U P P E R   J U R A S S I C   S T R A T I G R A P H Y

INTERNATIONAL SYMPOSIUM IN THE USSR

June 6 - 18, 1967

Program and guide-books

Moscow - 1967

P R O G R A M

of the International Symposium on the Upper Jurassic Stratigraphy in the USSR (June 6-18, 1967)

6 June (Tuesday) - Arrival of the delegates of the Symposium in Moscow.

7 June (Wednesday) - Session I in Moscow - 12.00-14.00

1) Inaiguration address of Academician A.L.Yanshin (USSR)

2) P.L.Maubeuge (France), Chairman of the Subcomission of the International Stratigraphic Committee (ISC) - Opening of the Symposium and its tasks.

3) G.Ya.Krymgoltz (USSR) - Problems of the study of the Jurassic deposits of the USSR.

4) V.A.Vakhrameev (USSR) - Subdivision of the Middle- and Upper Jurassic continental deposits of the USSR.

Session II - 16.00 - 19.00

1) A.L.Tzagareli - The Upper Jurassic zones of Georgia and their correlation to those of West Europe.

2) K.W.Barthel (FGR) - Possible faunal links between Southern Germany and the Russian Platform during the Upper Jurassic and supposed relations.

3) B.Ziegler (FGR) - Der Biostratigraphische West oberjurassische Ammonitenfaunen.

4) V.N.Sax and oth.(USSR) - Paleo-temperature conditions of the deposit formation in the Upper Jurassic basins on the areas of the USSR and Poland.

8 June (Thursday) - Session III - 10.00 - 14.00

1) P.A.Gerasimov, K.I.Kuznetzova, N.P.Mikhailov (USSR) - Volgian stage and its subdivisions.

2) V.N.Sax, M.S.Mesezhnikov, N.I.Shulgina (USSR) - Volgian stage of the Arctic.

Discussion: K.V.Paraketzov, K.M.Khudoley (USSR).

3) R.Casey (England) - The position of the Volgian stage in the English Jurassic.

4) A.Zeiss (FGR) - Der Beitrag Mitteleuropas zur Lösung einiger Probleme der Oberjura - Gliederung, insbesondere der Ober- und Untergrenze.

Session IV - 16.00 - 19.00

1) V.V.Drushchytz, N.P.Luppov (USSR) - On the Jurassic and Cretaceous boundary and a stratigraphic status of the Berriasian.

2) I.G.Sazonova (USSR) - The boundary between the Jurassic and Cretaceous systems and the position of the Berriasian on the East European platform.

3) V.I.Bodylevsky (USSR) - On the Upper Jurassic and Lower Cretaceous boundary in the boreal region.

4) V.Bieletcka, S.Marek (Poland) - The boundary between the Jurassic and Cretaceous systems.

5) T.Nikolov (Bulgaria) - On the boundary between the Jurassic and Cretaceous systems.

9 June (Friday) - Excursion to the suburbs of Moscow by bus.

10 June (Saturday) - Session V -in Ulyanovsk - 16.00-19.00.

1) V.G.Kamisheva-Elpatinskaya and oth.(USSR) - Callovian of the East European Platform.

2) I.I.Tuchkov (USSR) - Stratigraphy of the boundary layers of the Middle and Upper Jurassic in Yakut ASSR.

Discussion: N.T.Sazonov, K.I.Rostovtzev, E.E.Migacheva, B.P.Sterlin (USSR).

3) H.Hölder (FGR) - On the Middle-Upper Jurassic boundary.

4) N.S.Bendukidze (USSR) - On the Upper Jurassic boundary of Georgia.

11 June (Sunday) - Excursion up the Volgariver by ship and an examination of the lectostratotype section of the Volgian stage near the village of Gorodishche, higher than the town of Ulyanovsk.

12 June (Monday) - A flight from Ulyanovsk to Moscow and from Moscow to Adler. A tour to Sochi by bus.

13 June (Tuesday) - Excursions by bus along the Bzyb river to examine the Upper Jurassic sections. Night in Sukhumi.

14 June (Wednesday) - Excursion by bus to the town of Kutaisi; night in Kutaisi.

15 June (Thursday) - Examination of the Upper Jurassic sections near the settlements of Tzei, Ertzo and Tzona. Coming to Tbilisi.

16 June (Friday) - Session VI in Tbilisi - 10.00 - 14.00.

1) J.Fülöp (Hungary) - On the Jurassic-Cretaceous boundary.

2) R.Casey (England) - Jurassic-Cretaceous boundary in Europe.

3) N.G.Khimiashvili (USSR) - Tithonian deposits of the Caucasus.

Discussion: V.L.Egoyan, A.V.Krasnov, E.A.Uspenskaya.

Passing a resolution.

17 June (Saturday) - Coming back to Moscow by plane.

18 June (Sunday) - Departure of the delegates of the Symposium.

VOLGIAN STAGE AND UNIVERSAL STRATIGRAPHIC SCALE OF THE UPPER JURASSIC

As the International Colloquium in Luxemburg showed, the most complicated problem under discussion is the stage-division of the uppermost portions of Jurassic, on which no coordinated conclusion has been passed.

In 1849 d'Orbigny suggested the Kimmeridgian and Portlandian stages, and since then the discussion on their volume is still going on. Up till now we have no generally adopted universal stage for the deposits of the end of the Late Jurassic.

In the practice of the geological survey the three local stage subdivisions are used: the Portlandian for the Anglo-Paris basin, the Tithonian for the Tethys and the Pacific region and the Lower Volgian and Upper Volgian stages for the Russian platform, the north of Siberia and Poland.

D'Orbigny suggested the Portland or the Portlandian stage. The section in the south of England, isl.of Portland, was established as its stratotypical section. The scope of the stage as suggested by d'Orbigny, includes the deposits from the zone Gravesia gravesiana up to the zone Titanites giganteus.

This Portlandian volume is adopted by the majority of the geologists of the world and of the Soviet Union as well. The English geologists, however, proceed from the fact that in England the Kimmeridgian clays in a stratigraphical section include the zones Gravesia gravesiana-Pavlovia pallasioides. That is why the Portlandian is regarded by them in a restricted scope beginning from the zone Zaraiskites albani to Titanites giganteus, considerably lifting the upper boundary of the Kimmeridgian stage. All this complicates the solution of the problem concerning the stages of the Late Jurassio and their volume.

The Tithon or the Tithonian stage was established by Oppel in 1865 for the deposits of the Tethys northern region, which oocur between the Upper Kimmeridgian (zone Aulacostaphanus pseudomutabilis and the Lower Cretaceous. This stage was named not after the area, its stratotypical section being not shown. S.N.Nikitin proposed (1881) "....to introduce a special name of the Volgian formation" for the whole mass of the Jurassic beds of Middle Russia lying above the Oxfordian clays (page 49). He had no clear understanding of the term "stage" yet. Thus he distinguished "Calovian"beds Oxfordian beds and Volgian beds", while their zones are named stages (page 36). His next paper written in 1883, S.N.Nikitin (1884) entitles "Notes concerning the sequence of the Volgian stage beds of Moscow Jurassic". In this paper Nikitin describes the Volgian stage with reference to a more detailed description in his work published two years before (1881). Having pointed out a strong pre-Cretaceous washout, Nikitin wrote: "....It is natural, that the uppermost beds underwent a stronger destruction than the lower ones. That is why the Oxfordian clay has a more constant and wide distribution than the Volgian stage;... the beds of the Volgian stage are, with Am.virgatus of course, preserved more often than the beds with Am. fulgens, the latter in its turn is met more frequently than the uppermost portion, the aucellic bed with Am.subditus."

In the same year S.N.Nikitin (1884) divides the Volgian stage into two stages: the Lower and Upper Volgian stage" . (these are in fact "Mnevnikov" and "Khoroshov" stages by Shurovsky (1867), who marked briefly but definitely their place in the stratigraphic scale of the Jurassic period of the Moscow region), and continues to map it as J_3v. He explains in the foot-note once again "the meaning of the term "Volgian stage", (see page 37-49", (p.53).

Being influenced by A.O.Mikhalsky, Nikitin during a certain period of time considered the Upper Volgian stage to belong to Cretaceous.

A.P.Pavlov (1884) described in the Middle Volga region near the village of Gorodishche the deposits of the Volgian stage and the Kimmeridgian clays underlying them. Thus he defined more exactly the scope of the Volgian stage. D.N.Sokolov (1901, 1921) distinguished a Vetlianian horizon in the Orenburg Jurassic and attributed it to the lowermost portions of the Lower Volgian stage This scope of the Lower Volgian stage was adopted at the All-Union Conference of the Mesozoic stratigraphy of the Russian platform in 1954.

The Volgian stage of S.N.Nikitin combines his Lower and Upper Volgian stages and corresponds to the Tethonian regarding its scope. These deposits were developed in the Volga basin, but their exact stratotype was not pointed out.

The Upper stage of the recent Jurassic was hotly discussed at the first International Colloquium on the Jurassic system held in Luxemburg in summer 1962, no resolution, however, on this problem being adopted. The major part of the Colloquium participants were inclined to draw an upper boundary of Kimmeridge under the beds with Gravesia, and were ready to adopt the forth decision by R.Ene, who proposed to widen the scope of the Portlandian stage so that it should be equivalent to the Tithonian and Lower and Upper Volgian stages together, it having been proposed by Hauge (1898). This decision, however, was not adopted as well. Debates held at the first International Colloquium on Jurassic system (1962) and the subsequent discussions of its resolutions turned out to be extremely fruitful. They were discussed at the plen y session of the regular Commission of the Interdepartamental Committee on the Jurassic system (January-February, 1963). The Commission agreed with drawing the upper boundary of the Kimmeridgian at the basement of the beds with Gravesia; "the Commission recommends the Tithonian stage as the upper stage of the universal stratigraphic scale of the Jurassic system. The Commission also pointed out that for "Boreal region the Lower and the Upper Volgian stages should be retained, both being equivalent to the Tithonian stage". In case the Tithonian stage were not accepted by the International Geological Congress as the standard stage of the universal stratigraphic scale, the Volgian stages could be included into this scale as the stages of an international importance". As to the Portlandian stage, it is not to be recommended " because of the difference in the opinion regarding its volume... In addition, the upper boundary of the Portland stretches lower than the boundary of the Jurassic and Cretaceous system" (Resolution, 1963, pp.148-149).

At the meeting of the British Mesozoic Committee (in the early February, 1963), while discussing the Resolutions of the Luxemburg Colloquium, the geologists of England came to an agreement to draw the boundary of the Kimmeridgian stage under the beds with Gravesia according to d'Orbigny, Hauge and Zalfeld.

At the second session of the British Mesozoic Cimmittee in February,1964 it was decided to withdraw the Portlandian from the international stages and to terminate the Jurassic with the Volgian and Tithonian stages and to begin the Lower Cretaceous with the Berriassian or Ryazan horizon.

The Soviet geologists approve these resolutions of the British Mesozoic Committee regarding the upper boundary of the Kimmeridgian stage under the beds with Gravesia and withdrawing the Portlandian as a stage of the international stratigraphic scale. The distribution of the Portlandian deposits is practically limited with the Anglo-Paris basin and with the area northwards (F.G.R.). The deposits of the Volgian stages can be successfully isolated on the area stretching from the Far-East of the USSR to Greenland, Canada and Alaeka, i.e. almost throughout the whole Boreal region of the northern hemisphere; they are readily compared with the Portlandian considering zones. They cover the whole section from the roof of the Upper Kimmeridgian to the Berissian basement. The Portlandian corresponds mainly to the middle substage of the Volgian stage only.

The Tithonian stage is better developed, but it is named not after its locality and has no stratotype. Its zonal division is weakly expressed. Thus the Upper Tithonian stage is established, being composed of one-two zones which are very difficult to correlate with the Arctic deposits of the Volgian stages and which corresponds to their six zones.

At the Meeting of the Committee on the Mediterranian Mesozoic held in May 1964 in Cassy (France), a resolution was adopted recommending to approve the Volgian stage as a universal stage of the world stratigraphic scale at the next XXII Session of the International Geological Congress.

The Soviet geologists use in their practice the Lower and Upper Volgian stages for the end of the Upper Jurassic. Geologists from the foreign countries take them as one Volgian stage just as it was presented in the first works by S.N.Nikitin (I88I and I884) and by A.P.Pvlov (I884, I886).

Taking into consideration that this stratigraphic interval corresponds to one period in the evolution of ammonites, characterized by the florish of the representatives of the subfamilies Virgatosphinctinae, Dersoplanitinae, Virgatitinae and by the appearance of the early representatives of the family Craspeditidae from the Virgatus beds, it is worthwile to establish the universal Volgian stage in the USSR as well.

The Upper Volgian stage could be included into it as the upper substage. The introduction of the universal Volgian stage would result in simplifying the index (J_3v).

The Volgian stage will consist of three stages, each being divided into three zones. The lower substage (J_3v_I) with the zones Subplanites klimovi and Gravesia spp.,S.sokolovi, S.pseudoscythicus: it is up to the Vetlianian horizon of D.I.Sokolov (I90I) and corresponds to the zones: Gravesia gravesiana, Gravesia gigas, Subplanites spp.,Pectinatites pectinatus of the North-west of Europe and to the Lower Tithonian in the volume: Glochiceras lithographicum, Subplanites vimineus, Berriasella ciliata. The middle substage (J_3v_2) with zones Dorsoplanites panderi, Virgates virgatus, Epivirgates nikitini corresponds to zones Pavlovia rotunda, Pavlovia pallasioides, Progalbanites albani, Crendonites gorei, Titanites giganteus of the North-West of Europe. The upper substage (J_3v_3) is subdivided into the zones: Kachpurites fulgens, Craspedites subditus, C.nodiger. It can be correlated with the lower part of the Purbeckian. The middle and upper substages together correspond to the Upper Tithonian, zone Virgatosphinctes transitorius.

The three substages of the Volgian stage are approximately equal concerning their volume, and represent three subphases in the development of cephalopods of the Late Jurassic end.

The early subphase(= lower substage) is characterized by the ammonites of the genera Subplanites, Subdichotomoceras, Pectinatites of the subfamily Virgatosphinctinae, and by the appearance of the ancient representatives of the subfamily Dorsoplanitinae, genus Paravirgatites.

The middle subphase (= middle substage) is marked by the vigorous development of the genera of the subfamilies Virgatitinae and Dorsoplanitinae and appearance of the first Kachpurites and Craspedites, family Craspeditinae.

The late subphase (= upper substage) is known for the florish of Craspedites Kachpurites Garniericeras, family Craspeditidae and the survival of the genera Laugeites, subfamily Dorsoplanitinae and Virgatosphinctes, subfamily Virgatosphinctinae.

S.N.Nikitin, while distinguishing the Volgian stage, which he initially named "Volgian formation" wrote: I have chosen this name, because the Volga basin gives us mainly the instructive sections of this formation. We are researching its extreme points in Rybinsk, Moscow, Kineshma, Syzran" (1881,p.49)

We have no exact data concerning both the stratotype of the Volgian stage and the Lower and Upper Volgian stages, established by him later. In the regions of Rybinsk and Kineshma there are no complete sections of the deposits we are interested in. They lost their importance in the suburbs of Moscow due to the city construction. In the suburbs of Syzran and the village of Kashpir the lower part in the section of the Volgian stage deposits is poorly exposed. As a lectostratotype of the Volgian stage one can recommend a well-known section in the Middle Volga region on the right Volga bank near the village of Gorodishche, 25 kilometres (along a straight line) upwards the town of Ulianovsk, where A.P.Pavlov (I884) distinguished the Kimmeridgian clays from the Gorodishche clays, restricting the scope of the Volgian stage.

The detailed description of the lectostratotype of the Volgian stage is given below. "The tasks and rules of the study and description of the stratotypes and key stratigraphic sections", written according to the instructions, were approved and recommended by I.S.C.

Lectostratotype of the Volgian Stage

The subdivision range corresponds to the stage. The name is originated from the Volga river. The lectostratotype of the Volgian stage is in the Middle Volga region on the right bank of the Volga, near the village of Gorodishche, 25 km. upwards (to the north) from Ulianovsk, and I km. downwards Gorodishche (a schematic map is attached) (Fig.I).

The Volgian stage was suggested by S.N.Nikitin (I88I) for the beds lying above the Oxfordian clay; he named it at first "Volgian formation (I88I, p.49)

In his work of 1883 Nikitin S.N.(1884) names this formation "the Volgian stage. However, somewhat later (1884) he subdivided it into the lower and upper Volgian stages, being used at present. He remarks: "See the meaning of the term "Volgian stage" in my abovementioned work. page 37-49" (p.53). We have not got a more exact indication of the stratotype, except that these deposits have been developed in the Volga basin.

A.P.Pavlov (1883-1884) described the Volgian stage in the Middle Volga region near the village of Gorodiehche and subdivided it into: a) lower Volgian or Virgatus beds, and b) upper Volgian of Catenulatus beds. These subdivisions retained their meaning up to date, though being forgotten by the author himself. He wrote about them:

"The Volgian stage

b) The upper Volgian or Catenulatus beds with Oxynoticeras catenulatum Fisch., Perisphinctes subditus Tr.. In a larger portion of the area these beds can be further subdivided into two horizons: the upper horizon with Perisphinctes Kashpuricus Tr., and P.nodiger Eichw., and the lower one with Oxinoticeras fulgens Tr.and P.Okensis d.Orb.

a) Lower Volgian or Virgatus beds with Perisphinctes virgatus Buch, P.quenstedt Roul. and Belemnutes absolutus Fisch." (page 30).

The deposits of the Volgian stage as it was found by A.P Pavlov for the first time in Russia, are underlain by the clays with "Aspidoceras acanticum Opp., A.liparum Opp., Holpites cf. eudoxus d.Orb., H.pseudomutabilis Loriol" and by other ammonites of the Upper Kimmeridgian. The monographic description of these ammonites was published by A.P.Pavlov in I886; the "Volgian stage (page 5,6) or "de Létage volgian" (p.70) is mentioned in it.

However, in I892 and in his subsequent works A.P.Pavlov established the Portlandian or Bononian stage instead of lower Volgian beds (S.N.Nikitin's lower Volgian stage), and the Aquilonian stage, instead of the Upper Volgian beds (S.N.Nikitin's Upper Volgian stage).Soon he also related zone Riasanites rjasanensis to the latter; some western-European zones (Perisphinctes bleicheri, P.giganteus) being distinguished by him in the Portlandian of the Middle Volga region.

The establishemnt of these zones and the Portlandian and Aquilonian stages caused some founded critical remarks by A,N,Rozanov (I928). But the correlation made by Pavlov of his lower zone (P.bleicheri) with the Lower Portlandian and that of the upper zone (P.giganteus=Epivirgatites) with the upper zone of the Upper Portlandian proved to be correct.

D.N.Sokolov (I90I, I903, I905, I92I) suggested "the Vetlianian horizon on the Vetlianka river in the Orenburg Jurassic and within the lower part of the lower Volgian beds. D.I.Illovaisky (I94I) established two zones in it: Ilovaiskaya sokolovi, I.pseudoscitnica, considering these two zones worth grouping as an independent stage. N.T.Sazonov insisted on the same (I957).

The Vetlianian horizon is analogous with the zone P.bleicheri suggested by A.P.Pavlov.

At the All-Union Conference on the stratigraphy of the Mesozoic deposits of the Russian platform in I954 it was decided to establish a unified zone I.sokolovi and I,pseudoscythica, and to relate it to the lowermost portions of the Lower Volgian stage.

The section of the Upper Jurassic deposits on the Volga near the village of Gorodishche is the most complete and is chosen as a lectostratotype because it is here that A.P.Pavlov described the Volgian stage in his early works.

A picture and a drawing of the lectostratotype of the Volgian stage is attched.

The deposits of the Volgian stage underlie the Kimmeridgian clays which are related to the two upper zones of this stage according to the rich ammonite fauna contained in them: zone Aulacostophanus pseudomutabilis and zone Virgatoxioceras fallax. The Volgian stage is covered with the sediments of the Lower Cretaceous - phosphate sandstone (conglomerate) with Pachyteuthis (Acroteuthis) lateralis (Phill.) with those of tho Upper Valanginian, and with dark clays with Speetoniceras (Upper Heuterivian). In the Moscow region (Lopatinsk, phosphorite mine) the Volgian stage deposits overlie the beds with Riasanites rjascensis.

A detailed lithological and paleontological characteristic of the beds: x)

J_3km_2-ps I.Clay: light grey and grey, calciferous compact with pyrit concretions, with pyritized and argillaceous nuclei, less frequently with ammonite shells: below prevail Physodceras acanticum (Opp), Aspidoceras meridionale (Gemm); hence the following are evidently described by Pavlov (1886): Amoeboceros volgae Pavl. and A. subtilicostatus Pavl. Above there are numerous Aulacostephanus pseudomutabilis (Lor.). A.eudoxus (d'Orb.), A.subeudoxus (Pavl.), A.subundorae (Pavl.), A.jasonoides (Pavl.), Phydoceras liparum (Opp.), Pachytheuthis (?) gorodishchensis Gust., Cylindroteuthis (Logonibelus) ingens (Krimh.)x . (See Fig.3).

J_3km_2-f. 2. Grey clay, shaly, calcareous, with crushed shells: Virgataxioceras fallax (Ilov et Flor.), Phydoceras sp.. Together with them are met shells Aulacostephanus cf. jasanoides (Pavl.), A.cf.subundurae (Pavl.), seldom above and often below, and also rostra Pachytheuthis(?) gorodishchensis Gust. 3.0 m

J_3v_I-k. 3. Dark-grey clay, in some bands grey and brownish-grey, platy, compact, calcareous with large loose ochreous concretions with Subplanites cf. klimovi (Ilov.et Flor.), Neochetoceras sp., Glochyceras sp., Exogira virgula (Defr.),Cylindroteuthis (Cylindroteuthis) porrecta (Phill.). From here evidently came Glochyceras cf. fialar (Oppel.), mentioned by N.T.Zonov (1937) 3.50 m

4. Clay: grey, compact calcareous, containing at the base a band of fine black phosphorite concretions with crushed nuclei and shells Subplanites klimovi (Ilov. et Flor.), Gravesia cf. gigas (d'Orb.), Gravesia sp.,Cylindroteuthis (C.) porrecta (Phill.). Stephanoceras (=Gravesia) portlandicus Lor., mentioned by A.P.Pavlov (1901) and Gravesia ex. gr. gravesiana (d'Orb.) spoken by N.T.Sazonov, were apparently from here 0.80 m

J_3v_I-sk. 5. Clay: black, calcareous, stratified, with small disseminated limy concretions and rare nuclei Subplanites cf.sokolovi (Ilov.et Flor),S.pavida (Ilov.et Flor.) , Cylindroteuthis (C.) cf. porrecta (Phill.). 1.0 m

J_3v_I-psc. 6. Interstratified dark-grey platy calcareous clay and light-grey compact marl (two layers of clay and two layers of marl), with sparse and poorly preserved crushed nuclei Subplanites cf. pseudoscythicus, Physodoceras neuburgensis (Ilov.et Flor), Cylindroteuthis (C.) porrecta (Phill.), Pachyteuthis (?) gorodishchensis Gust. Total capacity about 1.60 m

J_3v_2-p_I. 7. Light-grey marl, compact with scattered small calcareous concretions with frequent, usually crushed nuclei Zaraiskites scythicus (Visch.), Z.quenstedti (Rouill.et Vos.), Pavlovia pavlovi (Mich.), rare Dorsoplanites panderi (d'Orb.), Cylindroteuthis (Lagonibelus) parvula Gust.,Pachyteuthis (?) gorodishchensis Gust. I.50 m

J_3v_2-p_2. 8. Light-grey marl, compact with scattered small calcareous concretions with bands above (0.50 m), of dark-grey calcareous clay with frequent shells and nuclei: Zaraiskites scythicus (Vischn.), Z.quenstedti (Rouil.et Vos.), Z.zarajskensis (Mich), Dorsoplanites panderi (d'Orb.), D.dorsoplanus (Visch.), Pavlovia menneri Michlv, P.pavlovi (Mich.), a large number of small rostra Cylindroteuthis (Lagonibelus) parvula Gust., and rare and less characteristic rostra Pachyteuthis gorodishchensis Gust. 2.30 m

J_3v_2-p_2. 9. Interstratified brown and grey platy calcareous clays and dark-grey brownish-grey bituminous-schistous clays. The four lower m contain crushed shells Zaraiskites scythicus (Visch.) Z.quenstedti (Rouil.et Vos), Z. zarajskensis (Mich.), Dorsoplanites cf.panderi (d'Orb.), D.cf.dorsoplanus (Visch.) In the lower part of the thickness are frequent rostra Cylindroteuthis (Lagonibelus) magnifica (d'Orb.), C.(L.).submagnica (d'Orb.), and in the upper half there are many rostra Cylindroteuthis (L.) rosanovi Gust.,C.(L.) submagnifica (d'Orb.), and Z.zarajskensis (Mich.)prevailing 6.0 m

J_3v_2-v. IO. Phosphorous conglomerate with virgatites virgatus (Buch.), Cylindroteuthis (Lagonibelus) volgensis (d'Orb.) and markedly rounded phosphorite nuclei Zaraiskites scythicua (Visch.), Pavlovia sp., and others of the secondary occurrence. 0.1 m

II. Sand: greenish-grey and brown, glaiconitic, dense, with phosphorite nodules, with Virgatites virgatus (Buch), V.pallasi (Mich.), V.pusillus (Mich.), C.(Lagonibelus) volgensis (d'Orb.) 0.55 m

I2. Phosphorous conglomerate in grey calcareous sandstone with Virgatites virgatus (Buch), V.pallasi (Mich.), V.pusillus (Mich.), C.(L.) volgensis (d'Orb.) 0.I5 m

Total thickness of the beds with Virgatites virgatus is about 0.80 m.

J_3v_2-nk I3. Sandstone: grey and greenish-grey, calcareous glauconitic with Epivirgatites bibliciformis (Nik.), E.nikitini (Mich.), E.lahuseni (Nik.), Lomonossovella lomonossovi (Visch.), L.blakei (Pavlov), Laugeites stschurowskii (Nik.), Pachyteuthis (Acroteuthis) russiensis (d'Orb.), P. mosquensis (Pavl.), P. praecorpulentus Geras, Aucella fischeriana (d'Orb.), A.krotovi Pavl.

In the lower part of the bed prevail Pachyteuthis (Acroteuthis) prorussiensis Gust. , and above are rostra P.(A.)rusiensis (d'Orb.) 0.5-I m.

J_3v_3-sb. I4. Greenish-grey, partly very loose sandstone with abundant (especially in the lower part) pebbles of grey calcareous sandstone. 0.8 - I m

In the main cementing rock: Craspedites subditus (Traut), C.okensis (d'Orb.), Garnierlceras catenulatum (Fisch.), Pachyteuthis russiensis (d'Orb.), P.mosquensis (Pavl.), P.praecorpulentus Geras.(in litt.), Camptonectes lamellosus (Sow.), Entolium nummularae (Fisch.), Inoceramus (Anopaea) sphenoides Geras., abundant aucellas Aucella fischeriana (d'Orb.) A.tenuicollis (Pavl.) Rouillieria michalskii (Fahr.).

In pebbles-Kachpurites fulgens (Traut).

J_3v_3-nd. 15. Sandstone: grey and yellowish-grey, calcareous rather compact with dark sandy phosphorite concretions and with pebbles of greenish-grey sandstone (the bed is preserved in some places from the latest wash-out) 0.0-0.15 m

Fossils: Craspedites milkovensis (Strem.), C.Kachpuricus (Traut.), C.parakachpuricus Geras. (in litt.). C.mosquensis Geras., Aucella terebratuloides Lah.

Gr_1vln_2. 16. Sandstone: yellowish-grey, unevenly ferruginous (conglomerate), overflowed with pebbles of weathered sandstone of two types. 0.30-0.45 m

In the main cementing rocks; rare Pachyteuthis lateralis (Phill.), Temnoptychites mokschensis (Bog.). In the pebbles of brownish-grey sandstone: Aucella volgensis Lah. (Gr_Ivln_1-st). In other (grey limy sandstone): Craspedites kaschpuricus (Traut),, C.parakaschpuricus Geras.(in litt), C.mosquensis Geras.,Pachyteuthis corpulentus (Nik.), P.russiensis (d'Orb.), (J_3v_3-nd).

$Cr._Ih_2$.I7. Clay: dark, partly sandy, with rare large concretions (septarium) of hard marl, with Speetoniceras versicolor (Traut), Astarte porrecta Buch. I.0-I5 m.

The monographic study of the fossils of the fauna remains of the Upper Jurassic deposits of the Russian platform, especially of cephalopods, and ammonites among them, unabled us to establish three substages and 9 zones in each substage.

Lower substage (J_3v_I)

I.Zone Subplanites klimovi and Gravesia sp.(J_3v_I-k) is characterized by: Subplanites klimovi (Ilov. et Flor), Neochetoceras sp.,Glochyceras sp., Gravesia cf.gigas (d'Orb.), Cylindroteuthis (Cylindroteuthis) porrecta (phill.),C.(Lagonibelus) nikitini (Sok.).

2. Zone Subplanites sokolovi (J_3v_1-sk) contains: Subplanites sokolovi (Illov.et Flor.), S.pavida (Ilov.et Flor.), S.cf.vimineus (Schneid.),Cylindroteuthis (C.) porrecta (Phill.), C.(L.) nikitini (Sok.), Aucella rugosa (Fisch.).

3. Zone Subplanites pseudoscythicus (J_3v_1-psc) is most fully characterized by cephalopods; Subplanites pseudoscythicus (ilov.et Flor.), S.schaschkovae (Ilov.et Flor.), Peotinatites (Pectinatites) aff.pectinatus (Phill.),P.(P.) iaлschini (Ilov.et Flor.), P.(P.) tenuicostatus Michlv.,P.(Weatleyites) aff. aetlecottensis (Salf.), P.(W.) arkelli Michlv.,P.(W.) spathi Michlv.,Physodoceras neuburgense (Opp.), Cylindroteithis (L.) nikitini Sok.,C.(L.) vetjankensis Gust.,C.(C.) porrecta (Phill.), Aucella rugosa (Fisch.).

<u>**Middle substage (J_3v_2)**</u>

4. Zone Dorsoplanites panderi (J_3v_2-p).

Lower subzone Pavlovia pavlovi (J_3v_2-p_1) contains:Zaraiskites scythicus (Vischn.), Z.quenstedti(Rouil.et Vos.), Pavlovia pavlovi(Mich,),Dorsoplanites panderi(d'Orb.),Cylindroteuthis(Lagonibelus)parvula Gust.,Pachyteuthis(?)gorodischensis Gust

Upper subzone-Zaraiskites zarajskensis (V_3v_2-p_2) contains a richer complex of cephalopods:Zaraiskites scythicus (Visch.),Z.quenstedti(Rouil.et Vos),Z.Zarajskensis (Mich.), Z. apertus (Visch.), Dorsoplanites panderi (d'Orb.), D.dorsoplanus (Visch.), Pavlovia menneri Michlv.,Pavlovia pavlovi (Mich.),Acusticostites acusticostatus(Mich.), Cylindroteuthis(Lagonibelus) parvula Gust.,C.(L.)magnifica(d'Orb.),C.(L.) submagnifica(d'Orb.)

C.(L.) rosanovi Gust.

For the zone Dorsoplanites panderi the following are characteristic: Aucella mosquensis (Buch), A.gracilis Pavl.,A. rugosa (Fisch.), Ostrea plastica Trd.,O.curva Geras.,Inoceramus pseudoretrorsus Geras.,Scurria maeotis (Eichw.) and others.

5. Zone Virgatites virgatus (J_3v_2-v)

Lower subzone - Virgatites virgatus (s.str.) (J_3v_2-v_1), Virgatites virgatus (Buch), V.sosia (Visch.),V.pusillus (Mich), V.palasianus (d'Orb.), Acuticostites acuticostatus (Mich.), Cylindroteuthis (L.) volgensis (d'Orb.).

Upper subzone - Virgatites rosanovi (J_3v_2-v_2), with Virgatites rosanovi Michlv, V.virgatus (Buch), Crendonites kuncevi Michlv,Behemoth sp.-(cf.lapideus Buck.), Lomonosovella lomonossovi (Visch), Kachpurites sp., Craspedites sp.,Cylidnroteuthis (L.) volgensis (d' Orb.) and sporadic P.russiensis (d'Orb.).

For the zone Virgatites virgatus the following are ussual in the whole: Trigonia intermedia (Fahr.), T.koprinensis Geras., Aucella russiensis Pavl.,Ostrea expansa Sow., Isognomon gibbum (Eichw.), Rhynchonella rouillieri Eichw., Russierhynchia fischeri Rouil., Zeilleria bullata (Rouil.), Rugothyris plicata (Geras.) and others.

6. Zone Epivirgatites nikitini (J_3v_2-nk.)

Epivirgatites nikitini (Mich.), E.bipliciformis (Nik.), E.lahuseni (Nik.), Lomonosovella lomonossovi (Visch.), L.blakei (Pavl.,L.michalskii Michlv., Laugetis stschurowskii (Mich.), Kerberites mosquensis Michlv.,Pachyteuthis (A.) russiensis (d'Orb.), P.mosquensis (Pavl.),Cylindrotheuthis (L.) volgensis (d'Orb.), Mosquella oxyophycha (Fisch), Russiella clemenci Lem.,R.truncata

Geras.,R.bullata (Rouil.), Aucella fuscheriana (d'Orb.), A.andersoni Pavl., Musculis fischerianus (d'Orb.), Astarte veneris (d'Orb.) and others.

Upper substage (J_3v_3)

7.Zone Kachpurites fulgens (J_3v_2-f).

Kachpurites fulgens (Traut.), K.subfulgens (Nik.), Craspedites fragilis (traut.),C.nekrasovi Prig.,C.okensis(d'Orb.), C.krylovi Prig.,Subscraspedites sp.,Pacyteuthis (A.) russiensis (d'Orb.) P.praelateralis Geras., P.mosquensis (Pavl.), Aucella andersoni Pavl., A.lahuseni Pavl.,A.fischeriana (d'Orb.), A.krotovi Pavl.,A.surensis Pavl.,Astarte veneris (d'Orb.), Rhynchonella loxiae Fisch., Russiella luna Fiscj.,and others.

8. Zone Craspedites subditus (J_3v_3-sb) - Craspedites subditus (Traut.), C.subditoides(Nik.),C.okensis (d'Orb.), Garniericeras catenulatum (Fisch.),G.interjectum (Nik.) Pachyteuthis (A.)russiensis (d'Orb.) P.proelateralis Geras.P.mosquensis (Pavl) Aucella andersoni Pavl.,A.lahuseni Pavl., A.fischeriana (d'Orb.), A.krotovi Pavl.,A.surensis Pavl.,Rhynchonella loxiae Fisch., Russiella luna Fisch.,R.volgensis Lehm.,R.chroschovensis Geras,etc

9. Zone Craspedites nodiger (J_3v_3-nd)

Lower subzone - Craspedites mosquensis (J_3v_3-nd), with Craspedites mosquensis Geras.(Frequent),C.nodiger (Eichw.), C.kachpurites (Traut.)(sporadic), C.kuznetzovi (Sok.)(sporadic), C.milkovensis (Strem.),C.parakaschpuricus Geras (in litt.), Garniericeras subclypeiforme (Mil.), Pachyteuthis russiensis (d'Orb.) P.mosquensis (Pavl.),P.praecorpulentus Geras.(in litt.), Leda cf. dammariensis Buv.,Aucella lahuensi Pavl.,A.tenuicollis (Pavl.), A.terebratuloides Lh.,Astarte mnevnikensis (Mil.) em.Geras., Pleuromya peregrina (d'Orb.), P.tellina Ag.,Guenstedtia parallela (Traut.),Macromya cf.excentrica(d'Orb.et Lor.),Lima consobrina d'Orb.,Entolium nummularae (Fisch.),Camponectes lamelosus (Sow.),Thracia incerta Roem.,Gresslya alduni (Fisch.), Rhynchonella loxiae Fisch.,Russiella luna Fisch.,Rhabdocidaris lahuseni Geras. and others.

Upper subzone - Craspedites nodiger (s.str.)(J_3v_3-nd), with Craspedites nodiger (Eichw.),C.milkovensis (Strem.),C.kaschpuricus (Traut)(sporadic),C.parakaschpuricus Geras.(in litt) (very frequent),C.kuznetzovi (Sok.)(single),Gernericeras subclypeiforme (Mil.)(frequent),Pachyteuthis russiensis (d'Orb.), P.corpulentus (Nik.)(sporadic),Cuculaea angularis Eichw.,Camponectes lamellosus (Sow.),Ctenostreon decemcostarum (Traut.), Isognomon rarum Geras.,Anopae brachovi Rouil.,Solemya togata (Traut.), Isodonta? arenicola Geras.,Trigonia falcki (Rouil.et Vos.), Pleurotoramia torosa (Traut.), Neritopsis auerbachi (Traut.) Ampulospira brevis Geras.,Neritaria ?congrua (Eichw.),Vanicoro psamobia Geras.,Scurria impressa Geras. and others.

The Volgian stage is the upper and the last stage of the Late Jurassic. Its deposits are underlain by the uppermost zone of the Upper Kimmeridgian and are overlain by the Lower Valanginian (Berriasian). In the development of cephalopods of the Upper Jurassic end one can observe one phase corresponding to the Volgian stage and three subphases corresponding to its substages. This phase (equal to the Volgian stage) is characterized by the ammonites of the sunfamilies Virgatosphinctinae and Dorsoplanitinae,occuring in all substages. On the Russian platform in the middle substage they join with the ammonites of the subfamily Virgatitinae. In its roof the representatives of the families Perisphinctidae (genera Virgatosphinctes) and Pseudoperisphinctidae (genera Laugeites and Chetaites) stop to exist; beginning from the zone Virgatites virgatus appear Craspedites and Kachpurites (Craspeditinae), to which join the representatives of the genus Garniericeras (Garniericeratinae), the latter entering the Lower Cretaceous (see fig.6). In the Lower Valanginian (Berriassian) the representatives of the two new subfamilies begin to appear: Berriasellinae and Tolliinae.

The lower boundary of the Volgian stage is well marked by the change of the Upper Kimmeridgian ammonites: Aulacostephanus, Amoeboceras, Aspidoceras, Virgatoxioceras and others are changed by Subplanites, Subdichotomoceras, Pectinatites, Gravesia. In its upper boundary the ammonite genera Craspedites, Kachpurites, partly Garniericeras and Laugeites, Virgatosphinctes surviving here, are changed by the Lower Cretaceous ammonite genera Riasanites, Surites, Euthymiceras.

P.S.Lyubimova (1955) observed a sharp change of genus and species composition of ostracods".... on the boundary of the Kimmeridgian and lower Volgian stage" (p.157). And also "..between the Upper Jurassic and Lower Cretaceous " (p.158), i.e. in the base and in the roof of the Volgian stage.

The early subphase(= the lower substage) is characterized by the ammonites of the genera Subplanites, Pectinatites and Subdichotomoceras, the latter coming from the Upper Kimmeridgian. At its end begin to appear the first representatives of the subfamily Dorsoplanitinae, genus Paravirgatites.

The middle subphase (= the middle substage) contains Pavlovia, Dorsoplanites, Lomonossovella, Crendonites, Laugeites, Kerberites, Behemoth, Strajevskya, Lydistratites and other genera of the subfamily Dorsoplanitinae, and also Zaraiskites, Virgatites, Epivirgatites of the subfamily Virgatitinae.

The late subphase (= the upper substage) is characterized by the abundant development of Kachpurites, Craspedites, Garniericeras, and by Virgatosphinctes in the north of Siberia. The are closely related to the corresponding changes of physical and geophysical conditions of the fossil basins.

The Volgian stage and its substage are distinguished according to belemnites, foraminifers and ostracods.

Zonal parallelism of the Volgian stage with the Portlandian and Tithonian stages are given in Table I.

The Volgian stage, being the last stage of the Upper Jurassic has a considerable advantage compared to the Portlandiand and Tithonian stages, and may be recommended as a universal stage for the International stratigraphic scale. At present the Soviet geologists are using for this stratigraphic interval the Lower and Upper Volgian stages which should be united.

The general stratigraphic subdivision of the uppermost portions of the upper division of the Jurassic system, which can be used both for the central and south-eastern part of the Russian platform, is given in the appendix.(Table 2).

GEOLOGICAL EXCURSION TO THE MOSCOW SUBURBS
(Tatarovo-Krylatskoye-Kuntzevo)

Near the village of Krylatskoye the bus drives into the region of the development of three river terraces on the right bank of the Moscow river and soon takes the participants of the excursion to the highest part of the village of Tatarovo, to the head of a small but deep gully named Gnylusha, which cuts the upper (Khodynskaya) terrace of the Moscow river. Let us go down the gully. Approximatelly in its upper third in the left wall, a rather good outcrop is seen. The following can be observed under the loam and sand of the old alluvium (fig.1):

Cr_1h 1. Sand - yellowish-grey, slightly micaceous, with an interbed (at the basement) of more or less rounded concretions (pebbles) of dark reddish-brown, rather compact phosphorite with sporadic nuclei of Riasanites rjasanensis (Venez.em.Nik.), R.subrjasanensis (Nik.) and oth. This is a basal layer of Simbirskites decheni zone with preserved remains of rewashed Riasanites rjasanensis of the Lower Valanginian (Berriasian), since in the sand containing phosphorite pebbles in rare ferruginized parts of its upper part there were found Simbirskites decheni (Roem), Craspedodiscus discofalcatus (Lah), Camptonectes cinctus (Sow.) and other fossils peculiar to Simbirskites decheni zone.

Thickness exposed - about 3 m.

J_3v_3-nd_1 2. Sand - greenish-grey, rather strongly micaceous, belonging to Craspedites nodiger zone (to the subzone with Craspedites mosquensis Geras) of the upper substage of the Volgian stage.

Thickness exposed-about 5 m.

Below the exposure the bottom of the gully is swamped. The basement of the sand of Craspedites nodiger zone and the underlying layers of the Volgian stage are observed only in the part adjacent to the mouth of the gully, and not always clearly enough. Under most favourable conditions the following layers are exposed lying above the aleurite of Epivirgatites nikitini zone from the base upwards:

J_3v_3-f 1. Sand - dark grey, glauconitic clayey with Kachpurites fulgens (Traut), K.subfulgens (Nik.), Craspedites nekrassovi Prig., C. fragilis (Traut), C.okensis (d'Orb.), Garniericeras catenulatum (Fisch.), Acroteuthis mosquensis (Pavl.), A.russiensis (d'Orb.) and oth.

0.9 - 1 m.

J_3v_3-sb 2. Sand - greenish reddish-brown glauconitic, partially loose phosphatitized sandstone with Craspedites subditus (Traut), C.okensis (d'Orb.), Garniericeras catenulatum

(Fish.) etc.

About 0.35 m.

J_3v_3-nd_1 3. Sand - ferruginized, micaceous with loose arenaceous phosphorite concretions in the lower part, with Craspedites nodiger (Eichw.), C.mosquensis Geras., C.kuznetzowi (Sok.), etc. This is the lowest part of Craspedites nodiger zone (subzone Craspedites mosquensis), its higher layers being exposed upstream the gully.

Thickness exposed - 0.5 m.

Having passed a somewhat protruding part of the original bank with the ancient stronghold on it (of a type of Djakov stronghold in Moscow), we come to the mouth of a rather narrow gully with a creek in the western part of the Kuntzevo park.

The deposits of the Volgian stage in the gully are not always exposed well enough due to small landslides, collapses and mud-flows. Yet, when stripping certain horizons, the following may be observed in the right wall of the gully under the moraine and fluvioglacial sands (Fig.2):

Cr_1h 1. Sand - yellowish-grey, fine-grained micaceous, locally ferruginized, with rounded phosphorite concretions (pebbles) of Riasanites rjasanensis zone of the Lower Valanginian (Berriasian) at the basement.

2.5 - 3 m.

J_3v_3-nd_1 2. Sand - yellowish-grey with a greenish tint (presence of glauconite), fine-grained, strongly micaceous in the lowest part that in most cases is hidden by a talus, with small concretions of sandy phosphorite with Craspedites nodiger (Eichw.), C.mosquensis Geras., Pleuromya tellina Ag., Camptonectes lamellosus (Sow.) etc.

5.3 m.

J_3v_3-sb 3. Sand - greenish reddish-brown, glauconitic, with small concretions of sandy phosphorite. In the lower third of the sand large growths of greenish grey limy sandstone are met. Throughout the stratum the following may be observed: Craspedites subditus (Traut.), C.subditoides (Nik.), Garniericeras catenulatum (Fisch.), Acroteuthis russiensis (d'Orb.), A.mosquensis (Pavl.), Aucella fischeriana (d'Orb.), A.piochii (Gabb), A.lahuseni Pavl., A.tenuicollis Pavl., Anopaea sphenoidea Geras., Entolium numulare (Fisch.),Camptonectes lamellosus (Sow.), Thracia incerta (Thurm. em.Roem.), Pleuromya tellina Ag., Rhynchonella loxiae Fisch., Russiella royeriana (d'Orb.), R.luna (Fisch.), R.choroschovensis (Geras.), etc.

o.7 - 0.8 m.

J_3v_3-f 4. Sand - dark greenish-grey, slightly clayey with rare concretions of sandy phosphorite, with Kachpurites fulgens (Traut.), K.subfulgens (Nik.), Garniericeras catenulatum (Fisch.), Acroteuthis mosquensis (Pavl.) A.russiensis (d'Orb.), Aucella fischeriana (d'Orb.), A.piochii (Gabb.), Camptonectes lamellosus (Sow.), Entolium numulare (Fisch.), Anopaea sphenoidea Geras., Rhynchonella loxiae Fisch., Russiella royeriana (d'Orb.), Polygonatium globulis Geras., etc.

1.7 - 2 m.

J_3v_2-nk 5. Sand - dark-green, glauconitic, aleuritic, with rare loose sandy glauconitic phosphotized nodules. There are a great many well preserved, but extremely bruttle fossils: Epivirgatites nikitini (Mich.), E.bipliciformis (Nik.), E.lahuseni (Nik.), Lomonosovella lomonossovi (Visch.), Laugeites stschurowskii (Nik.), Acroteuthis mosquensis (Pavl.), A.russiensis (d'Orb.), Pachyteuthis rouillieri (Pavl.), Astarte aff. veneris (d'Orb.), Entolium erraticum (Pieb.), Plicatula producta (Rouil.), Oxytora interstriata (Eichw.), Rhynchonella rouillieri Eichw., Mosquella oxyoptycha (Fisch.), Russiella truncata (Geras.), R.clemenci (Lehm.), R.royeriana (d'Orb.), Rhabdocidaris spingera (Rouil.), etc.

0.7 - 0.8 m.

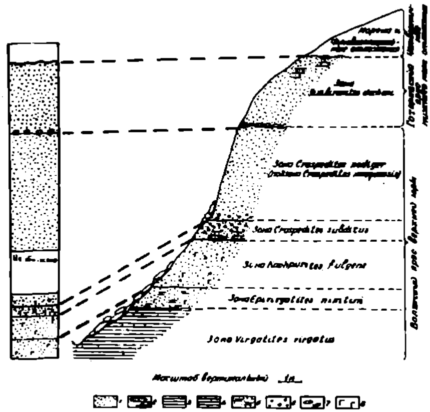
J_3v_3-v 6. Clay - dark, sandy, with Virgatites virgatus (Buch.), V.pallasianus (d'Orb.), Cylindroteuthis volgensis (d'Orb.), etc.

Thickness observed - about 1 m. to the bottom of the gully

The lower part of Virgatites virgatus zone in the given gully and its neighbourhood is not exposed; but it comes out to the day surface about 1.5 km lower than the Moscow river course, on the same left bank. At the water level, or a little lower, dark sandy glauconitic clay of Virgatites virgatus zone can be traced with phosphorite layer at the basement. This layer consists of partially soldered phosphorite pebbles. A careful examination of the layer enables to detect at least 3 generations: 1) rounded and worn-out by mollusks (Gastrochaena sp.) reddish-brown - black hard phosphorites of a clayey type (re-deposited Kimmeridgian phosphorites); 2) rewashed, less rounded, but usually worn-out by mollusks reddish-brown grey phosphorites of a glauconitic-clayey type in which we find nuclei of fossils of Dorsoplanites panderi zone of the Volgian stage (Dorsoplanites panderi (d'Orb.), D.dorsoplanus (Visch.), Pavlovia pavlovi (Mich.), P.menneri Michlv., Zaraiskites scythicus (Visch.), Z.quenstedti (Rouil.et Voz.), Z.zarajskensis (Mich.), etc.); 3) sandy-glauconitic phosphorites of Virgatites virgatus zone cementing the pebbles. In these are found Virgatites virgatus (Buch.), V.pusillis (Mich.), V.sosia (Visch.), V.pallasianus (d'Orb.), Acuticostites acuticostatus (Visch.) and oth. The phosphorite layer is underlain here by a dark slate of Amoeboceras alternans zone belonging to the Upper Oxfordian and hidden under the water of the Moscow river.

Рис. 1

Рис. 2



Description of the figures

Fig.1 - The scheme of succession of the Mesozoic deposits in gully Gnylusha near the village of Tatarovo in the suburbs of Moscow. (Explanation of the signs on fig.2)

Fig.2 - Section of the Volgian stage of the Upper Jurassic in the gully near Kuntzevo stronghold in Moscow. 1 - sand; 2 - sandstone; 3 - clay; 4 - sandy clay; 5 - clayey and aleuritic sand; 6 - phosphorite concretions; 7 - pebbles; glauconite in abundant quantities.

G e o r g i a

The Upper Jurassic in Georgia is developed in the Folded System of the Southern slope of the Great Caucasus, on the epihercynian median mass - Georgian Block - situated south of the latter and in the transitional belt between them. In the System of the Southern slope the upper Jurassic is represented by flyschoid deposits, on the Georgian Block mainly by continental-lagoonal red beds, while in the Transitional belt occur epicontinental marine fossiliferous formations. The latter consist of two complexes. The lower transgressive complex is mainly terrigenous and corresponds to the Callovian and Lower Oxfordian. The upper complex, essentially carbonate, regressive reef and lagoonal facies, corresponds to the Upper Oxfordian (Lusitanian), Kimmeridgian and probably to the Lower Tithonian.

The lower complex is developed in two marine gulfs: Abkhasian and Racha-South Ossethian whereas the upper complex spreads out from these gulfs between and south of them.

The sections of the Upper Jurassic will be visited in Abkhasia - in the valley of the river Bzibi, in Racha - in the valley of the river Rioni (village Tsessi) and in South Ossethia - near the villages Ertso and Tsona.

Section along the Bzibi valley

In the valley of the river Bzibi between 6-13 km of the road an anticline is exposed with the Bajocian porphyritic formation in the core. The limbs consist of thick Upper Jurassic deposits transgressively overlying the Bajocian and constituting abrupt slopes on both sides of the river. The Bathonian coal-bearing deposits are cropping out between the Bajocian and Callovian only on the left bank opposite the village Kaldakhvara. The lowermost strata of the Upper Jurassic overlapping the Bajocian porphyrites and the Bathonian coal-bearing argillaceous sandstones are best exposed on the left bank.

At the 6-th km near the turning there is a bridge across the river. After crossing the bridge proceeding along the left bank by some sheds towards the last house and prospecting adits one sees a few outcrops of the porphyritic formation and Bathonian argilo-sandy rocks. Before reaching the last house there is a stripping 50-60 m long, exposing argillaceous sandstones and sandstones with I-I,5 m thick coal intercalations (Bathonian). In the upper part of the stripping basal gray sandstones with pebbles crop out, in places passing into conglomerates. Above follow the Callovian argillaceous sandstones and sandstones which begin the Upper Jurassic section.

The general section of the Upper Jurassic of the Bzibi anticline is as follows:

$J_3 cl_1$ I. Basal conglomerate with porphyrite pebbles and carbonate-sandy cement . . . . I,5 m

$J_3cl_I+ox_I$ 2. Dark-gray and greenish arenaceous clays interbedded by carbonate sandstones with carbonate-arenaceous nodules. They contain Lower Callovian (Indosphinctes pseudopatina Par.et Bonar., Lima subrigidula Schlippe), Upper Callovian (Phylloceras antecedens Pomp., Hecticoceras pavlowi Tsyt., Aequipecten subinaequicostatus Kas.) and Oxfordian (Camptonectes virdunensis Buv., Lima laeviuscula Sow., L.tumida Roem., L.streitbergensis d'Orb., Trigonia perlata Ag.) fauna . . . . 60–I20 m.

J_3ox_2 3. Gray carbonate sandstones with marl intercalations, passing upwards into arenaceous limestones with dark cherts . . . . 30–40 m.

Westwards, along the river Psou, from the massive limestones corresponding to these strata N.S.Bendukidze (I959) mentions Rauracian corals: Thecosmilia maxima Koby and Montlivaltia truncata Edw.et Haime.

4. Thick-bedded and massive partly dolomitized limestones with Pseudomelania heddingtonensis d'Orb., Lopha solitaria Sow., Plesiodiceras usuntaschi Pčel. . . . . 40–50 m.

J_3km 5. Alternation of limestones, marly limestones, arenaceous limestones and marls, mostly bluish-gray, with thin intercalations of carbonate clays, containing Lucina plebeia Contej., and Cardium collineum Buv. . . . . I00–I20 m.

6. Alternation of marly limestones, marls and dolomites with clays, sandstones and conglomerates, of

characteristic bluish-gray and red colours. Only Pleuromya donacina Ag. has been found . .150-180 m.

7. Dolomitized and arenaceous limestones with Ceromya excentrica Ag., Mytilus pectinatus d'Orb., Hinnites cornueli Lor. . . . . 200-250 m.

8. Gray and brownish stratified bituminous limestones with Exogyra virgula Defr., Chlamys subtextorius Goldf., Hinnites inequirostris Voltz. about 800 m.

J_3tit. 9. Brecciated gray and white limestones. In the northern limb of the anticline between 35-37 km and south of the lake Ritsa Tithonian corals and lamellibranchs have been collected: Stylina tuberosa Ogil., St.parvipora Ogil., Thecosmilia cf.kiliani Koby, Thamnoseris strambergensis Ogil., Comoseris brevivalvis Ogil.(Bendukidze,1959), Chlamys quenstedti Blake, Chl.ricensis Khim., Chl.viminea Sow., Chl.polycycla Blaschke, Chl. arotoplica Gemm., Ctenostreon proboscideum rarecostatum Lev., Mytilus pectinatus d'orb., Diceras speciosum Münst., Dic.stascicii Zeusch. . . . . 300 m.

Cr_I 10. Dolomitized limestones with intercalations of arenaceous limestones, containing Zeilleria abchasica Nutz . . . . 20-25 m.

The transgressive overlap of the Callovian on the Bajocian is well observable in the Gega gorge. About 3 km upstream from the river mouth on the way to the karst waterfall, 150 m below the latter on the right bank the porphyritic formation crops out. Up the slope 30 m above the road the weathered and eroded surface of porphyrites is transgressively overlain by a carbonate conglomerate (2-3 m), in some places passing laterally into brecciated limestones (2-4 m). Upwards this layer passes into massive and thick-bedded limestones of 120-150 total thickness. The same conglomerate is exposed also near the karst waterfall, and everywhere it contains rather abundant but ill-preserved small ammonites, lamellibranchs, brachiopods and corals. From this layer following molluscs may be cited: Entolium demissum Phill., Camptonectes lens Sow., Lima duplicata Sow., Chlamys splendens Dollf., Ctenostreon proboscideum Sow., Calliphylloceras manfredi Opp., Holcophylloceras mediterraneum Neum., Sowerbyceras tietzei Till., Partschiceras viator d'Orb., Phylloceras puschi Opp., Ph. antecedens Pomp., Thysanolytoceras cf. adeloides Kud., Lytoceras polyanchomenum Gemm., Hecticoceras pseudocracoviense Tsyt., Lissoceras psilodiscus Schloenb., Grossouvria subtilis Neum., Perisphinctes cf. waageni Teiss., Reineckeia multicostata Petitcl.

The transgressive and unconformable superposition of the Upper Jurassic limestones upon the Bajocian porphyritic formation is well observable on both sides of the gorge.

From this list of fossils Grossouvria subtilis Neum. and Lissoceras psilodiscus Schloenb. indicate the Lower Callovian, Perisphinctes cf. waageni Teiss. and Reineckeia multicostata Petitcl. as well as Lima duplicata Sow., Holcophylloceras mediterraneum Neum., Sowerbyceras tietzei Till., Partschiceras viator d'orb., Lytoceras polyanchomenum Gemm. and Hecticoceras pseudocracoviense Tsyt. are Upper Callovian. But together with the Callovian species two others have also been found, which in Georgia do not occur below the Lower Oxfordian: Chlamys *splendens* Dollf. and *Ptychophylloceras korthense* Djan. Thus an impression is created that this 3-4 m thick layer contains the mixed fauna of three lowermost zones of the Upper Jurassic. This led V.I.Kurochkin (1938) to conclude that the fauna is redeposited and to date the limestones as Upper Oxfordian. In fact, neither of the specimens has any trace of redeposition. Well-preserved large thin-valved shells of *Hinnites*, abundance of small young specimens of *Phylloceras* as well as of thin-walled *Perisphinctida*, which inevitably would have been damaged while redeposition, the habit of the fauna - shallow water biocoenosis - contradict the redeposition hypothesis and indicate, that the Callovian-Lower Oxfordian are condensed in one conglomerate layer, deposited on the shoal.

The lower part of the massive limestones contains Rauracian-Kimmeridgian (*Aplosmilia semisulcata* Michelin) and Rauracian (*Dimorphastraea lamelosa* Solom.) corals. In the dejection cones of higher strata Rauracian-Kimmeridgian *Thecosmilia irregularis* Etall., Kimmeridgian *Thecosmilia maxima* Koby, Kimmeridgian-Tithonian *Calamophylliopsis etalloni* Koby and Rauracian *Microsolena fromenteli* Koby and *Dimorpharaea* cf. *koechlini* Edw. et Haime have been found.

Section in Tsessi

Here the Upper Jurassic overlies the eroded surface of the Bajocian volcanic-sedimentary porphyritic formation. The base of this transgressive series is dated as Callovian (Djanelidze, 1926, 1932, 1940). According to A.I.Djanelidze (1932), I.R.Kakhadze (1947), N.G.Khimshiashvili (1957) and N.S.Bendukidze (1964) here the following sequence is observed:

J_3cl_I I. Basal conglomerate with large (10-15 cm) pebbles or boulder breccia and coarse grained sandstones, consisting of the products of erosion of the Bajocian porphyritic formation. Sandstones and breccias contain fragments of thick shelled bivalves . . . . 5-15 m.

2. Greenish and gray carbonate sandstones with Gastropods, large Ctenostreon proboscideum Sow., Trigonia sp. and rich flora . . . . 5-15 m.

The packet contains near the church Barakoni a few oyster banks. East-and south-eastwards on the left bank of the river Rioni and at the mouth of the river Barula these rocks are laterally replaced by coarse grained sandstones and lumachell lenses with Isognomon promytiloides Ark., Astarte barulensis Khimsh., Ast. barakonensis Khimsh., Thracia incerta Thurm., Th. trigonata Pčel., Th. rionensis Pčel.

3. Banded bluish- and greenish-gray aleuritic shales rusty-brown on the weathered surface, foliaceous, with frequent spherosiderite loaf-nodules containing accumulations of the valves of Posidonia buchi Roem. Along the river Barula this packet is rich in flora.

The uppermost strata of this packet have yielded Macrocephalites sp., Perisphinctes sp. and Kepplerites georgicus Khimsh. . . . . 20–40 m.

4. Dark-gray slaty clays, arenaceous clays, argillaceous sandstones with arenaceous limestone intercalations. Spheric nodules are frequent in the clays, containing a rich Cephalopod fauna of the Macrocephalites macrocephalus (Schloth.) Waag., M.macrocephalus var.madagascariensis Lem., M.macrocephalus var.compressus Quenst., M.tumidus Rein., M.subcompressus Waag., M.lamellosus Sow., M.colchicus Djan., Cadoceras modiolare d'Orb., Grossouvria subtilis Neum., Indosphinctes pseudopatina Par. et Bonar., Sphaeroceras globuliformis Gemm. . . . . 130–150 m.

J_3cl_{2+3}–ox_I 5. Yellowish-gray arenaceous clays interbedded with gray sandstones. In the lowermost strata have been found Middle Callovian Macrocephalites transiens Waag., Hecticoceras lunuloides Kil. and also Platystomoceras jacobi Corr. and Calliphylloceras disputabile Zitt., in the uppermost part Callovian-Oxfordian Partschiceras pseudoviator Djan. and Oxfordian Oppelia georgica Khimsh., Trigonia perlata Ag., Tr.clavellata Park., Tr.reticulata Ag., Pholadomya lineata Goldf., Astarte ovata Phill. . . . . 70–80 m.

J_3ox_I 6. Brownish-gray carbonate and argillaceous sandstones, carbonate content increasing upwards. The lowermost strata have yielded Callovian-Oxfordian Partschiceras pseudoviator Djan., Aequipecten fibrosus Sow., Modiola bipartita Sow., Ctenostreon proboscideum Sow. . . 20–30 m.

The packets 5-6 eastwards, in the vicinity of the villages Kortha, Khirkhonissi, Kristessi are known in the literature since H.W.Abich as "the strata of Kortha". In 1932 A.I.Djanelidze distinguished in "the strata of Kortha" the following Upper Jurassic zones: Peltoceras athleta, Cardioceras cordatum, Peltoceras transversarium. Later N.G.Khimshiashvili (1957) established the presence of three more zones: Reineckeia anceps, Quenstedtoceras lamberti and Aspidoceras perarmatum.

The strata corresponding to the packet 5 contain Middle Callovian Kosmoceras proniae Teiss., Hecticoceras punctatum Stahl, H.metomphalum Bon. and H.zieteni Tsyt. (Reineckeia anceps zone), Upper Callovian Peltoceras athleta Phill., Hecticoceras pseudopunctatum Lah. and Sublunuloceras discoides Spath (Peltoceras athleta zone) and also Upper Callovian Quenstedtoceras lamberti Sow., Aspidoceras hirsutum Bayle and Distichoceras bipartitum Ziet.var.chirchonensis Djan. (Quenstedtoceras lamberti zone). In the equivalents of the packet 6 Lower Oxfordian fauna is known: Aspidoceras faustum Bayle, Asp.cf.perarmatum Sow., Oppelia georgica Khimsh. (Aspidoceras perarmatum zone) and above the latter Divisosphinctes chirchonensis Djan., Phylloceras plicatum Neum., Calliphylloceras manfredi Opp. (Gregoryceras transversarium zone).

I_3ox_2 7. Friable brownish-gray (in some places rusty coloured) coarse grained sandstones with characteristic spheroidal jointing, in upper part cross-bedded, with frequent fragments of charred and silicified wood and Lamellibranchs and Corals: Cryptocoenia cartieri Koby, Convexastrea bernensis Etall., Montlivaltia subdispar

From., Thamnasteria thamari Bend. and Latimeandra goldfussi Koby (the two last ones being Rauracian) 20-40 m.

East of Tsessi, in the vicinity of Kortha, Khirkhonissi, Skhieri and Bajikhevi this packet is completely replaced by limestones with Rauracian-Sequanian corals: Stylina tenax Etallon, Montlivaltia choffati Koby, M.truncata Edw. et Haime, Thamnasteria concina Münst., Th.thamari Bend., Dimorphastraea dubia From., Dimorpharaea lineata Eichw., D.koechlini Haime, Microsolena rotula Koby, M.ornata Koby.

From this packet I.G.Kuznetsov (1937) mentions also remains of the Rauracian-Sequanian Echinoids Paracidaris florigemma Phill. and Rhabdocidaris orbygnyi Des.

$J_3 ox_2$(?)+km. 8. Above gradually follow coarse grained brownish-gray quartz-arkosic and gray Wacke sandstones, rarely gritstones passing upwards into half-friable sands of the same composition, mainly of rosy and greenish colours with ill preserved thin-shelled Lamellibranchs and fragments of Belemnites. Visible thickness . . . . 10-25 m.

Eastwards this packet is again replaced laterally by massive limestones with Kimmeridgian corals Stylosmilia suevica Becker, Stylina excelsa Etallon (both Kimmeridgian), abundant Sequanian-Kimmeridgian Calamophylliopsis flabellum (Bl.) and Kimmeridgian-Tithonian Calamophylliopsis etalloni (Koby).

Their vertical distribution in the massive limestones indicates, that the greater part of the latter is Kimmeridgian. Still more eastwards on the left side of the river Kvirila (north-western slope of the Mt.Ribissa) the Kimmeridgian part of the massive limestones is replaced laterally by an ammonite facies whose age corresponds to the Streblites tenuilobatus zone (N.G.Khimshiashvili, 1957).

J_3km+tit(?) 9. Parti-coloured clays, argillaceous sandstones, marls, arenaceous limestones, dolomites and hard limestones sometimes with rosy and greenish designs on the surface, containing endemic fauna of marine Gastropods. On the left bank of the river Rioni the dolomites of the upper part of this packet are interbedding with gypsum lenses. A little eastwards the packet is laterally replaced by brecciform or massive dolomites also containing thick (up to I5 m) alabaster lenses .... 40-I00 m.

This packet eastwards (Kortha-Bajikhevi) is partly replaced by massive limestones, and partly is represented by the same parti-coloured rocks with gipsum lenses.

$J_3tit_2+Cr_I$ IO. Thin-bedded hard limestones generally referred to the Lower Neocomian but the lower unfossiliferous 30 m of this packet may yet belong to the Thitonian (I.P.Gamkrelidze, 1966). Eastwards, in the gorge of the river Barula near the village there is a thick (IO-I5 m) layer of a quartz-arkosic coarse grained sandstone which may represent the basal formation of the Tithonian (?)-Neocomian transgression.

As it was indicated above the packets 7, 8, 9 eastwards are wholly or partly laterally replaced by massive limestones containing in the lower part Rauracian Montlivaltia truncata Edw. et Haime and Rhapidogyra elegans (Koby). Above them are found Rauracian-Sequanian Actinastreaea bernensis (Koby), Thamnasteria explanata Münst., Stylosmilia michelini Edw.et Haime, St.coralina Koby, Meandrarea gresslyi Etall., Rauracian-Kimmeridgian Calamophilliopsis flabellum (Blainv.), Kimmeridgian Enallhelia elegans Münster and Thamnasteria prolifera Becker, whereas the uppermost part of the massive limestones contain Rauracian-Tithonian Thecosmilia longimana Quenst. and Kimmeridgian-Tithonian Calamophylliopsis etalloni (Koby).

Above follow coarsely bedded limestones with Calpionella alpina Lorenz of the Tithonian.

Thus the Coral fauna allows to establish in the massive limestones the presence of the Rauracian, Sequanian and Kimmeridgian, and to admit also the probability of the Tithonian. Rhypidogyra elegans Koby present in the lowermost part of the massive limestones might indicate the last zone of the Upper Oxfordian - that of Peltoceras bimammatum (L.S.Beridukidze, 1962).

In the region of the villages Tsedissi and Fasrago the Callovian and Lower Oxfordian are partly or wholly eroded and the upper carbonate complex (Upper Oxfordian-Kimmeridgian) of the Upper Jurassic directly overlies the uneven surface of the Bajocian porphyritic formation. At the base of the carbonate complex in some places a basal conglomerate may be observed whereas in most cases the reef edifices are growing directly on the rocky ground consisting of the Bajocian volcanics.

Near Fasrago a transversal section of the reef body is exposed. Between two limestone projections - remnants of the Upper Jurassic reef body - the Lower Cretaceous was ingressively deposited from the Hauterivian up to the Danian inclusively. But besides this in some sections presumably an uninterrupted transition may also be observed between the Upper Jurassic and the Neocomian.

Section around the villages Ertso and Tsona (Upper course of the river Kvirila)

The upper courses of the rivers Kvirila and Patsa are situated in the zone of tectonic contact of the Gagra-Djava and Flysch zones of the Great Caucasus. The section of the Upper Jurassic is developed in the first of these zones.

The oldest deposits of the region are represented by the Upper Liassic sandstones (Sori formation) forming the core of the Lessevi anticline of sublatitudinal strike. They are overlain by the Bajocian porphyritic formation.

The Upper Jurassic deposits spread over a considerable area north of the Lessevi anticline, forming three large folds: the Ribissa syncline, the Alkhashenda anticline and the Val-khokh syncline, which are complicated by minor folds and faults.

The Bajocian and the Upper Jurassic are transgressively overlain by the Middle- and Upper Eocene, cropping out mainly along the southern margin of the Lower Cretaceous Flysch overthrust, moving from the North and North-East.

The Upper Jurassic deposits cover the Bajocian transgressively and often with angular unconformity. They begin with a:

J_3cl I. greenish-gray conglomerate, consisting of the pebbles (0,5-IO cm) of the rocks of porphyritic formation, cemented by sandy-argillaceous material of the same origin. In some places the conglomerate is absent, whereas near the village Shadikau it attains the maximal thickness of 20 m, beginning with a boulder bed . . . 0-20 m.

2. Argillaceous sandstones and clays, yellowish-gray and greenish, mostly friable, without marked stratification.

They are characterized by rapid facies changes both in lateral and vertical directions. Along the southern slope of the Val-khokh ridge they are unstratified, with grains varying in size, and sometimes replaced by clays. Near the village Shadikau they are replaced by thinly bedded argillaceous sandstones and clays with micro-conglomerate and gravellite intercalations. In the gorge of the river Zembi-adag (village Lower Kemultha) and along the southern slope of the Ribissa mountain argillaceous sandstones occasionally pass into gray marls.

Charred plant remnants are frequent everywhere.

The unstratified argillaceous sandstones and gray marls contain spheric concretions (argilo-sideritic in the first and carbonate septaria in the second case) rich in ammonites.

J_3cl_I. Thus from the lower part of the argillaceous sandstones in the village Tsona (below the graveyard) have been identified Subbonarellia fuscoides Kuhn, Subbonarellia nurrhaensis (Waag.), Oecotraustes (Paroecotraustes) maubeugei Stephanov, Orionoides orionoides (Djan.), Grossouvria cf. curvicosta Siem., Gr. variabilis (Leh.), Calliphylloceras disputabile (Zitt.), Ptychophylloceras flabellatum (Neum.), Holcophylloceras mediterraneum (Neum.), Cadomites n.sp.aff.extinctus Bremer, Cadomites sp.

J_3cl_{2+3} . From the upper part of the same section (above the graveyard) are known Grossouvria meridionalis Siem., G.variabilis (Leh.), G.rossicus Siem., G.riasanensis (Teiss.), G. elegans Siem., Alligaticeras aff.alligatus (Leck.). The thickness is variable, attaining in some places 50—60 m.

$J_3cl_3+ox_I$ 3/ Stratified carbonate sandstones and arenaceous limestones, with frequent carbonate concretions containing ill-preserved ammonites (Perisphinctes sp.ind.), bivalves, echinids and their spines. On the northern slope of the Alkhashenda mountain Hecticoceras (Lunuloceras) pseudopunctatum pseudopunctatum (Lah.) Zeiss has been found . . . . 2-10 m.

J_3ox_2 4. In many localities these strata are overlain by a dark gray thin limestone bed with sponge colonies, passing laterally and vertically into carbonate sandstones again with sponges (Argovian), the thickness being 7-8 m. They are followed by massive and thick-bedded white reef limestones, in some places completely consisting of corals. Laterally they pass into calcareous breccias, stratified limestones, oolite limestones, arenaceous limestones and marls. This formation sometimes unconformably overlaps the whole section down to the Bajocian.

From the lower part of the massive limestones N.S.Bendukidze mentions corals of mainly Rauracian-Sequanian age: Rhypidogyra elegans Koby, Cladophyllia ramea Koby, Stylosmilia michelini Edw. et Haime, Stylina semiradiata Etallon, Cryptocoenia octosepta Etallon, Cr.decipiens Etallon, Montlivaltia truncata Edw. et Haime, Thecosmilia irregularis Etallon, Latiphyllia suevica Quenstedt, Calamophylliopsis flabellum (Blainv.) var.compacta (Koby), Epistreptophyllum excelsa Koby, Thamnoseris amedei Etallon, Dermoseris schardti Koby. The topmost part of the coral reefs in some places contains Kimmeridgian corals . . . 20-80-100 m.

J_3km 5. Stratified limestones and marls, sometimes of greenish and reddish colour, occasionally coral reefs and associated deposits (limestone breccias etc.). Thin bedded marls in the lower part of this formation have yielded Idoceras planula Hehl, I.balderus Opp., I. heimi Favre, I.allobrogicus Pillet, I.malletanus Font, Phylloceras praeposterius Font., Ph.aff.beneckei Font, Lytoceras orsinii Opp., Oppelia frotho Opp., O.cf. holbeini Opp. (zone of Streblites tenuilobatus).

In the massive limestones corresponding by age to the thin bedded marls, corals of mainly kimmeridgian age have been found: Stylosmilia suevica Becker, St. rugosa Becker, Rhabdophyllia disputabilis Becker, Diplocoenia coespitosa Etallon, Cyathopora bourgueti Defrance, C.claudiensis Etallon, Thecosmilia trychotoma Goldfuss, Isastrea helianthoides Goldfuss, Calamophylliopsis etalloni (Koby), Ovalastrea tenuistriata Koby, O.michelini Edw.et Haime (identified by N.S. Bendukidze). . . . . 30-100-120 m.

J_3km+t 6. The summit of the Ribissa mountain consists of gray and reddish sandstones, brecciform limestones and thin-bedded limestones with quartz grains, and with a microconglomerate (gravellite) layer of 15-2 cm at the base, containing quartz grains and material of the porphyritic formation . . . . up to 50 m.

In the above described general section the Callovian draws special attention. At different times and in different places (besides the village Tsona) from the argillaceous sandstones following ammonites have been mentioned: Calliphylloceras mediterraneum (Neum.), C.mediterraneum var.rionense (Djan.), Pseudophylloceras kunthi (Neum.), P.kudernatschi(Hauer), Partschiceras plicatum (Neum.), P.viator (Orb.), P.pseudoviator (Djan.), Sowerbiceras subtortisulcatum (Pomp.), S.tortisulcatum (Orb.), S.tietzei (Till.), S.fredericiaugusti (Pomp.), Lytoceras hatzegi Khim., L.adeloides Kud., L.sp.ex gr.lineatus Sow., Hecticoceras aff.evolutus Lee, H.cf.rossiense Teiss., Cadomites extinctum (Roll.), Macrocephalites macrocephalus (Schloth.) Waag., M.typicus (Blake) balkarensis (Ilyin), M.canizzarvi Gemm., M.madagascariensis Lem., M.intermedius Greif., M.caucasicus Djan., Perisphinctes pseudopatina Par. et Bon., Peltoceras sp.ind.(identified by I.R.Kakhadze, N.G.Khimshiashvili and T.A.Paichadze).

In the section of Tsona the lowermost part of the Callovian and the contact with the Bajocian are covered by the hill-side waste on the slope and probably by the alluvium below the graveyard(since the overlying carbonate deposits are almost horizontal and the passage between them and the argillo-arenaceous deposits is gradual and conformable, the exposed part of the latter must not be thicker than 30 m). At different times an abundant fauna has been collected from the argillaceous sandstones near the graveyard.

I.R.Kakhadze identified following species: Astarte episcopalis Lor., Enthalium cingulatum Goldf., Ent.spathulatum Roem., Aequipecten fibrosus Sow., Pseudophylloceras cf.kudernatschi (Hauer), Holcophylloceras cf.tsessiense (Djan.), Partschiceras viator (Orb.), Lytoceras adeloides Kud., Cadomites extinctum (Roll.), Macrocephalites subtumidus (Waag), M.compressus (Quenst.), Cadoceras modiolare Orb., Orionoides cf.orionoides

(Djan.), Perisphinctes pseudopatina Par et Bon. Later N.G.Khimshiashvili found Entholium cingulatum Goldf., Aequipecten fibrosus Sow., Aeq.fibrosodichotomus Kas., Astarte pulla Roem., Cadomites extinctum (Roll.), Hecticoceras aff.metomphalum Bonar., H.aff.lunuloides Kil., Macrocephalites cf.macrocephalus (Schloth.) Waag.. From the lower part of these argillaceous sandstones I.D. Tseretheli identified following species: Cadomites cf.deslongchampsi (Defrance), C.zlatarskii Stephanov, C.cf.orbignyi (Grossouvre), C.sp.,Polyplectites denseplicatus Lissajous, Opp. sp., Holcophylloceras mediterraneum (Neum.), Calliphylloceras demidoffi (Rousseau), Partschiceras sp.nov., Perisphinctes sp.

According to the fauna in their possession I.R.Kakhadze and N.G.Khimshiashvili placed these deposits in the Callovian. (I.R. Kakhadze proved the presence of the zone of M.macrocephalus, and N.G.Khimshiashvili faunistically dated the Upper Callovian).

In recent years I.D.Tseretheli suggested that the lower part of the argillaceous sandstones (below the graveyard), I5 m thick, should be dated as Bathonian on the basis of the above mentioned species of Cadomites.

Thus recently the age of the lower part of the Tsona sandstones has become controversial, whereas it must be noted that the Callovian age of the same part of the section in all other localities is beyond doubt.

As it was mentioned (in the description of the general section)in most places, and also in immediate vicinities of the Tsona section (near the villages Shadikau, Khampalgom etc.) these deposits start with the basal conglomerate, and often angular and azimuthal unconformity is observable between the latter and the Bajocian porphyritic formation (eastern extremity of the Val-khokh ridge, Minor Khikhatha mountain etc.)

Considering, at the same time, that the age of most ammonite species is undoubtedly Callovian in the lower part of the Tsona argillaceous sandstones, and Middle-Upper Callovian in the upper part, the controversial strata may with confidance be dated as Callovian.

The problem of the stratigraphic range of _Cadomites_ as well as that of the specific subdivision of this genus apparently must be subjected to special study, for there are certain indications as to their presence in the Callovian (Western Europe; Northern Caucasus - valley of the river Ardon).

C O N T E N T S