# Short communications

## The position of the Middle Volgian in the English Jurassic

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INTEGRATION of the various faunal realms established at the end of the Jurassic remains one of the outstanding problems of Mesozoic biostratigraphy. The latest attack on this problem is by Gerasimov & Mikhailov (1966), who urge the merits of the Russian Volgian stage as a global standard and attempt anew to correlate this stage zone by zone with the Portlandian of the Anglo-Paris basin and with the Tithonian of the Tethyan realm. These authors introduce a tripartite division of the Volgian, separating as Middle Volgian strata formerly classified as the upper part of the Lower Volgian. Following the earlier work of Mikhailov (1957), this Middle Volgian substage is equated with the top part of the Kimmeridge Clay (*Pavlovia* Zones) and the whole of the Portland Beds of southern England. This correlation is based on a few congeneric ammonite links among otherwise dissimilar faunas, notably the genera *Pavlovia*, *Zaraiskites*, *Crendonites* and *Kerberites*.

Proceeding from the discovery of Upper Volgian ammonites in the Spilsby Sandstone and the Sandringham Sands of eastern England (Casey 1962, 1963), the writer has had occasion to re-examine the position of the Middle Volgian in relation to the English succession. The following conclusions are summarized in Fig. 1:

(1) The Kimmeridge Clay zones of *Pavlovia rotunda* and *P. pallasioides* (together analogous to the basal part of the Middle Volgian) have been placed in the wrong stratigraphical order; the horizon of the Hartwell Clay (*pallasioides* Zone) lies below, not above, the *rotunda* nodules of the Dorset coast.

(2) The *rotunda* nodules are the most southerly expression of an important phase of inhibited deposition represented by the remanié Upper Lydite bed of the Swindon-Aylesbury sector,

(3) Reworking of the Upper Lydite bed continued while the middle part of the Middle Volgian (*Virgatites virgatus* Zone) was laid down elsewhere. In Dorset the *virgatus* Zone has its correlative in the thickness of Kimmeridge Clay formerly assigned to the *pallasioides* Zone.

(4) The top of the Middle Volgian (*Epivirgatites nikitini* Zone) corresponds to our Zone of *Progalbanites albani* in the lower half of the Portland Sand. Hitherto considered missing in the southern Midlands, the *albani* fauna is now identified as the indigenous element of the Upper Lydite bed.

(5) A large gap exists between the Middle and Upper substages of the Volgian in the Volga basin, during which interval the greater part of the Portland Beds were accumulated.

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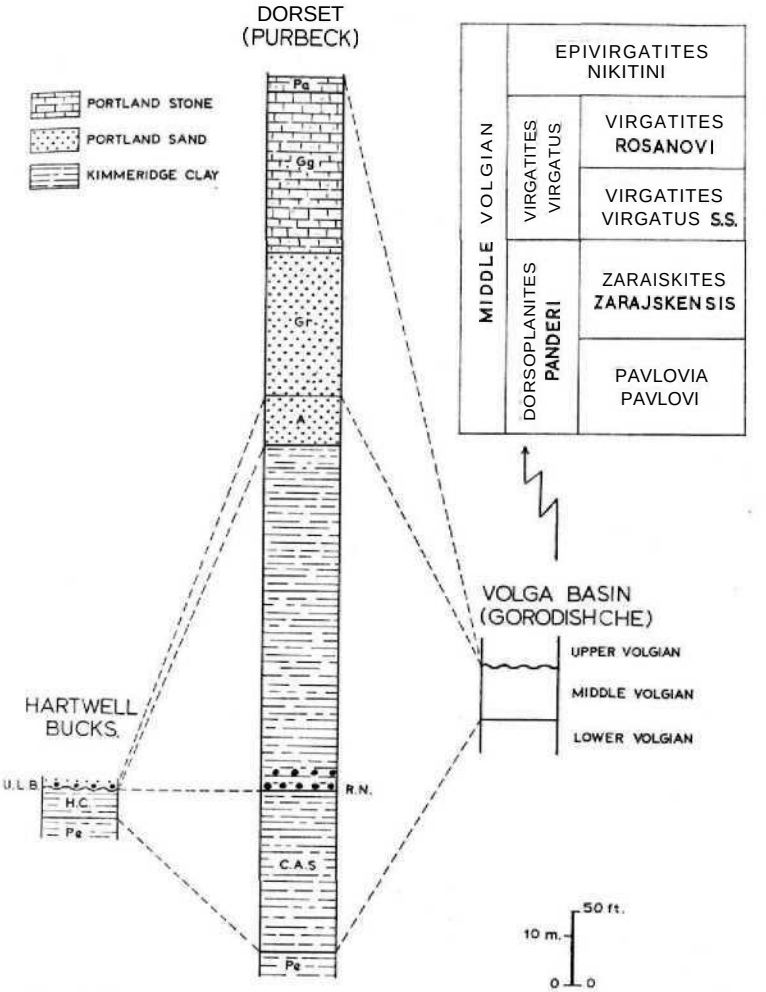


FIG. 1. Correlation of the Kimmeridge Clay-Portland Beds succession of Hartwell, Buckinghamshire, and Dorset (Isle of Purbeck) with the Middle Volgian of Gorodishche, Volga Basin. H.C.—Hartwell Clay (*pallasioides* Zone); C.A.S.—Crushed Ammonoid Shale; U.L.B.—Upper Lydite bed; R.N.—*rotunda* nodules; Pe—*pectinatus* Zone; A—*albani* Zone; Gr—*gorei* Zone; Gg—*giganteus* Zone; Pa—*Paracraspedites* horizon. (Table of Middle Volgian zones and subzones not to scale).

### *The stratigraphical position of the Hartwell Clay*

Some 15–20 ft thick, the Hartwell Clay is a local fades at the top of the Kimmeridge Clay of the Aylesbury district, Buckinghamshire, and is overlain by the Upper Lydite bed, the 'basal conglomerate' of the Portland Beds of the

southern Midlands. Forty years ago it was a matter of lively controversey where the Hartwell Clay should be fitted into the general Kimmeridgian succession (see Arkell 1933, pp. 464–7). Today it is accepted that its ammonite fauna, typified by *Pavlovia pallasioides* (Neaverson), represents a zonal assemblage younger than that of the *Pavlovia rotunda* Zone of the Dorset coast, the *rotunda* and *pailasioides* Zones having in the meantime become part of the standard Jurassic sequence (Arkell 1956, 1957). This stratigraphical concept stems from Neaverson's (1924, 1925) observation that ammonites of the *rotunda* Zone occur below the floor-level of the old Hartwell Clay pits, which yielded the beautifully preserved *pailasioides* fauna. Although posterity has given its assent to Neaverson's reading of the sequence at Hartwell, it seems that the only direct and independent support for it is Ballance's (1964) mapping of the Thame–Aylesbury neighbourhood. This author infers and depicts an angular discordance between the HartweU Clay and the Portland Beds, whereby the *pailasioides* Zone is overstepped south-west of Hartwell and the supposedly underlying *rotunda* Zone is brought into contact with the Upper Lydite bed at Westlington. The zonal placing is based on Dr A. J. Lloyd's determinations of foraminifera.

An analogue of the Hartwell Clay appears in Wiltshire and Oxfordshire—the Swindon Clay. Notwithstanding a record of an ammonite 'indistinguishable from Neaverson's *Holcosphinctes pallasioides*' in the top part of the Swindon Clay (Kitchin 1926), Arkell (1933, p. 455) was uncertain whether the *pailasioides* Zone was present there, possibly because of the *rotunda* Zone ammonites in the overlying Upper Lydite bed. Later he assigned the whole of the Swindon Clay to the *rotunda* Zone as a discrete stratigraphical unit below the Hartwell Clay (Arkell 1947A).

It is now suggested that the relative positions of the *rotunda* and *pallasioides* Zones is the reverse of that stated by Neaverson and others and that the horizon of the *pailasioides* fauna lies within the Crushed Ammonoid Shales below the *rotunda* nodules of Dorset.

Neaverson (1925) described only two ammonites ('*Pallasiceras ultimum* and '*Episphinctoceras*' *inflatum*) in support of his assertion that the *rotunda* fauna occurs in the Hartwell Clay. Both were new species and neither has as yet been found elsewhere. In this paper no mention was made of the '*rotundum* fauna' recorded from a depth of 18ft in excavations at Aylesbury (Neaverson 1924, p. 148). The Bucks County Museum, Aylesbury, possess a specimen of the common *pailasioides* Zone species *Pavlovia iris* Spath obtained at a depth of 18ft from excavations for the pumping station near the railway in that town (no. 142/20). As for the foraminifera, I am informed by Dr Lloyd that the Westlington samples were comparable with suites taken from the Kimmeridge succession of the Dorset coast, ranging from the middle of the Crushed Ammonoid Shales through about 90ft of strata currently assigned to the *rotunda* Zone. The fauna was different from that obtained in Dorset from the beds above the *rotunda* Zone (supposed *pailasioides* Zone), but no comparison was made with the stratotype section of the *pailasioides* Zone at Hartwell.

Kitchin's determination of the *pailasioides* fauna in the Swindon Clay of Swindon is confirmed from material in the Institute of Geological Sciences, including ammonites from the top 5ft, mentioned by Kitchin, and another, from an unspecified level in the clay, in the Hudleston Collection. Phosphatized ammonites in the Upper Lydite bed here belong, so far as they are specifically



determinable, to the *rotunda* Zone (Arkell 1960, p. 167). This is true also of the Upper Lydite bed at Aylesbury (cf. British Museum (Natural History), no. C74594). From excavations made in 1924 for a sewage tank in Buckingham Road, Aylesbury, Mr E. Hollis sampled the Hartwell Clay (*pailasioides* Zone) at 20ft and the underlying *pectinatus* Zone at 24ft (ammonites in the Buckinghamshire County Museum, Aylesbury).

*Upper Lydite bed—rotunda nodules.* With its black chert pebbles and rolled and phosphatized *Pavlovia*, the Upper Lydite bed forms a persistent base to the Portland Beds from Swindon to Aylesbury. Recently it has been interpreted as a local expression of a more widespread interval of inhibited deposition that widens northwards to embrace the basal beds of the Sandringham Sands and Spilsby Sandstone, eventually becoming lost in the much larger gap marked by the 'Coprolite bed' at the base of the Speeton Clay of Yorkshire (Casey 1963). In consequence of the realignment of the *Pavlovia* Zones here suggested, the *rotunda* nodules of the Dorset coast now fall into line as the southernmost end of this important marker-horizon. Calcareous and only slightly phosphatic at Chapman's Pool, these nodules denote that the centre of the sedimentary basin experienced only a slight pause in deposition in contrast to the protracted period of phosphatization and reworking felt in more marginal areas. It is at these nodules, however, that great changes take place in the heavy residue of the clays, quartz and glauconite coming in rapidly upwards (Lloyd 1959, fig. 1). Already, west of Holworth House, Weymouth, the condensed *rotunda* succession resembles the Upper Lydite bed at Swindon, as noted by Arkell (1947B, p. 82). The phosphatized *rotunda* fauna found derived in the Lower Cretaceous of the Weald (Arkell 1960) points to the former wide distribution of this horizon—surely one of the most important stratigraphical planes in the British Mesozoic.

The Upper Lydite bed is thus interpreted as a *rotunda* remanié at the base of the *albani* Zone. In the Swindon-Aylesbury district the *rotunda* Zone was probably accumulated originally under conditions of restricted deposition such as obtained in southern England during the Lower Albian, with spasms of both argillaceous and arenaceous sedimentation, contemporaneous reworking and phosphatization. Reworking of the *rotunda* deposits is assumed to have continued while the *virgatus* Zone was laid down elsewhere. In Dorset the horizon of the *virgatus* Zone is considered to lie within the thickness of Kimmeridge Clay formerly assigned to the *pailasioides* Zone, which has yielded as yet only indeterminate ammonites.

*The upper limit of the Middle Volgian.* In the zonal scheme now adopted in the USSR the top of the Middle Volgian is the Zone of *Epivirgatites nikitini*. This zone, the sole known repository of the genus *Epivirgatites* in the Volga basin, is correlated by Soviet authorities with the Zone of *Titanites giganteus* of the Portland Stone (Mikhailov 1957; Gerasimov & Mikhailov 1966). It is unfortunate that occurrences of *Epivirgatites* have hitherto been overlooked in Britain, for species close to *E. nikitini* (Mikhalski) are found, not at the top of the Portland Beds, but in the basal part, namely in the *albani* Zone of the Portland Sand. Crushed specimens from Hounstout, St Alban's Head, Gad Cliff, Emmit Hill and Blacknore, Dorset, are preserved in the Institute of Geological Sciences, together with examples from a depth of 1301ft in the Penshurst boring, Kent (Geol. Surv. Mus. nos. 72214–5, 72954, Pe 2071, 1718HBW, Geol. Soc. Coll. 2910; and 102190, 102195). They have been commonly identified as

*Pavlovia*, and they include *P.* (*Lydistratites*) *vulgaris* Spath (1936, p. 31; pl. 9, fig. 2; pl. 17, fig, 5), based on crushed specimens from Hounstout. Spath himself (1936 p. 30) noted the resemblance of his *Pavlovia worthensis* from the Portland Sand to *Epivirgatites* (Spath 1936, p. 30) but gave it no stratigraphical significance, believing that the whole of the Middle Volgian was post-Portlandian in age (Spath 1936, p. 168; 1947, p. 66). In southern England *Epivirgatites* is invariably accompanied by '*Provirgatites*' *albani* Arkell, the type-species of the genus *Progalbanites* Spath. The two genera are closely connected and the nearest match with *P. albani* in the Volga sequence was figured by Mikhalski (1890, pl. xiii, fig. 2*a*) as a variety of *E. nikitini*. The idea that *P. albani* is congeneric with the earlier group of *Zaraiskites scythicus* (Vischniakov) (Buckman 1926, pl. dclxxv; Arkell 1935, p. 339; 1947B, p. 93; Mikhailov 1957; Gerasimov & Mikhailov 1966) has been one of the stumbling blocks in the correlation of the Portlandian and the Volgian,

Though the *albani* fauna is thought to be missing in the southern Midlands, it is, nevertheless, preserved as the indigenous element of the Upper Lydite bed; *Lydistratites biformis* Buckman (1925, pl. dcv*a–b*) from this bed at Hartwell is a species of *Epivirgatites; Lydistratites lyditicus* Buckman (1922, pl. ccccliii*b* only) from the Upper Lydite bed of Swindon belongs to *Progalbanites*, Owing to the defective inner whorls of the holotype of *L. lyditicus* (Buckman 1922, pl. ccccliii*a* only), the type of the genus *Lydistratites* Buckman 1922, it is not possible at present to determine whether this nominal genus is a synonym of *Epivirgatites* Spath. Uncrushed *Epivirgatites* and *Progalbanites* occur also in the Portlandian of Boulogne (British Museum, Natural History, nos. C74595–74601), whence Sauvage (1912, pl. 9, fig. 1) figured '*Perisphinctes*' *nikitini*.

In support of his correlation of the *virgatus* and *nikitini* Zones with the *gorei* and *giganteus* Zones of the Portland Beds, Mikhailov (1957) has figured *Crendonites kuncevi* Mikhailov and *Behemoth* cf, *lapideus* Buckman from the *virgatus* Zone and *Kerberites mosquensis* Mikhailov from the *nikitini* Zone. In the writer's opinion the '*Crendonites*' is a species of *Pavlovia*, the '*Behemoth*' is an indeterminable Pavlovid fragment, and the '*Kerberites*' is a *Lomonosovella*. The last is very similar to *Kerberites*, though lacking the umbilical swelling of the ribs.

It appears therefore, that the Volgian stage as developed in the Volga basin is incomplete and that a large gap exists between the Middle and the Upper substages. Into this gap may be fitted not only the greater part of the Portland Beds of southern England, from the *gorei* Zone to the *Paracraspedites* horizon (Shrimp Bed of the Isle of Purbeck) but pre-Upper Volgian horizons newly discovered in the Sandringham Sands and Spilsby Sandstone of eastern England. The incompleteness of the standard Volgian is not surprising, considering that it is a highly condensed sequence, full of glauconite and phosphatic nodules. In the type-section at Gorodishche, in the middle reaches of the River Volga, the Middle Volgian is barely 35ft thick, compared with about 375ft of equivalent strata in the Isle of Purbeck.

Its greatly extended time-span, combined with its condensed and incomplete succession, raises doubts as to the suitability of the Volgian stage, as currently interpreted, as a world-wide standard. Accordingly, the following proposals are put forward for consideration at the forthcoming symposia on the Jurassic at Moscow and at Luxembourg: (1) The Volgian stage should be retained only for strata at present grouped as Upper Volgian. (2) The Portlandian stage should be defined as commencing with the *Pavlovia* Zones (base of the Crushed Ammonoid Shales of Dorset), ranging upwards to the boundary with the Volgian (as defined in (1)), thus embracing the Middle Volgian of Gerasimov & Mikhailov and the whole of the Portland Beds. (3) Strata at present grouped as Lower Volgian should be assigned to the Kimmeridgian, thus effecting a compromise between the Kimmeridgian *sensu anglico* and the Kimmeridgian *sensu gallico*.



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