



Fundamental stratigraphic problem of the Cambrian in the Holy Cross Mts. — discussion

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INTRODUCTION

The researches of the Cambrian deposits in the Holy Cross Mts. have been carried on for more than 100 years but the most important period of this history is connected with elaborating and publishing of the first National Stratigraphic Code (NSC) (*Zasady...*, 1975). NSC was prepared by a group of geologists and discussed during the Conference of Stratigraphers in 1974. It was approved by that conference, printed and dedicated to all stratigraphers working in our country to use it in the geological field work and in publications. This NSC is very similar to "International Guide to Stratigraphic Classification, Terminology, and Usage" (H. D. Hedberg, 1972). The lithostratigraphic, biostratigraphic and chronostratigraphic units are distinguished in the NSC along with procedure necessary to establish the formal units.

After publishing the NSC a Working Group consisting of some leading geologists was organized to examine the newly established lithostratigraphic units and to confirm them as formal ones. This ambitious enterprise was, however, realized only to a small extent because the controversies between the members of the group were too great. After some time the activity of the group ceased. In such a situation all the established units roughly corresponding to the demands of the NSC must be treated as formal ones.

The Cambrian deposits in the Holy Cross Mts. are covered over large areas by younger Palaeozoic rocks (W. Bednarczyk *et al.*, 1965) and by thick cover of the Quaternary deposits with loesses. Due to these reasons the stratotypes of the Cambrian formations are mainly composite. Usually the Cambrian formations make the so-called stratotype areas except the units established in large quarries. The boundaries between the formations are often situated in small valleys, and

they are covered by alluvial Quaternary deposits. Additionally there are fewer and fewer outcrops in result of industrial development of the region.

The succession of the Cambrian formations in the area is rather simple. The oldest ones are visible in the southern part (Klimontów Anticlinorium) while the younger ones are exposed in the northern part (Łysogóry Anticline). The lithologies are thick sandstones or shales, the total thickness varies from 2.5 to 3.5 km. Fossils are fairly common, trilobites are the most important group. Other groups are: brachiopods, coelenterates, echinoderms, hyolithids, snails, algae and acritarchs. The oldest trilobites were found in the upper part of the Lower Cambrian and because of that the Lower Cambrian was divided here in the past into two parts: Subholmia and Holmia. The trilobites exist of course also in the Middle and Upper Cambrian.

The modern Cambrian subdivision in the Holy Cross Mts. was published in the year of printing of the National Stratigraphic Code (S. Orłowski, 1975). As the chairman of the group of geologists elaborating the code, the author wanted to give an example of the usage of NSC in stratigraphic practice. In the mentioned publication a group, formations, members, and single beds were described but also biostratigraphic zones and subzones were established. All earlier published data concerning the stratigraphy and paleontology of the Cambrian were discussed and utilized in this publication. Additionally the biostratigraphic correlation with the Cambrian of Scandinavia was done. The next versions of the Cambrian subdivisions were published (S. Orłowski, 1988, 1992a, b, c) as results of new data concerning lithology,

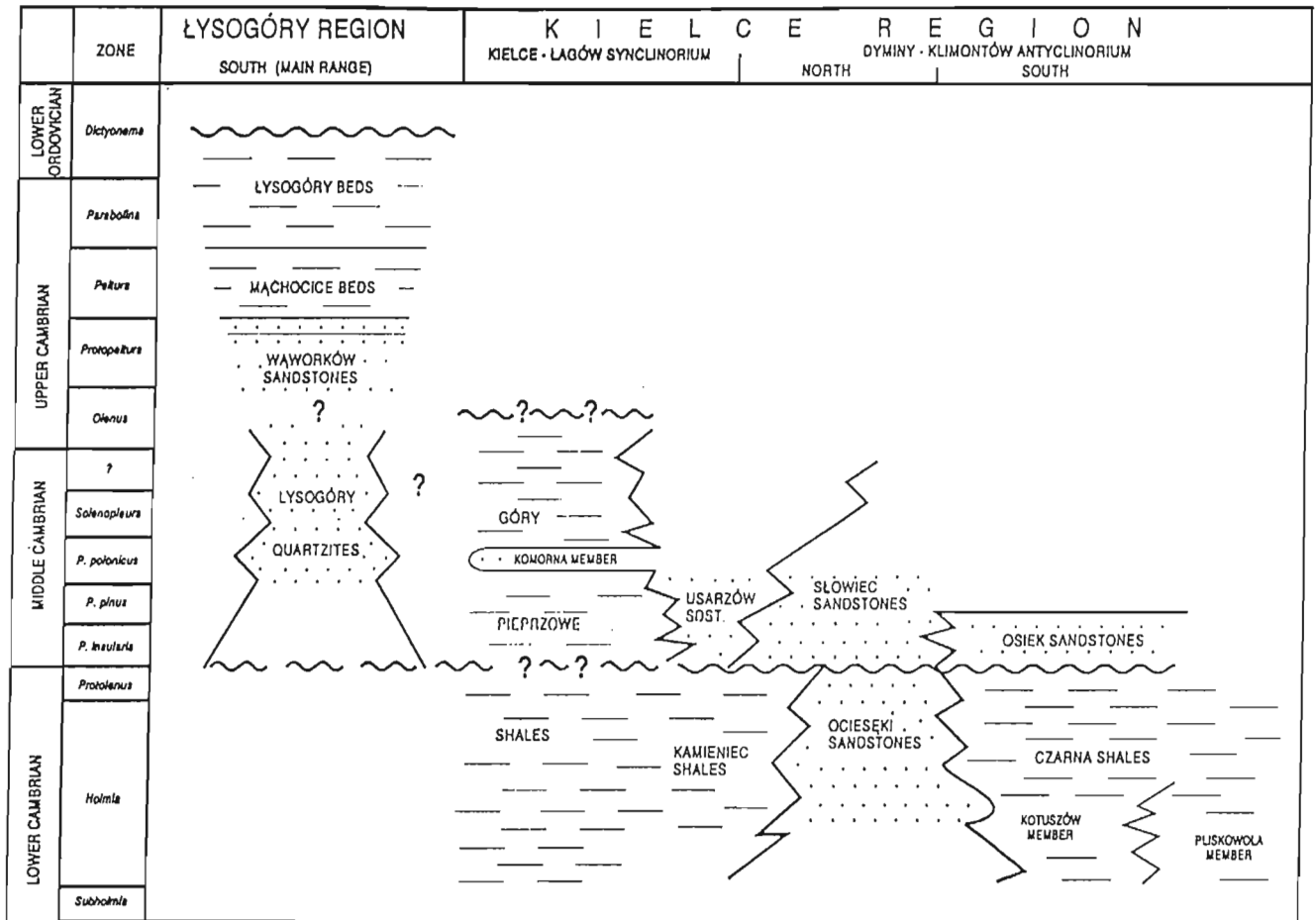


Fig. 1. Replica of fig. 8 in Z. Kowalczewski (1995) as confronted with Fig. 2

Powtórzenie fig. 8 z pracy Z. Kowalczewskiego (1995) dla porównania z fig. 2

thickness of formations, descriptions of new fossils and trace fossils.

The EUROPROBE meeting was organized in Kielce in 1994 and a paper concerning the Cambrian stratigraphy was presented there (Z. Kowalczewski, 1994). Discussion with this paper was done by S. Orłowski and W. Mizerski (1995a). Next paper (Z. Kowalczewski, 1995) contains a critique of the existing stratigraphic subdivision and a proposal of the author's own stratigraphic subdivision as informal units.

Not to make the scientific discussion senseless both opponents should, in my opinion, follow the same rules. I propose the following common points:

— new proposals of the Cambrian stratigraphic subdivi-

sions should be prepared on the basis of the NSC (*Zasady...*, 1975), which is now the best stratigraphic, theoretical base in Poland;

— the general succession of the formations in the Cambrian sequence of this area is from south to north as it is shown by dips of rocks;

— proper sequence of the formations should be respected;

— lithostratigraphic units are established on the base of the main lithologic features;

— the age of rocks is defined by fossils and the most important for stratigraphy are trilobites;

— the rocks laying below the deposits with oldest trilobites are of pre-trilobite age.

STATEMENTS

The stratigraphic subdivision of the Cambrian rocks in the Holy Cross Mts. was presented many times (S. Orłowski, 1975, 1992a, b, c), the fossils and trace fossils were described (S. Orłowski, 1964, 1968a, b, 1985a, b, 1989, 1992b), the tectonic structures were investigated (W. Mizerski, 1995). In

this situation I would like to remind the most important facts with some comments only.

The Czarna Shale Formation underlies the sandstones with earliest trilobites so its age is pre-trilobite (Fig. 2). In the shales were found: *Sabellidites cambriensis* Yanischevsky,

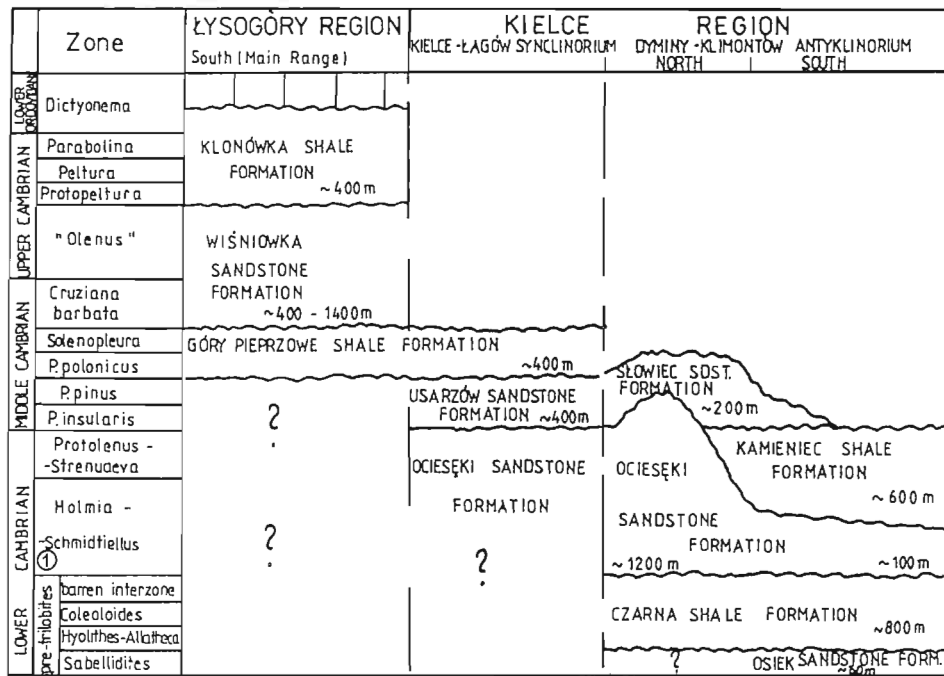


Fig. 2. Proper stratigraphic position of the lithostratigraphic units; compare with Fig. 1
1 — earliest trilobites

Właściwa pozycja stratygraficzna jednostek litostratygraficznych; porównaj z fig. 1
1 — najstarsze trylobity

Parasabellidites yanshevskyi Sokolov, *Platysolenites anti-quissimus* Eichwald, *Hyolithes czarna* Orłowski, *Allathea kotuszowi* Orłowski (S. Orłowski, B. Waksmundzki, 1986), *Tyrasotaenia podolica* Gnilovskaja, *Pilitella composita* Aseeva, *Vendotaenia major* Kowalski, small group of acritarchs (W. R. Kowalski, 1983) and few trace fossils (W. R. Kowalski, 1987; S. Orłowski, 1989). No trilobites were found in rocks till now so the formation cannot be trilobite in age as it is supposed by Z. Kowalczewski (1995, fig. 8; see Fig. 1 in the present paper).

The Osiek Sandstone Formation was recognized mainly in boreholes situated in the village Osiek but the rocks crop out near Kotuszów, too (W. R. Kowalski, 1983, pl. 1, fot. 2). The rocks dip under the Czarna Shale Formation. Small collection of trace fossils was found only in sandstones (W. R. Kowalski, 1983). Z. Kowalczewski (1995) considers these rocks to be a stratigraphic equivalent of the Słowiec Sandstone Formation (Fig. 1). This is pure speculation because neither lithological data nor fossil content justify such conclusions.

The Lower/Middle Cambrian boundary is best observed in the Jugoszów–Usarzów profile (S. Orłowski, 1964, 1975). Above the Kamieniec Shale Formation with trilobites of Protolenus-Strenuaeva Zone (collected in: Kamieniec and Wola Łagowska villages, S. Orłowski, 1985a) there is the Usarzów Sandstone Formation with many trilobites of Middle Cambrian age (S. Orłowski, 1964, 1985a). Z. Kowalczewski's opinion (1995, fig. 8; see Fig. 1 in the present paper) that the Kamieniec Shales pass directly into the Góry Pieprzowe Shales is a great misunderstanding. In fact, the Kamieniec Shale Formation and the Góry Pieprzowe Shale Formation are

separated by thick Usarzów Sandstone Formation with many trilobites and other fossils of Middle Cambrian age (Fig. 2).

The Ociesęki Sandstone Formation extends up to the top of the Lower Cambrian with one exception. North of the Zamczysko Hill, near Widełki village, a road was built a few years ago and some outcrops appeared in sandstones with numerous, well preserved trilobites (S. Orłowski, W. Mizerski, 1995b). Many of trilobites were described from the Jugoszów–Usarzów profile (S. Orłowski, 1964, 1985b). My Oponent mistakes these outcrops with the Łapigrosz outcrop in which Lower Cambrian trilobites of the Protolenus-Strenuaeva Zone were found.

The Słowiec Sandstone Formation in its stratotype locality (Słowiec Hill) belongs to the Polonicus Zone (S. Orłowski, 1985b). But the deposition of the lower sandstones of this formation in outcrops: Brzechów, Nowa Łagowica, Konary and others started at the very beginning of the Middle Cambrian (S. Orłowski, W. Mizerski, 1995b). In the Klimontów Anticlinorium these sandstones are preserved in fragmentary profiles in local synclines or tectonic grabens.

The Góry Pieprzowe Shale Formation overlies the Usarzów Sandstone Formation. Small collection of trilobites was found by G. Gürich (1892) in these rocks and in this way the Cambrian system in the Holy Cross Mts. was recognized for the first time. The history of this discovery was described (S. Orłowski, 1992a) and trilobites were revised (S. Orłowski, 1964, 1985b). The Góry Pieprzowe Shale Formation is overlain by the Wiśniówka Sandstone Formation. The boundary of the formations is visible in the ravines situated on the southern slope of the Main Range and in the Marcinkowice village near Opatów.

Z. Kowalczewski's opinion (1995, fig. 8; see Fig. 1 in the present paper) that the shales of this formation could be treated partly as equivalents of the Usarzów Sandstones and Łysogóry Quartzites (= Wiśniówka Sandstone Formation) is a result of neglecting the rules of stratigraphic succession (superposition) of these formations. Proper geological position of these formations is demonstrated on Figure 2.

The Wiśniówka Sandstone Formation is exposed over large area from the Wiśniówka Hill (west) to the Wąworków quarry (east) and the rocks belonging to it build the highest parts of this area. The quarries at Wiśniówka are well known because they yielded very common and well preserved trace fossils with important trilobite ichnocoenose (S. Orłowski *et al.*, 1970, 1971). Body fossils were found only in Duża Wiśniówka quarry (few trilobites) and in Wąworków quarry (trilobites, brachiopods, echinoderms). In the latter the fossils were found in a bed about 1 m thick (S. Orłowski, 1968b). I have never seen the trilobites mentioned by Z. Kowalczewski (1995) from Wąworków quarry found by J. Samsonowicz before 1939. Perhaps the collection was destroyed during the Second World War, so I could not use them in my biostratigraphic research.

The collection of the Upper Cambrian trilobites was enlarged during the last thirty years (S. Orłowski, 1968b; E. Tomczykowa, 1968) by few specimens only. New edition of "Treatise on Invertebrate Paleontology", Part Trilobites, will make a revision of the Late Cambrian trilobites possible. The systematic position of "*Olenus*" *rarus* Orłowski — leading fossil in the Wiśniówka Sandstone Formation — will be examined, too. This trilobite, named *Olentella rara* Orłowski, was found in Maentwrog Formation, North Wales,

together with: *Olenus micrurus* Salter and *Homagnostus obesus* (Belt) in the lower part of the Upper Cambrian in the Olenus Zone (Olenus cataractus Subzone) (P. M. Allen *et al.*, 1981). It is almost sure that the systematic position of the "*Olenus*" may change in future but its biostratigraphic position will remain the same: i.e. lower part of the Upper Cambrian.

The names of the units such as "Łysogóry Quartzites", "Łysogóry Beds", "Wąworków Sandstones", "Mąchocice Beds", used by Z. Kowalczewski (1995), are of historical value only and were mentioned as synonyms of the lithostratigraphic units (S. Orłowski, 1975).

Trace fossils are of lower stratigraphic value than body fossils; nevertheless they are useful in the situations of lack or scarcity of body fossils. *Phycodes pedum* Seilacher is a good example. It marks the earliest ichnozone in the stratotypic section for the Precambrian-Cambrian boundary in Newfoundland, Eastern Canada. In the Holy Cross Mts. *Cruziana barbata* Seilacher and *C. semiplicata* Salter are suitable for delimitation of the Middle and Upper Cambrian in the Wiśniówka Sandstone Formation. The stratigraphic position of *C. barbata* Seilacher was discussed by A. Seilacher (1970) for the upper part of the Middle Cambrian. *C. semiplicata* Salter was found here above the *C. barbata* Seilacher and it points to Late Cambrian age. In the upper part of the range of this ichnospecies Late Cambrian trilobites were found (S. Orłowski, 1968b; E. Tomczykowa, 1968; S. Orłowski, W. Mizerski, 1995a) In other areas this ichnospecies may have larger extent (T. P. Crimes, 1970) but our discussion concerns the Cambrian stratigraphy in the Holy Cross Mts. only.

CONCLUSIONS

The publication by Z. Kowalczewski (1995) neither takes into account the theoretical base i.e. the National Stratigraphic Code nor does it respect the real field geological data.

The informal, stratigraphic subdivision proposed by Z. Kowalczewski (1995, fig. 8; see Fig. 1 in the present paper) is a misunderstanding because he:

- is against the rules presented in the NSC (*Zasady...*, 1975) and does not propose other theoretical system for stratigraphic subdivisions;

- does not respect the rules of stratigraphic succession of the lithostratigraphic units in process of reconstruction of the Cambrian rock succession;

- does not accept the stratigraphic significance of trilobites;

- overestimates the stratigraphic significance of acritarchs.

The scientific discussion with the paper by Z. Kowalczewski is not possible and not suitable, because we both represent quite different theoretical approach to the Cambrian stratigraphy in the Holy Cross Mountains. As an argument for non-scientific character of Z. Kowalczewski's paper — two figures in the present paper are shown: Fig. 1 is reproduced after fig. 8 (Z. Kowalczewski, 1995) whereas Fig. 2 demonstrates true stratigraphic positions of the formations, their thickness and geographic distribution in the same geological regions.

PODSTAWOWE PROBLEMY STRATYGRAFICZNE KAMBRU GÓR ŚWIĘTOKRZYSKICH — DYSKUSJA

Streszczenie

W roku 1975 został opublikowany pierwszy polski kodeks stratygraficzny pod nazwą *Zasady polskiej klasyfikacji, terminologii i nomenklatury stratygraficznej*. Kodeks ten jest efektem pracy dużej grupy geologów, którzy wcześniej dyskutowali jego poszczególne części, całość przedyskutowali, następnie zatwierdzili na Konferencji Stratygrafów, a po wydrukowaniu skierowali do realizacji przez geologów zarówno w czasie prac terenowych, jak też w publikacjach.

Po raz pierwszy kodeks został zastosowany w podziałach stratygraficznych kambru świętokrzyskiego (S. Orłowski, 1975). Jako przewodniczący zespołu opracowującego kodeks uważałem za stosowne danie przykładu stosowania go w praktyce geologicznej.

W kambrze świętokrzyskim wydzielone zostały jednostki litostratygraficzne, biostratygraficzne i chronostratygraficzne. Wśród jednostek litostratygraficznych wyróżniono: grupę świętokrzyską, 9 formacji, a także ogniwa i warstwy. Obecnie podstawowe jednostki, czyli formacje, są te same, które wydzielono w pierwszej publikacji, ale ich treści są wzbogacone o pełniejsze listy skamieniałości i śladów organicznych oraz o nowe miąższości. Więcej danych zgromadzono jedynie dla formacji piaskowców ze Słowca (S. Orłowski, W. Mizerski, 1995b).

Poziomy biostratygraficzny kambru świętokrzyskiego zostały wzbogacone o poziomy poniżej najstarszych trylobitów (fig. 2) oraz o poziomy w stropie kambru środkowego. Opisano ponownie wiele trylobitów, a także jamochłony i szkarłupnie (J. Dzik, S. Orłowski, 1993, 1995; M. Masiak, A. Żylińska, 1994). Duży postęp zanotowano w opisanu śladów organicznych (S. Orłowski, 1989, 1992c).

Ostatnio ukazała się publikacja Z. Kowalczewskiego (1995) kwestionująca istniejące podziały: litostratygraficzny i biostratygraficzny oraz wiek chronostratygraficznych wydzielonych jednostek. Autor tej publikacji przedstawił też swój własny, nieformalny podział kambru świętokrzyskiego na jednostki, w którym:

— nie respektuje zasad zawartych w kodeksie stratygraficznym (*Zasa-*

dy..., 1975) i nie przedstawia żadnego innego systemu teoretycznego podziałów stratygraficznych;

— nie respektuje zasad podległości i nadległości jednostek litostratygraficznych, przez co wiele wyróżnionych przez Niego jednostek ma nieprawidłową pozycję stratygraficzną;

— deprecjonuje znaczenie stratygraficzne trylobitów kambryjskich;

— nie przyjmuje do wiadomości, iż skały występujące poniżej skał z najstarszymi trylobitami mają wiek przedtrylobitowy;

— przecenia znaczenie stratygraficzne akritarch.

Powyższa publikacja jest negatywnym przykładem dociekań naukowych, których autor nie porusza się w obrębie określonego systemu zasad teoretycznych, a często też lekce sobie waży fakty geologiczne stwierdzone w terenie, czyli przedkłada interpretacje nad szacunek dla faktów. Autor tej publikacji proponuje cofnięcie się przed rok 1975 — rok publikacji kodeksu stratygraficznego — do okresu dowolności stratygraficznej i luźnej dyscypliny warsztatowej.

Dla dobra nauki starałem się w rozdziale: „Stwierdzenia” przedstawić pokrótce fakty, często kolejny raz, o wydzielonych jednostkach litostratygraficznych i niektórych problemach biostratygrafii.

Odmienne poglądy na stratygrafię kambru Gór Świętokrzyskich między mną a moim Oponentem mają początek w odmiennych zasadach teoretycznych lub ich braku i różnym podejściu do faktów geologicznych. Jestem zwolennikiem kodeksu stratygraficznego (*Zasady...*, 1975) jako systemu wartości teoretycznych porządkujących polską stratygrafię i jestem za wcielaniem do praktyki zasad tego kodeksu.

Brak wspólnej płaszczyzny naukowej dokumentują fig. 1 i 2. Figura 1 jest wiernym powtórzeniem fig. 8 z pracy Z. Kowalczewskiego (1995), fig. 2 natomiast pokazuje prawdziwe pozycje stratygraficzne jednostek litostratygraficznych z ich miąższościami oraz zasięgi paleogeograficzne tych jednostek w tych samych regionach geologicznych co na fig. 1.

Fundamental stratigraphic problems* of the Cambrian in the Holy Cross Mts. — reply

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The discussion by S. Orłowski is composed of two parts. The first part contains some general, rather obvious questions which do not require a reply except for one problem (the validity of his Cambrian subdivision) which I shall address at the end of this text. The second part concerns the detailed

problems. They will be referred to in the following text using the same sub-titles. Some of these paragraphs are relatively simple and can be answered easily. The others are more difficult to discuss. A careful reader who will compare my text (Z. Kowalczewski, 1995) with the discussion by S. Orłowski will easily notice that some of the statements of my Opponent are rather evasive.

Let's start with the first group.

The Czarna Shale Formation. It was best investigated in boreholes Korytnica 1 and 2, at intervals of 140 and 110 m, respectively. In my paper (Z. Kowalczewski, 1995, p. 453) I

*The editors express sincere apologies for a mistake in the title of the discussed paper (Z. Kowalczewski, 1995). It should run: "Fundamental stratigraphic problems (instead of "problem") of the Cambrian in the Holy Cross Mts."