THE STATE OF SILURIAN STRATIGRAPHY

by

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This short article reviews recent decisions taken by the IUGS Subcommission on Silurian Stratigraphy, the procedures by which recommendations are made and some of the challenges still facing workers on the Silurian.

Introduction

The geological sciences demand close international cooperation as well as a rigorous and clearly understood language of words. Nowhere is this more keenly felt than in stratigraphy where, despite the luxury of long philosophical discussions on rocks versus time, many feel a sense of urgency about attempts to achieve a standard global chronostratigraphy. The now well-known pioneer work of the international committee on the Silurian-Devonian Boundary took 12 years to complete, though this was a pioneering exercise. Correlations about this level were also found to have been in such grievous error that much readjustment and eventual compromise were needed before agreement could be reached (Boucek et al., 1966; Holland, 1965; Martinsson, 1977). Now the IUGS Commission on Stratigraphy, thanks especially to the vision and initiative of past Chairman Academician V.V. Menner of the Soviet Union, acts as an umbrella to a whole list of Subcommissions for the various geological systems and of working groups concerned with settling the boundaries.

The Subcommission on Silurian Stratigraphy was constituted from an ad hoc body at a meeting held in the University of Birmingham, U.K., in 1974. At a formal meeting of the Subcommission held during the International Geological Congress in Sydney, Australia, in August 1976, it was agreed to proceed with an eight-year program designed to solve the major problems of Silurian chronostratigraphy. Work continued using questionnaires and eventually there was almost unanimous support for a comprehensive field meeting in Britain in 1979. This meeting ranged from South Wales, through the Welsh Borderland, North Wales, and the Lake District, to Moffat in the Southern Uplands of Scotland. Various formal meetings of the Subcommission were held, including shared meetings with the Working Group on the Ordovician-Silurian Boundary since these two groups had a number of members in common. The type areas of the Llandovery, Wenlock, and Ludlow series were examined, as was Charles Lapworth's famous locality for the Ordovician-Silurian transition at Dobb's Linn near Moffat.

The Subcommission has 16 Titular Members and a considerably larger number of Corresponding Members. Those present at individual meetings took part in discussions and decision making, but formal proposals were put to postal vote by the Titular Members. Decisions achieved by a substantial majority were:

The second and third of the four series into which the Silurian System is to be divided were to be called "Wenlock Series" and "Ludlow Series", and boundary stratotypes for the base of each of these were chosen in the Welsh Borderland, where fully described standard areas provide a setting for these sections. These are indicated in Figure 1 and details of the decisions were reported in Lethaia (Holland 1980). Full descriptions of the areas and sections are to be found in Bassett et al. (1975) for the Wenlock, and Holland et al. (1963) for the Ludlow. The sections are now cared for by the Nature Conservancy.

For stages within these two series, the Subcommission agreed to use the "Sheinwoodian" and "Homerian" stages for the Wenlock. These again had been defined by Bassett et al. (1975). The boundary stratotype for the base of the former was to be the same as that for the Wenlock Series. A boundary stratotype for the base of the Homerian Stage was accepted within the Wenlock area.

In the case of the Ludlow Series, Holland et al. (1963) had previously defined four stages, but the first and second of these were difficult to separate outside the Welsh Borderland and the third (Leintwardinian) stage corresponded to only one graptolite biozone, widespread though that is. Accordingly, the Subcommission decided that only two stages were appropriate for the Ludlow and, as in the case of the Wenlock, these correspond broadly to two brachiopod faunas as well as being tied more precisely to the graptolite biozonal sequence (Fig. 2). Many other groups are of course recognized as actually or potentially useful in correlation.

Those concerned most directly with work in the Ludlow area were asked to suggest names for these two new stages and the Subcommission approved their choice of "Gorstian" and "Ludfordian" (Holland et al. 1980). The boundary stratotype for the base of the Gorstian Stage is the same as that for the base of the Ludlow Series. For the base of the Ludfordian Stage, also sited within the Ludlow area (Fig. 1), the decision is to use the boundary proposed by Holland et al. (1963) for the base of their Leintwardinian Stage.

These decisions were presented to the Commission on Stratigraphy at its meeting in Paris in August 1980. Professor Anders Martinsson and Dr. M.G. Bassett, respectively Chairman and Secretary of the Commission, then circulated documentation and arranged a postal vote by all members of the Commission. The decisions already outlined above were ratified without dissent (see Martinsson et al., 1981).

Cocks, Toghill, and Ziegler (1970) had already divided the Llandovery Series into four stages, equated respectively with the much used lettered and numbered divisions A_1-A_4, B_1-B_3, C_1-C_3, and C_4-C_6. These were given geographical names based on localities within the type area near Llandovery in South Wales. As the lowest A_1 division at Llandovery proved to be unfossiliferous and of uncertain extent, these authors chose Dobb's Linn for the definition of the base of their first, Rhuddanian Stage. The basal boundaries of the remaining Idwian, Fronian, and Telychian stages were referred to localities within the Llandovery area. Unfortunately, detailed faunal changes through continuous boundary stratotype sections with accurately defined marker points were not available and indeed there was much discussion by Subcommission members on the difficulties of discriminating between at least some of these stages elsewhere in the world. A Subcommission working group is now looking carefully at the so-called "northern area" of the Llandovery district, where more graptolites may be available. But whatever the

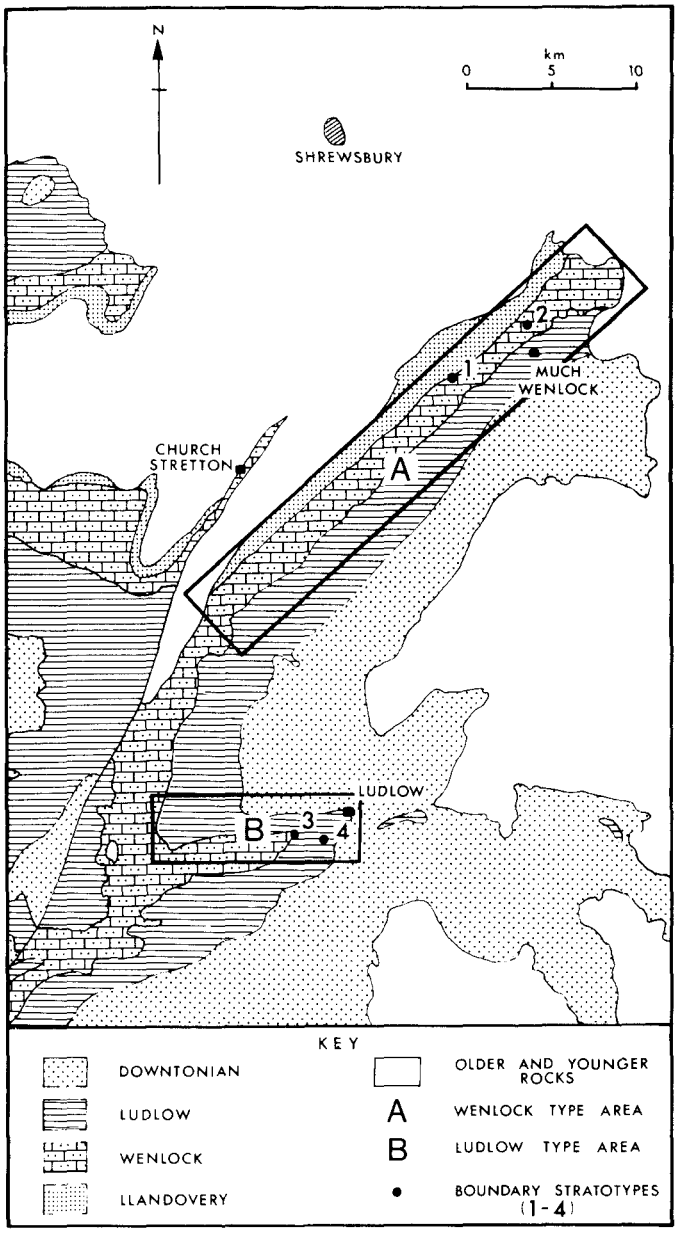

Figure 1: *Geological map of the Welsh Borderland showing Silurian subdivisions and standard areas for the Wenlock and Ludlow series. Boundary stratotype sections as shown in Figure 2 are numbered as follows: 1. Hughley Brook; 2. Whitwell Coppice; 3. Pitch Coppice; 4. Sunnyhill Quarry.*

final decision, the original type (as distinct from standard) area must continue to be regarded as providing significant parastratotypes in Llandovery stratigraphy.

In the meantime, in the summer of 1981 the Subcommission had the opportunity to examine an exceedingly fossiliferous and beautifully exposed Llandovery sequence on Anticosti Island, Quebec, Canada, where the structure is extremely simple (Barnes, 1982). In August 1982, it examined another promising sequence in the Oslo district of Norway and, hopefully in 1983 it will be possible to make decisions on boundary stratotypes for the chronostratigraphy of the first of the Silurian series. The base of the first of the two or three stages into which the "Llandovery (or Anticosti) Series" is likely to be divided must be that of the Silurian System, and here the Working Group on the Ordovician-Silurian Boundary is in the process of discussing the relative merits of Dobb's Linn and Anticosti for this purpose. They are concerned also with the difficult question of the biostratigraphical horizon best chosen for the boundary.

The fourth, post-Ludlow pre-Gedinnian series of the Silurian System is the division which was recognized as a result of the work of the Silurian-Devonian Boundary Committee (Martinsson, 1977). Errors in previous correlations had been such that the rocks deposited in this interval had actually been "lost", mainly because of the assumption that graptoloids must in some (mystical) sense be absent from post-Silurian strata. The top of the fourth series is already defined by the now agreed base of the Devonian at the base of the Monograptus uniformis Biozone, as recognized in the boundary stratotype section at Klonk in the Barrandian area of Czechoslovakia. Although there has been considerable discussion and three submissions have already been circulated, the boundary stratotype for the base of the fourth series, and indeed its formal name, are still to be decided by the Subcommission.

The three candidates for the series (Fig. 2) are the "Downton Series", "Pridoli Series" and "Skala Series", or perhaps an alternative name. These would be represented by basal boundary stratotypes in, respectively, the Welsh Borderland, the Barrandian area, or Podolia (U.S.S.R.). The Downton Series occurs in classic country where two of the Silurian series are already defined and its basal division, the Ludlow Bone Bed, is familiar to geologists. Here, however, the facies is of marine-brackish character. Bassett et al. (1980) have reviewed the considerable biostratigraphical data available, together with the correlation of the series across Europe and elsewhere, through the use of a chain of evidence involving ostracodes, spores, vertebrates, and graptolites. Kaljo (1978) has also detailed this web of correlative evidence.

The Pridoli rocks of Czechoslovakia have been classic since the work of Barrande. The base of the Devonian is already defined here. The strata are well known and well represented in museum collections. There are both graptolitic and shelly faunas. The third potential stratotype is in the area of the Dnestr River and its tributaries in Podolia where river cliffs and other exposures clearly display a sequence of highly fossiliferous Silurian to lowest Devonian rocks in marine facies and with structure of extreme simplicity. Brachiopods and ostracodes are especially well represented in the Skala.

The Subcommission is grateful to Academician B.S. Sokolov and his colleagues who are arranging detailed examination of the Skala Series in 1983, when it should be possible to assess the relative merits of all three areas under consideration. Many members have already seen the Downton and Barrandian areas, though few have previously visited Podolia. Opportunities are available for any necessary visits to the two former areas. As yet there is no demand for the definition of stages within the fourth Silurian series, though these will doubtless become the concern of the Subcommission in future years.

Once decisions have been made through the proper use of the international machinery provided by the Commission on Stratigraphy and its subsidiary bodies, it is exceedingly important that these should be implemented nationally and internationally. Publicity for the decisions is necessary: hence the presentation of this interim report on the activities of the Subcommission on Silurian Stratigraphy and the publication of various short statements of decisions already reached as variously referred to above.

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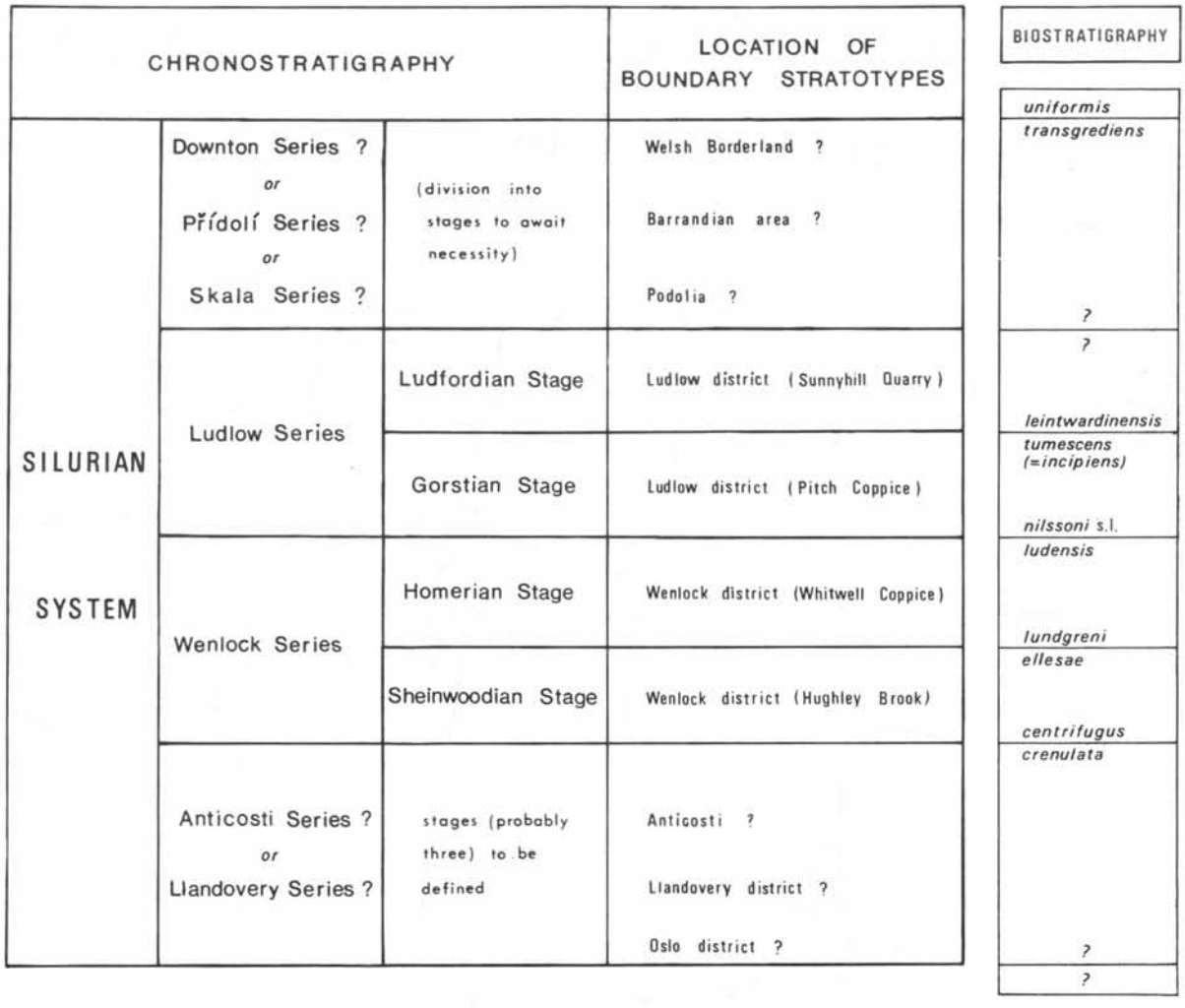

Figure 2: *State of Silurian chronostratigraphy. Critical graptolite biozones are also indicated.*

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