36. Carboniferous-Permian Boundary in Japan

By Hisakatsu Yabe, M.J.A.

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The *Triticites* zone\(^1\) once thought to be lacking in the Japanese Islands is now known to occur in the Kuma Mountainland (Kyūshū) and Hida Mountainland (central Honsū); but its geographical distribution and area occupied are more limited than those of the next younger formation, the *Pseudoschwagerina* zone.

In the Kitakami Mountainland, the *Pseudoschwagerina*, *Profusulinella*, and *Millerella* zones are represented by the Sakamotozawa formation, the upper part of the Nagaiwa formation, and its lower part plus the Onimaru, respectively. There the Sakamotozawa formation covers the underlying Nagaiwa with strong unconformity, lacking the *Triticites* and *Fusulina* zones between the former and latter two formations. This stratigraphical break is significant, since it implies a time-gap of the pre-Sakamotozawa denudation anteceded by a tectonic movement of the older complex (M. Minato, 1942).\(^2\)

The Akiyosi, Atetu, and Taisyaku Plateaux in the Tyūgoku region are built of a thick limestone complex of the *Millerella*, *Profusulinella*, *Fusulinella*, and *Pseudoschwagerina* zones; apparently there is no trace of the *Fusulina* and *Triticites* zones (R. Toriyama, 1954; Y. Okimura, 1958, communicated by S. Imamura to H. Fujimoto). In the Atetu district, Okimura observed the *Pseudoschwagerina* zone lying directly on the *Fusulinella* zone at some places and on the *Profusulinella* zone at others,—an evidence of an unconformity existing between the *Pseudoschwagerina* zone and the older ones. The case is similar to that in the Kitakami Mountainland.

The *Triticites* zone is well developed in the Hida Mountainland, in the Ōhara area near the provincial boundary of Mino and Hida; there is no physical break visible between the *Pseudoschwagerina* and *Triticites* zones, and between the latter zone and the underlying *Fusulinella*, the *Fusulina* zone is apparently lacking. All the zones here exposed comprise various clastic sediments, aside the limestones

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1) *Triticites*, etc. zones are here used in the sense of local stratigraphical units and are correlated with the Zone of *Triticites*, etc., especially on the fusulinid faunas contained therein.


with fusulinids (M. Kanuma, 1954).4"

In the Hukuzi district of the same mountainland, the Itinotani limestone with scanty intercalation of shale, sandstone, and schalstein comprises all of the six fusulinid zones, from the Millerella zone up to the Pseudoschwagerina zone, in regular succession. Though the Triticites and Fusulina zones appear as if conformable with one another, they have no fusulinids in common. On the other hand, the genus Triticites is well represented by many forms, mostly primitive, in the Triticites zone and by more advanced forms in the Pseudoschwagerina zone; further these two zones have Quasifusulina cf. longissima (Möller) in common. Stratigraphically as well as palaeontologically, the Triticites and Pseudoschwagerina zones of this district are intimately related (H. Igô, 1957).5"

The Ômi limestone, over 1,000 m thick, of the Ômi district, Niigata Prefecture, shows a vast calcareous deposition continued from the early Carboniferous to the late Permian. S. Kawada and H. Fujita independently discriminated in the limestone the Fusulinella, Triticites, and Pseudoschwagerina zones, but not the Fusulina zone. As he found a few remains of Fusulina cf. girtyi (Dunbar and Condra) in the uppermost part of his Fusulinella zone, there is still a possibility to expect the Fusulina zone though it may only be partially represented in the limestone. Here also the genus Triticites ranges from the Triticites zone to the Pseudoschwagerina zone, and the stratigraphic relation of the two zones are intimate (S. Kawada, 1954; H. Fujita, 1958).6" Ômi agrees with Ôhara, in having the Pseudoschwagerina, Triticites, and Fusulinella zones, and in lacking entirely or partially the Fusulina zone.

In the Kuma Mountainland, Kyûsyû, K. Kanmera found the Pseudoschwagerina, Triticites, Fusulina, and Fusulinella zones in regular succession in a thick limestone complex occupying the slope of Yayamadake, and presumed—rather forcibly as it appears to the present writer—an unconformity between the first and second zones, and a diastema between the second and third zones. Palaeontologically, however, the second and third zones have no fusulinids in common, while the genus Triticites ranges from the second zone to the first,

and *Quasifusulina cf. longissima* is common in these two zones, just as in the case of the Itinotani limestone of the Hukuzi district in the Hida Mountainland.

The stratigraphical accounts cited above are tabulated below for convenience.

<table>
<thead>
<tr>
<th>Localities</th>
<th>1</th>
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<th>4</th>
<th>5</th>
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<th>Permian</th>
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<tr>
<td><em>Pseudoschwagerina</em> zone</td>
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<tr>
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<td>- (a)</td>
<td>+</td>
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<tr>
<td><em>Fusulina</em> zone</td>
<td>+</td>
<td>- (b)</td>
<td>- (b)</td>
<td>+</td>
<td>?</td>
<td>- (b)</td>
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<tr>
<td><em>Fusulinella</em> zone</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td>- (b)</td>
<td>Carboniferous</td>
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<td><em>Millerella</em> zone</td>
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</table>

1: Kuma Mountainland, Kyūsyū
2: Tyūgoku region (Akiyosi, Talsyaku, Atetu, etc.)
3: Hida Mountainland, western part (Ōhara)
4: Hida Mountainland, middle part (Hukuzi)
5: Hida Mountainland, northeastern part (Ōmi)
6: Kitakami Mountainland

+: Present

-(a): Lacking, probably due to non-deposition

-(b): Lacking, probably due to erosion preceded by land-emergence of orogenic or epeirogenic origin

This table clearly shows that:

I. A plane of significant stratigraphical demarcation may lie beneath the *Triticites* zone.

II. This separation plane lies beneath the *Pseudoschwagerina* zone where the *Triticites* zone is lacking.

III. The sea of the *Pseudoschwagerina* zone had a wider extension than that of the *Triticites* zone and encroached over the land surface which emerged earlier in pre-*Triticites* age, either by orogenesis or epeirogenesis and subjected to denudation for a long time.

IV. The Carboniferous-Permian boundary, if drawn between the zone of *Pseudoschwagerina* and the zone of *Triticites*, does not coincide with the plane of the important stratigraphical separation within the Carboniferous-Permian sequence of the Japanese sedimentaries.

P. S.