Annales Societatis Geologorum Poloniae (1988), vol. 58: 487-492
PL ISSN 0208-9068

POLISH CALEDONIDES AND THEIR RELATION TO THE OTHER EUROPEAN CALEDONIDES REPLY TO DISCUSSION BY E. STUPNICKA*

Jerzy Znosko

Geological Institute, ul. Rakowiecka 4, 00-975 Warszawa

Mrs. Ewa Stupnicka (1988) has presented critical remarks regarding some of the tectonical conclusions and suggestions included in two of my papers (Znosko, 1983, 1986). The essence of her remarks is that typical Caledonian tectonic processes are not manifest in the structure of the southern part (Kielce region) of the Góry Świętokrzyskie (Holy Cross Mts.). According to Stupnicka (1988), the Góry Świętokrzyskie were subject to only gentle deformations and disjunctive tectonics in the Caledonian time. Her opinion is supported by: (i) the predominantly small angular unconformities between the Upper Silurian and Lower Devonian (Emsian) strata, (ii) the general conformity between the pre-Devonian and pre-Permian tectonic patterns, (iii) the lack of evidence for the occurrence of a typical post-Caledonian molasse in the Kielce region.

My first comment — our methods are obviously different, and we hold opposing points of view on the Góry Świętokrzyskie as a tectonic unit. I have tried to put the tectonics of the Góry Świętokrzyskie into a logical whole, so as to find their proper place in the complex mosaic of the tectonics of the western and central Europe. Therefore I have discussed, as is properly stressed by Stupnicka (1988), the evolution of the Palaeozoic structures in southwestern and central Poland against a wide historical and geographical background. On the other hand, Stupnicka (1988) when writing about the evolution of the Góry Świętokrzyskie, confines her discussion to these mountains only. She nevertheless hopes that the study of the tectonics of the Palaeozoic of this area may be of fundamental importance for the study of the substratum of the Mesozoic in the whole of central Poland. Such a hope may sometimes be justified, but may also be delusive, which became clearly manifested during the work on the 1st edition of *The Tectonic Map of Europe 1 : 2500000* (1964). It seems that the method "from the whole to a part" must be chosen when the method "from a part to the whole" does not bring the expected results.

---

* *Manuscript received October 1987*

I reject as unfounded the statement that the Caledonian tectonic processes in the southern part of the Góry Świętokrzyskie were not typical orogenic processes, and that they resulted in gentle deformations and faults only.

The very strong folding of the Precambrian and Cambro-Silurian strata is more than apparent to anyone who studies those superb uncovered geological maps by Czarnocki (1938) – sheet Kielce 1:100000 and 1:300000, which unequivocally confirm the Caledonian orogeny. Careful reading of this map reveals a distinct discordance between the pre-Devonian and Emsian rocks. The thrust scales of the Ordovician-Silurian strata are known at six localities (Dyminy, Posłowice, Brzeziny, Wysoczki, Kleczanówka-Święcica and Lenarczyce). Their position – jammed within the Cambrian rocks – proves that the pre-Emsian movements were strong enough to cause the thrusting. On the other hand, we do not know any single case of Ordovician or Silurian rocks jammed within Devonian rocks. This would have to occur, as noted by Stupnicka (1988), after the Early Carboniferous, and due to the great competence contrast between the Cambro-Silurian rocks and the Devonian carbonates it should occur **all the more!** Therefore if we do not observe this phenomenon in the Góry Świętokrzyskie, it becomes apparent that the competence contrasts were of no use, because the "Variscan" movements were simply too weak.

Similarly to Kowalczewski (1971, fig. 2), I consider that the Caledonian movements were those of orogenic nature, the Variscan movements rebuilt the Góry Świętokrzyskie in blocks, and the Alpine movements resulted in gentle arching. The same approach is apparent in Fig. 5, accompanying pp. 22--23 of my study (Znosko, 1974).

Analysis of the map of the Dyminy anticline and its surrounding leads to the conclusion that the Ordovician and Silurian scales are the result of an extremely strong compression. This compression folded together Ordovician--Silurian strata which discordantly overlie the Cambrian rocks, into the form of a syncline or an anticline. In the first case (syncline), the compression sucked the strata in, and it is interpreted in precisely this way in my cross--section (Znosko, 1983, Fig. 2). In the second case (anticline), the compression uplifted the whole Ordovician-Silurian complex. This was later eroded, and the scales remained in the place of a transversal depression of an undulated fold. The Devonian strate did not participate in this process, as is shown by the boreholes Prągowiec 1 and 1a. They reveal great angular discordance between the Silurian and Devonian strata – up to 90° and even more (see Kowalczewski & Lisik, 1974, p. 140, figs. 6 and 15). These boreholes confirmed the opinion of Czarnocki (1939, table IV) who shows clearly on his map the unconformable and transgressive position of the Devonian over the older Palaeozoic of the Góry Świętokrzyskie. Nota bene, as many as three unconformities are descernible on the map by Czarnocki (1939, tables II and IV): Ordovician, Silurian and Devonian ones. This tectonic interpretation is apparent also in the geological cross-section by Kowalczewski & Lisik (1974, p. 140, figs. 1, 2, 3, 5, 6(!), 15, 17). I can not understand at all how it can be that the statements and

conclusions of so prominent an observer and researcher as J. Czarnocki were not only not negated, but not even discussed. After all, his commonly known (so one would expect!) section through the Bardo syncline (Czarnocki, 1919) reveals, according to the state of knowledge of his time, two angular unconformities: between the Cambrian and Silurian (with the folding and thrusting of the Cambrian over Silurian – i.e. a post-Silurian tectonics) and the Devonian which cuts everything unconformably – and as such this section deserves the highest appreciation and is not to be omitted. The quoted facts do not allow us to accept that: (i) the discussed unconformities are "predominantly small", and (ii) they result from "disharmonic" folding of the Cambro-Silurian and Devonian rocks, as Stupnicka (1988) would like to explain it.

In do not accept the opinion on the "disharmonic folding", because it was not observed anywhere in the Góry Świętokrzyskie. However, **discordant, laterally discordant tectonic contacts** are frequent – but they may be caused by differences in rock competence. But, disharmonic fold structures, in the meaning given by Jaroszewski *et al.* (1985, p. 46), have never been described by anybody from the Góry Świętokrzyskie.

E. Stupnicka writes in the continuation: "one can hardly agree with Znosko (1983, p. 466) that the folding of the Vendian and Cambrian strata occurred together with the folding of the Ordovician-Silurian sequence". Does E. Stupnicka negate the presence of the Ordovician and Silurian strata in the Góry Świętokrzyskie? May be E. Stupnicka supposes that the Vendian-Cambrian and Ordovician-Silurian complexes were folded independently of one another? I can hardly imagine that during the folding of the younger strata, the older strata could be not affected by this process. I would think that any discussion of this subject is useless, if not for the reference to page 466, which indicates only that E. Stupnicka did not read the text carefully enough. On page 466 I dealt with something other than that which E. Stupnicka imputes me. Nevertheless, the matter for which E. Stupnicka blames me is present on the pages 463–464, where the following folding phases are discussed: Sandomirian, Cracovian, Ardennian and Erian, which, overprinted on one another, resulted naturally in the strongest deformation of the oldest, and the weakest of the youngest rocks. So it is in any orogen.

The next controversial issue is the "general agreement of the pre-Devonian and pre-Permian tectonic paterns" which inclines E. Stupnicka to opt for Variscan orogeny. A look at the map by J. Czarnocki 1 : 100000 and 1 :300000 casts doubts on the agreement of these patterns. Z. Kowalczewski, who devoted much attention to this problem especially, writes that the difference between the strikes of the older and younger Palaeozoic rocks is obvious. The Cambrian strata strike 100–120° (110–115° average), the Silurian – 10–140° (114–125° average) and this is a "Świętokrzyski" strike while the Devonian strata are strinking on avervge 90 to 105° (Kowalczewski & Lisik, 1974, pp. 138, 140; Kowalczewski, 1981, p. 149).

What can we do with the tectonical stereotype of the Variscan provenance of the Góry Świętokrzyskie? Nobody can negate that the younger Palaeozoic

horst-type movements were strong and rejuvenated morphologically the whole Paleozoic core of the Góry Świętokrzyskie. However, to say that the Góry Świętokrzyskie are a constituent part of the Variscan orogen, is to prove at the same time their exceptional and unique position with respect to the Variscan belt in Europe. Were it be so, we would have to agree that this is the only case in the world of the presence of a fragment of orogen externally to its foredeep. Meanwhile, the Upper Silesian foredeep, in its present erosional boundaries, occurs at the contact of two Variscan branches: the Sudetian-Moravian--Silesian and the Pracarpathian ones. This view is substantiated by the Variscan granitoids in Slovakia and Hungary, and the metamorphic rocks encompassing them, and most importantly, by the very abundant and sometimes great exotics of the Upper Carboniferous coal in the Carpathian flysch. These exotics could get into the flysch geosyncline only from its foreland on which the Variscan foredeep was present.

Hence, the Góry Świętokrzyskie as a non-Variscan element are in their correct place and they do not need to be ascribed to the Variscan orogen.

The next matter upon which E. Stupnicka and I differ is the statement on "the lack of evidence of typical post-Caledonian molasse in the Kielce region". This statement arises naturally the question of what E. Stupnicka considers a typical molasse and which molasse can be considered typically Caledonian, Variscan or Alpine? Though each is different and each is typical, E. Stupnicka could consider separate parts of them as non-typical. In order to avoid an irrational discussion in this matter, I would reply that molasse is understood as **all** products of destruction (erosion) of an emerging mountain belt (orogen), accumulating both in the intramontane basins and in the foredeep. To dispel all doubts about the typical character of any molasse I ask if E. Stupnicka considers the 200 m thick series of Krakowiec Clays in the northern periphery of the Carpathian foredeep a typical or non-typical molasse? I make no mention of the occurrence in the same foredeep of Sloboda Conglomerates which have the same tectonic meaning as the Miedziana Góra Conglomerates in the Caledonian molasse of the Góry Świętokrzyskie – without entering into the discussion of their actual position in the vertical section. Whatever it may be, they are a constituent part of a typical (!) (Oldred) Caledonian molasse.

I think that by the way the problem is cleared of the synorogenic sediments, which are formed during the tectonic act. Neither their thickness nor the facies have any value as "pro" or "contra" evidence. What counts is their synchroneity with the tectonic movements. Can one doubt that this feature is the property of the Niewachlów and Wydryszów Greywackes? It also should be noted that the thickness is not always decisive of the "miogeosynclinal--orogenic" nature of a basin. The position of the basin is decisive. By the way, what is the "miogeosynclinal-orogenic" bysin? Everything possible should be done to stop this terminological compound entering into a textbook! After all these are two well defined but separate concepts which can be joined neither by an equation mark nor a hyphen. Miogeosyncline is a precisely determined type

as well as a part of a sedimentary basin, and orogen is a terrane, mountain belt, which originates after the inversion of a geosyncline. How can a basin be at the same time miogeosynclinal and orogenic?

E. Stupnicka writes that the faults cutting the Upper Silurian strata do not continue into the Emsian sandstones, and that they prove the existence of processes of post-Late Silurian compression. These were not, however, the processes decisive for the present structure of the Góry Świętokrzyskie. And correctly (!) because each time the sum of the tectonic phases is decisive, not one of them and never only the last one.

E. Stupnicka is of the opinion that the Ordovician volcanism was developed only on a small scale, and that in the Ordovician section sandstones and limestones dominate. I dare to hold a different opinion. A careful reading of the paper by Chlebowski (1971), and especially of his fig. 16 confirms that the whole Tremadocian and Arenigian, i.e. from the Międzygórze to the Dyminy Beds in the most part tuffitic mudstones, chalcedonites and clayey cherts originated from the tuffogenic material. This volcanism continued in the Late Ordovician and the Late Silurian. This is evidenced by numerous bentonite intercalations. By the way—E. Stupnica negates her own statement that in the Late Silurian (or after the Late Silurian) compressive processes were manifested, if she explains the Late Silurian volcanism by tensional movements. Two controversial truths—and how can both be valid, if they are mutually exclusive?

The volcanogenic sediments in the Góry Świętokrzyskie evidence a process whose centres of activity were situated elsewhere. Only dust and volcanic ashes fell down in the Góry Świętokrzyskie. The kinematic processes (folding, overthrusting, faults) were accompanied by volcanism, which was manifest in the Góry Świętokrzyskie as an echo, and not as a direct magmatic activity. I have never stated anything more or anything different to this in my papers.

At the end, I have to note that the obsolete stereotypes which have found their way into textbooks and academic lectures (E. Stupnicka has her share in this), have produced strange and unfortunately rather persistent deformations in the tectonical way of thinking.

REFERENCES

Chlebowski, R., 1971. Petrography of the Ordovician deposits of the Bardo syncline in the southern part of the Świętokrzyskie Mountains. (In Polish, English summary). *Arch. Miner.*, 29: 193–304.

Czarnocki, J., 1919. Stratygrafia i tektonika Gór Świętokrzyskich. (In Polish only). *Pr. Tow. Nauk. Warsz.*, 28: 171 pp.

Czarnocki, J., 1938. *Ogólna mapa geologiczna Polski, 1:100000, arkusz Kielce.* Państwowy Instytut Geologiczny, Warszawa.

Czarnocki, J., 1939. Field works in the Święty Krzyż Mountains in 1938. *Biul. Państ. Inst. Geol.*, 15: 1–41.

Czarnocki, J., 1950. *Przeglądowa mapa geologiczna, 1:300000, arkusz Kielce.* Instytut Geologiczny. Warszawa.

Jaroszewski, W., Marks, L. & Radomski, A., 1985. *Słownik geologii dynamicznej*. Wyd. Geol., Warszawa, 310 pp.

Kowalczewski, Z., 1971. Główne rysy tektoniki Gór Świętokrzyskich. *Przewodnik 43 Zjazdu Polskiego Towarzystwa Geologicznego, Kraków*, Wyd. Geol., Warszawa, pp. 10–19.

Kowalczewski, Z., 1981. Wybrane problemy stratygrafii, litologii i tektoniki wendu i starszego paleozoiku Gór Świętokrzyskich oraz niecki miechowskiej. *Przewodnik 53 Zjazdu Polskiego Towarzystwa Geologicznego, Kielce*. Wyd. Geol., Warszawa, pp. 117–151.

Kowalczewski, Z. & Lisik, R., 1974. New data on diabases and geological structure of the Prągowiec area in the Góry Świętokrzyskie Mts., *Biul. Inst. Geol.* 275: 113–158.

Nowak, J., 1927. *Zarys tektoniki Polski*. Kraków, 160 pp.

Stupnicka, E., 1988. Polish Caledonides and their relation to other European Caledonides. A discussion. *Ann. Soc. Geol. Polon.*, 58: 000–000.

Znosko, J., 1974. Outline of the tectonics of Poland and the problems of the Vistulicum and Variscicum against the tectonics of Europe. *Biul. Inst. Geol.*, 274: 7–47.

Znosko, J., 1983. Tectonics of southern part of Middle Poland (beyond the Carpathians). *Kwart. Geol.*, 27: 457–470.

Znosko, J., 1986. Polish Caledonides and their relation to other European Caledonides. *Ann. Soc. Geol. Polon.*, 56: 33–52.