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My lifetime adventure with an expanding Earth

Stefan Cwojdziñski

In 1965 – 1970, I studied geology at the University of Wrocław. These were the times when the echoes of plate tectonics theory, developing in the West, had not yet reached Poland. I was lucky the lecturer of tectonics at that time, Prof. Józef Oberc, presented a whole range of various geotectonic concepts to us, many of them of historical significance. Therefore, I had the chance to ruminate and draw my own conclusions. As regards the theory of mountain building (orogeny), I had learned about the ideas of horizontal and vertical movements, about gravitational tectonics, and the concepts of Wegener, Argand, Wegman and Haarmann, Belousov and van Bemmelen.

In 1970, I started working at the Geological Institute, Lower Silesian Branch in Wrocław. I was a typical field geologist involved in the construction of geological maps at a scale of 1:25,000 in the Sudetes, the mountains of SW Poland. This began to have significant consequences in the future. At that time, I became interested in geotectonics; the first papers based on the assumptions of plate tectonics, so-called new global tectonics, were published at the Institute. These made a big impression on me then. Instead of local interpretations, the theory offered synthetic interpretations and interrelation of processes between remote areas. My first presentation at the Institute in 1972 had a naive title: "Was Wegener right?" Following the mainstream views, I began to study plate tectonics and try to apply its foundations to interpret the geological evolution of Poland in the Paleozoic, i.e. during the formation of Caledonian and Variscan orogens. My publications on this topic appeared in 1977 and 1978. In the late 1970s, I began to have doubts whether the so-called subduction process can really explain the complex geological evolution of the area of Poland. At the same time, at the University of Wrocław, I came across a presentation by Jan Koziar[1], who was my colleague during my study period, and later an assistant to Prof. Oberc. That presentation and subsequent closer personal contacts made me comprehend that many of my doubts disappear on an expanding Earth. It was a breakthrough in my understanding of the development of Earth as a planet. In 1980, the book titled “The Expanding Earth” by S.W. Carey appeared in the library of the Lower Silesian Branch of PGI. Reading it strengthened my conviction that the majority is not always right in science.

At that time, geotectonics was dominated by the so-called plate tectonics theory. The critical moment was at the turn of the 1950s, when Carey (1958) proposed the concept of lithospheric plates on the basis of ocean bottom research, and one of the discoverers of the mid-ocean ridge system - Heezen (1960) - pointed to Earth expansion as a process resulting directly from the spreading of ocean floors. Plate tectonics, as a “new global tectonics” that rejects this conclusion, arose from the assumption of constant-sized Earth - an assumption not supported by any real evidence (Dietz, 1961, Hess, 1962, Le Pichon, 1968). In its early stage of development, it was simply the concept of “non-expanding Earth”. However, while the generation of geologists active in the 1960s and 1970s - who kept in mind the discussions between different geotectonic ideas - witnessed the birth of plate tectonics and were aware of its foundations, the next generation of Earth science researchers lost this awareness. The picture of dynamics and palaeodynamics of our planet, infused into their minds during the university studies and research work, no longer gave room for doubts and questions.

Fig 1. *Jan Koziar*

The paradigm of plate tectonics, dominant in consciousness, and related *ad hoc* models facilitate the interpretation of an increasing amount of observational data and allow their ordering according to fairly simple patterns. Undoubtedly, this is one of the reasons for such a far-reaching acceptance of plate tectonics - the first global

[1] *See also the chapter by Jan Koziar.*

geotectonic concept in the history of geology, which tries to explain almost all geological processes combining them into one scheme. The plate tectonics theory also refers directly to the deeply rooted belief of geologists about the truthfulness of the idea of geological uniformitarianism and, in this respect, meets psychological needs. It was much easier to accept a theory that recognised the stability of dimensions of the Earth during its geological evolution and the repeatability of processes known from modern times, than to look at it from the perspective of its expansion, a one-way geological evolution, during which all the physical parameters (affecting such processes as sedimentation, tectonic deformation, metamorphism, magmatism, etc.) change.

These and other reasons contributed to the unique situation in the history of Earth sciences: the great discussion among geotectonicians virtually ceased, competition between scientific programmes died out, the conceptual apparatus of tectonics became completely unified, and the qualitative development was replaced by a quantitative increase in information. The competition of ideas, which is the basis for all progress in science, has disappeared! Is it a fault of contemporary, especially young geologists? The whole generation has been shaped in the spirit of plate tectonics understood as the “ultimate” theory - the last and greatest achievement of the community of Earth scientists. They are ready to discuss details, agree with one or another modification, but they are not prepared to look critically at the very “core” of the theory, at its foundations. The words of Le Pichon (1968), one of the creators of plate tectonics, wrote over 50 years ago: “if the Earth is not expanding, there should be other boundaries of crustal blocks along which surface crust is shortened or destroyed” are unknown to most geologists today. Nobody knows that these words contain an assumption - a hypothesis, not a proven fact, and that the entire gigantic building of the theory of plate tectonics has arisen just on this assumption.

Today’s generation of geologists no longer refers to the “classics” of plate tectonics; the knowledge transferred by experts and the calming awareness of the full dominance of the paradigm professed in the community are sufficient for them. The contemporary perception of a scientific career is also of considerable importance. The successful are those who publish a lot and quickly. And in the case where most of the world’s well-known periodicals are mastered by editorial committees and reviewers who adhere to this paradigm, it is hardly surprising that most young geologists do not bother to get to the core of the problem. It is not accidental that most of the contributions devoted to Earth expansion are published in less-known or minor journals. A notable exception was Elsevier, supporting the early, 16th-century tradition of Dutch freedom of speech (Carey, 1976).

In 1984, despite the opposition of some reviewers of Przeglad Geologiczny (Geological Review), I published an article entitled "Where geotectonics is going". The conclusions were clear: the expanding Earth scientific programme is the only prospective and promising one for the future. Since that point, I have been an uncompromising expansionist. Ironically, these were the years when a new generation of geologists came to the fore in Poland (and not only there), knowing only plate tectonics and recognising it as a kind of religion. The small group of Polish expansionists did not live an easy life.

In 1984, I took part in a geological expedition to Mongolia. The main topic was the prospect for rare earths (REEs) in carbonate veins in the Lugin Gol nepheline syenite massif of the Gobi Desert. The fieldwork had nothing to do with Earth expansion, but I took advantage of free wintertime in Ulaanbaatar to write a much more extensive paper under the same title "Where geotectonics is going". After my return to Poland and struggles with reviewers again, it was published in 1989 by the Polish Academy of Sciences in the popular science series "Nauka dla Wszystkich" (Science for Everyone). The paper provided a comparison of the four competing models of geological evolution of Earth: a shrinking Earth, a constant dimensions Earth, a pulsating Earth, and an expanding Earth, and described the history of their creation and mutual relations. Under the constant-sized Earth programme, two concepts competed: the stabilistic and mobilistic approaches.

The significant contradictions between them were easiest to explain using the expanding Earth model.

Is there a real, substantive scientific discussion between these two alternative tectonic theories today? After all, scientific discussion is the engine of progress; it is even the duty of the science community. It should be conducted with a respect for opponents and serve both reflection and searching for scientific truth. However, is this possible with the supporters of plate tectonics? My own experiences lead me to pessimistic conclusions. Primarily, the discussion lacks dialogue and discussion about facts. The response of the plate tectonics supporters to weighty scientific arguments is their defiance and reluctance to answer specific questions. They use such arguments as: "it is impossible", "it is such a historic concept", "it is a myth of no significance", "it is a theory rejected long ago", "expansionism is quackery today", and "after all everyone knows that subduction does exist", or arguments that are based on faith in the power of knowledge of others: "geologists distinguish many earlier cycles of growth and break-up of continents" (more than 200 million years), "palaeomagnetic and palaeobiogeographic reconstructions indicate that there were separate continents earlier than 200 million years ago, which were changing their positions relative to each other", or "we do not know the physical process that could explain the origin of Earth expansion". On the other hand, there is no discussion on the wide range of hard facts, which are after all observed and described mainly by geologists who operate under the current plate tectonics paradigm. And these facts are really striking. A true scientific discussion would have to focus on evidence based on these facts, formulated most clearly by J. Koziar (1996), pointing directly to Earth expansion. These are the progressive extensional development of the Pacific, deep rooting of lithosphere plates (substantiated by seismic tomography), longitudinal stretching of mid-oceanic ridges, and a gradual spreading of hot spots that are the surface equivalent of mantle plumes rooted in the lower mantle.

These are, obviously, absolutely basic facts, the explanations of which either cannot be found in the plate tectonics model or are glaring artificial. A great number of other planetary and regional facts contradict the plate tectonics hypothesis, but are easily explained on an expanding Earth. These include the existence of triple junctions, the extensional development of the Arctic Ocean (the so-called Arctic paradox), the progressive evolution of the Tethys, the passive origin of the vast majority of rifts, the lack of continuous "asthenosphere layer" under the lithosphere, and many others (Cwojdziński, 1995, Maxlow[1], 2001).

Instead of discussing the identified problems, we are actually dealing with declarations or overbearing statements, focusing on details that have little to do with the basic questions, and we most often face tacit avoidance of any discussion. The former reactions are typical primarily of those geologists who, generally not through their fault, have never had a chance to learn about another competitive geotectonic theory, and their consciousness has been shaped by the idea of plate tectonics. They treat each counterargument as a scientific heresy and react to it with indignation and rejection. The silent dodge concerns those less numerous who had a chance to learn the scientific basis of the theory of Earth expansion. Their attitude is more opportunistic. They prefer to remain silent than to discuss, and they opt for a "comfortable" and non-controversial life of a researcher and a quick career rather than to face the challenge of the expansion theory. Obviously, there are also glorious exceptions - people who,

[1] See also the chapter by James Maxlow.

acting within the rules of plate tectonics, either do not lose their critical view and are ready to discuss the facts presented by expansionists, or affably take into account their results in own research activity (see Cwojdziñski, 1995).

Facing the challenge of the expansion theory requires the effort of "digging through" the basic facts, rejecting the existing "world order", and developing your own opinion. However, it is a profitable effort. In place of the hypothesis that turned the Earth sciences into an endless competition for another microcontinent, terrane, palaeo-ocean, subduction zone, collision and accretion, the numbers and locations of which are difficult to comprehend, we can obtain a simple and elegant theory that is based on facts observed on the ocean floors and continents - the theory of an expanding Earth. And contrary to the views of many advocates of plate tectonics, the principle of "Ockham's razor" strongly supports the expansion theory. All you have to do is draw conclusions from what the research of ocean floors has proved beyond doubt - the young age of the floor of the entire World Ocean, not exceeding 180 million years, and the extensional development of the Pacific, to understand that the Earth has been expanding.

This natural fact can today be the basis for new global geotectonics - a science that is ahead of other natural sciences and provides a stimulus for the study of elementary particle physics, astrophysics and cosmology. The fact that the physical process responsible for the acceleration of Earth expansion over time is not yet known is not a strict scientific argument. We know many such natural phenomena, whose physical nature became understood much later than their real existence had been proved. It is not the role of geologists to explain the causes lying outside their field of knowledge. Their role is to properly see and correctly explain geological facts.

Main evidence for further exploration

Three types of evidence have ultimately convinced me about the idea of an expanding Earth. It was at the turn of the 1980s. I drew my conclusions based on available literature, mainly tectonic-plate contributions, and on analysis of various types of maps and the models of expanding Earth, scarce at that time. Of the greatest importance were the geophysical data on the roots of continents, on the evolution of the so-called supercontinents, and on the processes genetically associated with changes in the curvature of the surface of an expanding globe.

1. Continental roots

The geological structure and dynamics of the Earth have been of increasing concern of geologists and geophysicists over many years. This is because, among others, modern seismic methods have been developed: reflection seismic surveys and tomographic experiments. The former method, applied at prolonged recording time, enables reliable images of the tectonic structure of the Earth's crust and upper mantle to be obtained, especially in continental areas (Cwojdziñski, 2003). The latter method, being permanently improved, provides reconstructions of distribution of areas with different seismic wave velocities at various levels of the entire Earth's mantle. Areas of anomalously low velocities are believed to be associated with those parts of the mantle which show higher temperatures and lower density as compared with the cooler and rheologically more rigid surroundings (Dziewonski, Anderson, 1984, Anderson *et al.*, 1992). For the first time, an analysis of thermal-density structure of the Earth's mantle could be performed as deep as the mantle/core boundary. And for the first time, a direct image of dynamic processes, occurring inside the globe, was also obtained in the late 1980s. The existing plate-tectonic models lead to a number of discrepancies. The most important are: the stationary position of mantle plumes while assuming the convection process in the Earth's mantle, mantle convection process versus data on its viscosity, possibility of horizontal displacements of lithospheric plates above the discontinuous astenosphere zone that disappears under deep-seated continental "roots", the model of radially growing distance between mid-oceanic ridges and Africa (also Antarctica), the growing separation with time between hot spots occurring in neighbouring plates, and geophysical data indicative of considerable input of energy and material from the Earth's core into the mantle, not compensated by any exchange between the lower and upper mantle. New plate tectonic models have intended to explain the tomographic image by taking into consideration geochemical data, however with miserable results. The nature of mantle convection still remains controversial. The phenomenon of stationary hot spots relative to the accepted plate movements and the absence of evidence indicating deformation of mantle plumes by the convection system are also unclear and controversial. My model of expanding Earth (Fig. 2) (Cwojdziñski, 2004) offers a reasonable solution to these discrepancies and paradoxes.

Deep geophysical surveys suggest that the roots of continents reach a depth of several hundred metres, but also provide arguments that

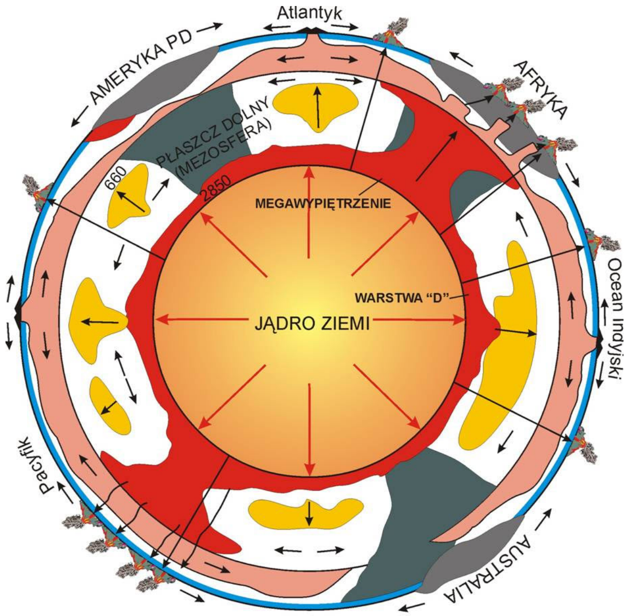


Fig 2. *The internal structure of the Earth and new models of geodynamics – proposed model of the expanding Earth's geodynamics (Cwojdziński, 2004). Continental roots reaching the core-mantle boundary and radial structure of the globe are visible.*

they may extend down to the mantle/core boundary. Such a situation obviously precludes the possibility of lateral displacement of continents, i.e. of the effect of tectonic-plate mechanism.

2. Supercontinents

The concept of a supercontinent, according to today's understanding, was introduced into the geology by Alfred Wegener in 1912. In Permian times, Wegener's Pangea comprised all the continents, forming a supercontinent that has gradually disintegrated from the Triassic onward. Pangea was surrounded on all sides by the all-ocean (Panthalassa) which must have obviously been much larger than the present-day Pacific. The concept of Pangea has been adopted for the theory of plate tectonics. The difference between the two reconstructions consisted in the different position of the Deccan that, in Wegener's Pangaea, was accreted to Asia, but on the map of Dietz and Holden (1972), involving palaeomagnetic data, it was separated from Asia by the extensive Tethyan Ocean. The continents presented in the reconstruction of the Pangaea supercontinent were grouped and formed two minor supercontinents separated by the Tethys: Laurasia (North America, Greenland and Eurasia) and Gondwana

(South America, Africa, Madagascar, India, Antarctica and Australia). The plate tectonic Wilson cycle, assuming successive amalgamation and breakup of continents, was the basis for the widely accepted view that other, older supercontinents must have existed in the Earth's geological past. As a result, the concept of a supercontinental cycle was introduced.

The tectonic-plate foundations for the reconstruction of supercontinents include the hypothesis of cyclic evolution of continental plates and the assumption that plate collisions lead to the amalgamation of successive supercontinents. Thus, a number of supercontinents must have existed in the geological history of Earth. They formed as a result of the global accretion process and amalgamation of plates, accompanied by orogenic events.

The amalgamation stage is followed by breakup of supercontinents. Continental breakup and drift give rise to the formation of new convergent boundaries (subduction zones) and active continental margins. It is not easy to explain the origin of the assumed cyclical evolution of continents. The global and cyclical nature of the process must be explained through deep internal reorganization of Earth geodynamics. The upper mantle system of convection currents is not sufficient for this. Currently, there are many hypotheses trying to explain this phenomenon. The methods of supercontinent reconstruction are based on palaeomagnetic studies. However, no reconstructions of the position of continents, which are based on palaeomagnetic data, provide information about the geographic palaeolongitude. With this respect, such reconstructions are completely arbitrary. Results of palaeomagnetic measurements are interpreted for the Earth of today’s size. As a result of such procedure, drastically different reconstructions of the position of individual continental plates and microplates are often obtained. Some even defy all logic and are geologically unrealistic. Usually, such reconstructions are also totally out of any logical mechanism of plate movement (the system of convection currents).

The palaeobiogeographic method is based on the analysis of geographical distribution of palaeofauna and palaeoflora. It provides information about palaeoclimatic zonation, allowing the coordination and verification of palaeomagnetic data about the latitudinal position and temporal isolation of areas that are characterised by a diversity (endemicity) of flora and fauna subjected to slow expansion. Palaeobiogeographic studies are commonly used to confirm the relative position of continental plates and drifting of the so-called terranes. However, they do not allow us to determine the geographical palaeolongitude (alike palaeomagnetic studies), and thus to reconstruct the routes of plate and microplate drifting. Palaeobiogeographic reconstructions currently play a supporting role in relation to the prevailing paradigm of plate tectonics. They assume that the size of the Earth was the same as the present-day one, and the climatic zones were similar. They also assume that the palaeo-oceans played a role of barriers, disregarding a similar role of wide epicontinental seas. Permian Pangea is a result of the plate tectonic amalgamation of continental plates and microplates that appeared due to the breakup of Rodinia in Paleozoic times. In the early Paleozoic, the Gondwana supercontinent was formed, comprising South America, Africa, the Deccan, Antarctica and Australia. The Laurasia, Baltica and Siberia continents have evolved independently. As a result of the Caledonian collision and the closure of the Iapetus Ocean, the Laurussia continent is thought to have been formed. The breakup of Pangea commenced in Middle Triassic-Late Jurassic times and it has continued until the present. It is, in fact, the only proven stage of the Wilson cycle.

Palaeobiogeographic studies have shown, e.g., the following biogeographic connections: Devonian connections (Thelodonta – freshwater fish): S China, Thailand, Australia, North America, Germany; Upper Triassic–Lower Jurassic around the Pacific Ocean (shallow-water benthic fauna – brachiopods - Ager, 1986); other Mesozoic cross-Pacific connections (e.g. dinosaurs - Shields, 1979); Permian-Carboniferous flora of Glossopteris and deposits of the Permian-Carboniferous glaciations typical of Gondwana, but found also in the Himalayas, Kashmir, Tibet, Arabia, China, Malaya, Thailand and Burma. Lack of endemic fauna in the Deccan during its supposed lonely travel across the Tethys palaeo-ocean from Gondwana northward, lasting about 100 Ma is evidence of its proximity to Asia. In the Deccan area, mixed assemblages of continental fauna, as well as flora of Gondwanan and Laurasian provenance, dominated at that time. The tectonic-plate concept of spreading of species on “floating/rafting/drifting islands” (terranes) across the palaeo-oceans is not only unnatural but also difficult to be accepted due to, e.g., the lack of endemic fauna and flora - their drift must have been fast.

Based on the hypothesis of supercontinental cyclity, two Precambrian periods of formation of supercontinents have been distinguished: the Meso-Neoproterozoic formation of Rodinia and the early Proterozoic formation of the pre-Rodinia supercontinent: 2150-1650 Ma. The breakup of the latter is claimed to have taken place in the period of 1500 - 1300 Ma.

The Rodinia supercontinent is thought to have been assembled as a result of amalgamation at 1320 – 1000 Ma during the Grenville orogeny. It has been reconstructed based on palaeomagnetic data and, to a minor extent, on geological data.

Noteworthy are some features of the plaeogeographical reconstructions of these supercontinents: Siberia is located opposite North Laurentia; the connection between Laurentia and Baltica was also very long-lasting – it is enigmatic why this connection had survived one or even two Wilson cycles. The breakup of the Middle Proterozoic supercontinent, followed by the amalgamation of Rodinia, occured before its final breakup at 650 – 600 Ma. A renewed contact (suturing) between Laurasia and Baltica is claimed to have occurred during the Caledonian orogeny. It means that Baltica returned to its position from before the breakup of the supercontinent.

All reconstructions of supercontinents are based on the plate-tectonic model. Because orogenic belts needed subduction and collision of continental plates to form, the natural consequence of this view is that the effects of the collisions are supercontinents that undergo fragmentation to be re-assembled during the next stage of Earth's evolution in the subsequent orogenic event. Thus, Pangea appears to be a series of different, successive Pangeas (Proto, Palaeo, NeoPangea) astonishingly similar to one another. To explain this phenomenon, a process of "self-organization" of plates is evoked. Pentagonal plates self-organize the sphere surface regardless of the effect of "internal" factors, such as mantle convection. This interpretation is an original attempt to resolve the problem.

On an expanding Earth, there was only one supercontinent – Pangea – composed of the continental lithosphere surrounding the whole planet that was smaller than it is today. The breakup of that supercontinent occurred once in the Earth's history.

Therefore, the Wegener's concept of Pangea as a supercontinent is still in the limelight of geotectonicists, and the discussion on the subject continues. This concept also has a lasting relationship with the theory of Earth expansion.

For it is impossible for the continents to be separated many times, returning later to the same unique configuration.

3. Changes in curvature of the surface of expanding Earth and their tectonic consequences

The problem of tectonics of flattening Earth became the subject of my habilitation thesis defended in 2003. It was based on analysis of the results of geophysical research using the reflection seismic method.

Seismic reflection investigations, in particular the so-called near-vertical reflection seismics, have been the main research tool of the Earth's crust and the upper mantle since the 1980s. Many international seismic research projects have been performed over the last 40 years, which provide plenty of data commonly interpreted with the use of the plate tectonics paradigm. However, these interpretations face many difficulties. First, it is difficult to explain the enigmatic general similarity of the seismic structure of continental crust under various geostructures that are different in age and origin; similarly, its commonly observed geometrical symmetry is an area of contention. The resemblance of seismic reflectivity in various geological environments indicates (1) the crucial influence of rheological properties of the lithosphere on reflectivity and (2) the common tectonic process responsible for development of seismic reflectivity. Depending on thermal conditions, the brittlely deformable continental crust occurs to a depth of 10–20 km, which corresponds to

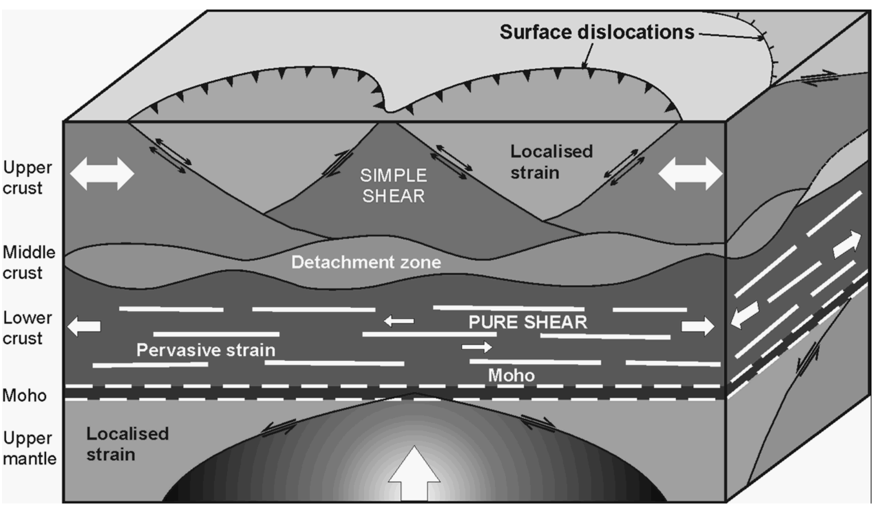


Fig 3. *The stress pattern, types of deformation and character of strain in different levels of the continental crust and upper mantle due to the process of flattening curvature of expanding Earth.*

temperatures of 300–400° C. (Fig. 3). Below this depth, there is a ductile deformation zone dominated by the flow of solid-state matter. Obviously, the boundary between the brittle deformation zone and the ductile deformation zone is not sharp. Its width is dependent on both the heat flow and the lithology. Another rheological boundary is the Moho surface. The subcrustal upper mantle is brittlely deformable under the thermal conditions existing in this zone. Reflection seismic analysis confirms this rheological behaviour. There is a strict relationship between the viscosity of the continental lithosphere and seismic reflectivity. Sparse reflection packets related to fault zones (mostly of listric geometry) are observed in all seismic reflection profiles in the crystalline upper crust, which in general is seismically transparent. These fault zones dip in different directions and flatten downwards. The lower crust is dominated by subhorizontal structures which are suggested by most authors to represent flow deformations. A transitional zone, sometimes referred to as the middle crust, occurs at the lower/upper crust boundary. Most of listric fault zones die out within this part of the crust. It contains intracrustal large-scale lenticular structures, marked by reflection bands. The subcrustal upper mantle is characterised by a transparent seismic structure. Therefore, from the rheological point of view, the lower crust is a "weaker" layer enclosed between the rigid upper crustal zones and the subcrustal lithosphere. Reflection lamination results from a process of tectonic deformation that is independent of the petrological stratification of the crust.

The multilayered stress distribution, proposed in the model of continental lithosphere, is responsible for the formation of seismic structures, and cannot be an effect of plate tectonic mechanism. The major features of these structures include: (1) a layered distribution of the stress field and deformation types; (2) a relatively young age of deformations; and (3) probable upward transmission of stresses. These features suggest the involvement of a tectonic process associated with Earth expansion. The expansion of the Earth's interior, accompanied by a decrease in the curvature of near-surface layers, could give rise to the stress pattern observed. The main focus of my thesis was the idea of the influence of curvature changes (flattening) of the expanding Earth on tectonic processes. This idea was earlier expressed by Hilgenberg (1933), Rickard (1969), Jordan (1971), Carey (1976) and Maxlow (1995, 2001). In the upper crust, the first phase of flattening is manifested as the formation of compressional crustal structures described by plate tectonics as flake structures or tectonic wedges, and also as crustal delamination processes. As the expansion accelerates, compressional structures are replaced by extensional structures in some areas. The subsequent geological evolution may proceed either towards further extension until the crust breaks, or, in the case of the consolidation of the area, towards another compressional phase that can result from the adjustment of the rigid upper crust to a new, smaller curvature of the Earth (tectonic inversion). Flattening structures correspond to those described by the plate tectonic theory as resulting from the so-called membrane tectonics. The tectonics of flattening structures also explains numerous strike-slip, transpressional and transtensional structures, palaeomagnetically determined lateral rotations of blocks, the formation of oroclines and foldbelts, etc., commonly described in recent literature.

In the light of the proposed geological interpretation, the seismic structures of the continental lithosphere, observed in reflection seismic profiles, reflect different states of tectonic stresses. Planetary and regional intracrustal detachments occur at the lower/upper crust boundary and the crust/subcrustal mantle boundary. Extensional stresses are transferred from the upper mantle towards the crust. This phenomenon is what we can expect to be the result of Earth expansion.

Main events, contacts and interactions

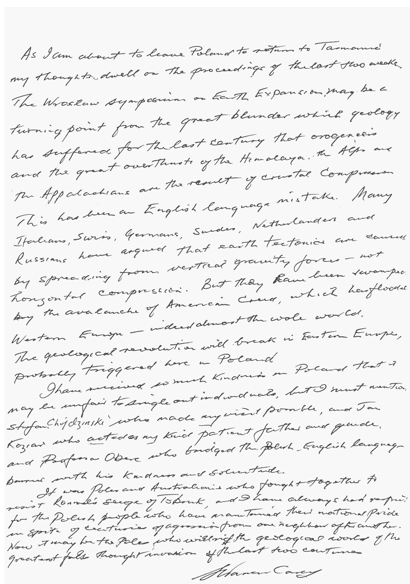
For many years, Prof. S.W. Carey from Hobart, Tasmania, was a "Master" to me. His views on the expansion process were most widely expounded in the book *The Expanding Earth* published by Elsevier in the well-known series Developments in Geotectonics (Carey, 1976). In 1981, he organized the first international symposium on Earth expansion at the University of Sydney. As a result, an extensive publication was developed, in the introduction of which Carey wrote that they met to discuss what most call heresy. Heresy denies certainty. But the advancement of science for centuries has consisted in the gradual erosion of self-evident certainties, followed by those considered false. He remained faithful to these words all his life. That publication (Carey, 1983) is a set of articles devoted to various aspects of an expanding Earth. The symposium highlighted a group of geologists and geophysicists involved in propagating the theory of expansion, among others: K. Vogel, H.G. Owen[1], C.F. Burret, G.O. Kremp, M. Gorai, A.R. Crawford, J. Stöcklin, F. Ahmad, B. Ciric, S.T. Tassos, J.K. Davidson, O. Shields, W.F. Tanner, and V.B. Neiman. I received the publication as a gift from Prof. Carey in 1983.

[1] See also the chapter by Hugh Owen.

Only three years later, a conference devoted to the problems of Earth expansion and pulsation was organized by academician E.E. Milanovskij in Moscow in 1984. Prof. Carey was the patron of the conference. The supporters of expansion from the USSR presented their arguments during the conference: V. Blinov, K. Veselov, I. Kirillov, J. Chudinov and others. Ever since then, international meetings of expansionists have become a tradition. S.W. Carey, K. Vogel, J. Tchudinov, J. Maxlow, J. Hladil and G-C. Scalera visited the Lower Silesian Branch of the PGI, and gave lectures also at the University of Wrocław and in Warsaw.

The conference in Poland was the last that Prof. Carey personally attended. As a retired professor at the University of Tasmania, he continued working intensively as a researcher. Two monographs were the fruit of his work: *Theories of the Earth and Universe: A history of Dogma in the Earth Sciences* published in 1988 by Stanford University Press, and *Earth, Universe, Cosmos* published by the University of Tasmania in 1996. In these monographs, Carey presented not only individual aspects of processes related to Earth expansion, including, for the first time, interpretation of the results of satellite geodesy data that clearly indicate the increase in Earth's radius, but also dealt with the evolution of the solar system, stars and space, proposing the original theory of the Null Universe. This theory assumes a continuous creation of

Fig 4. Prof. Samuel Warren Carey in Sosnowka in Poland. Autumn1994.



As I am about to leave Poland to return to Tasmania
my thoughts dwell on the proceedings of the last two weeks.
The Wroclaw Symposium on Earth Expansion may be a
turning point from the great blunder which geology
has suffered for the last century that orogenesis
and the great overthrusts of the Himalaya, the Alps and
the Appalachians are the result of crustal compression
This has been an English language mistake. Many
Italians, Swiss, Germans, Swedes, Netherlanders and
Russians have argued that earth tectonics are caused
by spreading from vertical gravity forces — not
horizontal compression. But they have been swamped
by the avalanche of American Creed, which has flooded
Western Europe — indeed almost the whole world.
The geological revolution will break in Eastern Europe,
probably triggered here in Poland
I have received so much kindness in Poland that it
may be unfair to single out individuals, but I must mention
Stefan Chojdzinski who made my visit possible, and Jan
Kozian who acted as my kind patient father and guide,
and Professor Obere who bridged the Polish-English language
barrier with his kindness and solicitude.
It was Poles and Australians who fought together to
resist Rommel's siege of Tobruk, and I have always had respect
for the Polish people who have maintained their national pride
in spite of centuries of aggression from one neighbour after another.
Now it may be the Poles who will rid the geological world of the
greatest false thought invasion of the last two centuries
Warren Carey

Fig 5. The letter S.W. Carey wrote one day before he left Poland in 1994.

matter, and the sum of matter and energy is zero. Thus, in his latest work, Carey also deals with the problem of the cause of Earth expansion. At the turn of the 1950s, the question about the cause of expansion became one of the reasons that most geotectonicists rejected this theory, despite the obvious geological evidence. "My first answer is I do not know" Prof. Carey wrote in 1976, "Empirically I am satisfied that the Earth is expanding". S.W. Carey was not only an outstanding geotectonicist; he was also a philosopher of nature and a historian of earth sciences.

Professor Carey has passed away (Fig. 4 & 5), but his work continues. Such conferences, at which the theme of expansion was presented, were held in 1993 in Olympia, Greece, in Wrocław and Sosnówka near Karpacz in 1994 organized by Koziar and Cwojdziński, in Lauthenthal in 2001 (Lauthenthaler Montanistisches Colloquium) to celebrate the 100th anniversary of the birth of O.C. Hilgenberg, in Theuern, Bavaria, in 2003 (Figure 6 and 7), in Urbino, Italy, in 2004, and in Erice, Sicily, Italy in 2011. In 2012, a separate session devoted to Earth expansion was held during the International Geological Congress in Brisbane. I was an active participant of all meetings except in Lauthenthal. In the 1990s and 2000s, the session at the International Geological Congress in Florence and the post-conference workshop in Urbino at the end of August 2004, devoted to new concepts in global tectonics, was an opportunity for the group of expansionists to meet. These were the meetings of "non-believers in plate tectonics". The theory of expansion was represented by a number of geologists and geophysicists who presented various aspects

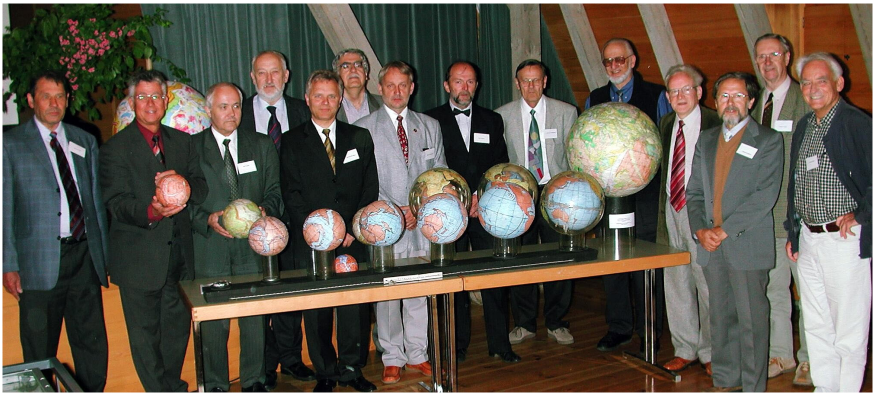


Fig 6. *Participants of Theuern meeting (Germany) in 2003. In the foreground Klaus Vogel models of the expanding Earth. Klaus second from the right. Jan Koziar third from the left.*

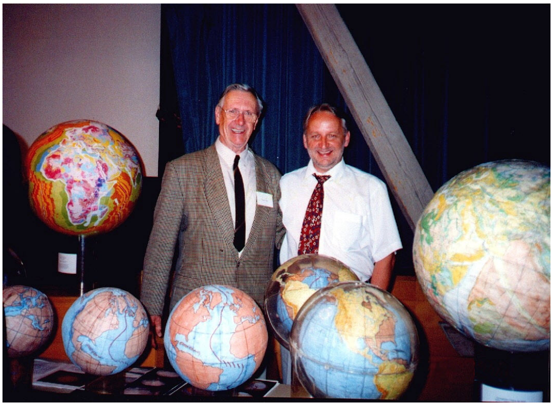


Fig 7. *Klaus Vogel and Stefan Cwojdziñski in Theuern with globes.*

Fig 8. *Globe within globe. Klaus Vogel's reconstructions.*

of this geotectonic idea. Direct evidence and premises indicating expansion of our planet were presented by G. Scalera based on analysis of the geotectonic situation in the Mediterranean Basin. He quoted many observations that prove an opposite phenomenon - the Mediterranean Sea is not a relic of the Tethys but a slowly emerging new ocean. Considering the conditions occurring inside the Earth, S. Tassos had calculated the planet's energy budget, concluding that the energy supplied by radioactive decay and other internal sources provides merely 2% of its demand for seismic and magmatic phenomena. According to him, this internal energy of the Earth comes from the creation of new matter in the Earth's core, resulting in expansion of the entire planet.

L.W.D. Bridges reinterpreted most of the circular structures that were previously considered impactogens to be a result of explosive-volcanic processes associated with the degassing of an expanding Earth. For example, he is of the opinion that the great extinction at the Mesozoic/Cenozoic transition is associated with the rapid degassing of the mantle, which caused the formation of great circular volcanogenic structures, including the large Chicxulub crater in Mexico, as well as the trap rocks of the Deccan and China. K. Vogel presented his own reconstruction of the positions of continents on three globe models corresponding to an Earth radius of 45, 65 and 75% of the modern radius (Fig. 8). He presented the old German traditions of research on Earth expansion, conducted by Lindemann (1927) and Hilgenberg (1933) (Fig. 9), abandoned due to the accusation of a lack of physical explanation for the cause of expansion. R. Gottfried compared the chemical composition of space and the

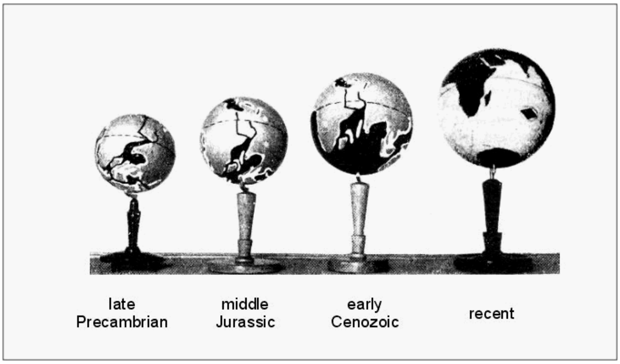


Fig 9. *Otto Hilgenberg's models of the expanding Earth (1933).*

present-day Earth. He believed that we did not need to reach for the hypothesis of the creation of matter or dark matter to explain the expansion, but it is enough to interpret properly the chemical processes taking place inside primordial Earth. M. Kokus presented a correlation between the seismic and volcanic activity of Earth and the relative position of the Earth, Moon and Sun against the background of global geotectonic processes, showing that the observed correlations are easiest to explain by the Earth expansion process. I personally presented a view that the modern seismic structure of the continental lithosphere is the result of the process of flattening of the outer geosphere of the expanding Earth. Arguments in favour of the expansion theory were also found in the presentations of P. Rajlich, C. Ollier[1], N. Pavlenkova and Dong Choi.

In the 1990s, new contributions of expansionists appeared: *Global Education Tectonics of the Expanding Earth* by J. Tchudinov (1998), *Why expanding Earth?* edited by G. Scalera and K.H. Jacob[2] - a collective work published in 2002 in honour of O.C. Hilgenberg, *Our expanding Earth, The ultimate cause* by L.W.D. Bridges (2002), and *Planet Earth Expanding and the Eocene tectonic event* by K.W. Luckert (1999). In 2005, James Maxlow's book, *Terra non Firma Earth*, was published in Poland by Wind, Wrocław. This latter book is a monograph presenting fully the most up-to-date arguments in favour of the expansion theory, as well as excellent original reconstructions of an expanding Earth. The author discusses geophysical arguments, including palaeomagnetic, and the results of satellite geodesy, palaeogeographic, and tectonic reconstructions, including orogenic, palaeobiological, palaeoclimatic and metalogenic processes. The book is the most complete contemporary lecture on the expansion theory based on hard data. We owe the possibility of publishing it in Poland to the author,

[1] *See also the chapter by Cliff Ollier.*

[2] *See also the chapter by Karl-Heinz Jacob.*

Fig 10. *Participants of Erice conference (Sicily, Italy), 2011. James Maxlow (5th from the right), Cliff Ollier (6th from the right), Stefan Cwojdziñski (8th from the left). Picture reproduced with permission from the book "The Earth Expansion Evidence" edited by Giancarlo Scalera, Enzo Boschi, Stefan Cwojdziñski and published by Aracne.*

sponsors and the excellent cooperation between James Maxlow, J. Wojewoda and me. At the conference in Erice in 2011, I presented, among others, an interpretation of the geological evolution of the Sudetes (SW Poland) on an expanding globe.

The main tectonic processes observed in this part of Central Europe are related to the extensional and strike-slip tectonics. Extensional tectonic processes were active at the upper mantle and lower crust levels, and their secondary manifestations include the vertical diapiric (domala) tectonics and gravity tectonics. Strike-slip tectonics is a reflection of rotation of crustal blocks - typical of the Paleozoic in Central Europe. These rotations of variable directions result from stress relaxation in a relatively narrow area of interaction between the three great cratons deeply rooted in the Earth's mantle: Laurussia, Gondwana and Baltica. Other manifestations of extension and rotation in the Meso-Cenozoic are genetically related to the reduction of the curvature of the crust in the European continent, constrained by the expansion of the Earth's interior.

Final thoughts about Earth expansion today

To sum up, although being on the margins of modern geotectonics, the idea of Earth expansion has constantly been investigated and developed. The arguments for expansion are so serious that they cannot be ignored. In many scientific communities, there is a growing belief that the plate tectonics theory is not the last response of the geology to the increase in observational data. Earth sciences need a new Geo-idea. The theory of Earth expansion can give a new impetus for further development of not only geological and geophysical but also physical, cosmological, palaeontological and biogeographical researches, etc. Why is Earth expansion a fact? This theory answers most of the questions raised today about geotectonics. It does not require artificial solutions, and complicated and contradictory interpretations. It is simple and comprehensible. The most common complaint is the lack of physical explanation for the expansion process. This is not the role of geologists! However, it should be remembered that modern cosmology and physics have already departed far from the traditional concepts of energy and mass conservation. Dark matter and dark energy of the Universe are taken very seriously by physicists today. It is time for geologists to draw conclusions as well. It would be a pity if geologists did not discover the process of Earth expansion. For the evidence is at their fingertips.

About the Contributor

Stefan Cwojdzinski was born in Wrocław, SW Poland in 1947. He completed his studies of geology at Wrocław University in 1970. In the same year he was employed in the Polish Geological Institute, Lower Silesian Branch in Wrocław where he worked until 2017 when he retired.

For over 20 years he was engaged in geological mapping in the Sudetes Mts. and their forefield, studying also the tectonics of metamorphic and magmatic rocks. In 1981 he obtained a doctor's degree on ground of work on geological evolution of Variscan Kłodzko-Złoty Stok granitoid massif. Geological mapping was also his professional activity during work abroad in Finland (1975), Mongolia (1984-86) and Algeria (1986-88). Since 1984 he undertook studies on Earth expansion. He published about 25 papers on different aspects of this theory and was co-organizer of the EE symposium in Poland in 1994. In the years 1988-2000 he performed the duty of director of the Lower Silesian Branch of the Institute. During this time he promoted an expanding Earth. In 2003 he defended his habilitation thesis on the decrease of surface curvature on the expanding Earth. Since 2006 he has occupied a post of professor in the Polish Geological Institute.

Other interests: political history, the times of Napoleon I, geotourism, collecting of mineralogical and paleontological speciments.

This essay was first published as a chapter in the 2020 book, *The Hidden History of Earth Expansion*, which is widely available from good bookshops in both Hardback and Paperback editions, as well as a Google eBook.

The *Hidden History of Earth Expansion* presents the personal histories of some of the most well-known researchers into Earth expansion in 14 original essays. In addition to furnishing us with their personal histories, as they strived to explore the seemingly overwhelming evidence for confirmation of Earth expansion, the authors' highlight areas where further research is required.

The chapters expressly written for the book are:

• Chapter XIII •

• Chapter XIV •

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