Age, Bronze Age and Iron Age. Wherever two of Thomsen's epochs could be found, the chronological sequence of Thomsen emerged. This means, without exception, Thomsen's sequence was confirmed. The sequence was not only in line with our expectations, but has proved to be the reality, which we study in prehistory.

The determination of a locality as belonging into the Bronze Age is made by the identification of objects typical of the Bronze Age. These objects are not necessarily of bronce. In the chronology of the Phanerozoic, they correspond to the index fossils. If indicators of the Bronze Age are lacking, the age, one arrives at will be too old, until the general increase of knowledge enables to correct the previous age determination.

The change from stone to metal-industry is not synchronous, wherever the relevant documents are to be found. Nor do we encounter an abrupt change from stone to metal. The transition is gradual. The oldest localities of Bronze Age contain ornaments, later localities contain ornaments and weapons, still later in time, utensils are found. Even today, the threshing utensil, the spanish "trillo" is armed with silex-blades, equal to Neolithic tools. Even today are flint-stones produced in Brandon in Suffolk, to fit muzzle-loader, which are sold to the native population in order, not to prevent it from using fire-potential of breech-loaders.

The author saw trillo-blades, fashioned from the porcellain of hightension isolators! Flint stones and trillo-blades correspond to the "living fossils" of the biologist. It is the existence of taxa, once dominant and now restricted to refugial areas, surrounded by modern, more "progressive" taxa. There are also ethnic groups, social structures and organisations, which correspond to the "living fossils"; for instance the modern food-gatherers, the aborigines of Australia, New Guinea, the Andamans, those of the Amazon region. The greater the difference of the civilisation level between the gatherers and their modern civilized neighbours, the more improbable is the existance of the gatherer. The big difference of cultural level between both is instrumental in the lability of the existence of the gatherer. More stable are organisations whose main function has faded, but whose secondary function is their raison d'être. For instance special military organisations, which , with uniform and drill, perform representation: The Swiss guard in the Vatican, the royal bodyguard in Copenhagen, the London horseguard. Workshops of artisans, producing garments and shoes for luxury consume, can be mentioned here.

Of Thomsen's three units, the oldest and the first is the longest, the last is the shortest. Each of the three units, measured on the preceeding one, shows an increase in efficiency, increase of division of labour, enlargement of the social units and increase in lability. Stone industry has no demand for fire. Bronce production requires temperatures of about 1000 centigrades;

the production of iron necessitates temperatures up to 1300 centigrades.

If we consider several centuries, progress in human history is manifest. If we consider a few decades, we may observe only cultural decay or the rule of reaction.

5.4 Progressive evolution of life

The sequence of biological evolution is known over 600 million years. From the beginning of the Cambrian regularly and cosmopolitically fossils are encountered in sedimentary rocks. The time from the beginning of the Cambrian up to the present, is subdivided into 10 systems. In the long time, about 3000 million years before the Cambrian enough non-metamorphosed sedimentary rock does exist. But comparatively few fossils have been found up to now. The length of the 10 geological systems differs. Their definition realized 100 years before the absolute chrono-determination was possible by means of the half life of radioactive elements. Each system is characterized by a sufficient number of fossils, indicative to only this system. They come into existence rather suddenly and get extinct after a short time; they are called index-fossils. The lower the integration of fossils, the more frequently one encounters homoeomorphy and no phylogenetic relationship. To proove it, the same fossil has to be found, in a different facies and hence in a different kind of preservation. It is hoped, that under these circumstances morphological differences are revealed. The higher the degree of integration of fossils, the lesser the chances of homoeomorphy, the more distinctly lineages emerge. When closed sequences in time can be studied, the most distinct progressive evolution is revealed. The shorter the time, lineages do not reveal morphological change. The ruling principle of any stratigraphical statement is the progressive evolution. Here, we have to investigate it. Every being is subjected to progressive evolution. Even the few fossils collected by William Smith, allowed an obligatory stratigraphic statement. Exactly as a molecule of copper reveals the characters of copper, so the fossil remains of a once living being; it bears the stamp of the time in which it lived - the stamp of progressive evolution. If this would be otherwise, there would be no stratigraphy, there would be no historicity of the biosphere. Instead of vector and order, there would be chaos.

Our historical perspective is conditioned by the chrono-grid we apply. Exactly as in human history, so in biological history. Fortunately, William Smith in 1820 used a very coarse grid, and fortunately he was in the position to find the stratigraphical principle. The finer the grid, the more haphazard the stratigraphical determination. It took more than 150 years to wield the tools to reveal the short time events, contradicting the steady course of progressive evolution, through the millions of years. The instruments to reveal global catastrophies had to be constructed. Geochemistry, geophysics, micropalaeontology and many other branches of geosciences all together contributed to a verdict that makes the existence of non-uniformitarian events a fact. Fortunately, the last of these global events, at the transition of the Cretaceous and the Tertiary, is so recent that the documentation is palaeontologically a good one. Hand in hand with the tooling, to reveal the material evidence, the mental faculty to appreciate non-uniformitarian evidence, had to be developed.

Once more: Our geo-bio-chronological grid was so coarse, that from William Smith in 1820 to Hsü in 1980, nobody was in the position to appreciate the evidence. The outcome, the existence of global interruptions of life histories slow and steady course, was the victory-procession of relation-formation of all geosciences. All had to be roped in, all contributed essentials to the result.

The simple question "what means superposition of sedimentary rock" offered itself to be answered by a single person, William Smith. The theory-breaking question: Are there non-uniformitarian traits in the history of the earth and in life, offered itself, to be answered 160 years later, - by the coordinated work of about 85 researchers. This is a measure of progress in our science.

The fossil vertebrates are not frequently enough found to serve as index fossils. However, their history reveals unequivocally rising independence, higher degree of integration, progressive evolution. Life in seawater is more simple than life on land. A swimming organism is suspended in the medium water and has not to carry its weight. Before life in freshwater is a possibility for vertebrates, osmoregulation has to evolve. The retention of minerals in freshwater against osmotic pressure has to be solved before the animal can pass the barrier of freshwater.

Our body-fluids are still after 650 million years practically isotonic with seawater. The oldest vertebrates known are fishlike and jawless inhabitants of the sea, living 200 million years before tetrapods (oldest jawless armoured fishlike animals from the Middle Cambrian of Canada, *Pikaia*, and Ichthyostegids). Reptiles with internal fertilization and egg with a big yolk, not to be deposited into water, are known from the Upper Carboniferous. Mammals, homoiothermic and with internal breeding care, we know from the Upper Jurassic. The first reptiles with feathers, ancestors of the birds, we encounter in the Upper Jurassic - *Archaeopteryx*. *Homo sapiens*, as all living beings, reproduces with genetic information-transmittance. But besides, he -solely- owns the transmittance of information by means of memory and language, additionally *Homo sapiens* developed the extracerebral memory storage (Literature etc.). *Homo* lives only in the last 2 million years.

We consider the vertebrates with the best fossil record: the actinopterygid fishes with finrays and use the coarsest time grid. We register a threefold acme and a twofold origination of the subtaxon, forming the next acme. The three taxa are the palaeoniscids, with their acme in the Carboniferous, the "ganoids" beginning in the Permian and their acme in the Jurassic, and the teleosts, beginning in the Upper Triassic and with their acme today. The two older subtaxa, today merely noticable, have living representatives. The sturgeons are palaeoniscids, *Amia* and *Lepisosteus* are ganoids.

If we do not consider whole systems, of between 30 and 50 million years, but divisions of them of 3 to 6 million years, progressive evolution is less obvious. Big differences between old and new are not to be expected; the amount of change resulting in largest new taxa are neither registered nor found. For their materialisation longer time is afforded. They are never the outcome of one mutation, becoming homozygous, but of a sequence of a multitude of coordinated mutations. As historical discernible is even such short time span, firstly because of the sequence of index fossils, secondly when faunas in time approaching each other, are compared: they display progressiveness proportional to the time they differ. Considering smallest time spans of circa a half million years, the progressive evolution is no longer discernable. Index fossils proove to be useless and faunae do hardly differ when found in superposition. We see no trend but fluctuation - unless we find evidence of an event: whole sale extinction and repopulation of vacated niches, spaces, continents and oceans. Thus, the present cannot offer evidence for the origin of a synorgan nor for the origin of a very high taxon. Both are historical phenomena.

5.5 Stasis in the biosphere.

We contrast the progressive evolution with the protracted, persisting of morphology and the mode of living, the stasis. Lampreys, fishlike jawless vertebrates display in their oldest representative from the Upper Carboniferous of Mazon Creek, Illinois, the same organization as the recent ones, parasititising fish. The solely specimen is a juvenile, the adult may reveal less plesiomorphic traits. The primitive mollusc *Neopilina*, a recent inhabitant of the deep sea is - as far as the comparison with fossil extends - hardly different from the Ordovician relatives. Recent *Lingula* has Lower Cambrian relatives, to be mistaken with the recent form, as far as the fossilizable shell is concerned. *Lingula* is cosmopolitan, lives in the vertical sandtube, under the surface, rises above the surface for breathing and for metabolism. No morphological change has befallen her, the procession of *Lingula*-feeders through the Phanerozoic, had to adapt; through the ages new ones came and old ones went into oblivion, but the adaptions of *Lingula* did cope with all vicissitudes, geological as well as biological.

The oldest known mite from the Devonian freshwater silex of Rhynie in Scotland could well night be a recent mite, the same comes true to the collembole from the same deposit. However, a German anonymous referee of a paper by Kühne and Schlüter (1985) points out, that the said statement has been reached by consideration of only plesiomorphic characters: "the specimen was - in 1923 - obviously described as a recent Arthropleona; even up to now - as belonging to a recent subtaxon of the same. But the Arthropleona have only in the structure of the abdomen a plesiomorphic condition which is in principle already present in the bauplan of Collembola, hence be evolved in the ancestral group from which Collembola derived. Thus, *Rhyniella* can belong into the stemgroup of Collembola, which seems to me the most plausible position of the fossil." The origin of the bauplan of mites and collemboles is before the Devonian and we know nothing of it. Both taxa have many recent representatives in a narrow scope. Both taxa flourished.

Sphenodon, Lepisosteus, Amia, Tapirus, Nautilus, Limulus, and *Peripatus* are relicts. The formation of their bauplan has ended before the onset of the Mesozoic; an acme has not been found in *Limulus* and *Nautilus*, both taxa being well fossilizable. The living fossils demonstrate clearly that progressive evolution is not a primary attribute of life, like metaboly or reproduction. Progressive evolution can happen, but must not happen. On the other hand the capacity to incur change, to make a not absolutely perfect copy in mitosis is without doubt an attribute of life.

All living beings are subjected to change by mutation, their populations form a genpool. Living fossils do not make an exception. Living fossils have generally few or no living relatives. Living fossils do not occur after a colonization or after an aromorphotic change, which widens the taxons ecological spectrum. They are survivors of a taxon which in the past had more genera and species.

Another case to explain the existence of living fossils: they are perfectly adapted. The absence of phylogenetic change and the long duration of the existence of the respective taxa allow the conclusion: the taxa are optimal adapted. They witnessed no historical event, altering their state of tension with the milieu forcing on them change.

The greatest selection pressure excerts the own taxon on its individual. "Regressive evolution" would result in unbearable selection pressure by the other members of the taxon. The inferior individual has less living offspring to guarantee its future. The geneticists find at the end of the fjord and in the last hamlet in the narrowing valley, those homozygote recessive allels, which exist only here, under the chances of minimized recombination. The hillbilly is recessive. Those hillbillies, who have initiative to develop, to learn, leave the isolation and seek the interrelation.

5.6 Ecological Licence

If change results in the impossibility to inhabit ones niche, it does not take place, because such change would be lethal. If change results in the taxons ability to live beyond the niche boundaries, the taxon either displaces an inhabitant of that niche or finds a new niche still empty. The greater the ecological lability, the greater is the chance of phyletical change of those taxa, forming such ecosystems. Many components, many parameters stabilize the ecosystem, a few increase its lability. Stable is the tropical rain-forest, labileis the tundra, stabil is the mixed forest, labileis the monoculture. Is the niche old, small and well limited, any change of the taxon will destabilize it. Hence we cannot perceive change. But evolution goes on, genes mutate. As the niche prohibites phenotypic change, only genotypic change is possible. Hence between the two *Microcricetus* of Israel, with a different genome, there has to exist a sterility barrier.

5.7 Historical licence

Aromorphotic success is coupled with a defined historical constellation: The possibility to colonize or to displace. But it can materialize or not. Before potential hosts came into existence, any change for parasitic life ended lethally.

Miniaturisation could materialize only after the interstitial space of sandy shore sediments was so rich in nutritive matter, as to lend itself to a biotope. Change happens only if there is contradiction between the taxon and the milieu in which it exists ("Umwelt"). If those elements of change - necessary to resolve the contradiction - can be integrated in the taxon, change can happen, if not, extinction follows.

When crossopterygians - changed into ichthyostegids - beginning to inhabit the shore, a new historical situation emerged. The potential, to change crossopterygians into tetrapods may have existed through the whole Lower Carboniferous, but it did not materialize a second time at the same spot: A second thrust of tetrapods from the water was an easy prey for the first thrust of tetrapods, already established in their new biotope and having developed meanwhile additional characters for the life on land.

Phylogenetic change does not happen, if taxon and "Umwelt" are in a state of homoeostase and no overpopulation results. With other words: The less the tension of the taxon, the slower is the phyletic change.

We can dynamize this statement: Phyletic change happens, if the tension of taxon and umwelt change. No change happens if the taxon is adapted to a high tension. Again *Lingula* is a fitting example: Its biotope migrated steadily in the littoral of the continents. Non-suitable biotopes became vacated, suitable biotopes were colonized. The predators changed steadily. If in the Upper Palaeozoic the predators were palaeoniscids, they would be ganoids in the Mesozoic, and teleosts in the Cenozoic. The adaptational type *Lingula* presented the organs and mode of life of protection, before the predators came into existence.

Less than 10 individuals of *Ondatra zibethica* emigrated via Bohemia into the old world. The megachiropteron *Pteropus* was blown by the monsoon from India to the islands Zanzibar and Pemba. Those landing on the African continent were never successful. The two examples of successful and futile colonization reveal two different ecological and historical situations: *Pteropus* meets a gigantic area - Africa - in the state of homoeostase, without free niches, saturated during a long time. *Ondatra* meets a gigantic area - Europe - quite recently freed from the inland ice, offering *Ondatra* a gigantic free niche. Central Africa is inhabited since the Tertiary, offering no more free niches. Northern Europe is inhabited since the Pleistocene anew, offering a multitude of open niches.

5.8 Extinction is the antithesis to progressive evolution

Why and when is it that larger taxonomic units die out? Extinction follows, when the taxon is confronted with tasks which it cannot meet by phyletic change.

A welter of large taxa, once dominant, has become extinct: The graptolithes in the Lower Carboniferous. The fusulinids in the Upper Permian, the trilobites and the rugose corals at the end of the Permian; the ammonites, almost all the belemnites and the rudists at the Cretaceous/Tertiary-boundary. The examples are taxa of great stratigraphic importance, as long as they had been dominant. The extinction is a gradual, slow process with graptolites and trilobites, and an abrupt one with the three taxa ending their existence at the Cretaceous/Tertiary-transition. The fading away of vertebrates is well known; of the jawless fishlike agnatheans all armoured forms are extinct, unless the chimaeras are finally regarded as direct relatives of arthrodires. Of Actinopterygia all non-teleosts are extinct, but for five taxa, *Acipenser, Polyodon, Amia, Lepisosteus* and *Polypterus*. The four grades of Actinopterygia, Palaeoniscoidea, Subholostea, Holostei and Teleostei successively substitute each other from the Permian to the Upper Cretaceous. They represent a well founded series of progressive evolution. Each unit is superior to the one before it. From each of the four grades we know matching adaptational types. Why substitution occurs, suggests itself by the superiority of each of the four sequential grades: The axial skeleton gets stabilized - the passive protection by thick scales, gets reduced. The organs of locomotion function more economically, the fin rays move faster, for greater velocity, by less expenditure of energy and the jaw apparatus can cope with larger prey.

The extinction of the dinosaurs, the Saurischia and the Ornithischia and the Pterosauria among the Archosauria, and the Ichthyosauria and the Plesiosaura was up to 1985 an enigma. There was no substitution, no displacement. In 1979 I wrote: "This unsolved problem will be incentive to think and to work; all solved palaeontological problems were quite recently unsolved." Today the problem has been solved, the protagonist of less than 100 research worker coordinated their work and received the Wollaston medal. The event of the K/T-transition, has been an inpact of 300 km diameter.

I regret this concerted effort and its successful conclusion because there is one major problem less. It was extremely difficult to find evidence of the event, always indirect, always begun under quite different auspices. The workers rarely aware what their special bit of evidence meant to the final proof of the meteoric catastrophe. Hardly a similar problem will be found and be solved, so brimful of tension, of unexpected results, and of failures, of detours and of blind alleys.

The faster and more drastic a biotope gets changed, the greater are the demands for the ability to change of the inhabitants of the biotope. And the more frequently are those, which cannot react with phyletic change and succumb. The biological experiment of the importation of a different taxon, new in the respective region, has been exercised over and over again, since navigation allowed transportation over the oceans. The extinction of the native population is the immediate result. The more stable a biotope, the smaller the demands on the changebility of the native population to survive the impact of the newcomer. *Bathynella* in freshwater, *Hutchinsoniella* in the marine milieu are inhabitants of the extreme stable biotope of the interstitial water in sand bodies below the watertable. With increasing degree of integration, the improbability of a taxon rises and with it its lability. Arranging bacteria and animals according to rising integration, and measuring the number of extinct subtaxa, we arrive at a rising number of extinct elements. One can measure the stability of a biotope by computing the number of relicts it still houses.

5.9 Reduction of organs and functions as a part of progressive evolution

Addition is not progress, reduction is not regress. Evolution is neither but change. Change is the mode to live in a different way, as previously. When discussing reduction-processes, our dependence emerges, on innate modes of thinking. The great variability of our eye is often called "degeneration", with the distinct undertone of its subfunction. Degeneration is not good, but bad.

In the regions of high civilisation, with division of labour and the reliable service of spectacles, the existence of impeded eyesight is a dialectical consequence of the high civilization. There is no high civilization where members have to have the eyesight of a siberian hunter, hitting the squirrel's eye - so that the fur does not get holes. High civilisation allows not only polymorphy by lowering the selection pressure, but sets a premium for it: gem cutter, watch maker, fine mechanic can make do shortsighted.

The lowering of selection pressure on a integrated synorgan one can compare with the laying of a townwall in the early 19th century. Before the lowering of selection pressure the variability is minimal, after the lowering it is large. The impeded eyesight does not have as a consequence lethality. If reduction of an organ can be tolerated, it vanishes immediatedly. Change of only one gene can impede the ontogenetic development of the synorgan. If we encounter blindness in nature, in cavedwellers or in blind trilobites, it is proof that here blindness has a selection-advantage. Blindness is an adapatation to permanent darkness. The eye does not afford to be maintained and to be protected. Progressive evolution is generally coupled with an increase of genetic information, but not in all cases, not exclusively. Following the principle of economisation, organs, which have become superfluous are immediately reduced. Functionless organs are ballast - unless selection pressure is very low or - a secondary function of the reduced organ saves it from reduction.

To postulate unworthyness, absence of a function of a organ, where the function is not obvious, is proof for the scientists naiveté, even arrogance.

The conditions of the niche determine, which structures of an organism can be reduced. Endoparasites can reduce all organs of sense, their alimentary canal, the organs of locomotion etc.

The penguins, the ratites and the great auk have transformed their wings into paddles. They jump into the water, but have to climb out of the water. They inhabit and inhabited the Antarctic respectively the Arctic regions. The penguins follow the cold Humboldt current beyond the equator. The penguins did not suffer interference by *Homo*, they still thrive. From the beginning of polar navigation, the great auk guaranteed the food supply of *Homo*, until the demand surpassed the supply. Their number dwindled, the last chapter of their existence was written by volcanism and by scientific man. The one but last abode of the great auk , a small island near Iceland was destroyed by volcanism and the last specimens, still breeding, were "collected" by icelanders, supplying museums.

Both taxa live socially and on land they are devoid of the flight-reflex. The different history of both taxa was instrumental for the extinction of one and the flourishing until today, of the other.

The ratites are inhabitants of the semideserts of Australia, Africa and South America. The regions are large, not very stable and disturbed by *Homo sapiens*. The prognosis for the further existence of the ratites is bad, at the margin of their biotope, they get interfered with by *Homo*. In the northern hemisphere, they are already extinct, since the Tertiary.

The evolutionary change of crossopterygians and ichthyostegids is accompagnied by the loss of the lepidotrichia, the exoskeletal fin-supports. But *Ichthyostega* has still lepidotrichia in its caudalis. Not a single Carboniferous amphibian has still lepidotrichia. On land, lepidotrichia are useless, they suffer reduction because of lack of function, even change of function does not apply to them.

When colonisation is not caused by drifting, island-hopping or chance, it is by development of organs enabling colonisation. But organs, which enable the taxon to reach the region to be colonized, are not necessarily those which have selection-advantage in the colony.

All elements of the apparatus which enabled crossopterygians to inhabit the shore of the land: lungs, the vertebral column as strut, four legs, protection from evaporation, are not necessarily required, after this has been the case. The oldest legless Amphibia are to be found in the Upper Carboniferous, hence only 25 million younger than the oldest tetrapods.

The amphibian repertoire of the legless Nectridia was adequate, to guarantee the first land-dweller the return to the water.

The first adaptation of the land dweller leads into the biotope of freshwater bodies, it is reduction of the four legs which have come into existence only a few million years previously. There was no future for the nectridians, but for a limited time, they ruled in their niche. The larger the newly colonized areal, the more niches are available which require other or less adaptations than those which the founder-population carried from the water to the land. The act of colonisation for instance by drifting, requires small size and lightness. In the colony there are, however, many niches fit for large animals with great weight.

A corresponding process in the history of science is the discovery of X-rays in 1895. The discovery opened a new and large field of research, in which many investigators qualified themselves. In the course of time - on the basis of X-rays, many discoveries were made, of greater weight than X-rays; but none of the numerous investigators discovered X-rays. The constellation for doing so was historic, the premises were unique, the personal qualification of Röntgen was likewise unique.

There are in science rare key-achievements, discoveries of laws, which - found out by a single person - sprout into a multitude of activities, for instance crystal analysis by X-rays. Detection of faulty welding, detection of faults inside cast iron structures etc., macromolecular crystallography etc. Whether the future of this achievement leads to decadence or to the gaining of a higher level of insight, is determined by the historical situation. The development of scientific tools and methods is aromorphotic, their application is ideoadaptive.

5.10 Evolution and the principle of economy

Quite recently, one tried to measure the dimension of evolution by pairs of concepts, indicating the extremes in a series of phenomena: micro- contra macroevolution, aromorphose contra ideoadaptation, evolutionary change and stasis, typogenesis and typostasis.

For different speed of evolutionary processes, Simpson conceived the concepts tachy- and bradytely.

However, since Bock and von Wahlert (1965) discovered the principle of economisation as one of the foremost factors in progressive evolution, there is a measure for the manifestation of evolution. To measure evolution, we do not longer use its speed or the origination of new taxa, but the level of economisation. Genetic advantage is direct proportional to the energetic expense of the existence. The surplus of living descendants is bigger, the lesser the consumption of energy-expenditure for maintenance.

Overpopulation of a taxon can ensue only where the taxon lives in a status of monopoly. *Rattus* on small islands, *Agrotis vestigialis* on *Pinus*, immigrants like *Oryctolagus* or *Opuntia* in Australia. Monopoly of *Homo sapiens* is singularly, without precedence, labile, endangering the biosphere and hardly controlled by homoeostase.

5.11 Progressive evolution of the biosphere and the society

It is not futile to point out the many correspondences one finds, comparing social and biological evolution. Coupling in cultural evolution, is an essential character of it. Transmittance, of culture, mixture of cultural and biological matter is the rule in human existence. The construction of an automobile by transforming a cylinder-pump with piston, into a motor, putting it, as power source, into a carriage, is a quite normal human procedure. The more components such procedure engulfs, the more complicated the resulting apparatus gets. The discovery of the large catastrophic and global events, is such a multiparameter achievement. Nature outside the human sphere, cannot utilize feedback, only genetic transmittance of information is possible.

By superposition of two independently formulated statements on the principle of economisation in biological and human evolution, I demonstrate the great similarity of both phenomena.

A. Technological-social principle of economisation: I cite from: "Politische Ökonomie 1955, p. 94. Akademie der Wissenschaften USSR (my translation from the German)": "The development of the powers of production for mercantile goods, is based on the law of values. The value of goods is determined by the necessary social labour. Those producers, being the first to apply a higher technology, produce cheaper, but - can sell their goods at the price, based on the still necessary social labour and make more profit. The other producers are forced to apply the higher technology to keep in business. Thus, the isolated actions of single producers, working for their personal advantage, drive to progress and drive to the development of the productive power of the society."

B. Biological principle of economisation.

"Every taxon is subjected to permanent change of the economisation of its demand, to exist in its niche. The less the demand on the individual, the bigger the available energy for the reproduction. This available energy can be used for reproduction, but this is not obligatory. Reproduction too is subject to economisation. The more economically adapted offspring dominates the less adapted one and can displace it. In the course of time, the phenotype of a taxon moves compulsorily in the direction of economisation." This statement is easy to make, since Bock and von Wahlert (1965). They have found many able supporters of their rational considerations of adaptation . Before, there are only a few, but of pioneers from the play-phase (chapter 3) of this theorem, more and more are recovered. Dialectics they have been only in few cases. Hence we have to find the antithesis to Bock's and von Wahlert's principle.

Economisation of a taxon in its niche con only manifest itself in a niche with gradual demands on the taxon. If the demands would be equal anywhere in the niche, the economisation of the taxon with its genpool, after reaching an optimum - would approach stasis.

5.12 Economisation by adaptation and by negation

According to Quiring (1930), there are two modes to the solution of the taxon in its niche. I will try to illustrate Quiring's statements with the example Poikilothermy versus Homoiothermy: "From a biotope with a small daily temperature amplitude - water - the first tetrapods fly on to the dry land. There, the daily temperature amplitude is greater. The extreme values of the daily temperatures are too high for the first tetrapods, when still being a fish. The simplest, oldest adaptation to counter heat, entailing the least demanding change, is the torpor for heat and cold. The later, more difficult adaptation to the terrestrial temperature amplitude is the evolution of homoiothermy. Torpor means solution of tension of individual and Umwelt on the route of least resistance. Homoiothermy means solution of the tension on the route of negation. That is the evolution of independence from the terrestrial heat extremes, by regulating the body temperature near the physiological optimum.

I can think of the evolution of torpor as a relatively simple act. The evolution of the internal temperature-control by means of homoiothermy is a process, necessitating many coordinated evolutionary steps, similar as they are observed with the evolution of a synorgan. In the Mammalia, the steps I can muster, are - among others - :

1. permanent intake of food, rising of the metabolic rate
2. mechanisms for heat control in the cerebellum

3. mechanisms for lowering the body temperature. Exudation of sweat.
4. mechanisms for rising the body temperature by movement. Tremor.
5. mechanisms for saving energy by contraction the peripheral capillaries or other organs of isolation: hair, fat, feathers etc.

After homoiothermy is established, torpor can no longer serve for temperature control. A new mode has to be developed: hibernation.

The most demanding homoiothermous animal is *Oceanites oceanus*, which, during the year lives in two summers, in the Antarctic and in the Arctic, that is, under conditions of longest days and shortest sleep.

The torpor of reptiles is - according to Quiring - the solution of the tension, the contradiction, by adaptation. Adaptation is fixing the taxon into its niche. Adaptation - as Quiring sees it - does not allow a widening of the niche. Homoiothermy of mammals is called by Quiring "negation of contradiction", between taxon and niche. Negation is not solution of the tension on the route of least resistance, but by means of the evolution of new contrivances, which actively solve the contradiction. Both types of change, torpor of reptiles and homoiothermy of mammals, birds, social insects, optimate the existence of the taxa concerned. With torpor the energy expenditure can be lowered, with homoiothermy, the energy expenditure has to rise. Rise of energy expenditure is strictly the negation of the principle of economisation. Is there a solution to this contradiction?

Survival in the face of rising selection-pressure can be done by migrating beyond the margins of the niche. Are for instance the niches margins, the border between water and land , flight out of the water, mean lessening of the selection pressure in the water, but hightening of energy expenditure - on land the body does not float. Higher energy expenditure is also the dialectic relationship between aggressor and defender. Agression and defence by running lead - in geological time - to an increase in speed and consequently to an economisation of the organs of locomotion.

With the progressive evolution of the organs of locomotion are coupled all organs of the organism and are subjected to a similar increase of performance. The origination of homoiothermy is "negation" according to Quiring. It is interpretable under the assumption of the displacement of therapsids of the Upper Triassic by the Archosauria. The therapsids shrink in size and inhabit the nocturnal and subterraneous milieu.

Optimation of the organs of the locomotory system and the nerves and organs of sense can result from economisation while hunting. Increase of demand on the locomotory system during hunting may lead to its economisation.

The two concepts of Quiring, adaptation and negation, correspond to the two concepts of Sewertzow, Idioadaptation and Aromorphose (SEWERTZOFF 1931, loc. cit., p. 156): "We define those morphological changes as idioadaptation, which adapt a taxon to different and complicated changes of the Umwelt, thus winning the struggle for life." Aromorphoses (loc. cit., p. 136) .. "are those alterations of the organisation and the functioning of a taxon, which are of general importance to it and rise the energy of its life-activity."

5.13 Centripetal and centrifugal adaptation

If the optimally adapted taxon increases its population in its niche beyond capacity, the optimum changes into the pessimum of overpopulation. Alleles, previously lethal or pessimal may now become optimal. For instance , changes which foster individualisation, compared with those which at an earlier phase, fostered socialisation. Socialisation is a negative factor when the optimum of density of the population is passed. The individual suffers hunger if it is tolerant to the neighbour, if the foodbasis is too small.

The example demonstrates the dialectical nature of both. Increase of one of the tendencies leads from optimum to pessimum.

If the contradiction between taxon and niche are dissolved by centripetal reaction of the genpool, the overpopulation is the result. If the contradictions are dissolved by centrifugal reaction of the genpool, the population is shrinking beyond the periphery of its niche and grows along its distributional borderline into the pessimum, into the region in which it can no longer exist. Centripetal adaptation lowers the pression of the population. Rising density of the poulation can be compensated by decrease of the individual demands on the foodsupply. The Pleistocene dwarf-elephants of Malta are an example. The adaptation to vegetable cost - an exception in Lacertilia, but the rule in therapsids and mammals, may have been centripetal adaptation. The utilisation of this potential food supply led to a lowering of phylogenetic potency. The greatest number of individuals and largest individuals are supplied today by therapsids and mammals. Though no new higher taxa stem from herbivores.

Man's success in domestication by producing - by castration - almost complete populations of females in *Gallus, Rangifer, Equus* corresponds with the phenomenon of parthenogenesis in nature. From equality shrinks the number of males to practically zero, the population density of the females increases. The population gets more and more homozygote alleles in its genpool and looses more and more the faculty, to react to external change via recombination. Little pressure on the niche, lack of competition foster the degree of parthenogenesis. Parthenogenetic taxa are to be found in a milieu, which does not demand great potential for change. Fossorial life decreases - in general - the phylogenetic potency. The locomotion of snakes is correlated with the loss of the extremities. From my point of view, this is "a change in the organisation of animals, of general importance to them and increasing their energy of life." In any case limblessness has created a new niche for lacertilians. Sewertzoff (loc. cit., p. 150) is of the opinion that the origin of snakes does not imply an aromorphotic step. But the loss of the extremities led to the existence of today 2500 species. Thus, the success of snakes is a fact and I call this an aromorphotic event.

The development of byssus in mytilids and the fixation of the larval oysters to the hard substrate on soft ground, that is on the shell of their parents, is of general importance for the taxa concerned. Their biomass increases considerably in a substrate which is not densely populated by lamellibranchiates, apart from the two taxa. I would call byssus and larval fixation aromorphotic. With *Homo*, the snakes, *Mytilus* and *Ostrea* originated "life of a new kind". With Quiring it is in all four cases change by negation. The example of the two Anisomyaria is telling. With the fixation of the larva, the niche of the taxon increases, hence it is centrifugal. But coupled with this, is tolerance to the extreme density of the population and tolerance to the own excreta, a conditio sine qua non. The elastic (*Mytilus*) and the rigid (*Ostrea*) connection of the individuals, forms a colony - better a superindividual, functioning in *Mytilus* as a breaker-protection. The series of morphological steps, leading to the final result are centripetal.

The observed miniaturisation of all Mesozoic mammals (KÜHNE 1973) is idioadaptation, it closes for them the biotope of the open country, the biotope of the Dinosauria, and it opens the nocturnal, subterranean biotope, as well as the arboricole one. From the Jurassic onwards, larger therapsids, the forerunners of mammals, have not been found. If miniaturisation is idioadaptation, homoiothermy is aromorphose. Both take place in the same taxon, at the same time, in conjunction.

5.14 Evolution in the small and in the big

The taxa subjected to evolution have a cell-count of one to 1 billion.This parameter alone is prone to condition the evolutionary happening. It is to be expected that in respect to the evolution, the one-cellular-beings are governed by different rules, than few-cellular, multicellular and beings with a still greater number of cells. The micropalaeontology as well as the genetic of microorganisms ought to differ from macropalaeontology and the genetic of macroorganisms. In micropalaeontology and in microgenetic one takes advantage of the great numbers and the fast sequence of generations. I think we are today far away from an insight of the many functions DNA can perform. Todays knowledge can be incorporated in todays statements. If the homoeostase of the individual is dependent on n inner factors, it is with n^n inner factors canalized , the changeability is restricted. The longer evolution lasts, the more integrated are the biota, the smaller the changeability and the more instable, the more vulnerable they are. Temporally nearer is the collaps, though information is taken up by the following generations.

5.15 Progressive change of organs and contrivances

We can build a sequence of phenomena of change, from the variability to the formation of the extremely historical synorgan.

1. Fluctuation of a taxon allows reaction to fluctuating change of the biotope. Litter size, body weight of the offspring, structure of the fur, water- and food demand are subject to fluctuation. Short dated and reversible change of the milieu can be met by fluctuation. The larger or smaller fluctuation is the mechanism , to survive shorttime extremes of the milieu. Degree of fluctuation and kind of fluctuating characters are inherited, irreversible attributes of the genome. The essential of fluctuation is its reversibility. The diminutive individual from the time of pessimum has normal sized offspring in the time of optimum. It is a character of beings, comparable with the elasticity of solid bodies. Under impact, the body is deformed, but does not break. Does the impact fade , the body regains its old form. Under fluctuation, a population's Gauss-curve, mooves on the ordinate in both directions.

2. Splitting up of a genpool. When the ecological and historical licence is enormous, when an ocean or a continent is vacant, and offers itself to colonialisation, splitting of the genpool of the only pregnant female is immidiate. In the breeding-cage, in 20 generations, *Mus musculus* can produce all colour variations from white to black from its genome. The races dove and dog are the same phenomenon. The Galapagos-finches are a similar case (LACK 1947). The breeding experiment is governed by strict isolation; in the natural experiment ecological and geographical isolation is acting.

The genpool contains homo- and heterozygous alleles. Measured for their suitability of the taxon in its niche, they may be suitable or not suitable, positive or negative. The areal of a taxon is filled with numerous populations of different size, with only minimal gene flow, but few measurable differences in their genome. In the optimum of the taxon's niche, it is different from the one at the border of the niche, at the pessimum. The distribution of each allele in the niche follows defined gradients. In 1952, Zimmermann mapped the evidence of the x-tooth in the north of the distributional area of *Microtus arvalis*. The ultimate upper molar, the M3 of the fieldmouse has 6 enamel-loops. But the simplex-variation has only five. In other microtines, this state of reduction has already been reached, respectively been passed; here it is a peripheral phenomenon. The genepool is a genetic reservoir . From it genetical material can be called off immidiately. This latent-heterozygous reserve is a normal load for the taxon. The woolly hair of the Pleistocene *Rhinoceros* and the long hair of the mammouth are probably the result of genepool-splitting. The colonisation of Australia by marsupials is a kindred phenonomenon. Palaeontologically, the splitting of a genepool can be demonstrated only with an excellent fossil record: In the Norian, the ammonites become extinct but for the lineage of the Phylloceratidae. In the Lower Liassic, from this source, already 20 new genera have been derived.

The historical situation gave the Phylloceratidae the chance, to inhabit all those niches, which now vacated, were previously inhabited by the Triassic ammonites. The sudden evolution of all larger taxa of scleractinian hexacorals, at the Lower Triassic is a kindred case.

If the reserve of the genepool is exhausted, further change in the taxon is slowed down. In this case the taxon is unable to compensate sudden fluctuations of the milieu. The taxon can only emigrate, if there is a free areal available. If fast and widespread changes of the milieu do happen, en-bloc-migration of the biosphere can be imagined, such, that the biosphere by migration lives under more or less stable conditions, with the loss of least qualified taxa.

If a system or an organ is subjected to change, not to be met by the genepool, the process of change slows down; fitting mutations are not those which change a certain character, but only those which can be integrated into the system or into the synorgan.

3. Manifestation of a trend. With some taxa of Foraminifera of the Lower Cretaceous whose subsequent populations can be traced through about 10 million years, very flat Gauss-curves (diagrams of variation) are observed (GRABERT 1956, GERHARDT 1963), the polymorphy is very large. It can be shown that, on the time axis, the mean values migrate in the same direction. For instance, the size of the foraminifers increases and the number of chambers too. These are processes of change, genetically conditioned. They are concerned with most simple, genetical change during long times. By mutation, the genes for larger size and more chambers have to originate, have to accumulate in a heterozygous state in the genpool, until they - in the homozygote state - come phenotypically into existence. In the course of time (Fig. 13) the

taxon migrates on the ordinate, the axis of chamber-increases; thus a progressive specimen from an older sample equals an oldfashioned specimen of a younger sample.

If one obtains sequential samples from a short time span - o.5 million - one observes a fluctuation of the mean value of the Gauss-curve.

A trend is only visible if it is followed through one million years - that is, if the degree of deviation from the taxon's mean value is surpassing the degree of variation.

The increase of one chamber of the shell of a foraminifer, one may regard as a rather simple matter. The hypsodonty of a molar of a horse is extremely complicated; in one lineage of the Equidae, it increases steadily through 50 million years. Increase of hypsodonty is an integrated process of phylogenetic change of many tissues to reveal the phenotypical result. Enamel, dentine, cement, the periodontium and bone are immediately concerned. Blood supply, supply of space, supply of minerals have to be granted. The simple "enlargement of the molar of an equide" in the course of 50 million years is an extremely complicated aromorphotic process, to which a synorgan is subjected.

4. Secular evolution. Phylogenetic change in systems and synorgans (aromorphose).

Synorganisation, aromorphose, is a process lasting several tens of millions of years. Sometimes we can observe the end of the synorganisation. Monodactyly in equids is the end of the reduction of the digits. The process lasts through the whole of the Tertiary - 60 million years. Only one lineage of more than 20 reaches the final stage.

The reduction of the bones of the lower jaw from eight to one in the lineage therapsids to mammals lasts from the lower Permian to the Lower Cretaceous. The inclusion of the articular in the middle ear, its liberation from the jaw joint, lasts from the Lower Jurassic to the Lower Cretaceous. From this time onwards, the triad, malleus = articular, incus = quadrate, stapes is established and does no longer change. The change of the angular into the tympanicum is still going on, an astonishing diversity is observable, from a simple ring to a bulla, with all possible neighbouring bones engaged in it. The diversity of the tympanicum is a function of its liberty; it is the only bone in the sound conducting apparatus not linked with the other bones, it serves the suspension of the tympanic membrane.

From the first vertebral column in the Upper Devonian, which serves as a strut to carry the body above the ground, to a vertebral column of five regions, with anticliny and an axial musculature allowing the gallop, 250 million years are necessary.

The evolution of the dentition from Permian Cotylosauria to Tertiary Mammalia is a process lasting 270 million years. 20 stages can be described in chronological sequence (KÜHNE 1973).

From the Upper Carboniferous to the Upper Triassic, that is 100 million years, upper and lower teeth do not differ, though the upper are wider. From the Lower Jurassic onwards they differ. Up to the Lower Triassic, dentitions are formed by similar, unicuspid elements. Later, regional diversity developes. The dentition is divided into incisors, canines and cheek teeth, serving different functions. From the beginning of the Jurassic there are teeth, which last lifelong, they are not changed, the molars. Before, all teeth are changed many times, i. e. polyphyodonty. In the Jurassic and Cretaceous our forerunners possess teeth which occlude. Upper and lower teeth have corresponding, almost vertical cutting edges and surfaces. Later in the Tertiary the primates possess less high cutting teeth. The shear function vanishes, the teeth are much flatter, free movement of the jaw is possible.

The evolution of the tooth and the dentition was permanently under heavy selection pressure. At no time during 220 million years, we notice stasis. The amount of change, we notice by comparing the first and the last step. That this series of integrated change did not happen faster, demonstrates that this has been impossible. The formation of the mammalian dentition is not a steady process, but it happens extremely slow, not as an occurrence but as a historical sequence of occurrences.

In 1949 L. v. Bertalannfy complains: the origination of higher taxonomic units and of the origination of synorgans, cannot be comprehended, taking recourse to genetics. Later Remane, Storch and Welch (1973, p. 160) write: "More difficult it is to explain synorganisations with the help of known mutations." They cite in this connection a letter of Darwin to Gray: "If I consider the human eye, my temperature rises." Darwin, v. Bertalannfy and Remane et al. witnessed inter alia the elucidation of mitosis, the elucidation of heredity, Mendel's laws, the discovery of the structure of the Double Helix of DNA. But they cannot witness the origination of the human dentition, of the human eye, or the origination of the taxon Archosauria, because all three phenomena are historical, they did happen about 300 million years ago. The answer to Darwin, Bertalannfy and Remane et al. is: "No, this question cannot be answered, because it is not answerable. We can enlarge on the wonder, the annoyance and the complaints: Synorganisation when they can be traced palaeontologically, through the hundred of million years, as for instance in the dentition, the vertebral column etc. are historical sequences. Palaeontologically, the bird's eye is not an object to study; the bird's feather is already the palaeontologist's object of research, thanks to resin-embedded feathers of the Lower Cretaceous resin from the Lebanon. The synorganisation of the mammalian dentition from the dentition of the Pelycosauria onward, from the Lower Permian to the Middle Jurassic, can be examplified in 20 phases. It can be subject matter of evolutionary teaching. Döderlein in 1921 examplifies one phase (of 20!) and considered it as the essential one: the evolution of root division.

Genetics can only elucidate the origination of species, this has the same reasons: Genetics cannot work historically. There is no cause, to deny progressive evolution. Large taxa are not out of time; punctual, or momentary; they are historical; their constitution is a long lasting process, not discernible in the time-moment of our presence. The origination of key characters, feathers, gnawing incisors, the enlarged tarsus of frogs, the rolling tarsus of Artiodactyla are aromorphotic events, but the steps to their materialisation have been passed, not of a different kind as for instance the origination of hair colour or wing venation of Lepidoptera; key characters have a history of their origination. The enigma of the origination of large taxonomic units, of synorgans can be elucidated by dialectical consideration of palaeontological evidence.

We observe the following conditions for the aromorphosis:

1. The unit of phylogenetic change is the mutation of a chromosomal locus of the gene.

2. The cladistic dichotomy of a taxon happens, if the number of mutations is sufficient to grant genetic isolation from the original population.

3. The selection pressure is such that adapatation in the sense of Quiring cannot materialize.

4. Survival chances are resulting from a change by means of higher demands in a system or organ which is in the position to solve a contradiction between taxa and Umwelt. Subsequent changes are not inhibited.

The number of aromorphotic changes in a certain taxon is limited. Likewise limited is its realisation in the history of the earth. Synorgans are not highly complicated, but are known by the coordinated function of their elements. Many such elements are built of simple mosaics or pavements of similar cells. The synorgans eye and ear are typical. Their subsequent build-up leads subsequently to an increase of efficiency. The series of functional increase of the eye reads: Sensitivity to light. Dark and light sensitivity. Perception of moving objects. Perceptivity of colours. The sequence for the ear reads: Perceptivity of noise, of different force. Perceptivity of noises, sounds, speech. Perceptivity of sounds and noises of different wavelengths. Stereophony. The build-up of a synorgan corresponds with the origination of a big taxon. Westoll (1949) has described it for the Dipnoa. Primarily in large intervalls a few evolutionary steps happen. Later on, the intervals get shorter. Until about 2/3 of the features constituing the taxon are existant; in the third phase the velocity of change decreases, the synorgan approaches the optimum. Mutation leading to further improvements getting rarer because the integrated synorgan leaves few openings for additional mutations.

If the build-up of the synorgan takes more than 10 million years, the partial or complete reduction is a matter of a few generations. This can happen when the ontogenetic process is disturbed. If we see the elements of the synorgan forming a chain, the loss of one link means the partial or the total loss of the synorgan, wherever in the chain the link is situated.

Evolution results from the conflict of changing and persisting tendencies. A state of tension between Umwelt and taxon is dissolved by change of the taxon. The alternative to change is extinction. Extinction follows if the contradiction between taxon and Umwelt cannot be dissolved. Withdrawal from the situation of contradiction, emigration, is only rarely possible and successful. It is merely a delay of the dialectical conflict. Staying in the contradiction means additional energyloss, it lowers the chances of survival, reduces the size of the niche and the size of the population. Finally, the last individual cannot find a partner. Rarely is this process so long drawn out, that the taxon concerned, lasts into the next higher biological stratum, as being a living fossil.

6 Practice is the criterion of truth

6.1 Dialectic-materialistic theorem

The title of chapter 6 is the most succict rendering of the theorem. It is characteristic that a subscriber of dialectical-materialism, leaves out as irrelevant considerable sectors of philosophical activity and proceeds to the solution of the problem, while the non-dialectic may be still occupied, with Kant's "Ding an sich".

We too are not "philosophical", but pragmatic and practical and acknowledge palaeontological truth in its all embracing practice.

6.2 Premises for palaeontological discoveries

The analysis of palaeontological discoveries in the preceeding chapters yields the following results: Discoveries are made when the required knowledge and prepositions are sufficient; in general these are little knowledge and few prepositions. Theories get formulated likewise, when the prepositions are sufficient and not after a great amount of evidence has been accumulated. The antithesis to a thesis, its falsification, can happen if one item is known, not in accord with the theory. The glacial rock-polish at Rüdersdorf (chapter 3) was sufficient to falsify the drift theory and to create the theory of inland glaciation.

6.3 Proof of relationship between fossil taxa

In palaeontological phylogenetics one meets the notion, to proove phylogenetic relationship of two taxa, "all characters" of the two taxa ought to be known. With this demand, the question of near or not so near relationship can be postponed until the scientist looking for new parameters, finds them, but has tired. Applying this procedure, more and more characters are found, but the answer to the question of relationship looses its distinctness and disappears finally, in a welter of characters.

"All characters" are a function of the moment of registering. It is obvious as long as phylogenetic research goes on, that new methods are developed outside of palaeontology, to be applied by palaeontologists; statistic of variation, ultrastructures, computerprograms are developed, to get answers from one hypodigm or of two. But these answers are not relevant to the original question. These emerge from observations of lineages and their quantitatively deviating from the norm in time (lineage-research, examplified by F. Bettenstädt, chapter 4.4), and by the demonstration of synapomorphies (HALDANE 1948, HENNIG 1966).

Such practice of phylogenetical research does not yield results, making visible a sequence of generations, it shows only change of few parameters in a chronological sequence of hypodigma. Under these conditions the lineages are short. It is easier and more probable, to follow 10 lineages through 10 million years but to follow one lineage through 100 million years. During this kind of work, the principle of optimalisation is of great importance; as it is with all practical work, pursuing one's aim: work, which detracts from the aim pursued, is bypassed.

6.4 Practice of palaeontological discovery

In palaeontology, there is - happily - a further field of activity, related to the theorem of this chapter: It is the supply of hitherto unknown fossil higher taxa, from the suborder upwards and from the Precambrian upwards, that is, from the whole Phanerozoic, including the oldest part, where it merges into strata where fossils - out of our view - are absent.

As I said in the introduction, in order that the result of our activity is such, that it is new, and I can proceed with its description, I have to avoid collecting as it is usually done, in rock which offers itself to the layman. Such kind of rock is for instance any kind of soft rock, weathering superficially or being committed to agricultural activities. Here the fossils can be picked up in damaged condition, but free from matrix, and generally have been picked up for decades. The fossils of Nehden of the Upper Devonian, with *Cheiloceras*, the fossils of the Oxfordian with the *Cosmoceras* fauna at Neuvizy, Novion Porcien, Launoy, the acre at Muallimöy, Gulf of Izmid near Istanbul, with *Arcestes*, and the rock of the fortress at Er Foud in South Morocco with its *Clymenia* we exploited. Such cultivated fields or naked badlands of marly rock are ideal locality, to sample large hypodigm - They offer themselves to any collector who knows the spot. The said localities do not offer to the collector any difficulties nor to the scientific author.

If we collect from any limestone "steinkern" and "abdruck" of molluscs, we have to collect of any fossil two specimens, and these two have to be kept, from the moment of being collected, as a pair, together and separately. To collect of Mesozoic cephalopods the abdruck "is not done". The steinkern falls out of the rock, the abdruck necessitates care and effort to free it from the surrounding rock more or less completely. And so it is with the trilobites and brachiopods from any weathered quartzite. A logistic, to perform this sort of collecting is merely to travel to the locality, or to the prospective region. I tried to collect in 1957 in Sauerland Upper Devonian *Clymenia*, as I could not demonstrate a single *Clymenia* during class work. I failed to find one. 10 years later, our excursion lead us to collect in Er Foud. We collected clymenians by the hundreds - I refused, to have fragments collected - only to learn at home, that fragments were better for sections than whole specimens. The first team visiting such spot can collect enough, to supply anyone needing such stuff. It comes handy for exchange.

6.5 The locus axiomaticus

The locus axiomaticus for the fossils we have decided to collect, is an artificial exposure, from which no or a few fossils have been collected previously, unless the fossils crop up as a function of the winning technique and are easily observed.

In the following, I give an account of five facies where I personally discovered and worked the deposit, or where others did the same. The five stand naturally for many others where my experience is less or absent.

6.5.1 Mesozoic karst

The phenomenon karst is a global one. The solubility of limestone is a fact which leads to karst whenever limestone rises above the watertable, and rainwater can circulate vertically through a mass of limestone.

In the Holocene, karst is present as hollow caves, the abode of Palaeolithic *Homo sapiens*, who uses often caves inhabited since the Pleistocene. The Tertiary karst is exposed as cave- or fissure-fillings and encountered globally. During quarrying the fissure-filling is exposed and is thrown together with overburden into the nearest exhausted quarry. Rarely one can find the karstfauna in such secondary deposits. Naturally Tertiary karst is known from such regions, which during the last 200 years have used limestone as burned lime, as road metal, or as flux in the siderolithic industry. The number of Holocene and Pleistocene karst occurrences is thousands. The number of Tertiary fillings is hundreds. A good field of Tertiary karst is the exposure of the Upper Jurassic from the river Main to near the region of Lions; it measures 800 km in length. Of Palaeocene karst I know only the locality Walbeck near Hannover, discovered by an unknown teacher who reported to Johannes Weigelt, who exploited the locality with great success. Another quarry near Rio de Janeiro is the only karst fissure filling known in South America, the material having been described by Paulo Couto. While I was working on this translation I happened to register graphically the karst fissure fillings in the geological systems of the world (Fig. 3). Only one fissure filling of Cretaceous age is known up to now. The curve, beginning with two Permian localities, registers a deficit of about 40 Cretaceous fissure fillings. They are not to be found in Central Europe, a region where the Cretaceous, has been mainly marine. No Tertiary fissure fillings are recorded from Great Britain and from North America. Apart from geological reasons for this absence, social reasons are manifest. Up to 1890, the Tertiary fissure fillings of Central Europe had been an important source of iron ore.The 800 km long belt of the Malm-outcrop contained the "Bohnerz-Formation", an oolithic limonite, not indurated, and to be dressed with flowing water alone. Along with the Bohnerz, the Tertiary mammalian remains became liberated from grit and clay and were collected and described, for instance by Rütimeyer. Where the populace was not depending on this iron resource, the fissure fillings were not exploited, were valueless.

A godsend for France has been the Quercy-field between Brive and Montauban, where the karstic cavity fillings are phosphatic. The preservation of bone is excellent, and so are the invertebrates (HANDSCHIN 1944). The same applies to the silicified arthropods from the Tertiary volcanics of Mfwanganu and Rusinga-island in Kenya, from where many vertebrates have been described.

To find the Mesozoic karst, the vast extent of Carboniferous limestone of Great Britain is the locus axiomaticus up to now. During Triassic and Early Jurassic times, these regions were land and subaerially eroded. As the region slowly subsided, below the watertable, the cavities, channels and sinkholes became sediment filled. Surface debris contains the bones of the animals, inhabiting the karst surface and the karst caves. The Jurassic fissure fillings have been near the sea or in the sea. The two Triassic occurrences in Poland I have not seen, nor the single Permian fissure at Fort Sill in Oklahoma. From there monographic descriptions of at least one taxon is available, but a synoptic view of the fauna, I have not seen up to now. A Permian fissure filling in the Spessart in Germany has recently been discovered.

6.5.2 Coal and sapropelite

These deposits are exploited globally. The smaller the industrial potential, the more frequently small and dwarf-occurences are exploited. In order that bone is preserved the humic acid of coal has to be neutralized. This is certainly not often the case. But among the thousands of coal pits working today, there is a vast unknown quantity of those occurences where the humic acids are neutralized.

The sapropelites are less frequently exploited and exposed. They often merge into paper shale. An unpublished chinese occurrence of Miocene age, promises to be even better than Messel (oral communication Kenneth J. Hsü). Of Mesozoic age, I do not know any locality. Of Permian age, there is the worldwide known *Mesosaurus*-locality in Brazil. Whole *Mesosaurus* are regularly offered on mineral- and fossil-markets, but the accompagnying fauna of fishes and invertebrates, I have not yet seen. The latter deposit contains habitus-specimens only, viz. complete corpses. The neutralized coal is generally the abode of predators - crocodiles - and the fossils are rarely complete corpses. The left-overs of crocodile are the dentitions of their prey. White mollusc shells are the best indicators for neutralized coal.

6.5.3 Metamorphosed clay sediments

Metamorphosed clay sediments, slate, is used as roofing stone in the temperate zone. The slatters split and formatize the slate. They cannot avoid to observe any fossil. If there is a market for fossils, they keep the fossils, until a buyer appears. Premises for the fossils to be observed and eventually prepared, is the identity of bedding-plane and schistosity. Any new slate locality will widen the fossil record, this is bourne out by the well known Devonian Bundenbach slate and the Miocene Glarner slate. However, greatest increase of knowledge comes from another Palaeozoic slate, the one of the Burgess-Pass in Canada. Since 1911 no second locality of this kind has been found.

6.5.4 Concretions

The discovery of another locality yielding concretions like those from the famous Upper Carboniferous Mazon Creek or the phosphatic ones from Uruguay, would be of greatest value. Mazon Creek is the most important fossil locality, because it is the source of invertebrates, vertebrates and plants, which have not been duplicated from other localities. The enormous number of concretions available has given a record of about 600 species.

6.5.5 Fossiliferous resins

A new locality for fossil resins would be a third window, through which the palaeontologist sees the reality of insect life as if he would observe a recent insect biocenosis. The two well known ones are the Baltic amber and the resin from Lebanon of Lower Cretaceous age. The known examples of the five kinds of fossil yielding rock are world famous for their fossils. But each kind is underrepresented. Each is known by less than 10 localities in the world; their potential however, through the whole Phanerozoic and even the Late Precambrian is hundred times larger.

6.6 Discovery

6.6.1 Each of the five kinds of fossils are practically encountered only in artificial exposures. This has the advantage of easy transport to and from the exposure. On the other hand it demands from the geologist a measure of tact and of human knowledge, which guarantees to him permitted access, sometimes for years. It is with other words, that the geologist is the friend of manager, foreman and workers. He must realize that quarry- or mining-interests have priority to fossils. Safety measures have to be strictly followed.

6.6.2 The discovery of Mesozoic fissure fillings began with Charles Moore of Bath, who - before 1867 - started work at Holwell near Frome, where a grey, respectively brown gritty clay contains so many Rhaetic fish teeth and scales, that any observer will be fascinated by the aspect of gathering the fauna. *Microlestes* (now *Haramiya*) was a rare faunal component.

The Eocene coal locality Geiseltal was discovered by the Mine-official O. Schulze, who reported to Johannes Weigelt in Halle. The Miocene coal locality Viehhausen near Regensburg was discovered by a person unknown to me, but at Viehhausen large Mammals do occur, which make themselves noticed during mining operations. The Kimmeridgian coal locality Guimarota was discovered by the Berlin team. We were lead to Portugal by the many dinosaur bones, exposed along 150 km of coastal exposures. The coal was sprinkled with white mollusc shells. The same is the case with the Upper Cretaceous coal of Ajka, Hungary, a locality not yet exploited for both resins and vertebrates.

The Upper Devonian slate of Bundenbach is so full of pyritized whole animals, that any slatter observed the fossils and a stream of Bundenbach fossils began to flow, as soon as a market for these fossils established itself. No Mesozoic slate is known to me with a fauna. The alpine, Miocene slate of Glarus, Switzerland, contains a fishfauna, it is a turbidite. The long *Lepidopus* are regularly broken, so that head and tail do touch each other.

The Middle Cambrian slate of Burgess Pass, British Columbia, was discovered by Charles Walcott; one *Marella* was on a rock specimen observed on the talus by him.

The concretions of Carboniferous age, in the British Midlands, at Autun in France, at Mazon Creek, Illinois, are near enough to palaeontological departments, to guarantee a flow of specimens to such departments and to satisfy the demand for concretions by amateurs, who soon began collecting by themselves. The phosphatic concretions of the Rio Negro in Uruguay of Carboniferous age are exposed in a river bed. The circumstances of their discovery are unknown to me. Every geologist, passing the spot in summer at low water, would split an exposed concretion and take it to the nearest binocular. Amber is known since the Magdalenian, and Columbus met amber ornaments worn by the red indians, when he discovered America. The Sicilian amber - the simetite - is mentioned in literature since Pliny. Of the Cretaceous resin from Lebanon, Fraas brought a sample to Stuttgart.

50 years later this sample was shown to Willi Hennig, and D. Schlee went to the Lebanon and collected about 10 kg of raw resin material. Accidents, lucky circumstances are instrumental for the discovery. Wherever the observation is beset with difficulties, the discovery could materialize, if the miners education would comprise an elementary knowledge of evolution and of palaeontology. Whereever I've made palaeontological discoveries in Europe, the miners had not the slightest idea of the stuff they were engaged with, for decades.

6.7 The fossil field

After the discovery of a locality, efforts have to be divided while the exploitation goes on; the prospecting for additional localities is imperative. Seldom is the first spot the best spot. Number one in Somerset produced *Haramyia* and *Eozostrodon* - isolated rare teeth. Number two gave us the hypodigm of *Oligokyphus*. The skeleton from the premaxillary to the tip of the tail. If the discovery and the exploitation of the locality is in an artificial exposure, and there is only the one where the discovery has been made, there cannot be a fossil field. Fossil fields are the Baltic amber, the Geiseltal, Somerset and Glamorgan for fissure fillings, British Midlands coal for concretions, respectively Mazon Creek. The Dordogne for prehistoric man. Isolated, single occurrences are the Glarus slate, Messel, Lebanon for amber, Burgess Pass of Middle Cambrian. Only 50 years after the discovery, the attempt was made to investigate the neighbourhood and to find six more occurrences.

6.8 Logistics

As almost all localities we are interested in are artificial exposures, the problem of transportation does not exist. The problem No. 1 is to guarantee the visit of an expert at our prospective exposures. If the visitor meets positive indicators, the exploitation begins, after an agreement with the mine-officials, or the quarry owners etc. has been reached. The scientist working at or near the sites of exploitation by the workers, is practically an intruder, a factor of disturbance. Hence a good measure of tact is required. Moreover it pays to be as informative as possible to any member of the crew who shows interest.. At Mazon Creek the collecting has been done by amateurs. The task of the scientists has been to build up a relation to the amateurs, which is so good that practically all specimens, which are of scientific interest find their way to the working bench of the scientist. There are different routes to achieve this object. Many amateurs have an innate interest to the specimens they collect. It would be senseless, to offer payment for their specimens. If conditions like Mazon Creek realize in a country of utter poverty, it may be opportune to engage workers to do the collecting. We had in the Guimarota and at Uña very good experience with Portuguese and Spanish women. A team of 10 Portuguese men we engaged in a dressing operation to produce isolated teeth of the Guimarota coal. A negative parameter in collecting is legislation or governmental supervision. The legislator regards - wrongly - fossils like archaeological objects and living animals and plants, as national property in order to claim a fraction of the scientist's result. The fossils collected owe their existence entirely to the activity of the collector; without the collector, they are eroded away or weather away or crumble to dust; as they did since the respective rock became part of a landscape. The way to the tip heap or to the cement kiln, or into the oven, to be burned for heating a powerstation or a house, is the way of any fossil in coal - unless a qualified worker intervenes and applies methods to make the fossils object of scientific interest.

If the collector is working in a country of very small cultural or educational potential, the national prestige is indirectly proportional. To respect this is imperative to the visiting scientist. In case of success, the indigenous colleagues cannot avoid the feeling that an opportunity to better their own reputation has been taken from them - this is a fact; the visiting scientist, the guest in a foreign country, has various means to counter the feeling of the indigenous colleagues. For instance, using copiously the name of indigenous colleagues, life and dead, as patronyms, if new taxa are named. Or to have papers printed in the local journal or official memoirs. For me it was self evident to return after description all described specimens to the respective national collections.

There is an obvious duty of the scientist to give his scientific results, by means of publication, to mankind. If any country possess a unique kind of fossil deposit as Solnhofen, Messel, Burgess Pass etc., two things are imperative: First, the publication of the fossil material has to be speedy and in an international acknowledged language. And the drawings have to be good enough to be copied in secondary literature. Delay to publish - mostly for personal reasons - often it is incompetence or an elitarian attitude of the prospective author - has to be counteracted with all means. Secondly, the surplus specimens have to be distributed as far as possible, as objects of demonstration in university classwork. Students have to have autopsy of "rare" occurrences, in order that they take such phenomena into their teaching program. This being the only means, that such occurrences as the Phyllopod-Bed at Burgess Pass, the sapropelite of Messel etc. are not a locality, the material of which is to be kept unavailable in masses in national collections. Such material has to serve as example, to lead to the discovery of other kindred localities in the world.

It is no wonder, that the authors of the Burgess Pass-fauna point out the uniqueness of this source of palaeontological evidence. Since 1911, no second comparable locality has been discovered. Of 1000 students of palaeontology, perhaps two have had autopsy of Burgess Pass material.

As the description of the postcranial skeleton of the Upper Devonian ichthyostegids of Greenland is postponed since 1930, I definitely recommend to deviate from an ethical rule, namely not to interfere if a scientist is engaged on a certain fossil. This applies to quite a number of cases of living and dead vertebrate palaeontologists.

6.9 Future aspects

The description of the Burgess Pass fauna by Whittington and Conway Morris, has opened new vistas in the field of macropalaeontology. To consider the phenomenon of the existence of the Phyllopod Bed as unique, is ridiculous. In the Phyllopod Bed no unknown parameters participate. An ordinary turbidite, of small size, engulfing a biotope, yielding a marine fauna, living in the photic zone, is nothing extraordinary. Certainly the absence of Bacteria in the turbidite is no hallmark of Cambrian sea bottom life. The Miocene Glarus slate is likewise sterile. The preponderance of animals without mineralized integument, is a fact decreasing towards the presence, increasing towards the beginning of metazoan life, in the Middle Precambrian. The numerical preponderance of *Marella*, which led to its observation on the talus by Walcott, is a positive factor, but it is nothing extraordinary. Any collector uses direct light from above, and oblique light, reflecting the lustre of the fossil when its preservation necessitates such activity. If we are programmed for fossils without hard parts, I am convinced that we will find them. Burgess Pass demonstrates us, what we can expect.

A sort of animal life exists wholly weird, without precedence in the Phanerozoic apart from the few survivors, regarded as oddities up to now. Not only *Lingula* is such a flourishing relict, *Amphioxus* may be the same, the soft bodied cnidarians may be the same. There is no evolutionary change if the taxon does not grow into contradiction with its Umwelt.

This is an optimistic view, conditioned by my experience with Carboniferous trilobites, with Mesozoic mammals and with my experience in the Geiseltal as a youth. Doubtless, the discovery of Phyllopod Bed II is difficult, it is not easy, many occurrences may be promising without yielding the desired fossils, but the wastness of the geological existence of the unlikely is such, that the relation-formation of the collector with the desired object is a function of the frequency of such contacts. The hope number one in macropalaeontology stems from Precambrian and early Cambrian slate. Here are to be made the inroads into our palaeontological "Weltbild". The table*gives the required 10 parameters. As soon as Phyllopod Bed II is discovered, feedback will be helpful to discover No. III to No. X.

6.10 The recent evidence in relation to the fossil record

Dialectically educated palaeontologists are able to interpret the non-existing as the not-yet-discovered. There is a wide field of profitable activity to refute wrong biological and palaeontological statements, by means of the best arguments, viz. the irrefutable discovery of yet unknown fossils.

The numerical array of fossils during the Phanerozoic (MÜLLER 1961, CUTBILL 1967) is regularly lacking the imposing evidence of the presence. About 100000 species have been described from the Phanerozoic, from the present about 1000000 living species. 100000 fossil species are distributed over 600 million years. 1000000 species we know from the timeless moment of our presence. The two numbers cannot be compared; of the recent number 800000 insects have to be detracted, because fossil insects are only 15 % of the whole number of fossils known. The reduced numbers are 200000 recent taxa against 85000 fossils.

In order to count the total of taxa having lived since the Lower Cambrian, we put into our count, the following parameters:
200000 recent animal species, without insects.
100000 fossil species, including fossil insects.
600 million years duration of the Phanerozoic.
1 million years average duration of the lifespan of a species.

Arithmetic increase of the number of species, beginning with one, at the beginning of the Phanerozoic and ending with 1000000 today.

We get about 6000000 fossil taxa against about 1000000 recent taxa. Of fossil taxa 100000 have been described. Hence 59/60 of fossil taxa are not yet discovered or described. The majority of the 100000 fossil taxa come from normal sediments and they are normal fossils. Neither extraordinary methods to win them, like rock digesting, nor extraordinary efforts have contributed

*on page 42

considerably to the 150000. The faunas from fossil resins, from concretions, slate, coal or karst are underrepresented in the fossil record.

Certain palaeontologists confess, that extinct taxa without mineralized skeleton cannot be found, because they did not fossilize. I do not underwrite such statements. As long as the oldest fossiliferous resin was only Lower Cretaceous age and since of the type of the Burgess-Pass sediment, one locality in 70 years, has been found, instead of 12, we have good hope to find the fossils, of which others are of the opinion that they cannot be found, because they did not fossilize. As an appendix to the uttered opinion, I cite Glässner (1969, p. 439):"From the Permian to the Pleistocene, there are 396 fossil Decapod genera, of recent there are 1001 !".

Under these circumstances, it is evident, that once cosmopolitic taxa, being now restricted to a small biotope, have not been found in the Tertiary. For instance the trigoniids, the coelacanthids, the crinoids. These three taxa are easily to collect as fossils, their fossilisation potential is excellent. Their apparent absence in the Tertiary is in accord with the hypothesis: Fossil taxa with a limited distribution areal are not (yet) to be found. In reverse: Fossils which have up to now been found, are cosmopolitic. If we begin the assumption, that - up to now, 1/60 or less than 2 % of the taxa once living, have been found, fossil dwarf populations showing the Sewall-Wright effect, the gene-drift, are palaeontologically not available. Palaeontological collecting may reach rare representatives of a taxon at the periphery of their taphotope. If we find certain fossils only rarely or only once, we have applied unsuitable methods or the fossil taxa have been collected outside their main distributional area.

Not rarely, recent dwarf populations are discovered today, for instance *Neopilina, Latimeria*. The last fossil representatives are older than 60 million years. From the long-time, while they suffered restriction of their distributional areal, one has not been able to find a single specimen. The presence offers for the sampling of the recent biota a thousand times better opportunity than the 600 times longer time of the past for the fossils.

Every new taxon is discovered the first time on one locality only. The first description of *Morganucodon* was based on one molar (KÜHNE 1949). In 1960 the taxon was found in Yunnan, South Africa and Europe. In fissure fillings of South Wales, *Morganucodon* is a rock component. In 1866 Plieninger described a single cheektooth of a tritylodontid from the Rhaetic bonebed of Württemberg. In 1884 *Tritylodon longaevus*, described by R. Owen, followed. Today, tritylodontids have been described from large, or even gigantic hypodigma from the Federal Republic of Germany (isolated teeth), from England (*Oligokyphus*), France (a jaw, still undescribed), from South Africa, Yunnan and Colorado. The Yünnan specimens, collected by the geologist Bien, turned the Tertiary basin of Yünnan into the Triassic basin of Yunnan. The colorado specimens owe their discovery to the prospecting for uranium. The two specimens from Normandy owe their existence to the application of the Hibbard process, after Rhaetic fish was found (LARSONNEUR 1964). Before the region was mapped as Permian (chapter 4).

If the mapping geologist cannot look for an object because he is not programmed for it, it is the ideal object for us. This is to be demonstrated with the Cretaceous resin with arthropod-inclusions from near Le Mans (SCHLÜTER 1975). Any fossil was once part of a population, it has a main distributional area, though it is mostly found as a minor component among other fossils, as straggler. Global ignorance of the palaeontological potential is the judgement of a fossil hunter, who during 50 years has searched for new evidence and who has found it.

6.11 Negative evidence in palaeontology

The tetrapods are the only class which differentiates so late, that the major dichotomies happen in the phanerozoic; between fishes and amphibians in the Upper Devonian, between amphibians and reptiles in the Carboniferous, between therapsids and mammals in the Triassic, and between archosaurs and birds in the Jurassic. The time of the dichotomy of the said subtaxa of tetrapods is known, but relevant fossils are rare and have been found late.

When in 1861 the *Archaeopteryx* was found, it was hailed as an excellent link to the prehistory of the birds, the prehistory of the other three subclasses has been documented much better. But if any evidence for the transition is still lacking, the "big bang" is conceived. By and after R. Goldschmidt the "Großmutation", and a generation later the Sewall-Wright effect, the genec Fl. It allows in dwarf populations a rapid change of the genom, resulting after a few generations in the origination of a new taxon. When the relevant fossils are to be found, one cannot predict; if they are lacking today, this is no proof for the Sewall-Wright effect, to be in operation. The earliest presence of a certain fossil in our collections is not a biological event. Exactly as witnesses of small evolutionary steps have been found between therapsids and mammals, so contradict the many found fossil predecessors the effectivity of the Sewall-Wright effect in palaeontology.

6.12 The search for living fossils

The presented ideas condition our notion on extinction. The smaller the dwarf-populations, the easier they evade the activities of the zoologist; the smaller their recent biotope, the less probable is the proof of their existence. We can extrapolate that quite a number of marine fossils - thought to be extinct -, have still living representatives in the deep sea. Marine biology will grow into a new task: The search after living fossils. Systematically this search can be developed with special tools and with feedback, as soon as a discovery has been accomplished. The search has not yet begun. The deep sea is still terra incognita. The success, even recent ones as for example *Neopilina* or the Pogonophora, was not planned, not intended, was a kind of godsent.Marine biology can thus gain spectacular success, it can contribute to the biology of the past. The fossil relations of the "living fossils" are - even under the most favourable conditions - the fish mummies of the Cretaceous of Brazil - dead. By finding living representatives of taxa thought of being extinct, marine biology can contribute to the biology of the postacme, practically a virgin field.

If the next living fossil has been found, two statements can be made: Firstly, specimens allow an enormous information on the soft anatomy of the fossils and their way of life. Secondly, by feedback of the logistics of the discovery of the said living specimens, one can modify the collection technique, to ease the future attempt. With each new success, the difficulties rise to achieve a further success, but this fact can be partly compensated by taking recourse to the report on the new discovery. Why has the living fossil not been found earlier? Have tools been used which have recently been constructed? Do they have been used the first time in the respective region? Then these modified and new methods have to be applied another time in regions, which have, without them, yielded living fossils earlier. Have earlier discoveries been stillborn, one did not recognize the objects as something new. If such case is suspected, the search has to be transferred into the collection, where the results of former dredging are stored. When the Pogonophora had been monographed, everybody concerned recalled their presence in the waters around Plymouth: They had been mistaken for algae or rope. They were part of the catch, but nobody had already the Pogonophora programmed in his brain.

Who dares today to regard the origination of a bauplan, or of a synorgan as typogenesis, as the result of a "Großmutation", - nobody has observed so far -, has in his lifetime to recall his words. Too great is the number of palaeontologists and field geologists and too easy is the accessibility of land and sea bottom, to be engaged in the collection of fossils. In his lifetime, the specimens become available, which bridge the gap of former deficient evidence. Their intermediary characters reveal the origination of bauplans and synorgans as a series of continuous change. *Morganucodon* is a telling example.

6.13 The history of fossil gathering

A consequence of the cumulative nature of palaeontological evidence is the increase of this evidence at any time moment in the history of palaeontology. Wherever the deficiency of the fossil record conditions scientific statements, this statement comes to grief, when additional evidence gets available. We can formulate dialectically: If research is based on the presently available evidence, the result is by necessity wrong; if the work based on the presently available evidence together with evidence not yet available, the results may get confirmation by later discoveries. If this is not the case, the worker can find out where his error has been.

In 1910, the transition of therapsids to mammals , the former with the primary jaw joint, the latter with the secondary one, could not be conceived. The process was "denkunmöglich", incomprehensible. In 1950, Schindewolf, to save his typogenesis of the Mammalia, had to restrict the application of his concept.

The typological event was now placed between the existence of the accessory jaw bones and their disappearance, respectively their change of function (SCHINDEWOLF 1950, p. 250-251). Today the representatives of the therapsid-mammalian lineage are subject matter of textbooks (*Morganucodon*, in Brinkmann: Abriss der Geologie, 10-11 edition, p. 201). The transition from one "class" to another as a complex process can be discussed, the evidence can be analyzed. We know, when certain bones of the lower jaw disappeared: the splenial before the Rhaetic (KERMACK et al. 1973, p. 93). The coronoid between Kimmeridgian and Aptian (KREBS 1971, p. 93). We know pretty certain that the change of function, of quadrate, articular and angular to incus, malleus and tympanic happened among the Peramuridae, probably at the Jurassic/Cretaceous. The forms with both jaw joints exist from the Rhaetic (*Morganucodon*) to the Valanginian: the Docodonta from *Haldanodon* in the Kimmeridgian to *Peraiocynodon* in the Purbeck. In the Symmetrodonta *Amphilestes* from the Bathonian of Stonesfield near Oxford, the condylus mandibularis exists, but the sulcus cartilaginus meckeli and the angular process are gone, present are the internal groove and the scar for the coronoid. Here no change of function and no preservation of the primary jaw-joint, but apparently complete reduction.

> "Among the order Multituberculata the earliest mandibula comes from the Lower Kimmeridgian of the mine Guimarota (Portugal). In both orders, Symmetrodonta and Multituberculata, hearing was evidently only by means of the stapes, - all traces of the primary jaw joint have vanished as well as the angular process. The Multituberculata are not "Mammalia", and they cannot have any phylogenetic relation to the monotremes, which have a middle ear of the Theria-type" (KÜHNE 1958, p. 223; 1968b, p. 110).

The passage indented here has been printed in 1979 and been translated literally here. But in 1988, we were visited by Miao Desui, and he showed me the Upper Palaeocene multituberculate *Lamdopsalis bulla*, with a middle ear consisting of the triad malleus, incus and stapes. On the previous page I wrote: "If confirmation is not the case, the worker can find out, where his error has been." Before 1979 I was convinced to regard synorgans as historical. That is , the probability of more than one mammalian ear being evolved, I regarded as impossible. A long series of integrated change was required to let the mammalian ear originate, and the probability to let this happen several times, I regarded as nil.

The multituberculates are descendants of the haramyids, which are the sistergroup of tritylodontids. The latter stem from gomphodont cynodonts. The Mesozoic mammals proper, for instance the Panthotheria, the Symmetrodonta and the Peramuridae are descendants of cynodont cynodonts. Both branches of cynodonts have their cladistic dichotomy, before they are found as such - in the Lower Triassic. Before this time, in the Upper Permian, a cynodont precursor, that is a gorgonopsid or a late pelycosaur, transmitted to both branches of cynodonts, the premises to develop a middle ear of mammalian construction, from the Middle Jurassic up to the Lower Cretaceous. This is - as I see it now - the case and my error before 1979 was the impossibility to imagine the amount of parallel evolution there is. The multituberculate middle ear demonstrates it (Miao Desui, Lillegraven 1986). A synorgan, less complicated, but functionally very important, is the pelvic girdle. For years, while I prepared the material of *Oligokyphus*, drew and described it, I observed the near identity of this bone complex with the same, for instance in Opossum. The pelvic girdle of *Oligokyphus* had achieved the marsupial level, at least 30 million years earlier. The theorem of this chapter cannot be applied everywhere. Where there is no practice, the theory has to do without confirmation or refutation by the practice. But as palaeontology is material-bound, any phylogenetic hypothesis can be judged on the presence or absence of the relevant material. If there would be no lineages, cladistic dichotomies, transitory zones or regions between large taxonomic units and progressive evolution, the relevant documents would never be found, because they had not existed. But they have existed, they have been found, and in future more of them will be found. The theorem can be reversed: The best proof of the truth is the practice, because there are no arguments against practice. At a time during the 19th century the argument ran: There is no flight of objects heavier than air. The first practised flight was the best answer to refute this argument. A theoretical statement "friction between wheel and rail would be insufficient, to grant rail-traffic up-hill." (LACOUR and APPEL 1905, p. 118).

The whole field of palaeontology is not evenly developed. Some branches are very modern, for instance micropalaeontology, other branches stagnate in a state of 1870, in some subfields procedure is still naive, not scientific. Palaeontological publishing has a tradition of 200 years. Palaeontological preparation has a tradition of 50 years. Up to 1920 the scientist was delegating this part of his work to a technician. The result was poor. Books on palaeontological techniques exist for 50 years. Among young palaeontologists are quite a number, who have never prepared and who are absolutely dependent on their technicians.

There is no tradition for palaeontological collecting. Either there is no such subject matter in teaching, or the subject is "secret science", that is, the scientist give conscientously or subconscientously examples of his strategy and the student tries to be his equal. Material gathering can not be delegated by the scientist. If the paleontologist is not, or no longer geologist, he has not the requirements to fossil gathering. During the 19th century the casual, untrained labourer gathered the fossils which he observed during his work and the paleontologist would pay a trifle. Paleontological objects - fossils - were by-products of the industry of stone and earth and without commercial value. The chance occasion as basis for an earth science! Nor educated the scientist a number of collectors, even with money from his etat. J. Barrande has been a worthy exception. His work is witness to the succesful material gathering by well paid laymen. With raising demands, when paleontology grew into an academic subject, first migrant buyers and later mineral and fossil traders developed in Saxony, Bohemia, France, and England. This trade in the middle of the 20th century went into a crisis, from which only the company Dr. F. Krantz survived. With the rising standard of life after the Second World War, mineral and fossil trade ("Fossilbörsen") bloomed anew in Central Europe.

Between the natural object and the scientist in the cut away, the direct relation did not develope; the agricultural labourer, the quarry worker, made direct contact with the earth, not so the geological scientist.

From three sources flows information into a science of fossil gathering: 1. From a cosmopolitic stratigraphical demand. 2. From the demand of national prestige. 3. From the enthusiasm of local amateurs.

To 1.: Geological surveys employed collectors. To 2.: The Cretaceous and Tertiary badlands of the central and western United States and Canada contain dinosaurs and large fossil mammals. The amply donated Natural History Museums, by exhibiting these fossils, offered the populace objects of awe and wonder - and to substitute evidence of the own history, badly needed in the U.S.A. and so copiously provided in the homelands of the millions of immigrants. An attitude, the ruling class was eager to maintain among the workers. The hunt for dinosaurs: apart from the west of the USA, Kaiser Wilhelm II. instigated the magnificient work in Tendaguru, D.O.A., -now Tanzania-. The American Museum of Natural History financed the first fossil hunt in the Gobi and the Royal Natural History Museum in Bruxelles was instrumental in the excavation of the herd of Iguanodontids of Bernissart, just inside the French-Belgium frontier. With dinosaurs, the difficulties to locate them is least, the increase of knowledge is least, measured on the cost, the increase of prestige is greatest. The new boom of dinosaurs today is partly fed by the same motives which brought them at the end of the last century into the public eye.

To 3.: Activity of the amateurs is of greatest importance for palaeontology. If palaeontology officials number ten, amateurs number thousands. They maintain a permanent supervision of quarries, they are the intermediary between the quarry worker and the scientist. Whereever important fossils or important discoveries are made, the amateur is the first to make them.

To foster the activity, to educate in natural history, to build up the enthusiasm of amateurs, is the duty of palaeontology officials and natural history museums.

In certain regions collecting and trading has been established and the permanent flow began from such regions into the national paleontological collections. The examples are few and they are all dated in the second half of the last century. As long as fossils crop up in the stone industry and a market for fossils is established, fossils get collected. For instance, at Solnhofen, Bundenbach -Lower Devonian slate-, the Dinotherium sand of the Rhine Valley, Matt, Canton Glarus with its Miocene slate fishes, Stonesfield, near Oxford, with Bathonian mammals, the Kupferschiefer of Mansfeld, the sideritic concretions of the British midlands with fish, arthropods etc., the Baltic amber, the vertebrates of the Quercy phosphorites. Components of the taphocoenosis, which do not yet have value are not collected. Fossils, which are not liberated from matrix during the industrial processes, remain hidden. Microscopic fossils can not be detected during such operations. Hence, only the larger components of the respective thaphocoenosis get collected.

The discoverer of the fossil is in any case the layman. He has to observe the fossil, he decided to collect or to reject the fossil. His programm is conditioned by the price he can expect. If his clientele consists of amateurs, keen on complete and regular fossils, biostratonomically interesting specimens - for instance decaying corpses will be collected rarely. Similar, only a partly collected thaphocoenosis is the result of excavations by geological departments or the collecting of amateurs during the years. I recall the excavation in the Geiseltal under Weigelt (Chapter 1), in the Triassic of the Monte San Giorgio under Peyer and Kuhn-Schnyder, von Huene's work at Trossingen. The excavation of the coal of Viehhausen near Regensburg under Wurm of Würzburg. The collecting in the Devonian of the Nellenköpfchen sediments near Alken, by Josef Hefter. The activities of Rühle von Lilienstern in the Triassic of Hildburghausen.

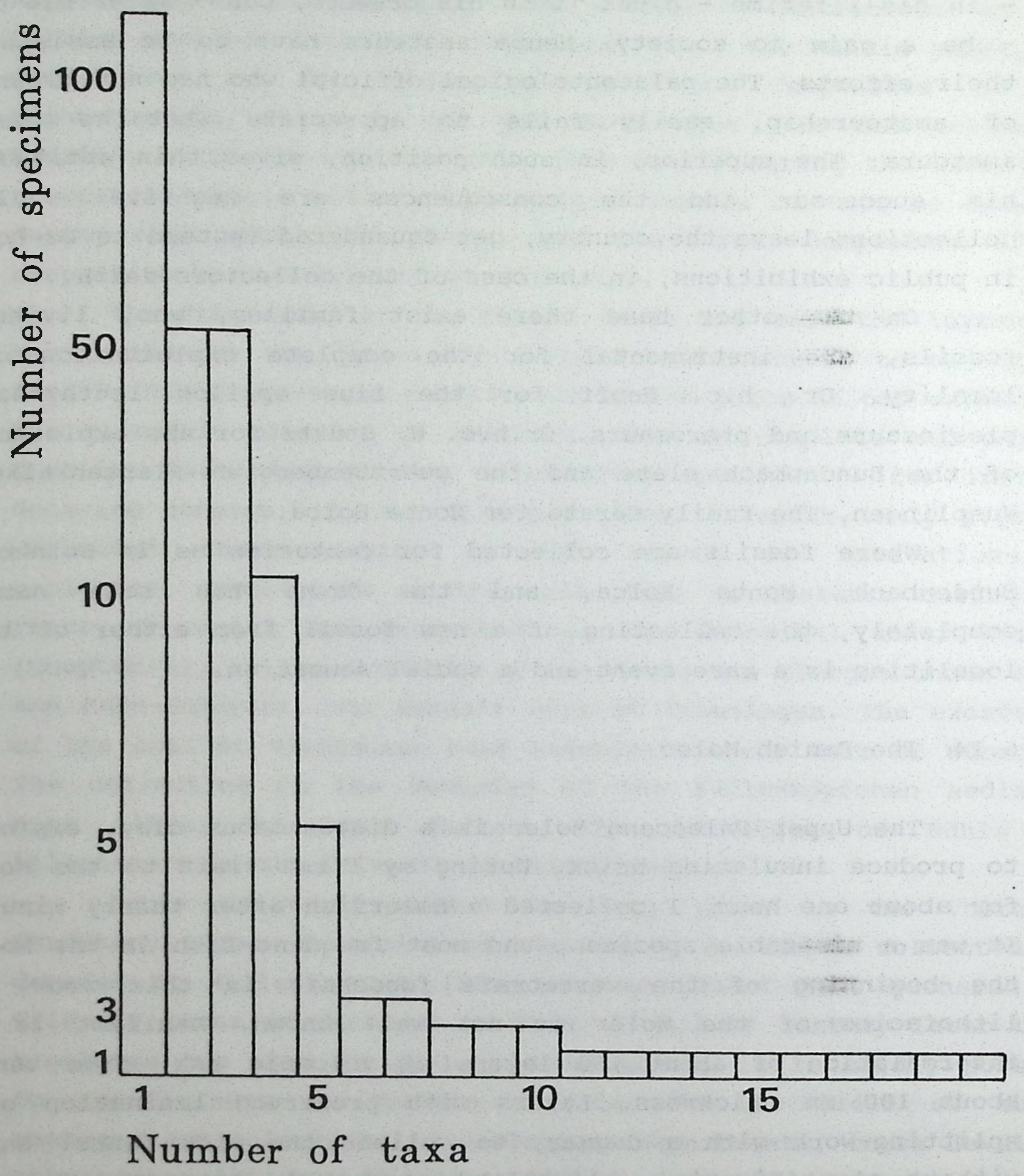
Louis Grauvogel worked for many years in the Voltzien-Sandstone (Upper Triassic) of the Voges, A. Straus collected for decades at Willershausen (Pliocene) and Josef Kahl gathered the Triassic fauna of Hassfurt on Main. If a half century later these treasures are seen in geology departments, it is hardly possible to recall such meritorious service. In the field of active amateurs and scientists in geological departments, there developed permanent relations: the amateur buys from the slatter and gives choice specimens from his collection to the scientist for description. Herold collected from the Kaisergrube at Bundenbach for years and Broili (1928-33) and Dehm (1932) described this material. Even in the times when fossil collecting is not fashionable, the number of amateurs surpasses the number of palaeontology officials. Hence the work of palaeontological amateurs is important and their activity is indispendible (see chapter on Mazon Creek). The fossil that could be collected but is not, is a loss to society. The fossil collected by an amateur who - in his lifetime - hides it in his drawers, can - after his death - be a gain to society, hence amateurs have to be assisted in their efforts. The palaeontological official who has not grown out of amateurship, easily fails to appreciate what he ows to amateurs. The superior, in such position, gives this attitude to his successor and the consequences are negative - local collections leave the country, get squandered instead to be housed in public exhibitions, in the case of the collectors death.

On the other hand there exist families, who, living on fossils, are instrumental for the complete exploitation of a locality. Dr. h.c. Hauff for the Lias epsilon ichthyosaurs, plesiosaurs and pterosaurs. Dr.h.c. W. Stürtz for the exploitation of the Bundenbach slate and the wuerttembergian Plattenkalke of Nusplingen. The family Cerato for Monte Bolca.

Where fossils are collected for centuries as in Solnhofen, Bundenbach, Monte Bolca, and the fauna has been sampled completely, the collecting of a new fossil from either of these localities is a rare event and a social sensation.

6.14 The Danish Moler

The Upper Paleocene Moler is a diatomaceous clay, exploited to produce insulating brick. During my first visit to the Moler, for about one hour, I collected a Molerfish after thirty minutes. It was a miserable specimen, the most frequent fish in the Moler, the beginning of the vertebrate foodchain in this rock. The lithofacies of the Moler is not well known. Manifest is the intercalation of about 150 layers of volcanic ash, from ten to about 100 mm thickness. Layers with preserved lamination offer splitting-work with a dagger, to collect the fish fauna. Layers without stratification, slightly bioturbated, are more frequent. Layers containing limecemented concretions house a slightly different fauna than the well splitting soft rock. A few horizons are solid limestones. Etching this rock produces beautifully uncrushed diatoms. The Moler between the concretions yields to splitting exactly as the rock without concretions, but maceration which affects the rock without concretions is practically absent in the horizons with concretions. Brittle star is frequent.



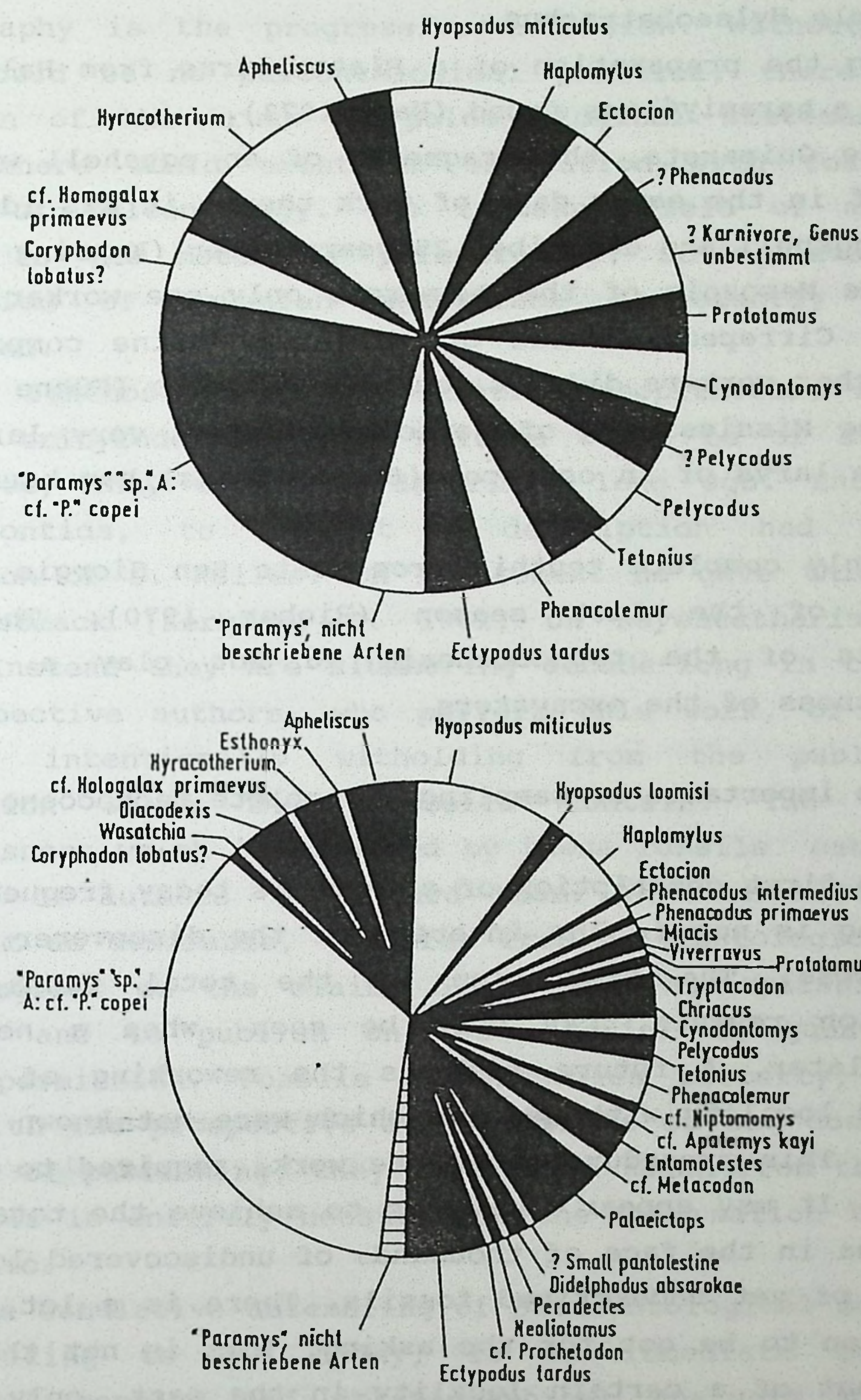
18 More than 90% of the fishes from the Upper Palaeocene Moler of Jutland, are represented by a small Argentoid. Among the up to now collected specimen are 10 taxa represented with only one specimen.

On the way to the seaside, on the Jammerbught and around Skagen, it is easy to make a detour to the islands Fur and Mors, the outcrop area of the Moler, to study the inland waterway of the marine Limfjord and to go fishing with a dagger in the soft Moler. Fifty years ago, we were able to locate near the base of the Moler, near ash-layer-30, a well splitting layer, whence both collections came; 1937 to the British Museum of Natural History, and 1938 to the Geology Museum in Copenhagen. Today the production has been mechanized and in situ collecting is practically impossible. Nevertheless, the yield of fishes during a day long splitting is considerably. The Moler is the only fishfauna in the world, where no commercial work has ever been done and the fishfauna has not yet been monographed. This mainly for personal reasons. Measured on the appearance of additions to the fauna, even today the fauna is much more extensive, than the about 50 different taxa present at the moment, do indicate. However apart from the argentoid which, as I wrote, can be expected inside an hour of work, all other fishes are of the utmost rarity. Apart from a syngnathid, a carangid, a berycid and mackarel, the Moler fishfauna consist of taxa, represented by one or two specimens. In fifty years *Rhamphosus rosenkranzi* has been found once. Before 1937 certainly nobody collected systematically and for at least several weeks. After 1939 a great number of fish has been collected, but mostly with hammer and chisel from the limecemented concretions, the socalled cementstone. Of these fish not one has been subjected to the transferprocess (Toombs and Rixon 1950). Hence, these cementstone fishes, split right through the median plane, still hide most of their information. On the contrary, all fishes from soft rock are leached; they are preserved as two abdrucks, and as such offer all information, not even hidden by the scales. As I wrote before, most molerfish have more or less been subjected to maceration, and this begins with the loss of the scales. An incentive to work in the Moler is the reasonable hope to find extraordinary fishes and tetrapods of any kind. In fig.18 I depict the tail-end of the fauna, consisting of ten taxa; we can easily assume that there are 100 ! It is imperative to try to get hold of these many rarities, they may yet throw light on the Paleocene radiation of the actinopterygids. There is not yet evidence for taxa only to be found in one thin layer of Moler. A sequence of faunas from the whole formation is still a desideratium. When corpses landed on the mud, consisting of dead diatoms and clay, they were drifted only by slow currents. The moler does not contain a bottom fauna. The method of collecting and the stratum where collecting is done, determines the composition of the resulting fauna. But the fauna seems to indicate to be the inhabitants of floating algal masses. This for instance is the habitat of the syngnathids. The insects in cementstone are quite frequently encountered. They make very good preparations with the transfer method applied.

6.15 The decisivness of the collecting method

The decisive importance of the collecting method. The overriding importance of the collecting technique. The most telling confirmation of the value of a new technique, to collect fossils, the significant example for the successful change of methods, while gathering a mammalian fauna gives McKenna (1960) with the application of the Hibbard-method (HIBBARD 1949) Fig. 19 (chapter 4.4). The laborious, conventional collecting from the lesedecke produces 18 taxa, the application of the Hibbard-method brings the same 18 taxa plus additional 17, which had not been observed during the surface picking. McKenna by using a too coarse mesh, lost the teeth of the insectivores and murids. This means, that a third time the locality can be worked with profit.

In vertebrate palaeontology, collecting up today has a strong bias for taphocoenoses in the lowlands. Karst-faunae make a qualified exception. The fossil biotopes of the mountain-region and the upland, are the lesser available, the higher their altitude. An insight into the taphocoenose is possible if in a lowland taphocoenose the rare stragglers are recognized. In the lowland they are never dominant, but they can crop up if very much material is at ones disposal, and if it is gathered by a few different techniques. Excavations embrace only a sector of a taphocoenose. Other sectors remain unrecognized or are not proportional represented in the material collected. Often excavations are planned, to collect well defined and required fossils. Excavations have generally a small programm. Excavations are not planned and started to collect a total taphocoenosis. If the excavators are very observant and at any time expect the unexpected, the programm can enlarge considerably.



19 The minimal collection of an Eocene North American locality yields 18 taxa. The application of the Hibbard process brings from the same locality 35 taxa.

1. In Bernissart the Iguanodontids have been excavated, but also the urodele Hylaeobatrachus .
2. During the preparation of a *Plateosaurus* from Halberstadt, the tooth of a haramiyd was found (Hahn 1973).
3. In the Guimarota, the fragments of an eggshell were collected by myself in the early days of work there; it was identified as a turtle eggshell and described 25 years later (Kohring 1990).
4. In the Mesozoic of the Guimarota only one worker observed the terga of Cirrepedia - one of the rare marine components there, eleven other workers did not see these fossils (Kühne 1968a).
5. In the Mississipian of Herborn, among a very large trilobite fauna the larva of an ostracod (*Bostrichopus*) has been found (Hahn 1967).
6. The only complete teuthid from Monte San Giorgio was found at the end of the last season (Rieber 1970). The unobserved components of the taphocoenosis do not play a role in the consciousness of the excavators.

6.16 The importance of sampling a complete taphocoenosis

The first description of a fauna is today frequent. The total harvesting is not in the interest of the discoverer, measured on his success. The proportion of the total fauna, the first description reveals, can only be seen when a new method is applied later. A future task is the reworking of a known and described locality with methods which were not known at the first occasion. This procedure saves the work, required to locate a new locality. It may appear senseless to achieve the total harvesting of a fauna in the face of thousands of undiscovered localities and a welter of yet undescribed fossils. There is a lot, worthy of description to be got for the asking. This is not the case ! The proof that of a certain locality in the past, only a sector of the total has been collected, is consciousness forming, is essential. This proof is eduacating the performer to measure the reality of the present moment on the possibility of the future. Untypically components of a local fauna are rarities in a biotope into they do not belong. Only by collecting them, one gains hints to neighbouring biotopes. The bustard *Palaeotis*, as inhabitant of the steppe, is found in the bog-fauna of the Geiseltal (Lambrecht 1928).

In chapter 5 I pointed out, the underlying principle of stratigraphy is the progressive evolution. Without stratigraphy there would be no paleontological practice, there would be no criterion of the truth of paleontological statements - at the utmost there would exist an occupation with fossils, but no science of paleontology. The imposant field of application of fossils is the motor of paleontology, acting even, where the endocranium of Devonian agnathians is exactly and minutely elucidated.

If *Ichthostega, Kuehneosaurus, Oreopithecus, Henkelotherium* and the tritylodontids from Arizona would be of stratigraphical importance, they would be described long ago. Enough of these tritylodontids, to warrant a description had been in the possession of S. Welles. On retirement he gave this material to Doris Kermack (Kermack, D. 1982, On *Kayentatherium wellesi* n. gen.). Instead they are slumbering decade-long in the drawers of the respective authors, who perform this work, or leave it, ad libitum; intentionally witholding from the public essential information which these fossils contain. The formation of consciousness which is conveyed by these fossils cannot be in the interest of authors who hoard them. In such blatant cases, I regard it as desirable, to defer from palaeontological ethics and to transgress on the claims of the non-accomplishing author or authors, and to publish on the material in question, without asking permission. Fossils are nobodies property, they are on trust with the prospective author. If he or she does not perform the duty of publishing, they have to be taken from them. The value of fossils is entirely measured on the information they convey to the public.

The cumulative assembling of palaeontological material, as it is realizing to 95% today, is an immediate consequence of geological mapping and stratigraphical analysis of sedimentary rock.

In chapter 2 the free field has been described, the opportunity the relation former possesses, where he can choose the optimal field of his activities. Palaeontological statements are no more a free field; the art of paleontological preparation is a field with a number of useful volumes available. Palaeontological assembling of material, discoveries to be made in civilized and not civilized countries, is a field free, unoccupied, wast and with the greatest freedom of action. Here the first steps into the unknown can be made. Those who perform them, march to success.

6.17 Examples

After the description of collecting in the moler, and the application of the Hibbard-process, I add eight examples, where application of a new collecting technique led to a considerable augmentation of the palaeontological record.

The old phenomenon has been coupled with a new method, the old reality was confronted with the new possibility, which became the new reality, with the application of the new method.

New qualitative statements are made possible by means of multiplication of the palaeontological material. This applies to invertebrates, vertebrates and plants.

6.17.1 Acari in the Baltic amber

Our preoccupation with Mesozoic resin (SCHLÜTER 1975) was preceded by a sandbox-play with the "Schlauben" of Baltic amber.Schlauben are masses of resin, consisting of numerous interrupted flows of resin, forming a transparent series of thin layers. As each flow was for a certain time exposed to air, insect and other small arthropods did land on them, stuck to it, or even sank into the fluid resin, to die there, to be shortly after ensealed by the next following flow of resin. The schlauben also contain spider-webs, scales of Lepidoptera, feathers and mammalian hair. Only schlauben do contain arthropods. The arthropod-containing specimens were ground, polished and inspected under the binocular. More arthropods were detected.

The Acari are the smallest arthropods in amber, they are today almost valueless as they do not yield to scientific statements etc. Our mites were found in pieces of amber which had previously yielded an arthropod. Dressing the schlauben, a few kg of sawn off amber had accumulated, and I proceeded to tumble it. Each time I renewed the charge of the tumbler, I inspected all pieces under the binocular and found more mites until the pieces were polished, were finally inspected for mites, drilled and used as amber chains for my friends.

The case is trivial but typical. The unconspicuous and smallest arthropods were only observed and collected under optimal conditions. Otherwise they became neglected, though the inspector was programmed for smaller arthropods. The postscript for mites from the Baltic amber is an idea and a hope: splitting the schlauben along the plane on which the mite is embedded splits the mite. The two hollow-halves can be inspected under the electron microscope, and I expect interpretable pictures.

6.17.2 Producing graptolites by digesting limestone and silex.

Carl Wiman was one of the first to isolate graptolites by digesting limestone and silex. His results were spectacular. Bulman recalls that in Wiman's serial sections of dendroids, the stolon has been depicted without Wiman being aware of it.

Two graptolite-complexes have determined the graptolite research. The utilisation of the flattened specimens from slate and shale for the stratigraphy of the Ordovician and Silurian, and the utilisation of the isolated - even transparent - graptolites from limestone and silex for structural analysis. With the discovery of *Monograptus* in the whole Lower Devonian by H. Jäger (1962), it became evident, that after century long research and error, discovery and radical reinterpretation are a reality, and contradictions dissolvable. The work of Bulman was devoted to the structural analysis of isolated Ordovician graptolites. Roman Kozlowski working on sessile Ordovician graptolites from silex, received the Wollaston medal. He determined the internal structure and the systematic position of the graptolites.

6.17.3. Rhynie

The monograph on the Devonian flora of Rhynie by Kidston and Lang (1917) does not mention with one word the arthropod fauna of Rhynie. Hence Devonian freshwater silex and its micro-arthropod fauna did not enter textbooks. At least one other locality, Gilboa in the State of New York, has been discovered in the meantime. But the invertebrate fauna of the Devonian freshwater is badly underrepresented. "Kieselsinter" would be the axiomatic locality for flora and fauna, but occurrences are small and in regions of Devonian volcanic activity difficult to locate. Another possibility, to get hold of Upper Carboniferous arthropods may be a systematic search in the coal ball-sections, -spherical-mineralisation of the uncompressed Carboniferous turf.

6.17.4. In the bodychamber of cephalopods, elements of the body can be found.

If we measure the value of the bodychamber on the phragmocone of planispiral cephalopods, the value is nil. Is the bodychamber so long as to hide the phragmocone, it hides the latest suture-lines too and its value is negative. A lucky discovery of phosphatic concretions with a Carboniferous fauna from Uruguay (CLOSS 1967) triggered off the living-chamber-research in Germany. U. Lehmann (1975) used in 10 papers in situ aptychi and reinterpreted them as jaws of ammonites. He found radula, ink sac and stomach. He pointed out the importance of early diagenetic concretion formation. This aspect of the living-chamber research may be instrumental for the discovery of non-mineralized Precambrian Metazoa. The oldest known occurrence is the famous Mazon Creek field (NITECKI 1979).

6.17.5. X-ray photography, x-ray stereophotography.

W. M. Lehmann began this work (1957), W. Stürmer followed, and J. Mehl is working today with spectacular success. The work began and continued with pyritized fossils from the Kaisergrube of the Lower Devonian Bundenbach slate, an epizonal turbidite. The absence of planctonic graptolites from Bundenbach is telling. The pyritisation gave Bundenbach a monolithic role. As soon as the Bundenbach type of lithogenesis is pointed out, the parameters enumerated, the typical features recognized and the systematic search for older and younger "Bundenbachs" has begun, we have a marvellous chance to look into the metazoal life of the Precambrian. The task is simply to discover 10 new Bundenbachs; this cannot be a very difficult undertaking, as the black non-metamorphosed alum slate of Cambrian age of Scane in southern Sweden contains pyritized trilobites.

6.17.6. Digesting of limestone with organic acids for the conodont stratigraphy is now routine.

The phosphatic remains, vertebrate elements, and a welter of phosphatic skeletal matter is the byproduct, and the laborious testing of any Paleozoic or Young Precambrian limestone may yet enlarge the known repertoire of sclerites. Obtaining of Palaeozoic fish scales by digesting limestone with organic acids. Between 1925 and 1940 W. Gross and F. Brotzen worked on the histology of scales of agnatheans and acanthodians. Fish scales were isolated with pliers from the rock, and sectioned. After 1945 Gross used acetic acid. Mechanical isolation yielded a hundred specimens. Digesting yielded 1000. This quantity increase let jump the increase of scientific results. The application of organic acids - 100 years belated - has been commented on in chapter 2 (GROSS 1966). A much more important field of application is the conodont-research. In the Ordovician conodonts are much less suitable for stratigraphy than in the Upper Palaeozoic. Hence, they have been obtained in lesser quantities and so has the by-product, the scales of agnathans. However, if we begin to tap for scientific ends the by-products of the Ordovician conodont-sampling, we may yet enlarge the stratigraphic range of agnathans beyond the Caradocian, the age of the Harding-sandstone with *Astraspis*.

6.17.7. Maceration and dressing to obtain microvertebrates from the Jurassic coal of the Guimarota in Portugal.

After we had for two summers split the coal, we continued work for three months, macerating and dressing the fines of this coal. The hope was to obtain a more complete record. From several tons in seven processes - sifting, jigging, etching and work with H^2O^2 (KÜHNE 1968a) about 200 g of bones and isolated teeth were gained.

The deficiency of splitting the coal, to get a more or less complete record of the Mammalia, was exemplified by the evidence of a peramurid (KÜHNE 1968b, p. 121). By splitting we had found a jaw but only with a P2 in situ; counting empty alveoli, a formula P4M5 was constructed. The P2 had a second accessory cusp behind the main cusp. Such tooth did not occur another time in the huge material of isolated pantotherian teeth. However, two lower molars, a right and a left one were found, which only fitted the jaw of the peramurid, which previously was named "cf. *Peramus*". Both teeth are the smallest molars, fitting the smallest jaw of cf. *Peramus*, both teeth had subequal roots, contrary to pantotherian roots, of which the posterior is double the size of the anterior one. The dentition (two molars) of cf. *Peramus* reveals greatest similarity with *Kuehneotherium* from the Rhaetic of Wales. The jaw does not have a sulcus cartilagius meckeli, but it has an internal groove; a distinct scar for the coronoid and a strong angular process are present. If *Kuehneotherium* would have the angular process of cf. *Peramus*, it would be the ideal predecessor of the Peramuridae. The symmetrodont *Kuehneotherium* is in the Glamorgan fissure fillings a seldom form. In the Guimarota the peramurid cf. *Peramus* represented with one jaw and two molars, I regard the taxon as a straggler. In the Upper Kimmeridgian fauna of Porto Pinheiro in Portugal, Krusat (1969) described one molar of a peramurid, among 350 isolated teeth. Only in the Purbeck fauna of Durdlestone of Jurassic/Cretaceous age the peramurid *Peramus* is frequent.

6.17.8. Artificial matrix for the salvage of vertebrate fossils from lignite or sapropelite.

The two rocks are colloidal with a considerable percentage of water. When they are drying, they shrink, not so bones and skeletons. Between the shrinking rock and the non-shrinking bone, shearing takes place and the bone gets broken. The Guimarota coal, the coal of the Geiseltal, the sapropelite of Messel are colloidal. Before a method was available to solve the problem between matrix and bone, the objects one took home to the binocular, were fragments of *Lophidon*'s teeth. Soon after the excavations in the Geiseltal under Walther, the problem was solved by applying hot paraffin wax to the exposed bones, and to have the hardened wax as an artificial matrix.

After the coal embedded skeleton had been exposed, the fossil was put on a pedestal and with 15 mm distance a ring surrounding the fossil formed of soft clay. After the space around and above the fossil became filled with paraffin wax, the fossil was exposed from the underside. More elegant is the lacquerfilm-method of E.Voigt (1933), suitable for flat skeletons.

6.17.9. The transfer method.

Fishes and amphibia are exposed as body fossils in split concretions. The split in general divides the fossil into two halves, both showing identical broken bones. Such fossils are not yielding much information.

The transfer method (Tooms & Rixon 1950) applies on both surfaces of the fossil polymerizing resin. Etching with organic acids exposes the upper and the lower surface of the fossil. Shortly before the last remnant of the calcareous matrix has gone, the etching process is continued with dilute acid under repeated inspection until the fossil is exposed. The transfermethod can be used on phosphatic flat fossils embedded in rock more soluble than fluor-apatite.

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