Anniversaries

Murchison in Russia 180 years ago

RODERICK MURCHISON'S VISIT TO TCHEKETAU PEAK, RUSSIA, 180 YEARS AGO

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In 1845, Roderick Murchison, Edouard de Verneuil and Alexander von Keyserling published the two-volume book entitled *The Geology of Russia in Europe and the Ural Mountains* which reports on the results of two field seasons in Russia (1840 and 1841) as well as additional field-work in Poland (1843) and Scandinavia (1844). Murchison was largely responsible for Volume 1 which focuses on the geology and stratigraphy of Russia in Europe and the Ural Mountains. Volume 1 is richly illustrated and includes both maps and cross-sections (Diemer and Diemer 2021), and was published in London by John Murray. De Verneuil described and illustrated the fossils collected during their fieldwork in Volume 2 which was published in Paris by Bertrand. During the field campaigns, Murchison used a collaborative methodology that contributed to his remarkable productivity (Diemer 2008, 2017). That methodology comprised several elements, including: reading in advance about regions to be visited; consulting with eminent geologists with knowledge of those regions; assembling relevant maps; interviewing local experts and examining their fossil collections; traveling with another scientist to verify observations and test interpretations; and rapidly announcing findings both at meetings and in print.

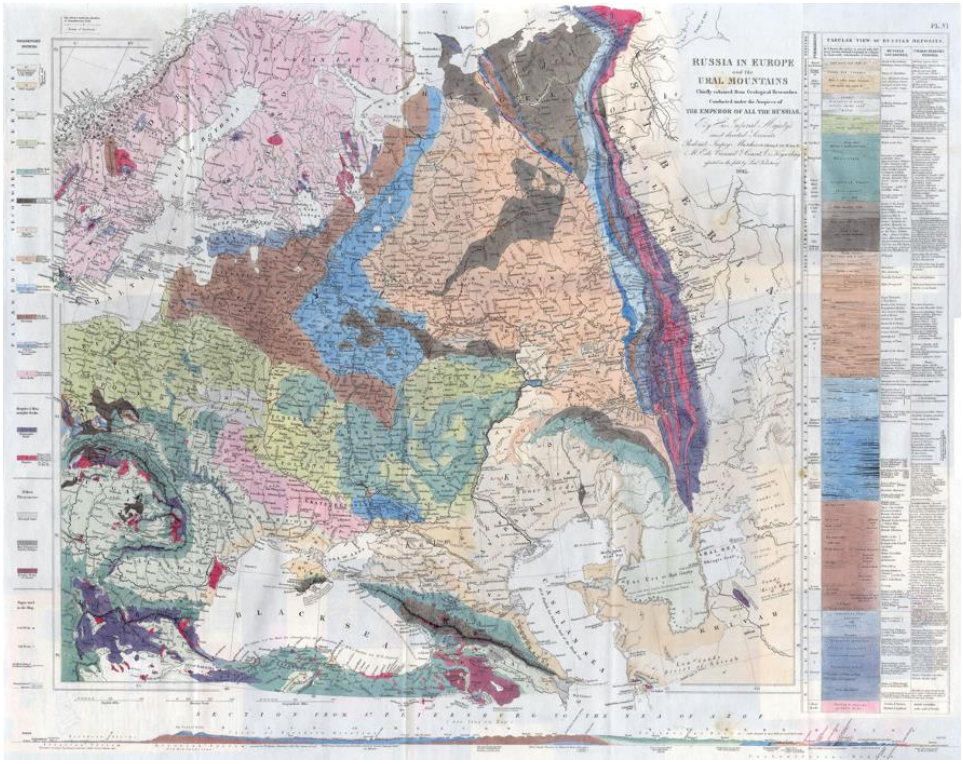

Figure 1. Geologic map of Russia in Europe, with stratigraphic column and cross-section. Plate 6 of *The Geology of Russia* (1845).

A noteworthy product of this collaborative methodology is Plate 6, the geologic map of "Russia in Europe and the Ural Mountains" that accompanied *The Geology of Russia* (1845) (Figure 1). The map is a 68 x 84 cm copper plate engraving with water color washes at a scale of ~1:5,000,000. Plate 6 has been described as "the finest hand coloured map ever produced" (Thackray 1978, p. 426). The map was engraved and colored by John Arrowsmith, based on Murchison's own observations and those of other geologists including von Dechen, Zejszner, Boué, Dubois de Montpereux, Hamilton, Ainsworth, and Helmersen. In addition to the map, Plate 6 also contains a "Tabular View of Russian Deposits" (a stratigraphic column with key locations of index fossils used to define the Systems), and a N–S cross-section extending from St. Petersburg to the Sea of Azof. Thus, Plate 6 represents a synthesis of much that was known in 1845 of the geology of Russia and surrounding territories. A notable contribution of the map, reinforced by Plates 2–5 which contain cross-sections, is the general structure of the Ural Mountains comprising igneous and metamorphic rocks along a central axis with tilted and folded Paleozoic and younger sedimentary rocks on its flanks. Also shown is the newly recognized Permian System, named by Murchison in 1841 based on observations made during the 1840 and 1841 field seasons (Benton and Sennikov, 2021; Murchison 1841; Murchison et al. 1845).

The travel routes taken by Murchison and his colleagues appear in Figure 2. They saw much of the Ural Mountains during the 1841 field season, visiting mining establishments and forges, where they received the assistance of landowners, mine directors, regional governors and military commanders. 180 years ago, in August of 1841, Murchison and his team were departing the Urals on the road from Werch Uralsk to Samara via Bielebei, when they decided to make a detour to inspect an unusual occurrence of limestone mountains surrounded by gypsum-bearing sandstones and marls near Sterlitamak.

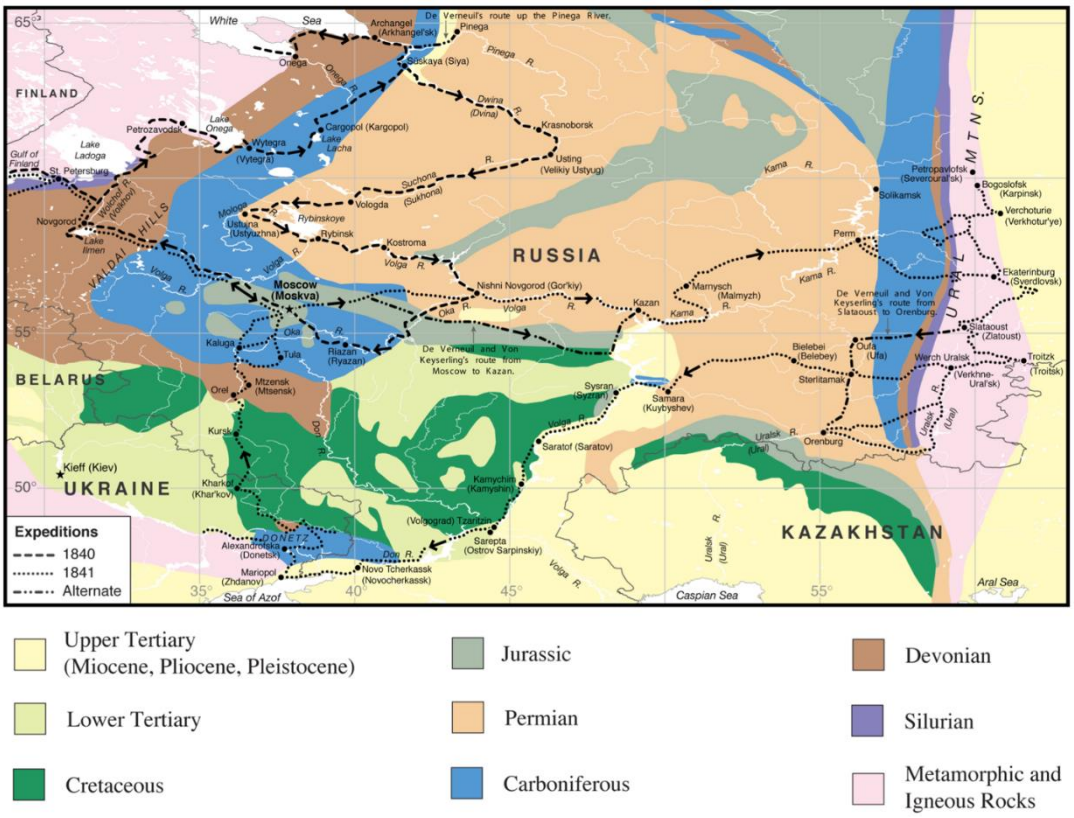

Figure 2. Travel routes through Russia taken by Murchison and his colleagues. They covered a very large area in the 1840 and 1841 field seasons, including the Ural Mountains, the central axis of which they crossed numerous times. Geology base map modified from Plate 6 of *The Geology of Russia* (1845).

In his journal account of this side trip to Tcheketau Peak, Murchison interprets it as an anticlinal outlier of Carboniferous limestone draped by Permian sedimentary rocks (see Figure 3). According to his journal account,

> The expedition to the Tchekatau [sic] was an after-thought. Our tarantasse was at the door, and our Cossack had started for Bielebei, when, on looking at the map of Perovski, I so much regretted to quit the Ural without a look at these peaks. . . . How we forded and reforded the Seleoak; how we threaded the brackens, among the aspen trees of gigantic size with beehives placed aloft; how we galloped along the plain; how we hammered the Tchekatau; and how we returned to our equipage, leaving our Russian avant garde behind, require to be told by a novelist (Collie and Diemer, 2004, p. 331).

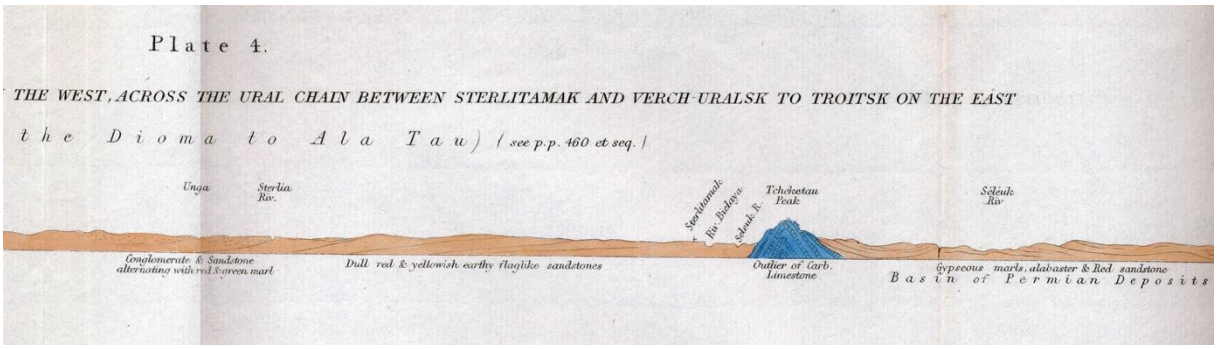

Figure 3. Extract from Plate 4 of *The Geology of Russia* (1845), with the Tcheketau Peak, identified as "Outlier of Carboniferous Limestone" folded as an anticline and draped by Permian sandstones and gypsum-bearing marls.

Murchison made a crucial observation on this excursion concerning the stratigraphic base of the Permian System:

> We had made ourselves thoroughly acquainted with all the details of the Mountain Limestone on the [we]stern flanks of the Ural near Sterlitamak, including the outlier of Tcheke-tau, before we visited our hospitable friend Major Wangenheim von Qualen at the zavod of Troitsk, near Bielebei. As we were thus the first to establish along this frontier a clear base-line for the Permian deposits, and thus to unravel their real age, at a time when others were wholly unacquainted with it, we were rather surprised to find that a year after we quitted the country, Major Wangenheim published a geological sketch (*Verhandl. der Kais. Russ. Mineralog. Gesells. zu St. Petersburg*, 1843, p. 1), in which he announced this emergence of the Carboniferous rocks as a discovery of his own. Our work has, indeed, been a long time in preparation, but the chapter which describes the Tcheke-tau, p. 130, as well as memoirs read to the Geological Society, were printed long before Major Wangenheim's paper. He was, indeed, entirely ignorant of the relations in question when we visited him, and begged us to explain the succession of the strata (*The Geology of Russia*, p. 461, footnote).

Thus, the limestone mountain near Sterlitamak occupies an important place in the history of geology as it contains a place where Murchison claimed that the base of the Permian System in conformable contact with the underlying Carboniferous could be seen.

Tcheketau Peak is today known as Shakhtau. It is referred to as a shikhan of the Sterlitamak region of the Republic of Bashkortostan, together with three other limestone mountains, Toratau, Kushtau and Yuraktau. They are today interpreted as lower Permian reef massifs of the pre-Ural reef system. Thus, Murchison's initial assignment of these limestone mountains to the 'Carboniferous Mountain Limestone', was incorrect. Nonetheless, they have been visited by many scientists over the years due to their geological and ecological importance (https://en.wikipedia.org/wiki/Shakhtau). Many of the scientists were participants in international geological conferences, such as the International Geological Congresses of 1937 and 1984, and the VIII International Congress on Stratigraphy and Geology of the Carboniferous in

1975. The shikhans are also coveted sources of limestone for soda and cement production. Mining activity has already largely destroyed Shakhtau and the remaining peaks are in danger of disappearing as well. There is a local initiative to declare the remaining peaks as protected conservation areas, in an effort to preserve them for the benefit of future generations (https://www.greenpeace.org/international/story/44648/police-stop-activists-kushtau-mountain-forest/).

Further Reading

Benton, M. and Sennikov, A.G., 2021. The naming of the Permian System. *Journal of the Geological Society*. https://doi.org/10.1144/jgs2021-037

Collie, M. and Diemer, J. 2004. *Murchison's Wanderings in Russia*. Keyworth: British Geological Survey, 474 pp.

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Diemer, J. and Diemer, L. 2021. The use of artwork to document geologic systems in *The Geology of Russia* (1845). In: *The Evolution of Paleontological Art*, edited by Renee M. Clary, Gary D. Rosenberg, and Dallas Evans. GSA Memoir 218, 117–126. Boulder: Geological Society of America. https://doi.org/10.1130/2021.1218(14)

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Murchison, R. I., de Verneuil, E., and von Keyserling, A. 1845, *The Geology of Russia in Europe and the Ural Mountains, Volume 1, Geology*. London: John Murray. *Volume 2, Paléontologie*. Paris: P. Bertrand.

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