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ON TECTONIC TERMINOLOGY

by

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Correction note, DRB translation T 475 R.

Page 2, line 12. Delete the from "In the addition to ...".

Page 2, line 26. Correct "V.I. Popova" to "V.I. Popov".

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Translator's note

This paper is of course not translated for the benefit of translators --- who can read the original. The original paper was not written for translators but for the Russian geologists (tectonicists). The translated paper may be of service to Western geologists who have to struggle with translations from Russian; it may help to know something about the input to the translation process.

ON TECTONIC TERMINOLOGY

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"A careful regard for terminological precision and clarity is one of the principal obligations of the scientist."
(A.N. Zavaritski: Notes on geological terminology, 1947.)

In tectonics there are at the present time serious difficulties due to contradictions in the terminology. In the Altai-Sayan region, for instance, the unique downwarp which developed in the Ordovician and Silurian, south of the Western Sayan fold system, is called by some authors [16] an "exterior geosynclinal downwarp" [*vneshnii geosinklinal'nyi progib*] and by others [32] a "geosynclinal frontal downwarp" [*prigeosinklinal'nyi progib*]. Also referred to the category of "geosynclinal frontal downwarps" is the Kuzneç Basin, which has also been described in the literature by the names "intermontane depression" [*mezhgornaya vpadina*], "basin" [*kotlovina*], "incompletely developed geosyncline" [*nedorazvitaya geosinklinal'*] or "geosyncline with no autonomous folding" [21], or "transverse marginal downwarp" [*poperechnyi krayevoi progib*] [59]. Some of the terminological contradictions have even been reflected in the tectonic map of the USSR compiled under the editorship of N.S. Shatski. Thus the term "depression" [*vpadina*] lumps together such different structures as the Kassian and the Khatangian formations in the West Siberian cratonic plate, * the Kansk, Rybinsk and Irkutsk ** formations at the foothills of the Eastern Sayan, and the Mesozoic depressions of Central Asia, Mongolia and Transbaikalia. ** The term "downwarp" [*progib*] is applied equally to the Páchelma trench *** and to the Melekess *** and Turgai depressions. All this hinders the development of geological theory and creates inconveniences in practical work.

Let us now look at some particular defects of tectonic terminology.

First of all we should note the inadequate definition of terms and the vagueness in our understanding of them. Often one and the same term is used in entirely different senses. For instance, by "parageosynclines" Schuchert [33, 49] understood recent geosynclines; Kay [26], following Stille, understood

* Cratonic plate: cf DRB translation T 400 R, footnote p.iv. [Translator.]

** Kansk, Rybinsk (or Rybinski) and Irkutsk Mesozoic basins: DRB translation T 435 R, stippled area in Fig. D. Re the Transbaikalian Mesozoic depressions see *ibid.*, p.xi. [Translator.]

*** Páchelma trench (aulacogene): see DRB translation T 400 R. Melekess depression: *ibid.* Fig. 1d and page 6. Concerning the word *progib*, which is translated as "downwarp" or, in appropriate contexts, as "trench", see T 400 R, footnote p.1. [Translator.]

depressions within cratons (about the same as *sinekliza* --- *synenclisis* * --- in the understanding of the Soviet geologists), while to Belousov [7] this term means structures of intermediate type between platform and geosyncline (synonym "semiplatform" --- *poluplatforma* --- in Sapozhnikov's terminology [46]). By the term "fold axis" [*os' skladki*] some authors understand the axial plane or surface [40], others understand the bend or hinge of the fold [*sharmir skladki*] [8, 29, 47, 54]; a third group understands "fold axis" as the line of intersection of the axial surface with the horizontal plane or with the earth's surface [9, 42], and a fourth group understands it as the projection of the fold hinge on the horizontal plane or on the earth's surface [22, 56]. These four definitions have entirely different geometric senses.

In the addition to the multiplicity of meanings, the reverse phenomenon is also widespread, that is, a multiplicity of terms having one and the same meaning. Thus to designate positive [upraised] platform structures of the first order, the following terms may be used: *antekliza* (intracratonic elevation) [58], *svod* (arch), *svodovoye podniatiye* (upvaulting) [34], *podniatiye* (uplift) [22], *subgeoantiklinal'* (sub-geoanticline) [53], or *vystup* (upthrust) [4, 34].

Voinovski-Kruger [13] has urged the necessity of restricting the use of such geomorphological and tectonic terms as are frequently observed to be interchanged --- *depressiya*, *kotlovina* (basin), *vpadina* (depression), *progib* (downwarp), *podniatiye* (uplift, rise).

Into the Russian geological literature different systems of terms have made their way, systems worked out to conform to different tectonic concepts (for instance, the terminological schemes used in the works of V.V. Belousov, V. Ye. Khayin, or V.I. Popova). The essential difficulty arises from the mixing-up of the different "autonomous" terminological systems.

An important source of contradictions in tectonic terminology is the distortion of terms in the translating of foreign geological literature. Often a foreign term is translated by a term which in our milieu has a different meaning. For instance in the Russian editions of textbooks on structural geology (R. and B. Willis, 1929, translated in 1932; C.K. Leith, 1925, translated in 1935; M.P. Billings, 1946, translated in 1949), we find the English word "fault" is translated as *sbros* --- although the term "fault" of the American geologists takes in all types of fault disturbance in which the limbs are displaced on the fissure (thrusts [*nadvigi*] and horizontal displacements [*sdvigi*], upthrows [*vzbrosy*] and vertical displacements [*sbrosy*]) --- whereas the proper Russian equivalent is the term *razryv so smeshcheniyem* ("fault with dislocation") proposed by Belousov [7]. Sometimes one and the same term is variously translated. Thus the English "normal fault" is translated as *sbros* (Hills, 1954, in the translation of 1954), or as *normal'nyi sbros* (R. and B. Willis, 1932, Leith, 1935; Billings, 1949). The English "reverse fault" is translated as

* The Russian word *sinekliza* is a dubious linguistic formation which, it seems, must be traced back to *synenclisis* (a sloping-together; inward-facing slopes). The translator's practice has been to render the word *sinekliza* as "intracratonic depression", this being the precise meaning (see definition, A.N. Krishtofovich, *Geologicheskii Slovar'*, Moscow 1955). Similarly the antonym *antekliza* is to be rendered as "intracratonic rise". [Translator.]

vzbros (Hills, 1953, in the translation of 1954), *sbros obratnyi* (R. and B. Willis, 1932), *sbros obrashchennyi* (Leith, 1935). "Strike slip fault" is translated as *sbros s dlinoi po prostiraniyu* or "fault with its length along the strike" (R. and B. Willis, 1932), and as *sbros s peremeshcheniyem po prostiraniyu* or "fault with displacement along the strike" (Billings, 1949). "Bedding fault" is translated as *sbros soglasnyi* or "concordant fault" (Billings, 1949), and as *sbros po naplastovaniyu* or "fault with slip on plane of bedding" (R. and B. Willis, 1932). "Dip fault" is translated as *sbros poperechnyi*, "cross fault" or "transverse fault" (Billings, 1949), or *sbros po padeniyu*, "fault in the dip direction" (R. and B. Willis, 1932).

The inadequacies of translation are in part explained by the fact that we ourselves still lack a single understanding of very many terms. This being the position, it is inadmissible that any translation should omit to cite the foreign term in its foreign orthography; sometimes an error made in translating is repeated, and re-repeated, and becomes the rule. This is essentially what happened with the English word "fault", which in textbooks on structural geology was unanimously translated as *sbros*, so that now in the works of some of our geologists we can find *sbros* understood as an synonym of the term *razryv so smeshcheniyem*. The failure to cite the foreign word at times results in some authors' putting their complete trust in a translation and using the translation-terms in their own papers [2, 10, 11].

The said inadequacies are complexly related among themselves. This is clearly seen from the example of this term *sbros*. Originally in the Russian literature the term *sbros* was used to designate a displacement with the motion mainly in the downward direction [19]. The term was understood in about this way by Lange [27], by Neumayr [40] and by Haug [42]. This is a *sbros* in the proper meaning of the word; that is, a fracture-displacement in which there takes place a slipping or sliding, a "throw" of the fractured parts due to the influence of gravity under conditions of tension. In the English language this is a "gravity fault", or "tension fault". Other geologists define *sbros* as a displacement of the sundered blocks in the vertical direction or near thereto, without regard to the direction of movement of the limbs [1, 24, 37, 39, 64]. According to Azhgirei [1] this may, genetically, be a *vzbros*, it may be a *sdvig*, and it may be a *sbros* in the first sense. A third group of geologists understands a *sbros* as a fault-displacement in which the fissure plane slopes downward in the direction of the subsided limb (hanging wall) [10, 11, 15, 38]. The term *normal'nyi sbros* is used in this same meaning [1, 20, 22, 24]. In the American literature, a fault displacement of this kind is called a normal fault, or downthrow fault, and these terms have been translated as *normal'nyi sbros* [8, 29, 54]. Some authors [22, 28] use the term *sbros* as a synonym for the term *razryv so smeshcheniyem*. Belousov [7] treats the *sbros* concept in an original manner, proposing to distinguish *sbros* in the genetic sense. Morphologically: a displacement of the hanging wall downward along the sloping fissure; genetically: a fault-displacement which is accompanied by downward movement of one of the blocks, without regard to whether this is the hanging wall or the foot wall. Consequently the term *sbros* in the genetic sense can be a *vzbros* [upthrow fault] in the morphological sense, and vice versa. Tetiayev [52] introduced the term *sbros* for breaks of continuity which are observed in a region of fluctuating movements, to designate the "phenomenon of breaking apart with formation of surfaces on which the separate parts, detaching themselves, begin to slip or slide". Of course such multiple meanings of a term are inadmissible.

The existing inadequacies of the terminology are due to many causes. The principal objective cause of terminological divergences is really the complexity and complications in the subject itself, namely, the tectonic study of the terrestrial crust and the earth as a whole. Hence, for instance, the vagueness in the understanding of such terms as "platform" and "geosyncline". Another cause is the contradictory character of the process of acquiring knowledge. In the rapid development of a science any newly discovered natural relationships may be evaluated in different ways. One and the same phenomenon may be variously defined, depending on the researcher's approach. This leads to the development of different tectonic schools with their independent systems of terms. The development of tectonics also leads to a deepening of our concepts, a process which brings about change in the sense of old terms and the appearance of new terms, thus producing both terminological multivalence and terminological multiplicity.

In examining the tectonic terminology we should allow for the specific character and the particular features of the historical development of our science. It is well known that in the tectonics of the first part of the twentieth century, up until the thirties approximately [52], a characteristic trait was the extraordinary variety of geotectonic hypotheses and their mutual contradictions. Hypotheses were classified, not according to one or another point of view, but by the names of their authors. The simultaneous existence of diverse views, the struggle between one view and another, the hybrid and eclectic tendencies all created, in tectonics, a very evident theoretical chaos. The proliferation of different tectonic concepts naturally led to the springing-up of many new ideas and terms, behind which there stood concepts that did not reflect the real natural relationships but as a rule depended on general, speculative notions. Many terms of this sort have been preserved to this day, and exist on a footing of equality in the present scientific language.

Today the interest in hypotheses of the above kind is decreasing: what interests us is above all the interpretation and comprehension of the whole total of accumulated facts. The study of new territories, the exploration of hitherto unsounded depths by means of boring and geophysical methods, have enriched the science with basically new facts, and this is inevitably leading to re-evaluation of the existing scientific concepts and to the appearance of new terms. The further development of geology and tectonics, particularly through the study of the deep interior parts of the earth, is making it plain that the development of a scientific tectonic dictionary is a process that will continue for a long time yet.

Tectonics is intimately reacting with other branches of geology, and also with physics, chemistry and mathematics. It is natural that part of the terminology is being borrowed from these sciences, but some of the terms are being transferred mechanically, without any allowance for the qualitative particularities of tectonics; often terms are so much transformed with the passage of time that they lose all concrete meaning. For example, such terms as deformation and stress, which are rigorously formulated in technological language, have in geology a broad and sometimes diffuse meaning, and are differently understood by different authors.

Furthermore there are causes of purely subjective order, of which Zavaricki [18] signalized the following. First: the inadequate erudition

of scientific workers. Second: an inadequate understanding of the fact that a scientific language is the property of all the scientists working in the given field, and that one must not employ words without taking any account of the way they are used by others. Third: the introduction of new and pointless terms, cluttering up the science --- a procedure which, in Zavarıçki's opinion, is most often due to exaggerating the importance of the concepts for which these terms are invented.

The unsatisfactory state of tectonic terminology is revealed with particular clarity when we compare the position of terminology in such sciences as biology and paleontology. In these sciences, questions of nomenclature have been worked out in detail and consolidated in the form of an international *Code*, with its never-to-be-ignored criteria of priority, its rules of description in typical form, its linguistic rules of name formation and so forth, all excluding the possibility of describing similar forms by different names, or different forms by one and the same name. "It may be asked why the paleontologists, who are usually very proper naturalists, should consider it necessary to study thousands of species and varieties and, in the best examples of their work, to describe in detail the finest particulars of the forms they are studying, whereas the geologists, who also should above all be naturalists, do not consider it necessary to describe in the same detail, and with the same love, natural phenomena which are no less interesting and no less important, namely, the structures of the earth's crust? Without exhaustive, detailed, many-sided descriptions of actual crustal structures, as developed in different major tectonic regions, it is impossible to set up, and make obligatory for all, a rational classification and terminology of tectonic forms, structures and processes" (Shatski, 1947).

It seems to us that in introducing new terms we should take our departure from the following principles: first, not to use old terms in a new meaning; second, not to create new terms for concepts that already have names; if, however, a new term should be proposed then one must demonstrate the use of the old term to be incorrect and that of the new term to be expedient; third, one should give a monographic description of the type-structure or formation, plus a precise definition of the meaning and content with which the proposed term is invested.

The work of systematizing a terminology is very complicated, and it requires a careful and attentive approach. Here, it seems, one should not proceed by simply throwing out old concepts and creating new systems of terms (as, for instance, Vassoyevich [12] has done in proposing a lengthy series of complicated terms in the nomenclature for facies: amphiose, signation, origosignation, lanidofacies, lensofacies and so forth, terms which found no application even in subsequent works of this same author).

Dictionaries and handbooks published in our country (and elsewhere) are not deciding this problem, since they give only the most generally accepted meanings of terms --- with the degree of general acceptance usually decided in a quite subjective manner.

In our view it is impossible to remove terminological contradictions by the decrees of special conferences, as has sometimes been proposed; decrees which would prohibit the use of some terms or of some of their meanings, and permit the use of others.

Success in organizing the terminology will depend on how deeply we analyse the whole mass of technical terms currents in the Soviet geological literature, together with their different meanings, from the viewpoint of the acceptability or inacceptability of synonyms, or in terms of priority, and so forth.

In the first stage of this work it is essential to collect terms and systematize them. In doing so it will be important to bring together as many terms as possible (including little-known and obsolete terms) and to list all the meanings in which they have ever been used. This refers not only to general but also to regional terms, since tectonic concepts are developed by generalizing notions of actual geological structures; on the other hand, the inadequacies and contradictions of the regional tectonic vocabulary may be carried over into general tectonic terminology. In practice it is possible to achieve all this by compiling card-files and by publishing systematic collections of terms.

The second stage of the work must involve a comprehensive analysis of the systematized terms according to the following criteria: 1) the question of priority; 2) justification for making a distinction; 3) correctness of constructing the word; 4) history of the development of the concepts inherent in the terms; 5) perception of inadequacies and contradictions in the use of terms (indefiniteness, multiplicity of meanings, multiplicity of terms, mixing of different systems of terms, mixing with non-tectonic concepts, errors of translation, and so forth). As an example of such an analysis one may cite the discussion of the terms "clastic dyke", "facies" and terms defining rock bedding in the Tectonic Colloquium held at the Institute of Geology and Geophysics (Geologiya i Geofizika, no.2, 1960).

This work should be a collective research, conducted in scientific geological establishments and with a broad representation of the geological community. As a result, we should obtain a full and comprehensive notion of every term, of the groupings of terms, and of the general state of the tectonic terminology.

In the concluding stage it seems essential to convoke special conferences for the purpose of discussing concrete suggestions on selection of terms and acceptance of the most rational systems of terms.

Only after carrying out all these measures will it be possible to proceed to collective work on the compilation of one single tectonic dictionary.

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