QUATERNARY GEOLOGY AND THE VERTEBRATE FAUNA

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Historical geology follows all the other historical sciences in endeavouring to forge its chronological chain of events from links which correspond to three requirements: they must be unique events happening only once and never repeating themselves, they must be members which in the chain of logic cannot be interchanged and, lastly, they must not be of too long a duration. At the present stage of research, paleontology alone can furnish geology with material satisfactory in respect of these three conditions. This explains why research in historical geology is based from its beginning up to the present time on data supplied by paleontology.

The areas of our present continents not planed off by continental ice sheet are built up mostly by epicontinental deposits of different periods. Details of their history are known to us mainly by the study of mollusc-remains found everywhere in these deposits. This way of geological research based with few exceptions on the history of the marine malacological fauna was, however, bound to fail in the later periods when, in these areas, the sea turned either into a brackish then freshwater lake or into swamps or rivers or even continental deposits. This very situation prevails in the Pliocene and Quaternary deposits attaining in some places a very considerable thickness. No wonder that we became isolated with our special Pannonian stratigraphy, and that, for the lack of an adequate molluscan fauna, researchers in Upper Pliocene and Quaternary are still groping in the dark. In addition, coming nearer to recent times more and more precise horizonting becomes necessary and, generally speaking, possible. In the Pleistocene, however, the species of molluscan faunae do not follow each other as rapidly as would be desirable from the point of view of stratigraphy. In this period, we can only rely on the quick phylogeny of the members of mammalian faunae to keep pace with stratigraphic requirements. In the Holocene, even this study of the mammalian phylogeny turns into an instrument far too coarse to be of real assistance to the stratigrapher who, therefore, is compelled to hand over the decisive role to the archeologist who, in his turn, can but fall back on phytogeographical data based on palinology.

Under these circumstances, it is obvious that when it comes to the strati-

graphic division of the Great Plain of Hungary which is filled by Quaternary deposits of several hundred meters' thickness, it is the task of vertebrate and mammalian paleontology respectively, to decide the subdivision of the glacial series and its delimitation downwards. On the other hand, it rests with the palinologist to fix sharply the Pleistocene-Holocene boundary and to furnish finer details within stages. Finally, minute partition of the Holocene calls for the archeologist.

The present study endeavours to develop in conformity with our present knowledge the data furnished by vertebrate-paleontology into a uniform Quaternary chronology. In order to attain this end, it examines first of all the question of the lower boundary of the Quaternary period, outlines the periods ensuing from the data of mammalian paleontology, endeavours to accord these periods with other recurrent ones established during the Quaternary and, finally, attempts the correlation of the Quaternary deposits of the Hungarian Basin with other periods apparently well established.

The Delimitation of the Quaternary Period

Although all questions concerning boundaries may be considered as having only a secondary significance, from the point of view of the field geologist it is of utmost importance to know where these boundaries should be placed and to realise that they must not be shifted at random. It is therefore important that the question of the lower boundary of the Quaternary should be seriously dealt with at a Congress to be convened to discuss the practical problems connected with the geological surveying of the Hungarian Basin.

Up to the present, mainly arguments connected with glaciology and faunal development have been advanced in the course of the often rather heated disputes, the glaciologists — with rare exceptions — wishing to draw the line representing the lower boundary of the Quaternary at the beginnings of glaciation, while vertebrate-faunists start the Pleistocene and the Quaternary, respectively, with the sudden appearance of the genera *Equus*, *Bos*, *Canis*, or with the extinction of the forms of life characteristic of the Tertiary.

The glaciological determination of the boundary has lost its accuracy and convincing power the moment it became evident that from the *Unio wetzleri* horizon upwards we have to consider the probability of advancing ice attaining Pleistocene dimensions.

Even those who argue on the basis of the extinction of certain faunistic elements do not agree with each other, and it seems to be quite improbable that between the partisans of the three different ways of fixing the boundary a compromise can be attained, because they lay stress, quite at random, upon the extinction of this form or that. Some scholars mark the end of the Pliocene by the disappearance of the *Mastodons*, although even in Europe this occurred at

different times, not to mention the fact that the *Dinotheres* extinct in Europe since the end of the lower Pliocene lingered in Africa up to the middle of the Pleistocene. Others close the Pliocene with the extinction of the genera *Epimachairodus*, *Mimomys*, *Hypolagus* etc., all missing in the Later Pleistocene.

Under the given circumstances only the faunistical boundary fixed by the appearance of the South Asian *Archidiskodon (Elephas)* and *Leptobos (Bos)* as well as of the American *Canis*, *Equus*, *? Epimachairodus*-line is suitable for the separation of the Pliocene and the Pleistocene. It must be added, however, that this boundary is by no means as clearly defined as the lower boundary of the Pliocene (appearance of the *Hipparion*-faunae on the Eurasian continent) and that the appearance of fluvio-glacial sediments in the Middle Pliocene also obscures the boundary.

On considering the question when did the Tertiary fauna actually become extinct, we are astonished to find that, whilst the *Proboscidean*, *Rhinoceroses*, *Equines*, large *Bovines* or large *Carnivores* really did become extinct at the upper limit of the Pliocene, the Tertiary fauna as a whole with its *Elephants*, *Rhinoceroses*, *Bovids*, *Horses*, *Lions*, *Hyenas* did not disappear from the Arctogaea with »the beginning of cold climate« but, on the contrary, after the culmination of the Pleistocene, i. e. at the beginning of the new warm — Holocene — period! They lingered for some time in the refuges of Africa and Southern Asia but by the end of the Pleistocene, within a geologically insignificant span, the prevailing continental animals of the Tertiary period i. e. the »ruling« mammals became extinct and ceded their place to the new, the human fauna! The replacement of the mammalian fauna by man meant the same catastrophic change which had taken place on the boundary of the Cretaceous and the Paleocene when *Reptiles* had been replaced by *Mammals*. However, not only the mammalian faunae confirm a coherent Tertiary period, including also the Pleistocene, for, obviously, with its similar crust movements and glacials the Pleistocene attached itself to the Tertiary as its concluding part. The only disputable point is whether the Holocene should be considered as the beginning of a new geological period or as a short transition to it. For the time being, it seems to be useless to argue this point.

Phases of Evolution of the Mammalian Fauna in the Quaternary

At the opening of the twentieth century the scholars of Pleistocene faunae relinquished the idea of monoglacialism and accepted the polyglacialism of *Penck* and *Brückner* and, under their influence and that of *Nehring*, set about with feverish haste to establish »cold« and »warm« faunae, and the »postglacial fauna of the steppe period« respectively. This trend also penetrated into our country but could not attain a firm footing, although, in fact, it survived in a different

form. Whereas in Germany, even today, it is a matter of serious discussions which mammoth fauna should be wedged, as a »glacial« one, into their »interglacial« faunae with *trogontherii* and *antiquus*, the Hungarian scholars, towards the end of the second decade, growing tired of the barren theoretical play of shifting faunae to and fro, returned to the most rigid monoglacialism and more or less persist in it to this day. The reason for this conspicuous reversion was the fact that, at that time, Hungarian scholars only knew faunae from two very restricted Pleistocene periods (some faunae of the »depression« between the first and second wave and of the last faunal wave) which they, being unable to divide them among the four glacial and three interglacial periods, simply considered to be arguments in favour of a homogenous and indivisible glaciation.

Some lucky findings filling up gaps in their faunistic and stratigraphical knowledge and the purposeful exclusion of foreign faunal data from their research work helped the Hungarian scholars to create a basis on which, if developed further, they could bring their own particular problems nearer to solution.

Researches have shown that the development of our Quaternary faunae shows five consecutive principal types. We propose to call them faunal waves (»Faunenwellen«), because the course of their development can best be explained by comparing them to the waves of the sea collapsing into themselves. In each of these five »waves« evolution does not begin with the highly differentiated top forms of the preceding fauna, but again springs from a more primitive (perhaps even the same) faunal type and so attains its own evolutional peak. In other words, these faunal waves do not, with rare exceptions, develop from each other as evolutional descendants. On the other hand, within these waves, from their bottom to the crest, certain evolutionary changes, a certain development can be perceived — especially in dimensions — inasmuch as every form of life within one wave attains a higher degree of development than the corresponding form attained within the preceding wave. This briefly means that under certain circumstances, especially under the effect of climatic changes caused by the advancing ice sheet, the forms of life within a wave continue to develop, attain a perceptibly higher evolutional degree and greater size than their predecessors, and that towards the end of the wave they die out (?) giving up their places to the corresponding but more primitive forms within the next wave which, in their turn, pass through the same evolutionary specialization and disappear from the stage in the same manner. Summarising, whereas the German school presumes migration and recurrence of a warm and a cold mammoth fauna, our researches prove that, in the course of the Quaternary period, five non-recurring faunal waves succeeded each other. Each of these faunal waves, assimilating according to need to the environmental influences caused by climatic changes and the advance of the ice sheet, developed its own »cold« (arid-continental) top forms which with the reappearance of the former — milder, humid — environmental

conditions became extinct and ceded their place to the small, unspecialized forms of the new faunal wave. Within each wave these differences in specialization can, of course, be proved only in relation to some smaller forms. In connection with the larger-sized forms, the striking feature is that moving from preceding to succeeding wave we find them becoming gradually more primitive, which fact further proves that one cannot speak of recurring but only of new faunal waves.

Where, within one faunal wave, no increase in the sizes of forms can be observed, there the fact is indicative of the rate of progression that on the ridge of the waves all the forms are missing which were present in the trough of each wave, i. e. in its initial stage, but for the lack of adaptability gradually disappeared when the process of specialization by acclimatization set in.

The five faunal waves can briefly be characterised as follows :

First faunal wave : faunae with *Mastodon*, *Archidiskodon planifrons-meridionalis*, *Leptobos*, tridactyl *Allohippus*, (immigrated) *Canis* of American type, *Parailurus*, *Protarctos*, archetypal *Cervids*. The primitive elements gradually become extinct, and on the crest of the wave we get a modernised *meridionalis*-fauna. Barót-Köpec, Kisláng, Dunaalmás, Süttő (the travertine), Perrier, Tegelen, Senèze, Valdarno a. s. f. represent this faunal wave. Its fluviatile gravels, sands and terrestrial deposits are covered under the name of Villafranchian. Probably, this faunal wave can be divided into two phases of faunal evolution : a lower phase, with *Mastodons* and »*Elephas*« *planifrons*, and an upper one, with »*E. meridionalis*«.

Second faunal wave : faunae without Mastodons, with »*Elephas trogontherii*«, *Bison*, monodactyl form of *Equus*, with *Alces*, *Megaloceros*, *Cervus*, *Capreolus*, in place of the (extinct) primitive cervids (cf. *Rusa)*, with extinct — or nearctic — *Carnivora* and *Rodents* appearing for the last time simultaneously with new types *(Epimachairodus*, *Pachycrocuta*, *Nyctereutines*, *Baranogale*, *Pannonictis*, *Dolomys*, *Mimomys*, *Trogontherium*, *Hypolagus* a. s. f.). Generally speaking, with this faunal wave all groups which do not reach the end of Pleistocene, disappear. Classic habitats of the remains from this faunal wave are the red clays of the fissures in the Villány Mountains (Villány, Csarnóta, Beremend), Püspökfürdő, Gombaszög, the caves of the Schwäbische Alb (Sackdillingen, Moggaster) and the Forest-bed series of Cromer. Hence the designation »Cromerian«. The first of the two phases of this wave (Villányian) is characterized by certain forms doomed to become extinct later, and the second (Mosbachian) by the absence of these forms.

Third faunal wave : faunae with *Elephas (Palaeoloxodon) antiquus*, »*Rhinoceros merckii*« represented by peculiar species or subspecies of the groups characteristic of the cave-bear faunae with Mammoth and woolly Rhinoceros. This very incompletely known stage has been made familiar by the fauna of Steinheim (Germany). The occurences in caves of the Mediterranean are still

to be revised. On the basis of its culture this stage is called the Chellean stage, but this name is incorrect as it has been taken over from archeology and originally indicates a stage in human culture. Up to the present time we are unable to distinguish its phases.

Fourth faunal wave : this Pleistocene faunal wave, which is the best known of all, is characterised by *mammoth*, *horses*, *bisons*, *Bos primigenius*, *Megaloceros*, *red deer*, *reindeer*, *ibex*, *Rupicapra*, *cavebear*, *hyena*, *wolf* and *lion*, by the *polar fox* and the *Gulo*, by rodents such as the *Microtines*, the *lemmings*, large and dwarf *hamsters*, *jumping mice*, *Citellus*, *Ochotona* and, besides the usual insectivores, by the *Desmana*.

Abundant occurrences and findings, cultural remains and favourable stratigraphical data enable us to subdivide this faunal wave. On the basis of investigations made but still requiring completion in many respects, we distinguish four phases :

1*st phase :* without arctic microfauna, with meridional forms, e. g. *Macaca*, *Testudo ;* the large mammals appear in remarkably small species. In Hungary this phase is well characterised by the fissure of Süttő.

2*nd phase :* the fauna has a subarctic forest character, the dominant form is the *cave-bear*, but *Asinus* and *Cuon*, both missing in the next phase, are still present. Characteristic occurrences are Subalyuk, Ponorohába, Cotencher a. s. f.

3*rd phase :* the former arctic fauna without *Asinus* and *Cuon*. This phase yields most of the cave-faunae. It is represented in Hungary by the Szeleta cave, the Istállóskő, the Herman cave a. s. f.

4*th phase :* in the faunae characterized by the preponderance of the reindeer instead of the cave-bear, there appear the characteristic forms of the tundra — the *lemmings* — and the rodents of the cold steppe *(Cricetus*, *Citellus*, *Ochotona*, *Allactaga)* and steppe birds, e. g. *Syrrhaptes*. Thoroughly examined occurrences of this phase are in Hungary Pilisszántó, Puskaporos and the Remetehegy abri.

Fifth faunal wave : following the extinction or disappearance of the *mammoth*, woolly *rhinoceros*, *elk*, *giant deer*, *reindeer*, *cave-bear*, *lion*, *hyena*, *Gulo* and of many northern rodents of the cold steppe there develops, in the Holocene, the faunal picture as it exists today under our climate. Apart from the mixed forest and steppe character of this fauna, and the absence of the large Pleistocene forms its most remarkable feature is the appearance of domestic animals.

The first two of these five faunal waves represent consecutive waves of immigration from North America and Siberia, the third gives an opportunity to infiltration of the south-eastern (and even southern) elements, the fourth indicates an increase in strength of the elements from the inner parts of the Eurasian continent, and the last wave shows the advance of the western-southern humid element.

Correlation of the Faunal Waves

It is not our intention to interfere with the parties disputing for several decades the point of how to reduce to a common denominator the diverse divisions of the Quaternary beds. On the other hand, it is absolutely necessary for us to elaborate the question of how a division of ages based on the paleontology of terrestrial vertebrates can be placed within the great malacological-stratigraphical system of historical geology. In addition, we must deal separately with the chronological division developed independently by the geomorphologists and astronomers ; with the first, because of the practical problems of the identification of deposits, and with the latter, because of its absolute importance from the point of view of chronology.

So far it has been very difficult to establish parallelistic moments, for while stratigraphical and malacological data were being collected mainly on the Mediterranean and Atlantic coasts, morphological (glaciological) data and data emanating from terrace studies all issue from sources in the neighbourhood of the Alps and in the area of the retreating continental ice sheet. The two divisional systems could only then and there be brought into accord when and where it was possible to reconcile the morphological system of terraces with an identical number of changes in sea level of the same direction and volume (i. e. in the region of the Mediterranean). Only in this manner did it prove successful to project, with the aid of an intercalation of the system of fluvial terraces, the chronology determined by the fluctuations of the glaciers onto the rhythmicality of the Mediterranean sea level changes and, by this route, onto the sedimentary cycles and malacological horizons of Hungary. It became possible, by this method, to correlate the Günz glaciation with the Calabrian, the Mindel with the Sicilian, the Riss with the Tyrrhenian and the Würm with the Monastirian. (However, the correlation of the northern [climatic] malacological marine horizons is still very uncertain.)

At this stage, only a thin line separated the marine malacological chronology from being brought into parallelism with the division, based on vertebrate-paleontology, of the continental deposits and the isolated sediments of the caves.

Ever since the end of the last century it would have been possible to establish parallelism on basis of the four glacials, had it not been prevented by the obstinate search of vertebrate-paleontologists for »cold« and »warm« faunae. A fair amount of data had been collected in support of the vertebrate-faunal character of the terraces of different ages, yet belated recognitionand acknowledgement of the consecutive faunal waves prevented the full recognition of the true connections. Now that the theoretical calculations of *Milankovič* and *Mišković* relating to the astronomical chronology of the Glacials — especially in the evaluation of *Soergel* and *Bacsák* — turned the

recognition of the Glacials in a new direction. The periods considered up to now simply as a succession of subsequent faunal waves became a practical reality replacing the supposed succession of cold and warm faunae.

It would be an exaggeration, of course, to maintain that it is possible to evaluate faunistically every environmental influence or, reversely, to retrace in a reliable manner all faunistical differences to changes of environment. On the contrary, quite a number of problems are still open. The question of the stadials and interstadials, together with the problems of the so-called »Vollgliederung«, is for the time being faunistically inapproachable. May be, this is because we do not dispose of sufficient faunistical data, or, because we still look at the interstadials — on the authority of *Soergel* — through the eyes of the old contemplators of the glacial periods.

Finally, a new point has come to be of importance : in the succession of faunal waves we do not yet perceive the adequate factor evolving the glacial periods. However, this is to a large extent a paleogeographical question, besides, it is not solely a problem of the glacial periods.

All this, of course, should not prevent us from correlating the four main glaciations of the Pleistocene together with the four bundles of terraces attached to them and the four phases of the fluctuation of the Mediterranean coast, with the four faunal waves of the period. Consequently :

Calabrian = Villafranchian = *Planifrons-Meridionalis* faunae. To this is attached the Günz glaciation and the fifth terrace of the rivers as also the Neoroumanian orogene.

Sicilian = Cromerian = Arnian + Mosbachian = *Trogontherii* faunae. Mindel glaciation and fourth bundle of terraces ; Bakinian orogene.

Tyrrhenian = Chelléan = *Antiquus* faunae. Riss glaciation, third bundle of terraces.

Monastirian = *Primigenius* faunae. Würm glaciation and second bundle of terraces.

Holocene period = present fauna, first terrace.

In conclusion, it should briefly be mentioned that from the chronological periods of archeology the Mousterian would cover the second phase (with *Cuon* and *Asinus*), the Aurignacian-Solutréan the third phase and the Magdalénian the last or fourth phase of the *primigenius* faunae.

Determination of the Age of our Quaternary Sediments

In relation to continental sediments the division of the Quaternary as outlined above is in many respects devoid of any practical value : it refers to marine sediments, to the regressions and transgressions and in the inner regions, at the best, to local terrace systems, sometimes to the sediments of caves and fissures, but leaves open the problem of the age of the enormous Quaternary

sediments filling up the youngest basins, in the first line that of the Hungarian Plain.

In order to surmount this very substantial obstacle and to get our chronology confirmed in the field, since without such a confirmation it remains hanging in the air, we must grasp every opportunity to interpose this or that sediment into the chronological order. In this respect the following are the most important Hungarian data :

1. Our »Meridionalis«-gravels and (at least the greater part) of our »Mastodon«-gravels are of Calabrian age. Thus, the high-level gravels and sands of the Danube-delta south of Budapest, at Ercsi and the outcropping, highly deposited part of the gravel extending from the Bakony and Velence Mountains to the SE as far as the Danube (Kisláng) and, finally, the sand and pebble beds of drillings below 300 m in the Alföld, with *Mimomys* of old shape (Szeged, Makó), should be ranged into this Age, to which also belong the travertines above Süttő and Dunaalmás (as its lower part).

2. The *Tulotoma böckhi* strata of the Hungarian Plain (to depths of 250 m and more), the terrace gravels of the Várhegy in Buda and the red clays of the fissures of the Villány region are considered to be of Sicilian age.

3. The fissures of the Calabrian travertine in Süttő were filled up in the first phase of the Monastirian, the low travertines at Tata belong to its second phase and all occurrences of typical loess to its last phase (typical locality for our chronology is Ságvár). Besides, all occurrences being certainly of second terrace origin belong to this age. The subsurface »blue clays and sands« of the Hungarian Plain produced without exception findings of Monastirian age.

4. Finally, the first terrace always yielded Holocene fauna. It is a grave deficiency of our chronology that due to the lack of paleontological findings and owing to the complicated character of the terraces, the huge gravel cover of the rim of the Little Hungarian Plain and of its adjoining system of terraces could not be properly classified.

The question of loess represents another serious problem to be solved. It is still undecided whether deposits existed before the Monastirian IV which could be considered as loess. It is easily imaginable that under our climatic conditions typical loess did not form until the Monastirian IV, inclining towards the arid-subarctic as proved by its subarctic tundra or steppe fauna, set in.

Many further data need to be carefully collected before we can proceed to the classification of the huge series of fluviatile sediments from the Quaternary covering the Great Hungarian Plain. Even if we rely on the scanty data at our disposal today, we can, with a fair amount of certainty, classify from the succession of coarse grained layers the thick series of Quaternary deposits of the Great Hungarian Plain, parallel to the pebble terraces, possessing in the alternations of clay-sand-pebble layers observable in the sections of deep borings, a reliable control.

SUMMARY

Comprehensive vertebrate-paleontological researches indicate five phases in the Quaternary chronology of the Great Hungarian Plain, which are characterised not — as was hitherto believed — by the alternation of the same cold and warm faunae, but by the succession of five faunal families or faunistic waves of easily discernible types. These five faunal waves are as follows:

1st wave : faunae with »*Mastodon*« *arvernensis* and »*Elephas*« *meridionalis*. Calabrian (Villafranchian) stage, fifth (Günz) terrace, gravels with *E. meridionalis*. Chief occurrences : Baród-Köpec, Kisláng, Süttő.

2nd wave : »*Trogontherii*« faunae. Sicilian (Cromerian), fourth (Mindel) terrace. Chief occurrences : Villány Mountains, Püspökfürdő, Gombaszög, Brassó, a. s. f.

3rd wave : faunae with *E. antiquus*. Tyrrhenian. Third (Riss) terrace. Only Hungarian occurrence : Solymár.

4th wave : faunae with *E. primigenius*. Monastirian. Second (Würm) terrace. This wave can be divided into four phases : warm fauna with *Testudo* and *Macaca*, fauna with *Asinus* and *Cuon*, fauna with cave-bear, mammoth and bison and, finally, an arctic-subarctic tundra and steppe fauna.

5th wave : present (forest and steppe) fauna.

РАСЧЛЕНЕНИЕ ЧЕТВЕРТИЧНОГО ПЕРИОДА НА ОСНОВАНИИ ФАУНЫ ПОЗВОНОЧНЫХ

М. Крецой

Резюме

На основании независимых от результатов исследований посторонних дисциплин, сводных исследований фауны позвоночных котловины гор Карпат, расчленение четвертичного периода может быть осуществлено следующим образом :

I. Калабрийский ярус. — Фауны : Anancus, Archidiskodon planifrons — meridionalis, Leptobos, Allohippus (tridaktyl=трехпальцевый !), с примитивными формами Canis, Parailurus, Protarctos, Eucladocerus, Metadicroceros. Это соответствует фаунистическому типу местностей Перрье, Сенеце, Валдарно, Тегелен. Местонахождения : Барот — Кёпец, Кишланг, Дунаалмаш, Шюттё (травертин) ; в нижней фазе (баротский подъярус) лигниты (Леффе) травертины, а в верхней фазе широко распространенные песчано — гравийные покровы, (арнский подъярус) — т. е. континентально — флювиатильное развитие яруса — виллафранкский ярус.

II. Сицилийский ярус. — Фауны без мастодонтов (Anancus, мамонт) с »Elephas trogontherii«, бизоном, однопальцевым monodactyl? Equus, вместо дюжих »rusoid« и »polyclad« оленей с видами Alces, Megaloceros, Cervus, Capreolus, как и появляющимися здесь в последний раз южными и неарктическими формами Epimachairodus, Pachycrocuta, Nyctereutina, Baranogale, Pannonictis, Dolomys, Mimomys, Trogontherium, Lagotherium (= Hypolagus). Классические месторождения ; террароссовые заполнения щелей Вилланьских гор (Беременд, Виллань, Чарнота), Пюшпёкфюрдё, Гомбасёг, Брашшо. Сюда относятся пещеры Швабской Альбы (Саккдиллинген, Моггастер), Мауер, Мосбах, кромерская серия Форест бед, Сензел и т. д. Характер фауны в его нижней части (вилланьский подъярус) определяется появлением перечисленных древних форм, а в верхней части (мосбахский подъярус) — их отсутствием ; первая характеризуется слоями терра росса, а последняя гальками террасы № IV (миндель), по крайней мере в континентальном развитии яруса.

III. Тирренский ярус. — Фауны с Hesperoloxodon antiquus,»Rhinoceros« mercki, с группами следующих фаун пещерного медведя, но со свойственными, характеристичными для яруса видами или подвидами. Макрофауна этого, фаунистически еще неполно известного яруса представляется Штейнгеймом, а его микрофауна еще не опубликованной фауной шоймарской пещеры.

IV. Монастирский ярус. — Вюрмские фауны с мамонтом, пещерным медведем и Rangifer-ом можно разделять на четыре фазы :

1. Теплая фауна с южными формами, как напр. Testudo, Macaca, небольшой Leo, небольшая Crocuta и т. д. Эту фазу, хорошо известную во Франции и Испании, характеризует фауна заполнений щелей д. Шюттё.

2. Характеристичная субарктическая фауна с пещерным медведем, Asinus-ом и Cuon-ом. Аналогии фаун этой фазы, сопровожденных западной мустьерской культурой, предоставлены пещерой Шубайук, местонахождениями дд. Понорохаба и Уппонь, как и недавно вскрытым, более глубоким плейстоценовым горизонтом пещеры в д. Чаквар.

3. Предыдущая арктическая фауна без Asinus-a и Cuon-a, сопровожденная оринякской и солютрейской культурами. Этот горизонт представлен пещерой Селета, горой Ишталлошкё, пещерой Германн и т. д.

4. Господство пещерного медведя возьмет на себя Rangifer, наряду с которым присутствуют Dicrostonyx, Lemmus, Gulo как и субарктические степные элементы. Магдаленская культура. Хорошо обыщенными местонахождениями этой фазы являются пещера Пушкапорош, каменная ниша горы Реметехедь в д. Пилишсанто.

Весь ярус в своем разнообразии показывает на местности едва ли синхронизируемую серию отложений глины, самана, песка и лёсса. На настоящей степени развевленных изысканий можно установить только то, что осадки террасы № II, как и типичный лёсс следует отнести сюда. Все месторождения типичного лёсса, подтвержденные культурой, оказались магдаленскими.

V. Голоцен. — Современная фауна с его лесными и степными формами.

В противоположность соображениям, обоснованным старой интерпретацией ледниковых и междуледниковых периодов, т. е. многократным возвращениям одной и той же холодной или теплой фауны, самым значительным характером очерченного в предыдущем фаунистического разделения четвертичного периода является последовательность пяти волн фауны, окончательно сменяющих одна другую.

Из пяти фаунистических волн первые две представляют две консекутивные волны иммиграции из Северной Америки и Сибири, третья показывает инфильтрацию юго-восточных и южных элементов, четвертая отмечает продвижение евразийских внутриконтинентальных элементов к западу, а пятая, в противоположность этому, наступление западного — южного влажного элемента.