



# Series and Stages of the Silurian System

by C.H. Holland

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*The Subcommittee on Silurian Stratigraphy has recently completed an eight-year program resulting in the formal adoption of four standard Series and seven standard Stages for the Silurian System. This review summarizes the background to the chronostratigraphical subdivisions now established as units of global applicability.*

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## Introduction

The top of the Silurian System, that is to say the base of the Devonian, is taken at a point coincident with the base of the *Monograptus uniformis* Biozone in a boundary stratotype section in the Barrandian area of the Prague Basin, Czechoslovakia. Decisions concerning this boundary were approved by the Commission on Stratigraphy as long ago as 1972, and very full details of the whole subject are given in Martinsson (1977).



Figure 1: Members of the Subcommittee on Silurian Stratigraphy and of the Ordovician-Silurian Boundary Working Group at Ludlow, Welsh Borderland, April 1979 (C.H. Holland).



Figure 2: The boundary stratotype for the base of the Wenlock Series at Hughley Brook, Wenlock district, Welsh Borderland during clearing (R.J. Aldridge).



Figure 3: The boundary stratotype for the base of the Ludlow Series at Pitch Coppice, Ludlow district, Welsh Borderland. Hammer head is on the boundary (P.G. Bartlett).

The base of the Silurian System (the Ordovician/Silurian boundary) is now agreed at a point coincident with the base of the *Parakidograptus acuminatus* Biozone, in a boundary stratotype at Charles Lapworth's classic locality of Dob's Linn in the Southern Uplands of Scotland (see article by L.R.M. Cocks in this issue).

Since the International Geological Congress at Sydney in 1976, the Subcommittee on Silurian Stratigraphy has been engaged upon a program to settle the internal chronostratigraphical divisions of the Silurian System. The work was completed, as far as intended, in time for submissions (supported by substantial majority votes from Titular Members of the Subcommittee) to be made at the Moscow Congress in August 1984 (see Holland, 1984). These decisions have now been ratified by the Commission on Stratigraphy (Bassett, this issue).

Much progress was made at an historic field meeting and other formal gatherings held in Britain in 1979 (Fig. 1). Decisions concerning the second and third of the four Series, into which it had been decided the Silurian System should be divided, were later ratified by the Commission on Stratigraphy. The Wenlock and Ludlow Series (Figs. 2 and 3) were each divided into two stages, respectively the Sheinwoodian and Homerian and the Gorstian and Ludfordian. The boundary stratotypes for the bases of these divisions were taken in the type Wenlock and Ludlow areas of the Welsh Borderland (see Holland, 1982, for a summary).

CHRONOSTRATIGRAPHY				LOCATION OF BASAL BOUNDARY STRATOTYPE	GRAPTOLITE BIOSTRATIGRAPHY
SILURIAN SYSTEM	Upper Silurian	PRĪDOLI SERIES	(Division into stages to await necessity)	BARRANDIAN (Pozary section)	<i>uniformis</i>
			LUDFORDIAN STAGE	LUDLOW DISTRICT (Sunnyhill Quarry)	<i>transgrediens</i>
		LUDLOW SERIES	GORSTIAN STAGE	LUDLOW DISTRICT (Pitch Coppice)	<i>ultimus parulimus</i>
			HOMERIAN STAGE	WENLOCK DISTRICT (Whitwell Coppice)	?
	Lower Silurian	WENLOCK SERIES	SHĒIN-WOODIAN STAGE	WENLOCK DISTRICT (Hughley Brook)	<i>leintwardinensis tumescens (=incipiens)</i>
			TELYCHIAN STAGE	LLANDOVERY DISTRICT (Cefn Cerig section)	<i>nilssonii s.l.</i>
		LLANDOVERY SERIES	AERONIAN STAGE	LLANDOVERY DISTRICT Cefn Coed - Aeron Farm	<i>ludensis</i>
			RHUDDANIAN STAGE	SOUTHERN UPLANDS OF SCOTLAND (Dob's Linn)	<i>lundgreni</i>
					<i>ellesae</i>
					<i>centrifugus</i>
			<i>crenulata</i>		
			<i>turriculatus</i>		
			<i>sedgewickii</i>		
			<i>triangulatus</i>		
			<i>cyphus</i>		
			<i>acuminatus</i>		
			<i>persculptus</i>		

Figure 4: Stratigraphical classification of the Silurian System.

### The Llandovery Series and its Stages

In the case of the first (lowest) Series of the Silurian System, members of the Subcommittee present at the British meeting in 1979 were not impressed with the type Llandovery area in southern Wales, for well documented boundary stratotype sections were not then available and graptolites appeared to be scarce. A working group was set up to investigate the Llandovery area in modern terms and, in particular, to examine the 'northern area' where forestry roads provide a veritable network of sections and where graptolites are more readily available.

The base of the Llandovery Series, as it is now agreed it shall be called, together with the base of its lowest Stages, is of course defined at the boundary stratotype for the base of the Silurian System at Dob's Linn. It is also agreed that there shall be three stages within the Series: the Rhuddanian, Aeronian and Telychian (see article by Bassett, this issue). The boundary stratotypes for the bases of the second and third of these are in sections in the type Llandovery area and relate respectively to the bases of the *Monograptus triangulatus* and *Monograptus turriculatus* biozones as indicated in Figure 4. A full account of the new investigations, of the Llandovery area as a whole, and of the definitive chronostratigraphy is now available in Cocks and others (1984). The Subcommittee approved adoption of the name Llandovery by majority of 14 votes to 1 against. In each case the Stages of the Llandovery were approved by 10 votes for, 3 against, with 2 abstentions.

The Subcommittee also gave careful consideration to two other areas where the first Series is very well displayed: Anticosti Island in Canada and the Oslo Region of Norway. The sections in Anticosti were examined by the Subcommittee in 1981 (Fig. 5). The structure of this very large island is extremely simple (Lespérance, 1981). Rich shelly faunas and assemblages of microfossils are present in the platform carbonates and clastics, which are so well exposed in coastal and river sections. Unfortunately, graptolites are not usually common, and the conodont boundaries suggested here are not at present readily correlatable about the world.

At Oslo (examined by the Subcommittee in 1982) the structural situation is more complex, but nevertheless there are superb sections rich in shelly fossils and, in some parts of the region, in graptolites (Worsley, 1982).

Members were undoubtedly influenced partly in their choice of the type Llandovery area by its historical importance in Silurian stratigraphy. A clear majority decision having been made, it is important that uniformity of usage should now follow. In the rigorous biostratigraphical and interpretive work that must be done in the years ahead, the sections in



Figure 5: Silurian Becscie Formation; earliest Llandovery limestone at Major Falls, Salmon River, Anticosti Island, Canada (T. Bolton).



Figure 6: Gifts and greetings for members of the Subcommittee visiting in May 1983 the Silurian-Devonian boundary section in Podolia, first seen by some members during the historic excursion of 1968 (C.H. Holland).

Anticosti and Oslo, like the Chinese sections for the lowest part of the Llandovery, will be of considerable importance as parastratotypes.

#### The Přídolí Series

With the fourth (uppermost) Series of the Silurian System, matters were not easy, for the available sections all have their problems in catering for the multifacial developments in rocks of this age around the world. As for the other agreed divisions and candidates, detailed submissions were circulated to both Titular and Corresponding Members of the Subcommittee. Three candidates for the fourth Series had been shortlisted: the Barrandian area in Czechoslovakia, the Downton area in the Welsh Borderland, and Podolia in the Soviet Union.

Members had seen something of the Downton area in 1979. It was emphasized that, as Stages within the fourth Series are not yet required, concern lay only with a basal boundary stratotype. The base of the Ludlow Bone Bed can now be correlated through a biostratigraphical web across Europe and beyond. However, the sequence is of a somewhat restrictive facies, running from shallow marine to fluvialite (Bassett et al., 1982).

Podolia (Fig. 6) in the Ukraine is a magnificent area for Silurian-Devonian geology, with highly fossiliferous rocks and little structural disturbance in beautifully exposed long, river cliffs of the Dnestr and its tributaries (Abushik et al., 1985). A comprehensive field meeting of the Subcommittee was held there in May 1983. During the excursion and later at Kiev, final discussions were held concerning both the first and fourth Series of the Silurian System, before these matters were put to formal postal vote by Titular Members

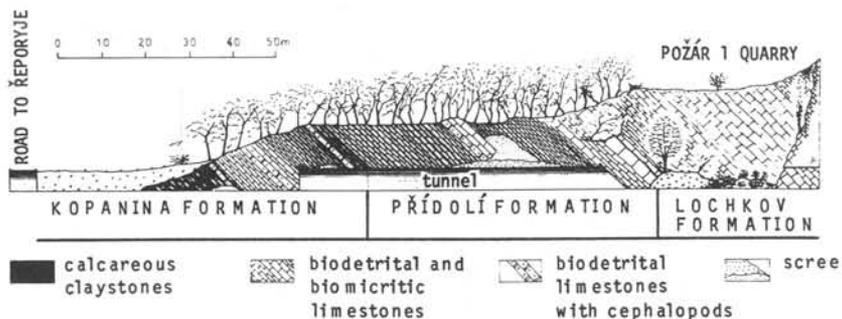


Figure 7: The Pozary section as illustrated by Jíří Kříž in a submission to the Subcommittee dated March 1983. The Přídolí Formation has been renamed to avoid conflict with the usage of Přídolí Series.

of the Subcommittee. Unfortunately, the beds immediately above the base of the Skala series in Podolia are in cyclic dolomites with only limited ostracode evidence for correlation.

The Subcommittee, therefore, decided upon an horizon coincident with the base of the *Monograptus parultimus* Biozone in a boundary stratotype in the Pozary section of the Barrandian area for the base of the fourth Series (Fig. 7), which is formally named the Přídolí Series. Many members had already visited the Barrandian area on an individual or group basis. A most detailed submission by Dr. J. Kříž and others was circulated and will shortly be published. Classic in lower Palaeozoic geology, as are Wales and the Welsh Borderland, the Barrandian area also now provides the stratotype for the base of the succeeding Lochkovian Stage at the base of the Devonian. The Subcommittee approved the use of the name Přídolí by majority of 12 votes to 3 against.

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