



The naming of the Permian System

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Abstract: The naming of the Permian by Roderick Murchison in 1841 is well known. This is partly because he ‘completed’ the stratigraphic column at the system level, but also because of the exotic aspects of his extended fieldwork in remote parts of Russia and his reputed character. Here, we explore several debated and controversial aspects of this act, benefiting from access to documents and reports from Russian sources. Murchison or Sedgwick could have provided a name for the unnamed lower New Red Sandstone in 1835 based on British successions or those in Germany, so perhaps the imperial aim of naming time from British geology was not the urgent task some have assumed. Murchison has been painted as arrogant and imperialistic, which was doubtless true, but at the time many saw him as a great leader, even an attractive individual. Others suggest he succeeded because he stood on the shoulders of local geologists; however, his abilities of brilliant and rapid geological synthesis are undoubted. Two unexpected consequences of his work are that this arch-conservative is revered in Russia as a hero of geological endeavours and, for all his bombast, his ‘Permian’ was not widely accepted until 100 years after its naming.

Supplementary material: Original text and English-language translations of five of the key papers (Murchison 1841d; Helmerson 1872; Shafranovsky 1964; Chuvashov 2010; Malakhova 2012) are available at: <https://doi.org/10.6084/m9.figshare.c.5412079>

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In 1940, Carl O. Dunbar, Professor of Paleontology and Stratigraphy at Yale University wrote, in a review about the Permian System:

... one can not read Murchison’s great classic, *The Geology of Russia in Europe and the Ural Mountains*, without a feeling of amazement that in so brief a time he had grasped so accurately the major features of so extensive a region. The explanation lies in the fact that much work, mostly local, had already been done in Russia, and all this was made available to the British geologist.

(Dunbar 1940, pp. 237, 239)

Dunbar was writing 100 years after Murchison’s first trip to Russia, but at a time when the concept of the Permian was still controversial. Now that there has long been international agreement about the definition of the Permian, it is perhaps a good time to consider what Murchison achieved 180 years ago and how he did it.

Roderick Impey Murchison (1792–1871) (Fig. 1) named the Permian System in 1841, plugging the last gap in the stratigraphic column. We now see this achievement as a great moment in the establishment of geology as a science. Murchison certainly hoped so and, as he was then at the height of his powers, he could use his elevated position as President of the Geological Society of London to drive home the point. In his annual addresses in 1841–43, he cast his eyes over the achievements of geologists around the world and emphasized that everyone should adopt the standard stratigraphic scale (including his Silurian, Devonian and Permian systems) worldwide. This fits with a common assumption that Murchison saw the naming of time as an urgent task and that he was able to promote his cause because of his domineering and autocratic approach.

Murchison visited Russia twice, in 1840 and 1841. Both expeditions were sponsored by Tsar Nicholas I (1796–1855),

whom Murchison admired hugely, despite contemporary and subsequent impressions of him as a supremely reactionary Tsar. The naming of the Permian in 1841, based on these Russian adventures, raises some unexpected issues that we explore here.

(1) Why did Murchison not name this geological system earlier? He could have provided a name for the lower part of the New Red Sandstone in 1835, based on rocks in the UK, where he could readily have found the evidence he needed.

(2) How was Murchison regarded at the time? Was he a domineering imperialist, or a good team leader?

(3) Did Murchison rely too much on the work of others? The second comment from Dunbar (1940) was that Murchison succeeded in Russia because much work had already been done; good planning, or plagiarism?

(4) Ironically, although Murchison was a classic aristocratic high Tory of his day, he came to be revered in Soviet and post-Soviet Russia as a hero of geological endeavours (although this was doubtless because he named an international time unit in Russia rather than because of his politics or other opinions).

(5) The concept of the Permian as propounded by Murchison was not widely accepted until the 1940s and he had to fight throughout his lifetime to keep the ‘Permian’ alive.

In this paper, we add to an earlier account focused on Murchison’s first encounter with the Permo-Triassic boundary at Vyazniki (Benton *et al.* 2010). We add information from a broad sweep of historical accounts in Russian (e.g. Koksharov 1890; Shatsky and Yanshin 1986; Vaksman 1991, 2008; Malakhova 2012; Sennikov 2020) to provide a richer view of events and opinions. This allows us to explore the five unexpected or critical points listed here. We look at Murchison’s plan to go to Russia and why and how he achieved his objectives. In doing so, we also explore a little of his personality and his relationship with Tsar Nicholas I, as well as subsequent reflections on his achievements in Russia. Then we



Fig. 1. Portrait of Roderick Impey Murchison. Mezzotint version (1851) by William Walker (1791–1867) from an 1849 portrait by H.W. Pickersgill (1782–1875). Murchison is proudly wearing his Order of St Anne (second class), awarded by Tsar Nicholas I in 1841, and his Military General Service Medal with a portrait of the young Queen Victoria, awarded to surviving soldiers from the Napoleonic Wars of 1803–15 by decree in 1847 (red ribbon and three clasps, each representing a separate battle or campaign). In the full portrait, his hands rest on a leather-bound copy of his *The Silurian System* (Murchison 1839). Courtesy of Paul D. Stewart and Science Photo Library.

consider whether Murchison really had an imperial plan to build an international stratigraphic timescale and impose it on the world, and how he and others viewed what he was doing. We explore the impact of Murchison and his work in Russia since 1840 and the remarkable fact that what Murchison called the ‘Permian’ represented only two-thirds of what we now call Permian, and indeed that leading geologists disputed his concept throughout his

life and beyond and that the ‘Permian’ was only finally accepted internationally in 1941. All translations quoted in this paper are by the authors.

New Red Sandstone in Germany and England

A major question is why the Permian had not been named far earlier – after all, convincing rock successions existed in Germany and Great Britain and they had been identified as widespread and repeatedly recognizable. As Lucas and Shen (2018, p. 22) note, the German Rotliegend and Zechstein were named in the 1700s by German mining engineers and geologists, the names meaning roughly ‘red beds’ and ‘mine stone’. In addition, German geologists had noted a unit within the Zechstein, the Kupferschiefer (‘copper beds’), as a widespread economically valuable horizon. Similarly, the overlying Buntsandstein, Muschelkalk and Keuper had long been identified as distinctive formations and all five could be traced throughout southern Germany and into Poland, Austria, Switzerland, eastern France and the Low Countries. This framework of major, mappable German basin sedimentary groups was well established and known throughout Europe, so in all explorations of the British Permian and Triassic, geologists indexed their findings against the German standard (Fig. 2).

The Permian and Triassic geology of Great Britain is rather different. In the 1830s, the succession was referred to as the ‘New Red Sandstone’, in contrast to the ‘Old Red Sandstone’, now recognized as essentially Devonian. The relative ages of the middle Paleozoic rocks of England had been actively debated throughout the mid-1830s; Adam Sedgwick (1785–1873) and Murchison had established that the marine Devonian rocks of Devon, full of corals, brachiopods and crinoids, were equivalent in age to the terrestrially deposited Old Red Sandstone with its fish and plant fossils. This episode, dubbed the ‘Great Devonian Controversy’ (Rudwick 1976, 1985) rumbled from 1834 to 1840, when Sedgwick and Murchison (1839, 1840) named the Devonian and firmly established that they had been right all along.

However, the ‘New Red Sandstone’ remained. The Triassic was named by Alberti (1834) based on the classic three-part Buntsandstein, Muschelkalk and Keuper succession of the German basin. But below these units lay some other rock successions. Indeed, as argued by Holliday (2018), Sedgwick had already laid the groundwork in 1829 and could have declared a formal name for the time represented by rocks between the

Sedgwick's stratigraphic terminology	Current terminology	German equivalents
7. Upper red marl and gypsum	Mercia Mudstone Group	Keuper Group
		Muschelkalk
6. Upper red sandstone	Sherwood Sandstone Group	Buntsandstein Group
	Roxby Formation	
5. Grey thin-bedded limestone	Brotherton Formation/ Seaham Formation	Zechstein Group
4. Lower red marl and gypsum	Edlington Formation	
3. Yellow Magnesian Limestone	Cadeby Formation/ Raisby and Ford formations	
2a. Compact and shelly limestone and variegated marls		
2. Marl Slate and compact limestone	Clent Formation	Rotliegend Group
1. Lower red sandstone	Sub-Carboniferous unconformity	
	Salop Formation	

Fig. 2. Stratigraphic nomenclature of the New Red Sandstone of eastern and northern England according to Sedgwick (1829, p. 64), the current terminology (Smith *et al.* 1986) and equivalents in the German basin. Modified from information in Holliday (2018).

Carboniferous and Triassic (Sedgwick 1829). Indeed, the fieldwork on which the 1829 monograph is based was carried out in 1821–23, so Sedgwick had the systematic knowledge in the mid-1820s to name the ‘New Red Sandstone’ as either a single formal unit or two, but he did not do so. Likewise, the German geologists had long had the evidence to provide formal names for the Rotliegend to Keuper succession.

So, should Sedgwick be granted priority for naming the international geological system that we call the Permian and ascribe to Murchison (1841a)? That claim was certainly made by Sedgwick’s biographers:

If Murchison’s Permian is the same as Sedgwick’s previously described Magnesian Limestone Series, then all that Murchison did was to find that certain rocks on the continent were the equivalents of the Magnesian Limestone Series, but that does not entitle him to priority of classification and nomenclature.

(Clark and McKenny Hughes 1890, vol. 2, p. 506)

They went on to say that Sedgwick had ‘priority of correct description of all the series of rocks called Permian’ (Clark and McKenny Hughes 1890, vol. 2, p. 507). Holliday (2018) suggested not, and the evidence of his papers supports the opposite view, that Sedgwick did not entertain any such intention or desire.

Sedgwick is best known for his work on the lower Paleozoic of Wales and the Lake District of northern England, but he did publish a detailed account of the Permian of eastern and northern England (Sedgwick 1829). In this, he tracked the ‘lower New Red Sandstone’ through Nottinghamshire, Derbyshire, Yorkshire and Durham, noting a comparable succession of red sandstones, overlain by the Marl Slate, the Magnesian Limestone, further limestones, and then red sandstones and red marls with gypsum.

Sedgwick showed how the distinctive lower New Red Sandstone succession of England (Fig. 2, his beds 1–5) was repeated throughout the 250 km lateral extent of the outcrop. He noted the major unconformity between the Carboniferous, which was then well defined in terms of the coal-bearing horizons and associated deltaic sediments, and the overlying red bed succession, although the lower units of the succession are now identified as Carboniferous in age, including the Salop and Clent formations, parts of the Warwickshire Group (Smith *et al.* 1986; Wakefield *et al.* 2016). Sedgwick (1829) correlated his Division 1 with the German Rotliegend, Divisions 2–5 with the German Zechstein, Division 6 with the Buntsandstein (or Bunter) and Division 7 with the Keuper. He concluded (Sedgwick 1829, p. 110), ‘Such are the seven great natural divisions of the new red sandstone series’.

In later work in the Vale of Eden, Sedgwick (1836) suggested his Division 1 red beds, and the German Rotliegend, might indeed be latest Carboniferous in age, partly because the coal-bearing classic Carboniferous interfingers with some of the red sandstones, but also because both units show tectonic deformation, which we now ascribe to the Hercynian (Variscan) orogeny, whereas the higher beds are not disturbed. Further, he had examined the German Rotliegend (named by him using the older name, ‘rothe todteliegende’) first hand and could confirm the same transition from coal-bearing grey Carboniferous into red sandstones without coals. Further, Sedgwick (1829) understood that most of the New Red succession he recorded was distinct from the Carboniferous below, named in 1822, and the Jurassic above, named in 1829. In addition, after Alberti (1834, p. 324) had named the Triassic, encompassing the Buntsandstein–Muschelkalk–Keuper divisions, it might be asked why Sedgwick did not formalize a system–period name to discriminate the leftover portions of his recorded section, minimally his Divisions 3–5 (Fig. 2), as distinct from the Carboniferous below and the Triassic above, and at the same hierarchical level.

Alberti could not have been clearer about his intention in naming the Triassic. After hundreds of pages describing the Bunter, Muschelkalk and Keuper of Germany, he wrote:

Wer die vorstehende Zusammenstellung näher prüft, wer die Petrefakten der 3 bis jetzt getrennt gehaltenen Formationen zusammenreicht, und hiezu die Uebergänge der verschiedenen Glieder in einander, wer überhaupt den ganzen Habitus des Gebirges näher prüft und die wesentlich verschiedenen Versteinerungen des Zechsteins und des Lias in die Wagschale legt, dem kann es nicht entgehen, dass bunter Sandstein, Muschelkalk und Keuper das Resultat **einer** Periode, ihre Versteinerungen um mich der Worte E. de Beaumont’s zu bedienen, die Thermometer einer geologischen Epoche seyen, dass also die bis jetzt beobachtete Trennung dieser Gebilde in 3 Formationen nicht angemessen, und es mehr dem Begriffe Formation entsprechend sey, sie zu **einer** Formation, welche ich vorläufig *Trias* nennen will, zu verbinden.

[Anyone who examines the entire habitus of the mountains more closely and puts the essentially different fossils of the Zechstein and the Lias in the weighing pan, cannot fail to see that the Buntsandstein, Muschelkalk, and Keuper are the result of **one** period, and in which the fossils, to use the words of E. de Beaumont, are the thermometers of a geological epoch, so that the division of these units into three formations is not appropriate, and it is more in accordance with the concept of formations to combine them into **one** unit, which I will call provisionally the *Trias*.]

(Alberti 1834, pp. 323–324)

Note that the term ‘formation’, as used in Germany at the time, was analogous to the French ‘terrain’, meaning a regionally confined, but geographically characteristic rock succession.

However, Sedgwick did not mention the contribution of Alberti (1834) when he published his paper about the New Red Sandstone of the Eden Valley (Sedgwick 1836) because his monograph was based on a paper delivered to the Geological Society of London on 1 February 1832, even though it had a postscript dated 7 August 1835. Alberti’s book might not have reached Cambridge until later, although it was not as obscure as it might seem now; the book was under the imprint of J.G. Cotta of Stuttgart and Tübingen, world famous as the publisher of Humboldt, Goethe, Herder and others.

Perhaps, though, Sedgwick had other ideas. He wrote:

I think that the phenomena [*sic*] exhibited by our lower secondary deposits lend some support to a classification now generally adopted in Germany, which regards the whole carboniferous [*sic*] group but as an integral part of a great formation of red sandstone, commencing with the old, and ending with the new red sandstone series. The zoological argument certainly gives some consistency to this arrangement.

(Sedgwick 1836, p. 401)

He might have contemplated a future stratigraphic scheme in which the lower New Red Sandstone was subsumed within the Carboniferous System and the upper New Red Sandstone would continue to be regarded as the lower part of the Jurassic System, as was the case at that time (e.g. Buckland and Conybeare 1824). Thus no new name was needed and Sedgwick probably would not have fought his case in the way Clark and McKenny Hughes (1890) suggested he ought.

First expedition, 1840

Planning

Murchison began planning a geological expedition to Russia in 1838 (Collie and Diemer 2004, pp. 2, 20), as soon as he had finished writing *The Silurian System* (Murchison 1839). This was part of a wider plan, extending his field of study from Britain to Europe as a whole, for which he carried out fieldwork with Sedgwick in Germany and Belgium in 1839, covering large amounts of territory fast and meeting distinguished naturalists on the way, including in Berlin. This allowed them to test the validity of their Silurian and Devonian systems by observations in other nations; in addition, Murchison was refining his methods of carrying out fieldwork overseas.

Whereas travel through western Europe was feasible – and Murchison’s fluency in French, and patchy knowledge of German, helped him to visit the places he wished to see and find accommodation and food – Russia was clearly a different matter. Murchison could rely on his excellent French at Court, but he never learned Russian, which was needed outside St Petersburg, and travel was dangerous and bureaucratically demanding (Collie and Diemer 2004, pp. 2–3). However, Murchison’s scientific and diplomatic contacts, as well as his high social standing, enabled him to lay the groundwork for success. It seems that he achieved what he needed rather rapidly by following the simplest approach – namely, asking the Russian ambassador in London to help. This all happened in the first two weeks in May, between Murchison’s trip to France during April and his departure for Russia, so he might have had earlier communications to convince himself that he would be welcomed in Russia, although there is no record of these.

A sequence of letters in British Library documents how Murchison made the official links. The first letter (British Library Add. 46127, no. 326/7) is from Sir Gore Ouseley (1770–1844), dated 17 May 1840, in response to a request from Murchison to introduce him to Baron Philipp von Brunnow (1797–1875), the new Russian ambassador to London, who served from 1840 to 1854, and then again from 1858 to 1874. Ouseley, evidently an old friend, sends Murchison a letter of introduction to Sergey Uvarov (‘Ouvoroff’; 1786–1855), the Minister for Education in St Petersburg, and reports that Brunnow was immediately agreeable to Murchison’s request, and that he had prepared seven letters of introduction. One of these, in French, and dated ‘4/16 mai, 1840, Londres’ (British Library Add. 46125, no. 256/7), explains that Murchison hopes to visit Arkhangel’sk, Moscow, and the Baltic provinces, and that he is visiting for scientific purposes. The double date used here is a reminder that many Russians preferred the Julian calendar, still used by the Russian church, and then 12 days earlier than the Gregorian calendar in use elsewhere. Here, we use the Gregorian (western) dates throughout. Brunnow writes further that Murchison is authorized to demand the protection and guidance of a postilion of the Department of the Posts.

Murchison travelled to France from 1 to 30 April, where he carried out fieldwork and gave papers at learned society meetings in Paris. He prepared for the Russian trip with his friend, the French palaeontologist Edouard de Verneuil (1805–73; Fig. 3a). Verneuil then came to London and they embarked for Hamburg on 19 May, Murchison having received all the letters he needed from Brunnow. They went straight to Berlin, where the two geologists spent time with Alexander von Humboldt (1769–1859) and other naturalists, who made a point of showing them fossils from Russia as well as examples of the copper-bearing rocks of Perm, readily identified as similar to the Kupferschiefer of the German Zechstein (Collie and Diemer 2004, p. 24). Murchison sought practical help and recommendations from Humboldt, whose work he held in high regard. Humboldt was the only noted naturalist who had already

undertaken an extensive expedition in Russia (in 1829), as far as the Chinese border, accompanied by the mineralogist Gustav Rose (1798–1873) and the zoologist Christian Ehrenberg (1795–1876), both professors at the University of Berlin (Naumann 2007). Murchison admired the fact that Humboldt had undertaken such an ambitious trip and had mastered so many scientific skills and probably sought to model himself on the great German naturalist (Collie and Diemer 2004, p. 10). In Berlin, Murchison consulted Humboldt, Rose and Ehrenberg on everything they had seen in Russia.

Murchison and Verneuil then travelled overland from Berlin to Lübeck and from there took a passenger steamship to St Petersburg, where they arrived on 23 May 1840. There, as planned, they joined the expedition led by Baron Alexander Kasimirovich von Meyendorff (1798–1865; sometimes ‘Mayendorf’), the brother of Baron Pyotr Kasimirovich von Meyendorff (1796–1863), the Russian ambassador in Berlin from 1839 to 1850, whom they had just met. Alexander von Meyendorff (Fig. 3b) had been commissioned to travel throughout the northern parts of European Russia to prepare statistical reports on the state of industry and natural resources (Meyendorff 1849; Shchurovsky 1866; Bessudnova 2017, p. 222). Oddly enough, Meyendorff had visited Sir Walter Scott at Abbotsford, near Edinburgh, in 1829 (Struve 1950), but whether Murchison exploited this unusual Scottish connection cannot be said. In St Petersburg, Murchison met numerous important officials, including Count Egor (‘Georg’) Frantsevich von Kankrin (‘Cancrine’; 1774–1845), the Minister for Finance, and General Konstantin Chevkin (‘Tcheffkine’, ‘Tchevkin’; 1802–75), Director-General of mines and public works under Tsar Nicholas I. Note that, in the 1840s, Russian names were often transliterated according to a French or German system, so explaining the variants. Today, a third, English transliteration scheme is more commonly used. It was Kankrin who had invited Humboldt to undertake his expedition across European and Asiatic Russia in 1829.

The field party assembled in St Petersburg, with Meyendorff in the lead, as well as Murchison, and Verneuil. They were joined by the German–Russian geologist and biologist Count Alexander Andreevich von Keyserling (1815–91; Fig. 3c), who had studied in Berlin and returned to St Petersburg in 1840 to act as liaison for expeditions at the Institute of Mines. Keyserling invited his friend, the German zoologist Johann Heinrich Blasius (1809–70; Fig. 3d), with whom he had studied in Berlin: they had just completed their *Die Wirbelthiere Europa’s* [*Vertebrates of Europe*] in October 1839, published in 1840. Blasius arrived in St Petersburg a few days after Murchison and Verneuil, also by steamship from Lübeck. In addition, the young Russian mineralogist Nikolai Koksharov (1818–92; Fig. 3e) joined the party as an official of the St Petersburg Mining Museum. A detailed account of Koksharov’s commission survives (Shafranovsky 1964, pp. 59–61), in which General Chevkin instructed the newly qualified mineralogist to follow orders from Meyendorff, to collect samples of rocks and fossils for the Institute, to learn from Murchison, Verneuil and Keyserling, and to inform the Institute about his discoveries every two weeks, or more frequently, and for which he was allocated 450 silver roubles to cover expenses. In addition, Meyendorff invited Paul Vasilyevich Zinoviev (‘Sinovieff’), a young employee of the Finance Ministry, who had technical skills in chemistry (Meyendorff 1841a, p. 61; Blasius 1844, p. 17). This mysterious young man was persistently named ‘Tenovieff’ by Murchison (Collie and Diemer 2004, pp. 57, 60, 153). In addition, there was ‘Meyendorff’s man Ivan’, who acted as cook and driver (Blasius 1844, p. 82), as well as unnamed tarantass drivers and servants.



Fig. 3. Portraits of Murchison's five companions on the 1840 expedition. **(a)** Edouard de Verneuil (1805–73), the French palaeontologist. **(b)** Alexander von Meyendorff (1798–1865), the expedition leader. **(c)** Alexander von Keyserling (1815–91), the German–Russian mining expert. **(d)** Johann Blasius (1809–70), the German naturalist. **(e)** Nikolai Koksharov (1818–93), the Russian mineralogist. Verneuil is pictured about 1850, Meyendorff in 1859 and Blasius in 1840, but the other two considerably later in their lives. All images are in the public domain; the portrait of Johann Blasius is by Heinrich Brandes (1803–68) in 1840 and the portrait of Koksharov is by Nikolay Dobrovolsky (1837–1900) (State Hermitage Museum, St Petersburg).

Travelling through northern Russia

The party set off on 14 June 1840, following a sweeping 6000 km route (Shchurovsky 1866; Collie and Diemer 2004, p. 77; Bessudnova 2017, pp. 222–223) from St Petersburg NE to Arkhangel'sk, then SE to Krasnoborsk and Veliky Ustyug, following the Dvina River, then SW to Ustyuzhna along the Sukhona River, SE along the Volga to Nizhny Novgorod, and then along the Oka River to Ryazan, Moscow and St Petersburg, arriving on 25 August 1840. Murchison and Verneuil left Russia five days later. Johann Blasius had become ill at Veliky Ustyug at the Dvina–Sukhona confluence (Murchison *et al.* 1845, p. viii footnote) and Keyserling remained with his friend. These two continued their explorations separately, spending time in the south and SW of European Russia, and returning to Moscow in December 1840 (Keyserling 1841, p. 871).

For the naturalists, the expedition must have been dramatic and impressive, even for the Russians, who rarely left St Petersburg,

especially as the life of the serfs would have seemed other worldly. All six evidently kept journals, of which Murchison's survives (Collie and Diemer 2004), and all six participants published geological, natural history and ethnographic observations. Most famously, Verneuil and Keyserling cooperated with Murchison on his huge monograph (Murchison *et al.* 1845). In addition, Murchison led on the publication of a barrage of short and long articles from spring 1840 onwards. Verneuil (1841) wrote an account, published in German. Meyendorff (1841*a, b*) presented a short outline of the geology of Russia and a tentative geological map of European Russia, drawing on his earlier work and new observations on the expedition, as well as the official report somewhat later (Meyendorff 1849), in which he gave a detailed account of the rock succession from the Silurian to the Pleistocene and modern sediments, focusing on the building stones, clays and minerals that should be exploited by Russian industrialists.

Keyserling (1841) also published an account of the geology of European Russia, in which he describes the Silurian and Devonian,

and expresses satisfaction that the team identified the Mountain Limestone ('Bergkalk') along the Pinega and Dvina rivers. After a few words about the difficulty of recognizing the Zechstein because of the absence of fossils (Keyserling 1841, pp. 894–895), he notes that the Jurassic overlies the New Red at Kostroma, and reports seeing 'dark blue-grey clay full of fish' in Devonian deposits at Oka near Ore, which they observed under the snow on 1 December (Keyserling 1841, pp. 899–900). Later, Blasius (1844) published a narrative account of the expedition, focusing on the scenery and history and customs of the Russian people. Koksharov (1840) also published a paper about the results of the 1840 expedition, discussing the younger red sandstones above the Carboniferous limestones; he described his impressions in much more detail later in his memoirs (Koksharov 1890).

Puzzling over the Permian

Murchison and Verneuil saw New Red Sandstone rocks at three points in this circuit, but they were unsure how to date them. First, they saw extensive deposits of gypsum, red marls and yellow sands along the Dvina and Pinega rivers (Collie and Diemer 2004, pp. 79–80); at Ust' Vaga and Veliky Ustyug on the Dvina they saw red sandstones and more gypsum. Then, as they travelled up the Sukhona, a tributary of the Dvina, they saw more cliffs of red and green sediments. Along the Oka River, near Nizhny Novgorod, they saw more red marls, with associated gypsum, and even reported some small fish bones (Collie and Diemer 2004, p. 112), but their route took them SW on the current R76 highway, which follows the Oka River; they did not take the turn through Vyazniki on the current M7 highway, although coming within 20 km.

Verneuil and Murchison (1841) collaborated on their reports of the expedition, presented to the British Association for the Advancement of Science during the week of 17–24 September 1840, not long after Murchison's return to the UK, then to the Geological Society of France on 21 December 1840 and to the Geological Society of London on 24 March 1841 (Murchison and Verneuil 1841). In tracing who was the guiding influence, we note that in his report from November 1840 (Verneuil 1841), Verneuil makes no mention of the New Red Sandstone, nor indeed of anything between the Carboniferous and Jurassic, but the topic is fully developed in their joint papers from about the same time. In these papers, which are more or less exact translations of each other, they present an orderly summary of the rock succession they had seen, from pre-Silurian 'crystalline rocks' to the Pleistocene. Murchison and Verneuil (1841, p. 494) assign the Dvina gypsum beds to the Carboniferous and the other red beds to the 'Newer Red Formations', referring to 'a vast basin in the governments of Vologda, Nijnii, Kostroma' seen along the banks of the Dvina, Volga and Oka. They express their suspicion that the

... newer red system may be found eventually to contain the *equivalents* of the upper coal measures, lower new red sandstone (*rohle-todte liegende*), magnesian conglomerate, zechstein, and the Trias of German geologists, [but] the authors reserve their opinions until they have accomplished a tour to the Ural Mountains.

(Murchison and Verneuil 1841, p. 494)

The words concerning the New Red Sandstone in Verneuil and Murchison (1841) are different: Verneuil describes their concern to fill the gap between the marine Carboniferous and Jurassic sediments:

La solution de ces problèmes nous a beaucoup occupés, et nous n'avons épargné ni peines ni voyages pour chercher les éléments d'une décision qui pût complètement nous satisfaire ... Il'y a là

en effet un grand système rouge avec calcaire, gypse et sel qui occupe une partie des gouvernements de Vologda et Nijnii-Novgorod. Mais les points de jonction de ce système rouge avec le calcaire de montagne sont cachés presque partout ... et ce dépôt rouge est d'ailleurs si pauvre en fossiles que nos recherches à cet égard ont été infructueuses.

[The solution of these problems has occupied us a great deal, and we have spared neither labour nor travel to seek the basis for a decision which could completely satisfy us ... There is indeed a large red system with limestone, gypsum and salt which occupies part of the governments of Vologda and Nizhny-Novgorod. But the junction points of this red system with the Mountain Limestone are hidden almost everywhere ... and this red deposit is also so poor in fossils that our research in this regard has been unsuccessful.]

(Verneuil and Murchison 1841, pp. 60–62)

Verneuil is clear that the red sandstones, lacking fish fossils that could identify them as Old Red, and associated with evaporitic deposits (gypsum, salt), indicate terrestrial conditions, very different from the marine Carboniferous below and marine Jurassic above.

Second expedition, 29 May–1 November 1841

Preparing for the second expedition

Murchison returned to London from his first expedition early in September 1840. One of his first actions was to write a letter of thanks to Ambassador Brunnow; that letter does not survive, but Brunnow's hearty reply on 12 September does (British Library Add. 46125, no. 258/9). In perfect English, he expresses his pleasure that Murchison's trip had gone so well. Soon after, the two men must have met for the first time, because later letters from Brunnow in the collection (British Library Add. 46125, nos. 260/1–300/1) express a new intimacy and refer to dinners and reciprocal visits. At the same time, Murchison wrote a letter of thanks to Count Kankrin, the most senior Russian minister he had met in St Petersburg and, in a formal reply in October 1840 (British Library Add. 46125, no. 358), Kankrin says that he will make every effort to introduce Murchison to 'the Emperor'. Kankrin also thanks Murchison for the gift of a book he had sent (perhaps *The Silurian System*). This illustrates something of Murchison's *modus operandi* in securing his objectives: he identifies key people, sends them gifts, partly to elicit a reply, and partly to indicate what he has to offer as a professional geologist. Having met Kankrin in St Petersburg in May 1840, Murchison probably saw him as the most direct conduit to Tsar Nicholas I, then often called 'the Emperor'.

Among flurries of letters to other Russians of influence, Murchison wrote to the mine-owners of the Urals. The Prince de Butera wrote a reply (British Library Add. 46125, no. 352/3; 22 February 1841), delighted that Murchison would revisit Russia, and offering him letters of introduction to people in Perm. He also reports that General Konstantin Chevkin, Director of the Bureau des Mines in St Petersburg, has spoken to the Emperor, who willingly approves the trip. Murchison had also met Chevkin in May 1840 and there is a letter from Chevkin himself (British Library Add. 46128, no. 175/6; 22 March 1841) saying that all practical preparations for Murchison's visit are underway. He gives details of steamers to St Petersburg, promises to make arrangements to help Murchison and Verneuil through the customs formalities, gives details of maps and of suitable conveyances for the expedition, indicates that Meyendorff, Keyserling and Koksharov are available to accompany Murchison and, most welcome news of all, he reports

that Count Kankrin has obtained the Tsar's support for the expedition.

Ambassador Brunnow wrote two letters to Murchison in March 1841 (British Library Add. 46125, nos. 260/1 and 262/3), expressing 'the high importance which my Government attaches to your second visit to Russia' and arranging to meet in London to discuss the trip. In March 1841 also, Sidney Herbert sent Murchison a letter of introduction (British Library Add. 46126, no. 394) to Prince Michael Vorontsov ('Woronsow'), a third line of approach to the Tsar.

These letters confirm that the Tsar had offered Murchison's expedition the diplomatic, financial and logistical support he would need to travel away from the centre of government in St Petersburg. Based on the earlier trip, Murchison wanted to revisit the region east of Moscow to consider the New Red Sandstone red beds that he had seen along the Oka River to Nizhny Novgorod, and then to head into areas he had not visited before on the east side of the Volga, then over the Ural Mountains to see the mining areas, and then back through the southern regions of European Russia and the far SW to see the great coal basins of the Donetz basin, now largely located within the present day borders of the Ukraine.

All these letters came as Murchison was packing for his expedition and heading through France to meet Verneuil. They then travelled overland to Berlin and on to St Petersburg, where they arrived on 30 April 1841. Murchison's intention was to meet the senior Russian officials, but also to see the Tsar as soon as he could to begin detailed planning, to confirm that the logistical and diplomatic support would be there and to establish the frame of the expedition. On arrival, Murchison wrote to John de Buergh, 1st Marquess of Clanricarde (1802–74), the British ambassador in St Petersburg, from whom there is a reply (British Library Add. 46125, no. 382/3; 3 May 1841): 'The Ct. de Woronsow lives in his own house, in the little Morskoia ... Tell him you wish to go to the Balls; and then I can present you to the Emperor on Wednesday night'. On receiving this information, Murchison contacted Prince Mikhail Vorontsov (1782–1856), sending maps and books for him to present to the Emperor. Vorontsov was an anglophile, whose father, Semyon Vorontsov (1744–1832) had been the Russian ambassador in London from 1785 to 1806 and had lived in Britain for the last 47 years of his life. Vorontsov replied (British Library Add. 46128, no. 329/30; 4 May 1841; dated Russian-style 22 April 1841), saying that he will indeed present the volumes to the Tsar who 'is a just appreciator of Mr Murchison's eminent merit and of his fair and manly exposure of the state of intelligence of Russia'.

In his journal, Murchison records this series of encounters (Collie and Diemer 2004, pp. 148–154), including meeting Lord Clanricarde, and the efforts of the British Embassy to discover Murchison's fate. It was debated at this point whether he would become a temporary paid Russian official while he did the survey work, but that was rejected, the assumption being presumably that his status meant he could be regarded as a gentleman foreigner and not as a paid functionary. On 1 May he writes, 'If I have only good authority, and can travel where I please, my objects will be obtained'. Clanricarde immediately wrote asking that Murchison be invited to the Great Ball to meet the Emperor.

His main object now achieved, Murchison spent most of his two weeks in St Petersburg (30 April–11 May 1841) gathering information. He consulted the small number of local geologists, as well as others with travel experience through the areas he intended to visit. On Monday 3 May 1841 he visited Alexander Keyserling, whom he knew from the 1840 Meyendorff expedition, and who was to join him in the field again, and Gregor von Helmersen (1803–85; spelled 'Gelmersen' in Russian), Professor of Geology at the School of Mines. They showed Murchison maps and reported new discoveries in the geology of the Urals, including the new work of Helmersen (1841). On the following Monday, 11 May, he

returned to the School of Mines to inspect all the rock and fossil collections, noting materials from sites he hoped to visit, and he met Professor Karl Eichwald (1795–1876) for two hours. Murchison had spent time with Eichwald before the 1840 expedition and reported that he was unreliable: 'He is also a thin-skinned and bilious person, so that he makes enemies. I need not say he is no geologist' (Collie and Diemer 2004, p. 127). Shafranovsky (1964, p. 55) confirms this, noting that, unlike Eichwald's declared enemy Helmersen, 'who was cautious in his conclusions, Eichwald was often carried away and made mistakes, but at the same time he possessed great self-confidence and fervour in his judgements' ['В отличие от осторожного в выводах Гельмерсена Эйхвальд часто увлекался и ошибался, но вместе с тем обладал большой самоуверенностью и горячностью в суждениях']. These judgements seem overly negative as Eichwald had introduced modern palaeontology to Russia and named many fossil species that stand today; on the 50th anniversary of his doctorate, a large gathering of friends and admirers met to celebrate his wide-ranging contributions (Lindemann 1870).

Socially, Murchison also made the most of his time in St Petersburg, visiting counts and princes, and attending the ballet and the opera. For example, on 19 May he was invited to a soirée at the palace of the Prince Golitsin ('Galitzin'; British Library Add. 46126, no. 294). This Prince, like Butera, owned many mining factories (*zavody*) in the Urals and his permission was required for visits.

Meeting the Tsar

Murchison first met the Tsar at the Great Ball on 5 May 1841 and then at three subsequent public events, including balls and a great military parade. Murchison then rode to Moscow, where he spent two weeks, making a side expedition to see some geology around Tula and Kaluga south of Moscow, but returning on 28 May to see the Tsar present his son Alexander, later Tsar Alexander II, to the people of Moscow. It seems Murchison was a distant bystander at this event and had not been invited to the royal wedding earlier in St Petersburg; perhaps he had delayed in the hope of another meeting with the Emperor. Murchison and his party finally left Moscow on 29 May.

Murchison was famously a great admirer of Tsar Nicholas I (Fig. 4) and he wrote extensively about their meetings (Geikie 1875; Page 1976; Secord 1982; Stafford 1999; Collie and Diemer 2004). The Great Imperial Ball of 5 May was a particular high point and it is worth exploring Murchison's reactions and how the Russians there viewed Murchison. He had already seen the Tsar four days earlier, at the ballet on Saturday night. He sat with the British ambassador and provides a thorough description of the Tsar and his party, noting that, 'The Emperor looked, what he is, a noble Hercules' (Collie and Diemer 2004, p. 152).

Importantly though, these meetings in early May had a practical purpose. They would determine whether he could lead his planned expedition and, if so, under what authority. Murchison relied on receiving the full approval of the Tsar so he could proceed effectively, but also such approval would presumably lend greater weight to any later publications from the work. There is no doubt that Murchison relished the glitter and acclaim of meeting and being honoured by such noble people and that this would also enhance his standing back in Britain.

On Wednesday 5 May, Murchison attended the Great Ball as a guest of Count Vorontsov. He describes the scene in detail (Collie and Diemer 2004, pp. 154–158), records all the nobility and reports their dress. He was presented to the Emperor by Lord Clanricarde and explained his intentions, referring to his 1840 expedition, how the whole northern region of Russia, 'was made up of strata which I had spent so many years in classifying and arranging in other parts



Fig. 4. Tsar Nicholas I (1796–1855), portrait by Franz Krüger (1797–1857), a variant of a portrait produced for Queen Victoria when Tsar Nicholas visited London in 1844. She reported in her Journal in 1847 that he was ‘very striking [...] he is still very handsome; very tall with a very fine figure [...] & beautiful Grecian profile’. In this version, the blue sash passes from his right to left, whereas in the original, in the Royal Collection, it passes from left to right and Nicholas looks out straight at the viewer. Public domain, Wikimedia.

of Europe’. The Emperor replied that ‘all [his] wants should be supplied’ for the expedition and then spoke to Verneuil. These conversations were conducted in French, which Murchison and the Emperor spoke fluently. The Emperor had been briefed by Kankrin and others on Murchison’s previous expedition and knew the value of geological surveys in the search for coal and valuable minerals and in producing accurate maps of his territories. Murchison wandered off to explore the palace, when suddenly the Emperor appeared and ‘entered into a most familiar conversation’ about coal, timber and industrial development. Murchison favoured the Emperor with ‘a little geological lecture’, stressing the importance of mapping and accurate fieldwork and why coal would never be found in the northern regions covered with Silurian and Devonian rocks, a neat explanation of the economic value of stratigraphy.

As the Emperor spoke to Verneuil, Murchison stepped back and admired the cut of Tsar Nicholas’ outfit (Collie and Diemer 2004, p. 157):

When the Emperor is in full costume, it is impossible to behold a finer sample of human nature. The tight breeches are unusually well fitted, and especially on the upper part of the thigh, so as to delineate even the virile member with great precision. Your eye glances from these to his beautiful family, and the animated but *épuisée* Empress, and the history is told. This night all the men were in shorts and stockings, and everyone had his tights equally drawn as those of His Majesty. I never saw so clear a display of the virile member!

The Empress had been exhausted (*épuisée*) by having borne 15 children.

Murchison was evidently well regarded. It seems the Russian men admired his court dress just as much as he had admired the Emperor’s:

Мурчисон явился во дворец в том самом мундире полковника, который носил во время своего похода в Испанию с Веллингтоном, что, по-видимому, было очень приятно императору; мундир этот был очень красив: красный, с серебряным шитьем на черном воротнике и с серебряными эполетами.

[Murchison appeared at the palace in the same colonel’s uniform that he wore during his campaign to Spain with Wellington, which, apparently, was very pleasing to the Emperor; this uniform was very beautiful: red, with silver embroidery on a black collar and with silver epaulettes.]

(Koksharov 1890, p. 14)

Murchison made a favourable impression, largely by his military bearing (Geikie 1875; Koksharov 1890; Vaksman 1991; Collie and Diemer 2004; Malakhova 2012). The Tsar commented on Murchison’s military background, noting, ‘that his doctrine always had been that the army was the best school for every profession, and he was right glad to see that it made a good geologist’ (Collie and Diemer 2004, p. 156).

Вообще Мурчисон, по своим изящным манерам и умению обходиться с людьми, производил на всех приятное впечатление. Он был предупредителен, учтив и крайне деликатен в общении.

[In general, Murchison, by his graceful manners and ability to deal with people, made a pleasant impression on everyone. He was helpful, courteous and extremely delicate in communication.]

(Koksharov 1890, p. 13).

After the Great Ball, Tsar Nicholas I met Murchison several times, inviting him to military reviews and receptions in St Petersburg and Moscow, and the friendliest relations were established between them:

Мурчисон часто получал от государя приглашение к обеду, и всякий раз государь Николай Павлович долго беседовал с ним.

[Murchison often received an invitation from the sovereign to dinner, and each time sovereign Nikolai Pavlovich had a long conversation with him.]

(Koksharov 1890, p. 14)

Motivations

The Tsar’s motivations in engaging with Murchison mainly concerned the debate in St Petersburg about whether or not Russia should industrialize (Collie and Diemer 2004, pp. 5–6). Murchison’s job was to report back on the state of mineral resources and industry throughout European Russia and to recommend to the Tsar and his ministers how far he might encourage a western-style industrial revolution. General Konstantin Chevkin, whom Murchison had met before his 1840 expedition, had visited western Europe to study the railway systems and he wanted to promote modernization. Most of the economy in Russia was

agricultural at this time, but the Tsar was aware of rich mineral reserves along the Ural Mountains and in the Donetz coal basin. Other ministers at the St Petersburg court, including Kankrin, advised strongly against any such modernization because they feared social unrest and the collapse of their privileges. The princes who owned mines in the Urals and the Donetz area often exploited them sufficiently for their own expenses, but not in a modern way, and indeed many hardly ever visited their properties, preferring to stay in St Petersburg near the Tsar and enjoying the safety and luxury of modern living there. The Tsar may have viewed Murchison as a useful foreigner who would provide confidential information through the eyes of someone who had no preconception of Russian society. His report could be accepted or ignored, and his geological investigations for scientific purposes might also be practically useful to the Tsar in terms of estimating mineral reserves.

The first railway in Russia had been built in 1837 between St Petersburg and Tsarskoe Selo, the Tsar's summer residence. Tsar Nicholas I then ordered a railway line to be built from St Petersburg to Moscow in 1842. It was completed in 1851, but industrial development was slow, especially in the Urals. For example, whereas railway building was at its peak throughout western Europe in the 1830s and 1840s, it did not peak in Russia until the 1860s and 1870s. It was only 100 years later that Stalin drove a major wave of Russian industrialization in the 1920s and 1930s.

Murchison's intentions were four-fold, as [Collie and Diemer \(2004, p. 6\)](#) outline: (1) to establish and test the stratigraphic scheme he and other British geologists had established in their homeland, but in an entirely new land; (2) to gain access to a large geographical area where very little geological research had been carried out by overcoming the obstacles that prevented others from even trying; (3) leading a large-scale collaborative team to achieve such an enormous endeavour within a reasonable span of time, something he was equipped to do by his character and contacts; and (4) to complete a broad-scale report and map ranging across all fields of geology, including regional and economic geology, stratigraphy, palaeontology and igneous rocks.

Moscow to Vyazniki

After leaving Moscow on 29 May 1841, the four geologists (Murchison, Verneuil, Keyserling and Koksharov; [Figs 1 and 3](#)) travelled for five months, sometimes as a party of four, sometimes splitting into two groups. They first headed east from Moscow towards Nizhny Novgorod, across the Volga to Kazan and Perm, over the Ural Mountains, and backwards and forwards a few times to visit all towns and mines, then through Orenburg to the southern provinces, through the Donetz basin, and north to Moscow and then to St Petersburg ([Murchison 1841a, b](#); [Geikie 1875](#); [Shatsky and Yanshin 1986](#); [Vaksman 1991](#); [Collie and Diemer 2004](#); [Benton et al. 2010](#)). This challenging and lengthy circular route covered over 20 000 km ([Fig. 5](#)). When the party reached Vladimir, 186 km ENE of Moscow, they divided, Koksharov and Murchison passing through Nizhny Novgorod to Kazan, and Verneuil and Keyserling taking the southern route through Penza to Simbirsk ([Collie and Diemer 2004](#)).

As they passed through the religious city of Vladimir, Murchison noted classic Carboniferous brachiopods in the limestone blocks of the churches; he had observed the slightly dipping Carboniferous throughout the Moscow basin. Therefore, based on their observations of New Red Sandstone red beds along the Dvina, Pinega, Sukhona and Oka rivers in 1840, he was not surprised to come back to these red beds as he headed east. In his journal, Murchison reports ([Collie and Diemer 2004, pp. 181–185](#)) how he and Koksharov were forever stopping and examining rock exposures along the way, including making themselves thoroughly muddy at various points along the Klyaz'ma River, until they arrived in Vyazniki on 31 May, where they conducted detailed geological observations.

Vyazniki and first sighting of the Permian

Murchison and Koksharov liked Vyazniki. In his field diary, Murchison wrote:

Viasniki is a pretty small town, with a very good (Russian) *gastinitza* or Inn, the Nijny Gorodskaya. The town is at the base of red alluvial and diluvial hills, on a flat, from which the river has receded.

([Collie and Diemer 2004, p. 184](#)).

[Sennikov \(2020, pp. 59–62\)](#) was intrigued by this confident naming of the hotel, as there is no record of any hotel with such a name in Vyazniki. In Russian, 'Nizhegorodskaya' is an adjective describing the hotel, which at the time might have been situated in several rooms of the private Sizyakov house. Murchison named the hotel 'Nijny Gorodskaya' because it was located on Shosseinaya Street, part of the Moscow to Nizhny Novgorod highway. [Sennikov \(2020\)](#) noted that the Sizyakov house was described by the writer [Avdeev \(1853, p. 341\)](#):

Вязники – очень порядочный уездный город, лежащий под горою, скат которой густо усеян яблонями, бывшими уж в цвету. В Вязниках есть изрядная гостиница, помещенная в большом каменном доме. Гостиница эта замечательна не отделкой своей в купеческом вкусе с расписанным потолком и картинами, деланными, кажется, одной с потолком кистью, но тем, что в ней есть очень хорошие сафьянные диваны на пружинах – вещь, которая единожды встречается в гостиницах всего моего двухтысячеверстного пути.

[Vyazniki is a very decent district town, lying under a mountain, the slope of which is densely dotted with apple trees that were already in bloom. In Vyazniki there is a substantial hotel housed in a large stone house. This hotel is remarkable not for its decoration in a merchant's taste with a painted ceiling and paintings made, it seems, with the same brush as the ceiling, but for the fact that it has very good morocco sofas on springs – a thing that I have only once encountered in hotels through all my two thousand miles of travel.]

The merchant family Sizyakov had established the first bookstore, the first local publishing house, the first telegraph (in their own house), the first power plant (on land behind their house) and later the first cinema in the town. A description of 1851 mentions a solid main house with outbuildings and a bathhouse ([Telcharov 1995](#)). In drawings ([Fig. 6a](#)), this is a one-storey building built of stone in the midst of wooden houses and it still exists ([Fig. 6b](#)), with a new upper, wooden storey, but still traces of the six windows along each wall, located on Sovietskaya (formerly Shosseinaya) Street.

The key point about Vyazniki, apart from the intriguing local history, is that this is where Murchison began to feel he was on the trail of the Permian ([Benton et al. 2010](#); [Sennikov 2020](#)). He had traversed great distances through classic Carboniferous limestones all round Moscow and the sudden switch to younger red bed sediments was striking. Although he did not provide any detail in his journal ('The geology of Vladimir and Viasniki I pass over and refer to my big book'; [Collie and Diemer 2004, p. 183](#)), there is much to see in his manuscript field diary in the archives of the Geological Society of London (LDGSL839, N86, pp. 60–71), where he illustrates and describes the section through the red beds on the south bank of the Klyazma River ([Fig. 7a](#)), but it is important to establish just where he measured this key section.

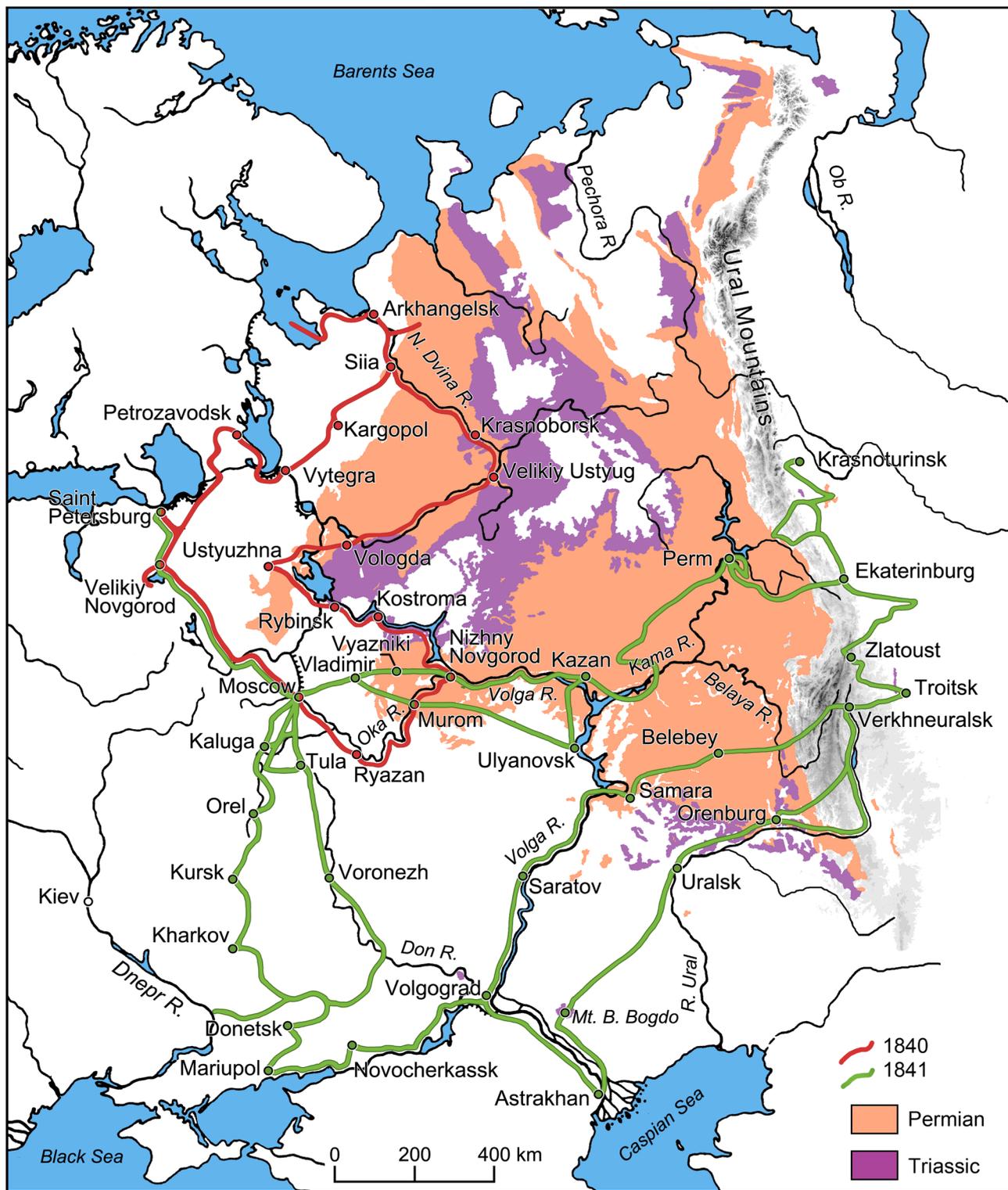


Fig. 5. Routes of the expedition of Murchison across Russia. The red line shows the route in 1840 and the green line the 1841 route according to Shatsky and Yanshin (1986), Vaksman (1991) and Collie and Diemer (2004).

Our visits to Vyazniki have confirmed the spot. Benton *et al.* (2010, pp. 315–317) and Sennikov (2020, pp. 62–65) note that the only possible location is a 40–50 m high cliff on the right bank of the Klyazma, in a ravine under the Venets viewing platform (56814.321 N; 42811.968 E; Sennikov and Golubev 2006, locality 9; Fig. 7b), located in the Tolmachevo area of modern Vyazniki. This is confirmed by the cross-sectional shape of the cliff in Murchison's drawing (Fig. 7a), with the river channel at the foot, uniquely seen here. A confounding aspect is that Murchison

mentions the section 'is in a ravine near a Church on the top' and he shows a small church in his drawing (Fig. 7a), and yet there is no church at this point. However, Sennikov (2020, p. 64–65) notes that there is a very visible church next to the highway in Tolmachevo, the Church of the Exaltation of the Cross, dating from 1794, at number 10 Gor'kogo Street. The building is large, painted red and white, with a green roof and substantial tower, located at the point today where the road to the river viewpoint splits from the main highway (now called Veterinarnaya Street). The viewpoint is not shown on

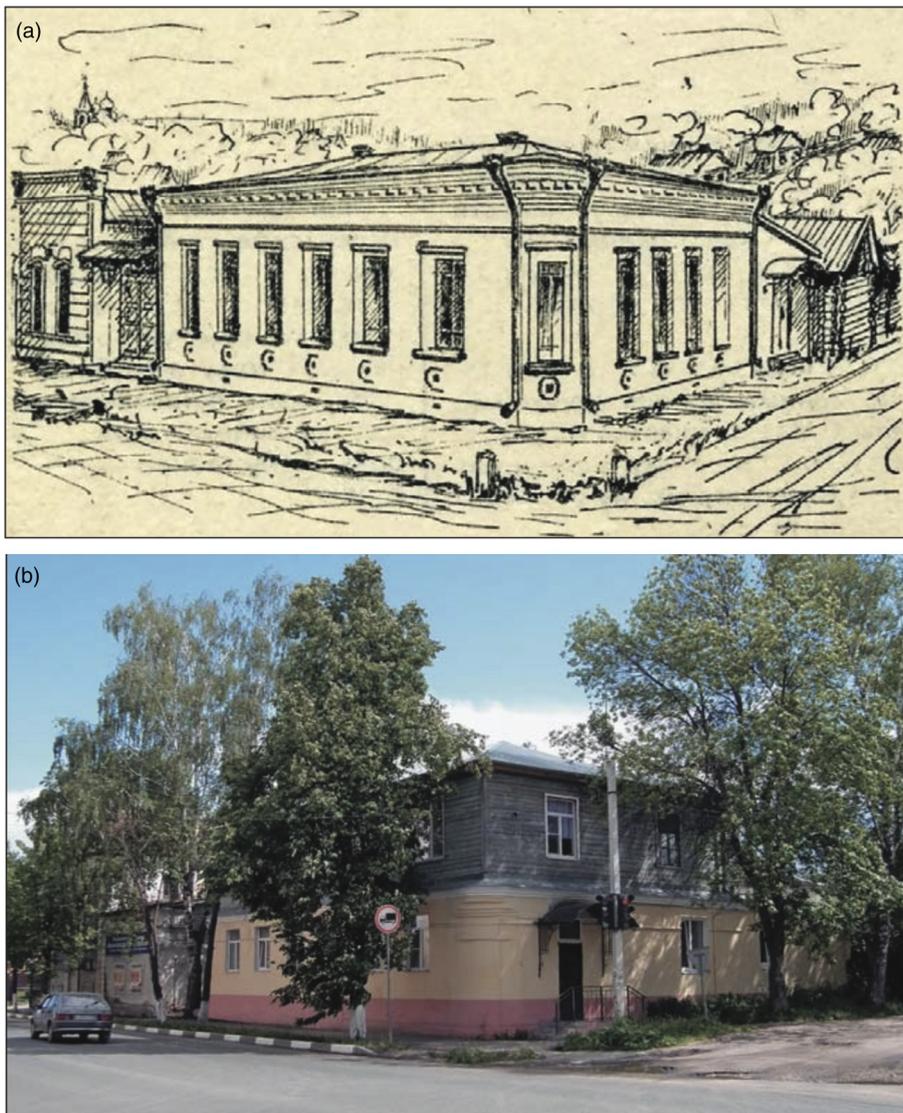


Fig. 6. Sizyakov's house, probably the mythical Nizhni Gorodskaya hotel where Murchison and Koksharov stayed on 31 May 1841. (a) The house with an outbuilding, one of the few stone-built residences on the main road through Vyazniki; drawing by L.I. Anosov. (b) The house today, located at the corner of Sovietskaya Street and Simonov Street at No. 36/2; to the left and behind the trees on Sovietskaya Street is a rebuilt wing, formerly the electricity plant; photograph by E.A. Sennikova.

the 1850 map and there was no road to it; however, driving out of Vyazniki on the post road, Murchison could not have failed to notice this church and he used it as a landmark to mark the side turn for the river, even though it is located 1.5 km from the Venets exposure. Today, suburban housing fills the space between the church and the viewing platform, but in 1841 this was open farmland, with no trace of a nearer church.

The Tolmachevo–Venets site is confirmed by a later memoir produced by the Geological Committee to create a General Geological Map of Russia. Survey geologist Nikolai M. Sibirtsev (1860–1900) describes the only good outcrop in the Vyazniki area at exactly this spot, where ‘almost immediately below the city the Klyazma comes close to the high bank and washes it away’. In addition, in his description of this section, Sibirtsev (1896, p. 99) mentions that ‘as early as Murchison, in local sandstones and conglomerates, associated with *Estheria* sp. and *Bairdia* sp. there are also *Palaeoniscus* scales’. Currently, this outcrop is heavily overgrown.

More Permian, from Nizhny Novgorod to Perm and over the Urals

Continuing along the highway to Nizhny Novgorod, Murchison noted that the watershed plateau between the Klyazma and Oka rivers is composed of the same variegated deposits as the outcrops at

Vyazniki, now assigned to the Upper Permian, stretching to Gorokhovets, behind which it flattens. In the section from Gorbatov to Nizhny Novgorod, in cliffs along the right bank of the Oka, the researchers observed the same thick unit of variegated Late Permian rocks, only with a large number of gypsum layers near the village (Collie and Diemer 2004, pp. 184–185).

Murchison and Koksharov passed through Nizhny Novgorod on 1 June 1841 and continued east along the right (south) bank of the Volga towards Kazan, a distance of c. 400 km. Murchison reported (Collie and Diemer 2004, pp. 186–192, 202–212) continuing observations on the red mudstones, marls and sandstones and white limestones of the New Red, making comparisons with rocks they had seen the year before on the banks of the North Dvina River. Between Sviyazhsk and Kazan, the geologists worked their way through a section of the Permian, consisting of three units: gypsum and thin, white fossiliferous limestone; grey limestone; and red, green and white marls and sands (Fig. 8a). In his journal (Collie and Diemer 2004, p. 190), Murchison writes:

My notebooks are full of sections and descriptions of the limestone series of rocks, to which I afterwards gave the name of Permian, showing how they are subordinate to, **and pass up into**, all the red and green marls and sands before described; and how at Sviyazhsk the lower beds contain the characteristic Permian fossils.

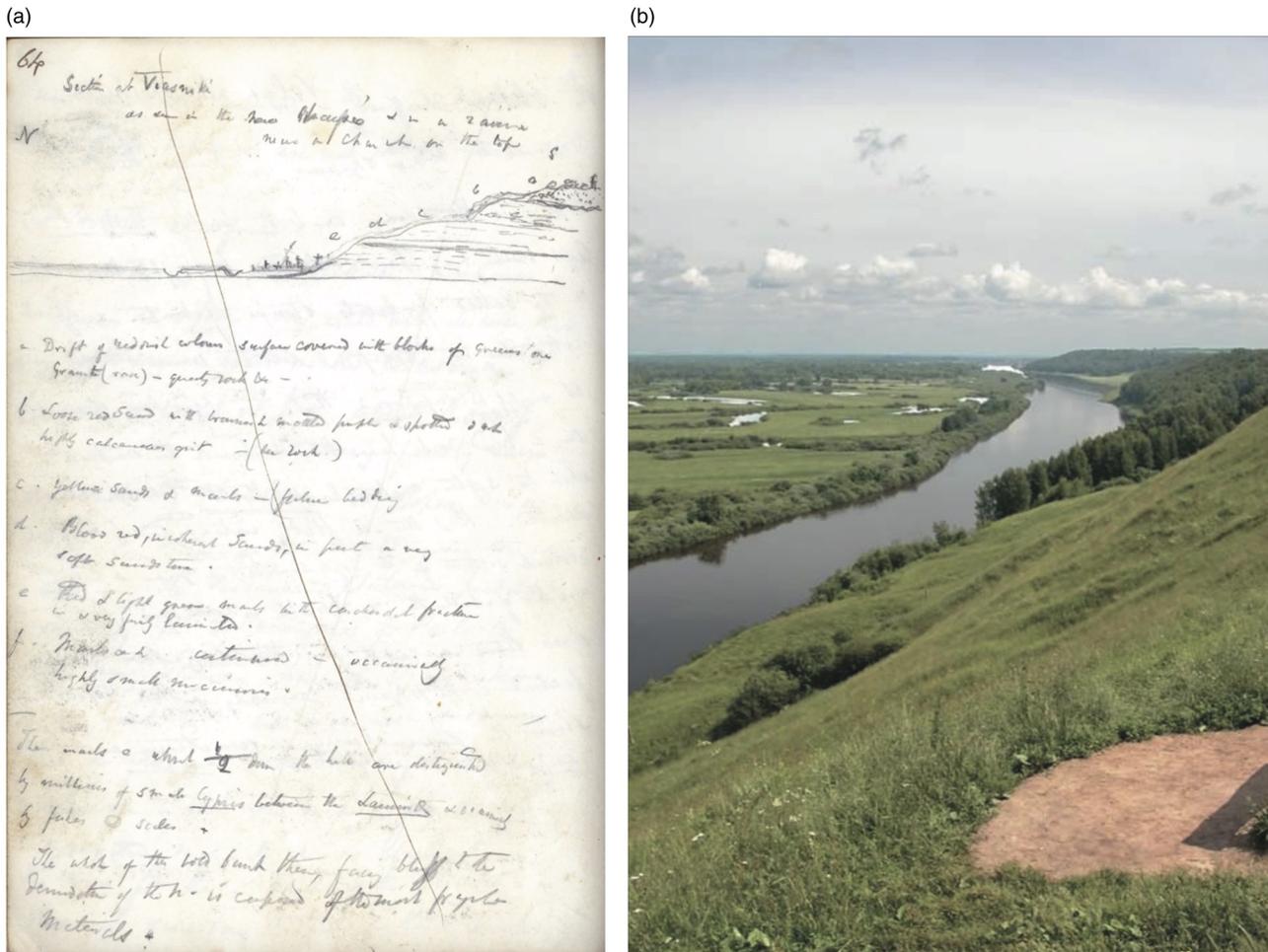


Fig. 7. First identification of Permian rocks in Russia. (a) Page 64 from Murchison's notebook for 19 May 1841 (LDGSL 839, N86) showing his pencil sketch of the log through the ravine at Tolmachevo, at the eastern end of Vyazniki, on the south (right) bank of the Klyaz'ma flood plain. (b) View of the Klyaz'ma River from the Venets viewing platform at Tolmachevo, east of Vyazniki; photograph by E.A. Sennikova.

The notebooks show one of these important sections, at Sviyazhsk (LDGSL M/N 86, p. 93), and key evidence for the establishment of the Permian System, as the lower beds contained fossils that seemed to him to define the base.

The two parties met on 7 June 1841 in Kazan, where Murchison inspected the small university and museum, and they set off the following day along the Kama River, and then over the Vyatka River on the way to Perm. He continued to observe the Permian red beds and limestones with *Modiolae* (= bivalves) and he noted that the village Russkiye Sarsazy beside the floodplain of the Kama, '... stands on a bluff cliff of red and white marls, overlying, but quite conformable to, the Zechstein, which here subsides' (Collie and Diemer 2004, p. 204). This is the Chistopol section, named after the nearest large town (Fig. 8b). NW of Mamadysh on the Vyatka River, he visited the 'Taisheffskoi Zavod' copper works, where he noted (Collie and Diemer 2004, p. 207) details of the copper ores and their occurrence all the way to Perm, as well as making the connection to the German Permian and Triassic successions.

The party of four headed over the wooded uplands towards the city of Perm, pausing at Yugo-Kamskiy to see the *zavod* (works) of Prince Butera on 13 June, where Murchison described (Collie and Diemer 2004, pp. 209–211) specimens of greenish copper-bearing sandstones with plant remains and added that 20 species of plants had later been identified. Murchison noted 'grits' consisting of pebbles of older rocks (Silurian, Devonian and Carboniferous) from the Urals mountain chain, and that the miners sank shafts 12–40 m through the surface rocks, passing through the 'surface drift' and then red marls

and mudstones, to reach the copper-bearing sandstones, sometimes with rich plant remains and even coal beds up to 1 m thick. Murchison reached Perm on 15 June 1841, but mainly noted the difficulties the governor had in handling large numbers of exiles passing through his 'Gouvernement' on their way to Siberia.

As the party headed east, passing deeper into the Ural Mountains, Murchison continued his observations, at pains to discriminate definite Carboniferous from New Red using fossils, and clearly unsure about the succession of both and where the boundary lay. He again (Collie and Diemer 2004, p. 218) reported the conglomerate containing pebbles of Silurian and Devonian sedimentary rocks, as well as metamorphic rocks, forming beds up to 0.5–1 m thick, with 'wayboards' (interruptions to sedimentation between thicker beds), interpreted now as high-energy deposits with multiple tongues of sediment, such as within an alluvial fan. He noted a fragment of a *Productus* in one clast, and suggested it was all probably Rotliegend in age, and added a later note that this marked the base of the Permian as he defined it. Indeed, according to the current Russian geological maps at his locality Bisserskaia (modern 'Bisert'), he was at the edge of the large Permian basin around Perm and entering the massively north–south faulted Carboniferous and older Paleozoic part of the central Urals.

Murchison and his friends arrived in Ekaterinburg on about 22 or 23 June and they then spent a month exploring the copper and gold mines around that city and in criss-crossing the Ural Mountains from east to west and back again, exploring the heavily faulted and folded Paleozoic rocks and their mineral wealth.

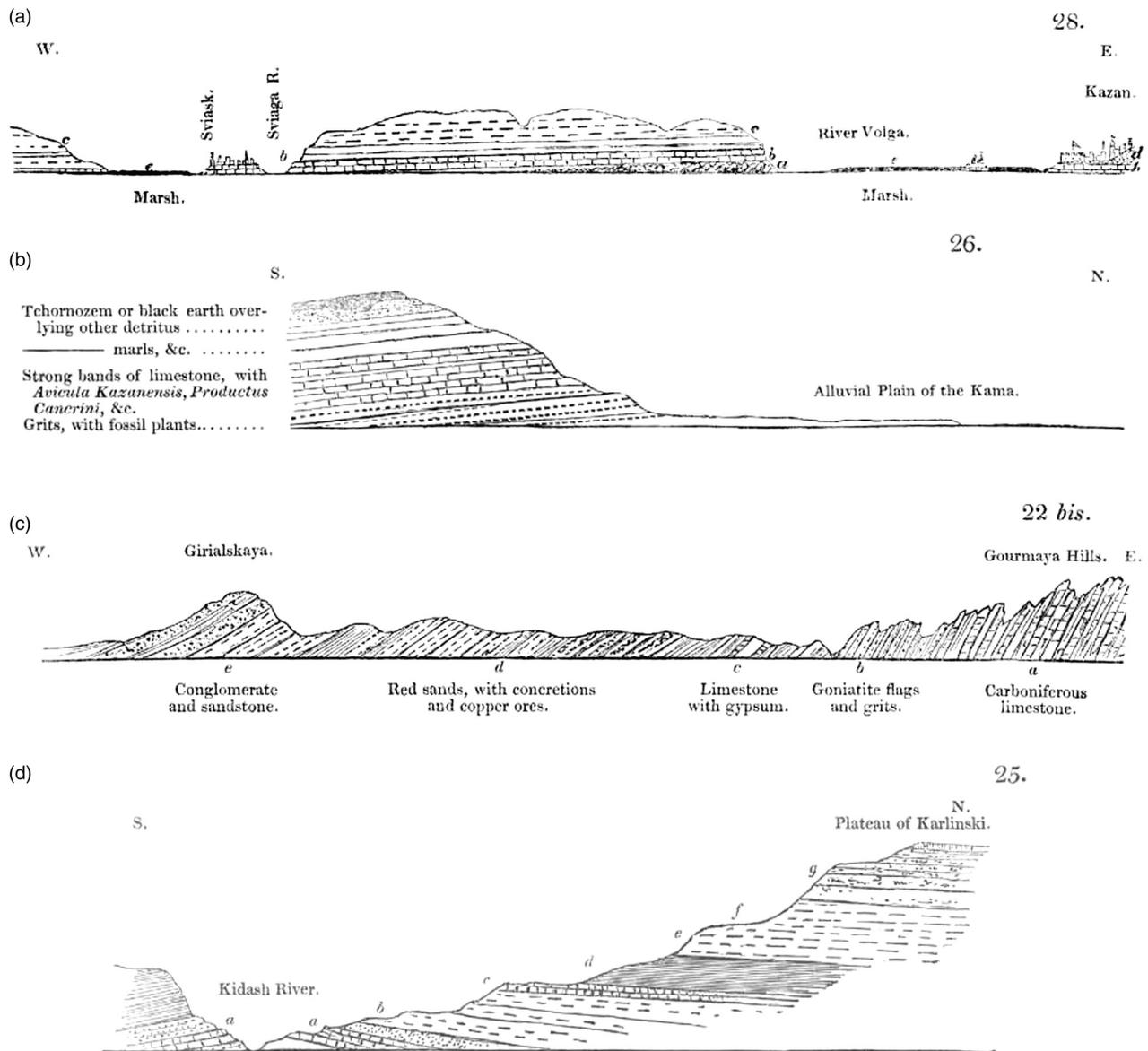


Fig. 8. Stratigraphic sections based on field sketches from Murchison *et al.* (1845) showing (a) the Sviyazhsk to Kazan section along the River Volga, (b) the section at Tchistopol, (c) from Giryal to the Gourmaya Hills and (d) on the banks of the Kidash River. In part (a): a, gypsum and white limestone; b, grey limestone and shale, with *Productus cancrini*; c, red, green and white marls and sands. In part (d): a, calcareous flagstone with *Productus cancrini*; b, grey sandstone; c, white marl passing to tuffaceous limestone; d, yellow calcareous shell beds, with bivalves and plants; e, thick white marl; f, red and green sands with some copper; and g, white marl with red shales.

Fixing the limits of the Permian and meeting Wangenheim von Qualen

The four geologists eventually headed south and the parties split for the traverse of the great Asian steppes south of the Urals and just north of Kazakhstan, reaching the city of Orenburg, located on the border of Asia and Europe, on 31 July 1841. Murchison noted a classic section of overturned beds, spanning from Carboniferous limestone in the so-called ‘Gourmaya Hills’ to conglomerates and sandstones at Gir’yal, 100 km east of Orenburg (Fig. 8c); parts of these alluvial fans are, in fact, of earliest Triassic age (Tverdokhlebov *et al.* 2003). In his publications, Murchison frequently referred to the Gurmaya Hills (Fig. 9), a southern extension of the Urals that meets the Ural River at Verkhneozernoye and hosts the Carboniferous–Permian contact, but the name Gurmaya does not appear on modern maps. From Orenburg the party travelled south to Sol’Iletsk to see the Permian salt deposits and brine lakes, now identified as Kazanian-age salt domes. On the

Sakmara River west of Orenburg, Murchison observed Permian limestone overlain by red sandstones and marls.

Heading north and east, they visited Belebey in Bashkortostan, one of the great Russian oblasts, or regions, and met the mine manager Friedrich Wangenheim von Qualen (1791–1864; Fig. 10a), a German geologist. von Qualen knew the Zechstein in his native land and had already recognized the similarities in geology, not least in the copper-bearing sandstones his mine was exploiting, associated with rich remains of fossil plants and some rare reptile bones, just as in the Kupferschiefer in the German Zechstein. Murchison reports (Collie and Diemer 2004, p. 333) that fossil reptile bones had been found above and below some purplish red siltstones that von Qualen called the ‘Leber Thon’ (‘liver clay’), a sedimentary unit observed from Orenburg to Belebey, and always occurring below the Zechstein. The bones came from fine-bedded sandstones, some with copper, at Klyuchevskoye near Karkala, south of the Dyoma River, and some from red coarse sandstone at Verknetroitskoye (Murchison



Fig. 9. One of Murchison's favourite images of the Russian expedition of 1841. Here, he and his colleagues are racing along in a tarantasse, with long wheelbase, past the Gurmaya Hills at the southern end of the Ural Mountain chain, here composed mainly of Carboniferous limestones underlying Permian red beds. The location is 120 km east of Orenburg, at the point where the Ural River cuts through the southern toe of the mountains, on the highway from Orsk to Orenburg (modern P336). Image from Murchison (1872, p. 312).

calls it 'Verchy Troitsk') on the Kidash River, 40 km WNW of Belebey.

The party marched 40 km from Belebey to the Kidash River, where they saw a section that would become of key importance in Murchison's later stratigraphic decisions (Fig. 8d). At Nizhnetroitskiy (the 'lower' village to the 'upper' Verknetroitskoye, where bones had been found), he could identify seven distinct horizons, with the key mollusc Verneuil later called *Productus cancrini* in the lowest unit (a), as well as further productids and fossil plants in bed (d) and some copper in red-green sandstones (f). He spent two days (5–6 August) walking over these rocks, drawing sections and making comparisons with the Rotliegend and Zechstein of Germany, impressed by the evidence from marine fossils (productid brachiopods) associated with plant remains and copper that the succession precisely matched the German Rotliegend and Zechstein; in other words, a complete

section of his planned Permian (Collie and Diemer 2004, pp. 335–338). Murchison expressed his gratitude to von Qualen, 'our kind and intelligent Major ...' who left them that day.

Before meeting Murchison, von Qualen had already made several geological and palaeontological contributions through correspondence with the savants in St Petersburg. These included discussions with the noted Gotthelf (Grigory Ivanovich) Fischer von Waldheim (1771–1853; Fig. 10b), who became his friend and mentor, another German transplanted to Russia. von Waldheim (1840) described von Qualen's fossil plant collection from the copper-bearing sandstones. A year later, von Waldheim (1841) named *Rhopalodon*, a dinocephalian reptile, based on a jaw with teeth collected by Wangenheim from the copper mine at Klyuchevskoye, and he also refers to reptiles from the Kidash River, noting that they lie above definite Carboniferous, and compared the reptile with German finds in the Zechstein.



Fig. 10. Two geological friends. (a) Friedrich Wangenheim von Qualen (1791–1864), photograph from the collection of the group of the history of geology of the Geological Institute of the Russian Academy of Sciences, Moscow. (b) Gotthelf (Grigory Ivanovich) Fischer von Waldheim (1771–1853), Director of the Natural History Museum at Moscow University.

von Qualen (1843) published a detailed geological account of the Orenburg oblast, mapping the Carboniferous as 'Bergstein' and the Permian as 'Zechstein'. In the text, he provides a full discussion of the local geology and palaeontology, using Murchison's Permian term. He describes the bones in detail, noting the occurrence of:

... eine grosse Menge Saurierknochen, wie z. B. mehrere Rückenwirbel mit elf Rippen eines dieser Thiere im grauen und röthlichen Sandsteine. Wir sehen Saurierreste, fossile Holzstämme, Conglomeratbildung, Kupfergrün und Pflanzenabdrücke in einer und derselben Gebirgsart, ja bisweilen in einem und demselben Handstücke beisammen.

[... a great mass of reptile bones, such as several dorsal vertebrae with eleven ribs of one of these animals in the grey and reddish sandstone. We see reptile remains, fossil tree trunks, conglomerate formations, copper-green and plant impressions in one and the same rock unit, even together in one and the same hand specimen.]

(von Qualen 1843, pp. 553–554)

He refers these to his 'lower group' of the succession, equivalent to the Rotliegend, and overlain by more calcareous sandstones that lack fossils and conglomerates; his 'middle group', equivalent to the Zechstein. He is clear (p. 557) that these are older than the Buntsandstein and Keuper of Germany (Triassic) because of the occurrence of productids, which in Germany occur last in the Zechstein.

Murchison's opinion of the 'kind and intelligent major' then turned and, in a footnote, Murchison *et al.* (1845, p. 461) declared that 'He was, indeed, entirely ignorant of the relations in question when we visited him, and begged us to explain the succession of the strata'. Murchison was presumably offended by von Qualen's 1843 publication, believing he had stolen his work and the latter defends his integrity:

Dabei muss ich bemerken, dass alle diese so deutlich sprechenden Thatsachen grössentheils Folge meiner späteren Forschungen sind, und deshalb weder Murchison noch anderen Geologen bekannt sein konnten.

[I have to note that all these so clearly speaking facts are largely the result of my later research and therefore could not be known to either Murchison or other geologists.]

(von Qualen 1843, p. 551)

Having bid von Qualen a courteous farewell, Murchison and Verneuil continued west towards the large city of Samara on the Volga, then along the Volga heading SW to Saratov (14 August), examining the marine Jurassic on the way, and then Sarepta (a region of modern Volgograd, then called Tsaritsyn) in late August. While Murchison and Koksharov headed west, Keyserling took a side trip to Mt Bogdo, 212 km east of Volgograd, known as the only previously reported Triassic in Russia and entirely isolated from all the sedimentary basins they had explored east of the Volga. Murchison headed through Mariupol (Zhdanov) and then north from there through the Donetsk coal fields and through Kursk, Orel and Kaluga, arriving in Moscow on 2 October 1841.

Naming the Permian

The 1841 paper in its many guises

Murchison spent a week (1–8 October 1841) at Mrs Howard's Hotel in Moscow, during which he prepared a draft map, stratigraphic

section and a 14-page report of the main results of the expedition for Count Kankrin:

[A]lso a letter was concocted to old President and Professor Fischer, for publication in the '*Bulletin de Moscou*', and the German periodicals, giving a slight sketch of our doings, and in which I first suggested the term 'Permian'.

(Collie and Diemer 2004, p. 408)

This is the famous letter, in French, sent to Fischer (Fig. 10b) on 8 October, read at the next meeting of the Society of Naturalists of Moscow on 15 October and then published before the end of the year (Murchison 1841a; Fig. 11). It was preceded by the geological observations of Keyserling (1841) on the 1840 expedition, which had been sent to the Society in February 1840. Both papers were published in Part 4 of Volume 14 of the *Bulletin*, dated 8 (=20) September 1841, but how Murchison's letter, written in Moscow in early October and presented to the Society on 15 October found itself in Part 4, passed for publication by the censor a month earlier, is unclear. The next issue of the *Bulletin* was Part 1 of Volume 15, published on 3 January 1842. For non-French-speaking Russians, the original letter to Fischer (Murchison 1841a) was also translated into Russian for the *Mining Journal*.

The paper indeed went to the 'German periodicals', appearing in the last issue of *Neues Jahrbuch* in 1841 (Murchison 1841b). This version was like the classic Russian *matryoshka*, a doll within a doll within a doll: Murchison's letter was wrapped by comments from Fischer, which were wrapped, in turn, by being a letter to the Editor,

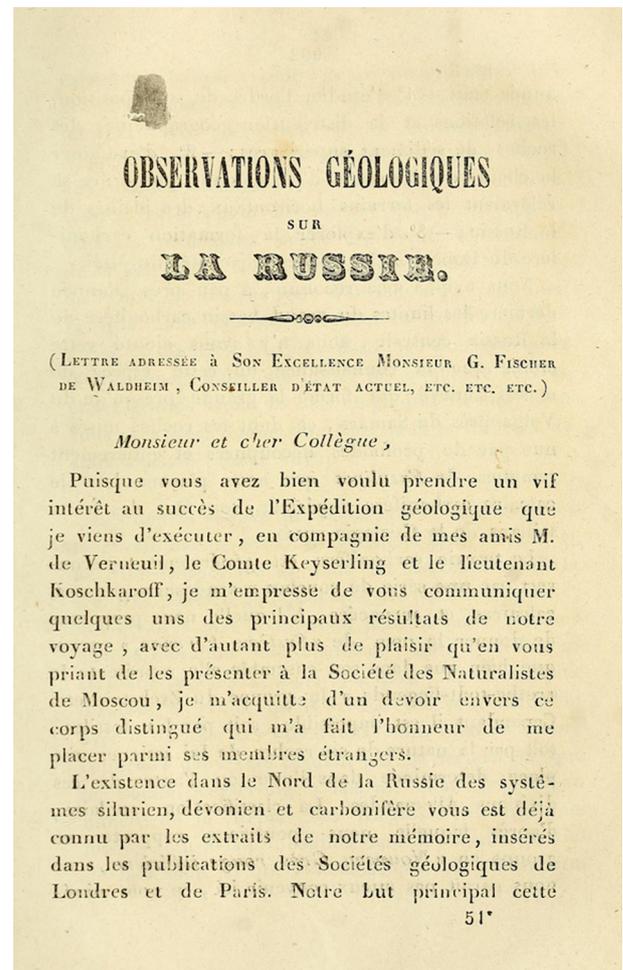


Fig. 11. Title page of Murchison (1841a), in which he names the Permian System.

Professor Heinrich Bronn. The letter was dated 27 October 1841 (probably a Russian-style date, so in fact 7 November 1841) and Fischer announced that the Moscow *Bulletin* version (Murchison 1841a) was already published, so before 7 November 1841, confirming that the presses in Moscow must have been halted to get the letter to Fischer (Murchison 1841a) in type within two weeks of its oral presentation. The German in Murchison (1841b) is more or less a translation of the original French, with Fischer adding a few more remarks at the end about the forthcoming table of strata. He provides the dates on which Murchison wrote the letter as 26 September–2 October, the Russian version of 6–14 October, the first date marking when Murchison sent the letter to Fischer, and the second perhaps when it was read to the Society of Naturalists of Moscow.

In the letter, Murchison (1841a) first names the personnel of the expedition, always giving credit to his collaborators (Collie and Diemer 2004, p. 7), and mentions the Silurian, Devonian and Carboniferous briefly, and then makes his primary announcement:

Le terrain carbonifère est généralement recouvert par une série de couches marneuses argileuses, calcaires et arenacées, à laquelle nous proposons de donner le nom de 'Système Permien', parce-que bien que dans son ensemble elle représente le 'rothe-todt-liegende', le groupe du Zechstein etc. [There is an English translation of the letter in Mather and Mason (1939).]

[The Carboniferous terrain is generally covered by a series of argillaceous, calcareous and arenaceous marly layers, to which we propose to give the name of 'Permian System' because as a whole it well represents the 'rothe-todt-liegende', 'the Zechstein group etc.]

(Murchison 1841a, p. 902)

He goes on to explain that the English term 'New Red Sandstone' is unsuitable because it cannot accommodate the marls, limestones and mudstones seen in Russia. He notes that the Russian Permian includes economic resources of gypsum, saline waters and copper, as well as the fossil plants described by Fischer von Waldheim (1840) from the Urals and Orenburg regions. The succeeding red beds around Vologda and Nizhny Novgorod he ascribes to the Triassic, as also the sediments of Mt Bogdo, where Keyserling had found an ammonite that suggested equivalence to the Muschelkalk. After reviewing the Jurassic, Cretaceous and Pleistocene, he notes the unexpected occurrence of a great north–south outcrop of Devonian, demarcating a huge, symmetrical Moscow basin of deposition.

Interestingly, while Murchison was writing this letter to Fischer, Verneuil was busy crafting his own account, perhaps in a neighbouring room in Mrs Howard's Hotel, and he sent a letter to the Geological Society of France on 4 October 1841, which was read at their meeting on 8 November and published early in 1842 (Verneuil 1842a). Therefore, Verneuil named the Permian System in manuscript four days before Murchison (4 v. 8 October 1841), but his paper was delivered in public 24 days later (Moscow v. Paris) and definitively published later (1842 v. 1841). Verneuil's account is very different from Murchison's, and indeed he does not mention Murchison, Keyserling or Koksharov. He considers the structure of the Urals, refers to the gypsum deposits, saline waters and copper around the South Urals and Orenburg as well as the reptile bones, and notes the occurrence of these beds as far as the Volga. He then names the system:

La vaste échelle sur laquelle il est développé en Russie, et la différence lithologique qui le distingue des dépôts

contemporains dans le reste de l'Europe, pourraient peut-être autoriser à lui donner un nouveau nom. En le plaçant sur le parallèle du Todtliegende, du Kupferschiefer et du Zechstein de l'Allemagne, nous ne pouvons nous dissimuler qu'il présente une succession de dépôts très différents de celle que nous venons de nommer, et comme il nous paraît plus complet ici que dans aucun autre pays, nous pensons qu'il restera le terrain-type, et qu'il servira de terme de comparaison. Le nom de *Système Permien*, nom dérivé de l'ancien royaume de Permie, aujourd'hui gouvernement de Perm, donc ce dépôt occupe une large part, semblerait assez lui convenir ...

[The vast scale on which it is developed in Russia, and the lithological difference which distinguishes it from contemporary deposits in the rest of Europe, might perhaps allow it to be given a new name. By placing it on a parallel with the Todtliegende, the Kupferschiefer and the Zechstein of Germany, we cannot hide from ourselves that it presents a succession of deposits very different from the one we are about to name, and as it seems to us to be more complete here than in any other country, we believe that it will remain the type terrain, and that it will serve as a point of comparison. The name *Permian System*, a name derived from the ancient kingdom of Permia, now the government of Perm, of which this deposit occupies a large part, would seem to be appropriate ...]

(Verneuil 1842a, pp. 12–13)

At the following meeting, on 20 December 1841 when Verneuil was back in Paris, he presented his table of Russian stratigraphy (Verneuil 1842b) and this time included the names of Murchison and Keyserling as collaborators.

Murchison, Verneuil and the others travelled to St Petersburg on 8 October 1841 and delivered their reports to Count Kankrin. Murchison was awarded the Order of St Anne, Second Class 'in diamonds' (Fig. 1) and Verneuil a plain cross, presented to them by the Tsar on 21 October. They left the following day, sailing from St Petersburg to Lübeck and then from Hamburg to London on 1 November. In the last page of his account, Murchison writes that he delivered his reports that same day to Lord Aberdeen, Foreign Secretary:

... and had a pleasant colloquy with him about Russia, and our then good relations with the Empire, in which I had left so many friends, and on which I was too happy to dilate in grateful terms.

(Collie and Diemer 2004, pp. 419–420)

The only record of the 14-page report to Count Kankrin was a full translation in Russian, published on 5 (= 17) December 1841 in the *Mining Journal* (Murchison 1841d) and generally repeating the same justifications for naming the Permian, but with much more detail of their travels in the Urals and in south Russia, with an emphasis on the great generosity of all the Russians from the Tsar and Kankrin himself down to local mining officials, and a number of pointed pieces of advice for the Tsar to improve and modernize mineral and coal mining practices. It is not clear whether Murchison arranged for the publication of this report, or if he was even aware of it at the time.

Four days after arriving in England (5 November), Murchison sent an expanded version of his letter to Fischer to be published in English in the December 1841 issue of *The London, Edinburgh and Dublin Philosophical Magazine and Journal of Science* (Murchison 1841c). He provides a one-page preface explaining the context and promising a more detailed account through the Geological Society of London. His statement establishing the Permian is not an exact translation of the original French, but the differences are trivial. This

publication is usually regarded as the definitive naming of the Permian because its date of publication is clear, although the fact that Fischer in Murchison (1841*b*) indicates that the Moscow version (Murchison 1841*a*) was published before 7 November 1841 makes it the earlier version.

It would be helpful if we had documents other than Murchison's transcribed journal (Collie and Diemer 2004) to indicate what was going on, but not many letters survive from the time after Murchison had set out on his second expedition. There is one letter from Prince Vorontsov (British Library Add. 46125, no. 331/2; 6 September 1841) in which he mentions previous correspondence while Murchison was en route and requesting advance information about the Donetz coal basin. Murchison also wrote to his wife Charlotte when he was able to get a letter into the overseas post from remote points in Russia. After he returned to England, Murchison continued corresponding with the influential people he had met in Russia, hoping to set up another expedition, although this never happened, promoting his plans to publish his large Russian book and trying to get the Tsar to fund it. Count Kankrin wrote several letters in late 1841 and early 1842, thanking Murchison for copies of the papers and maps he had sent (British Library Add. 46125, nos. 359/60, 361/2 and 363/4; dated 29 December 1841, 12 January 1842 and 28 April 1842). Murchison also continued writing to Brunnow, Meyendorff and Chevkin for some time after.

At this point, in November 1841, Murchison had to prepare his presidential address for the Geological Society of London, which was presented on 18 February 1842, consisting of 51 pages in published form (Murchison 1842). In this, he reviewed everything published in the previous year concerning the geology of the world and, in his section on Russian geologists (pp. 663–666), defended the originality of his own work and complained about the paper and map of Erman (1841), claiming that Erman had copied their ideas through his discussions with Meyendorff. Murchison states that their results bear the date September 1841 (perhaps September, Russian-style), notably the Fischer letter (Murchison 1841*a, b, c*), and that although Erman (1841) is right to say Russian geologists had long known the Permian rocks in terms of their mineralogy, they had failed to recognize their age and significance.

So strongly indeed was the difficulty of placing these strata in their correct geological horizon felt by Russian observers, that Major Wangenheim von Qualen, who had long and patiently studied them *in situ*, and Dr Fischer, who had ably described many of their fossil contents, at once abandoned the field to my associates and myself, and put us in possession of all their knowledge.

(Murchison 1842, p. 666)

Soon after, Murchison made a substantial apology to Erman, 'the distinguished modern explorer of Siberia and Kamschatka [*sic*]' (Murchison and de Verneuil 1842, p. 724, footnote), presumably having learned the truth, or at least reflected on his apparent bullying behaviour.

The Fischer letter (Murchison 1841*a, b, c*) established the Permian as an entity, but its definition was little more than a wave of Murchison's confident hand. He still had to justify his bold gesture; what exactly did he mean by the Permian?

Defining the Permian

The detail of the Permian System was fleshed out through a series of papers commencing in April 1842. Murchison and de Verneuil (1842) presented a first synopsis of the second expedition, with five pages devoted to the Permian, explaining its huge geographical extent over the provinces of Kazan, Vyatka, Perm

and Orenburg, the wide range of lithologies, and the fossils, stressing the bones of reptiles, fishes and plants, '... a more copious fauna and flora than have ever been observed in their equivalents in Western Europe' (Murchison and de Verneuil 1842, p. 724). Throughout, they stress that all the fossils are intermediate between those of the Carboniferous below and the Triassic or Jurassic above: corals, brachiopods, molluscs and plants. Further, the great Permian formations everywhere rest conformably on definite Carboniferous.

Murchison (1843, pp. 105–106) developed these themes further in his subsequent presidential overview of the geology of the world and accepts the Permian as part of the Paleozoic, while indicating that his Permian can be recognized not only in Russia, Germany and England, but also in North America. Murchison and de Verneuil (1845) provided their first reasonably detailed account of the Permian, both in Russia and elsewhere in Europe, with reports of an additional expedition by Murchison to Poland and Germany in summer 1843. They note the nature of the base of the Rotliegend on the Carboniferous, and also the red sandstones (Buntsandstein) overlying the Zechstein. They now understood the enormous difference between the fossils of the Permian and Triassic, even though the red sediments may look similar in places. They tabulated the number of fossil species common to the Permian and Carboniferous and note that 148 of 166 species are unique to the Permian and that many are shared between Russia and Germany. These papers were preludes to the great book that Murchison and Verneuil had been working on since 1841.

Murchison had secured a promise in 1842 from Chevkin that the Russian government would purchase 100 copies of the book at £7 each and, with this, John Murray agreed to publish the book. Printing began in 1842, but Murchison struggled to decide on the audience and the book is part a professional geological argument and part travelogue. Further, he kept revising the book as it was printed, not least because he continued to undertake lightning geological trips through 1843–45 to territories within modern Germany, Poland, Czechoslovakia, Denmark, Norway and Sweden (Thackray 1978; Diemer 2008, 2017). What was planned as a 600-page volume was split in two, with Volume 2 comprising the palaeontological part, published in Paris, in French, as essentially a separate book by Verneuil. A Russian translation followed (Murchison *et al.* 1849), as well as other editions, and the accompanying geological map of European Russia and the Urals was deemed the best hand-coloured geological map ever produced and was indeed the best geological map of Russia until a much-revised version by the Russian Geological Survey in 1893 (Thackray 1978).

In his various papers and the book, Murchison compared the Russian rocks he assigned to his 'Permian' with the Rotliegend and Zechstein of Germany and the New Red Sandstone of England, but noted about this new system:

Но ея литологическія и палеонтологическія различія не позволяютъ намъ отнести ее навѣрно къ той или другой изъ этихъ Формаций. Обширная степень развитія ея въ Россіи заставляетъ насъ почитать ее лучшимъ или истиннымъ образцомъ осадковъ этой эпохи, разсѣянныхъ тамъ и сямъ отдѣльно въ Европѣ. Вотъ почему мы предлагаемъ имя Пермской системы, имя, которое, мы надѣемся, будетъ принято геологами другихъ странъ, потому что оно лучше старыхъ названій.

[But its lithological and palaeontological differences do not allow us to attribute it probably to one or other of these Formations. The extensive degree of its development in Russia makes us consider it the best or true example of deposition of this

era, distributed here and there separately in Europe. That is why we propose the name of the Permian system, a name that we hope will be accepted by geologists of other countries, because it is better than the old names.]

(Murchison 1841*d*, p. 157)

Having explored all the evidence about what Murchison did and how he did it, we should also explore his motivations.

Murchison's motivations

Murchison's imperial plan?

As presented in textbooks, the naming of the Permian in 1841 plugged the last span of Phanerozoic time that had not been named, filling the gap between the Carboniferous (named in 1822) and the Triassic (named in 1834). In fact, the Permian was not the last geological period to be named, but was followed later by the Oligocene (1854), Paleocene (1874), Ordovician (1879), Holocene (1885) and Anthropocene (2013). However, these did not bridge gaps, but were named by subdividing earlier named time units. It suits the story of an imperial plan that Murchison and Sedgwick were jockeying to name the stratigraphic systems, having already fixed the Cambrian (1835), Silurian (1835) and Devonian (1839).

However, it is not clear that Murchison went to Russia to name the Permian, nor that he saw the completion of the international stratigraphic column as a prize. This is suggested by the fact that he did not approve of the naming of the Triassic by [Alberti \(1834\)](#). Murchison refers to 'the excellent monograph of Alberti', but, in a footnote on the same page, says:

This work is full of merit and accurate research, though I cannot say that the new word *Trias* of the author, appears to me a happy selection in reference to these three formations; nor can we apply it in England, seeing that one of them, the *Muschelkalk*, is wanting.

(Murchison 1839, p. 32)

He was quibbling over the descriptive properties of the name, but did not suggest an alternative.

There are three possible interpretations of this view of Alberti's *Trias* ([Murchison 1839](#)). First, it could be that he simply objects to the strict meaning of *Trias* as 'three part', which meant that the term could not be applied in parts of the world where those three German units did not occur. Second, and more likely, Murchison probably wanted to consider a new definition of the true extent of what [Alberti \(1834\)](#) had called *Trias*, so he could confidently match the term to the British rock successions. A third interpretation might be that Murchison thought the name was unnecessary, following [Sedgwick \(1836\)](#), because the New Red Sandstone of both Britain and Germany could be allocated to existing named geological periods: the Carboniferous below and the Jurassic above.

Therefore, having named two geological systems, the Silurian and Devonian, Murchison could have named the Permian and Triassic in 1836–39 based on British or German successions, both of which he had studied in detail. As we have seen, he clearly felt the need for speed in October 1841, reflecting a growing urgency through the summer of that year while they were in the field. But the fact that it took him five years to act does not speak strongly for a deep-seated, driving imperial design beforehand. The aftermath is different, because he spent the rest of his life, from 1841 to 1871, defending and promoting the idea of an international stratigraphic column encompassing as much of his nomenclature as possible.

Murchison's character

'Mr. Murchison looked like a God when he made [his speech], which I most cordially believe for Mr. Murchison is certainly the handsomest piece of flesh and blood I ever saw'. These are the words of Mary Anning (1799–1847) in a letter to Charlotte Murchison (1788–1869), Roderick's wife, famously very friendly with the Lyme Regis fossil collector ([Lang 1945](#)). Mary Anning also wrote a lengthy 'Encomium Murchisonaum' in which the first stanza reads, 'Who first surveyed the Russian states? And made the great Azoic dates? And worked the Scandinavian states? Sir Roderick ...' (quoted in [Davis 2009](#)). Nikolai Koksharov, who accompanied Murchison on both Russian expeditions, wrote:

Р. Мурчисон, один из богатейших английских ученых, представлял собой тип англичанина высшего общества; Он был высокого роста, не толст и не сухощав, с открытым, доброжелательным лицом, на котором отражалась некоторая гордость или, вернее сказать, сознание собственного достоинства.

[R. Murchison, one of the richest English scholars, was a type of Englishman of high society ... He was tall, not fat or lean, with an open, benevolent face, which reflected a certain amount of pride, or rather, the consciousness of his own dignity.]

(quoted in [Shafranovsky 1964](#), p. 59).

On the other hand, in 1838 Benjamin Disraeli referred to 'Murchison a stiff geological prig' ([Patterson 1983](#), p. 189). Indeed, many contemporaries disliked his manner. Archibald Geikie wrote that a substantial change in his character took place following the completion of the big Russian project:

In the course of a few months the geological structure of a vast empire embracing the greater part of Europe had been sketched out – a feat to which there had probably been no parallel in the annals of geological exploration. The success of the campaign and the applause which that success brought from all quarters, were so great that a more than usually well-balanced nature might well have felt the strain too severe to keep its equipoise. From this time forward characteristics which may be traced in the foregoing narrative became more strongly developed in Murchison's character. In his letters and in his published writings his own labours fill a larger and larger space. His friends could trace an increasing impatience of opposition or contradiction in scientific matters, a growing tendency to discover in the work of other fellow-labourers a want of due recognition on their part of what had been done by him, a habit, which became more and more confirmed, of speaking of the researches of his contemporaries, specially of younger men, in a sort of patronizing or condescending way.

([Geikie 1875](#), p. 356)

We have seen how he sought to extinguish Erman and von Qualen for trivial slights or errors, and in ways they could never answer.

Murchison's feeling of being ignored or undervalued was raw in 1845, ironically at the point of his greatest achievement and greatest international recognition. He wrote about Charles Lyell (1797–1875), then touring the USA, in his narrative journal in 1845 ([Murchison 1844–1845](#)), when he was in Moscow to present his great book to the Tsar:

I really think that Lyell might have been glad to indicate, to the American as well as to the British public, the use which my

classification had been, in enabling the American geologists (and, through them, himself) to reach off, interpret, and parallel all these rocks! But not a word of recommendation to the author of this classification, produced after 7 years labour in the field ... (Note. – This fate has followed me in almost all the geological publications of the day. No one has ever written of the ‘Silurian or Permian of Murchison’, though in plenty of books you will see ‘Eocene, Miocene, and Pliocene of Lyell.

This forms part of the long-running tension between the two fellow Scots (Page 1976).

There is also no doubt that Murchison derived great pleasure in receiving and wearing medals and honours (Fig. 1). Part of this presumably came from his earlier life, when he joined Wellington’s army while very young and served as a soldier through the Peninsular wars, retiring when he was about 30. He kept his army uniform and used it to great effect at the St Petersburg balls and in meeting the Tsar. His pleasure in receiving awards and medals, and in being allowed to wear them, as well as his pursuit of his knighthood and baronetcy, are well documented (Geikie 1875; Secord 1982, 1986; Stafford 1999; Collie and Diemer 2004).

Murchison’s synthetic ability

When Dunbar (1940, p. 239) stated that Murchison was able to achieve all he did in Russia because ‘much work, mostly local, had already been done in Russia, and all this was made available’, it might be inferred that he did little more than compile his information from maps and essays by others. Indeed, some words of the first historian of the study of geology in Russia, Shchurovsky (1866), appear to confirm this view, ‘... at that time, as if to help Murchison, major works on the geological structure of Russia appeared’, then listing books and papers by von Buch, Eichwald, Meyendorff, Helmersen, Keyserling and Blasius (quoted in Bessudnova 2017, p. 223; see also Shatsky and Yanshin 1986; Vaksman 1991; Collie and Diemer 2004). Further, in the Murchison archive at the British Geological Survey, there are 24 maps and sections of parts of European Russia that Murchison took with him (Collie and Diemer 2004, pp. 456–459).

However, counter to such a claim, it was simply prudent for Murchison to study everything he could in advance of an expedition into new lands, exactly the norm for him and others (Thackray 1972; Diemer 2008, 2017). Further, following his first remark, Shchurovsky went on to say:

Russian geologists interested in the expedition, began to pay more attention to their own country, and reported the results of their researches to Murchison; also sending him newly discovered fossils or describing in greater detail localities which had previously been only in passing examined ... It can be said that all of Russia and all of the estates, took part in the expedition of Murchison.

(quoted in Bessudnova 2017, p. 223)

The evidence from the Russian expeditions tends to confirm that Murchison was not heavily reliant on existing work by others, other than to lead him to particular localities where he could make observations. The available geological descriptions (Olivieri 1838; Erman 1841; Helmersen 1841) and tentative geological maps (Helmersen 1841; Meyendorff 1841*b*), as well as independent accounts by his colleagues on the expeditions (Keyserling 1841; Meyendorff 1841*a*; von Qualen 1843), all tend to share qualities of uncertainty and tentativeness in geological descriptions. These authors provide narrative accounts, but little synthesis, and their arguments about the relative ages of the rock units and regional structure are vague. For example, Blasius (1844), who was not a

geologist, says almost nothing about the rocks, but gives lengthy accounts of the history of the church and the state of religion. Meyendorff (1841*a*, *b*, 1849) organized his reports by the major stratigraphic divisions (Silurian, Devonian, New Red), but focused only on the commercial usefulness of the rocks. Keyserling (1841) and Helmersen (1841) read as narratives or travelogues that report interesting rocks and fossils, as well as commercial possibilities. On the other hand, the publications by Murchison and Verneuil are clear, orderly and hypothesis-led, testing the Russian observations against comparable rocks and fossils in other lands. As an example of the contrast, Keyserling ends his report with the wish that some light might be shed on the red sandstones by the Oka, and adds in a footnote:

Dieser Wunsch is erfüllt worden. Murchison und Verneuil haben diese Gegenden besucht und bewiesen, dass diese Schichten dem Devoniansysteme angehören.

[This wish has been fulfilled. Murchison and Verneuil have visited these areas and proven that these strata belong to the Devonian system.]

(Keyserling 1841, p. 900)

Murchison’s abilities were recognized by his contemporaries. The great German geologist Leopold von Buch (1774–1853), his elder by 18 years, said to Murchison, that he

... had taken his place among geologists of the first rank not only because of the immense quantity of factual material at his disposal, but also because of his astute judgement and ability to take the large view.

(Collie and Diemer 2004, p. 9)

David Livingstone (1813–73), the great explorer, reported:

I discovered that my friend, Sir Roderick Murchison, while in his study in London, had arrived at the same conclusion respecting the form of the African continent as I had lately come to, on the spot ... There was not much use in nursing my chagrin at being thus fairly ‘cut out’, by the man who had foretold the existence of Australian gold before its discovery, for here it was, in black and white. In his easy chair he had forestalled me by three years, though I had been working hard through jungle, marsh, and fever ...

(Livingstone 1857, p. 500)

Did Murchison apply these brilliant synthetic qualities in Russia? The Russian geologists certainly thought so, as expressed both by Eichwald and Helmersen, united for once in their opinion. Eichwald wrote that Murchison’s work:

... was especially important for us because he, during his second scientific trip through Russia and the Ural Mountains, at the expense of the Russian government, managed to determine the boundaries of most of the mountain formations of our fatherland.

(Eichwald 1846, p. 24)

Eichwald noted ruefully that:

для нас, в особенности, важен тем, что он, во время вторичного ученого путешествия по России и Уральским горам, на иждивении Русского правительства, успел определить границы большей части горных формаций нашего отечества... если бы русские геологичмели те же средства от правительства, как г. Мурчисон, то они были бы

также в состоянии гораздо более содействовать развитию геологии в России.

for us, in particular, it is important that he, during secondary scientific travels in Russia and the Ural mountains, at the expense of the Russian government, managed to define the boundaries of most of the rock formations of our fatherland ... if Russian geologists had the same funds from the government as Mr. Murchison, they would also be able to contribute much more to the development of geology in Russia.

(Eichwald 1846, p. 412)

Helmersen also lavished rich praise on Murchison's achievements in his obituary, specifying the eight major contributions that Murchison made to Russian geology by his two expeditions. Helmersen then wrote:

Геологическое строение России, бывшее до того времени извѣстнымъ более или менее отрывочно, и графическое изображение котораго было, въ виде опыта, набросано на двухъ небольшихъ картахъ, явилось въ названной книгѣ определеннымъ твердыми и ясными чертами... со свойственнымъ Мурчисону мастерствомъ, соединены въ одну цельную геологическую картину страны... Заметимъ только еще разъ, что «Geology of Russia» Мурчисона открыла новый путь науке; она стала исходною точкою и путеводною нитью для многихъ позднейшихъ работъ нашихъ отечественныхъ, геологовъ.

[The geological structure of Russia, which was known until that time more or less in a fragmentary manner and the graphic image of which was sketched on two small maps, appeared in his book with definite solid and clear features... everything was combined with Murchison's characteristic skill into an integrated geological picture of the country... Let us just note that Murchison's 'Geology of Russia' opened a new path for science; it became the starting point and guiding thread for many of the later works of our domestic geologists.]

Helmersen (1872, p. 347, 350)

It took until the 1880s and 1890s before Russia had a formal geological survey, when at last the work of updating Murchison's map and monograph could begin.

Diemer (2008, 2017) explored Murchison's method in his rapid campaigns to master the geology of Norway and Sweden in 1844:

Murchison's impressive scientific output was made possible by his energy, ambition and networking skills. In addition, Murchison was a master of logistics and he conducted his research in an efficient and effective manner that helped him to accomplish his scientific goals. His research method depended upon correspondence prior to a trip, the assembly of publications and maps covering the areas to be investigated, networking with local experts so that he could inspect their fossil collections and geologic maps, arranging for an expert geological travelling companion to confirm his findings, prompt announcement of his results both at meetings and in print, and revision of his findings as new data became available.

(Diemer 2008, pp. 31–32).

Murchison's leadership ability

Leadership can be all pomp, or real. Murchison's biographers (Geikie 1875; Stafford 1999) noted his natural assumption of leadership ('he was a man born to fill presidential chairs'; Secord

1982, p. 419). It is interesting to observe how he took charge of the Russian expeditions, in a land with a language and customs he did not know.

Soon after he arrived, Murchison jostled to lead the 1840 expedition, even though it had been made clear that Baron Meyendorff was in charge; he had the government commission, the official permissions, the maps, the vehicles and supplies. Murchison complained:

... on this occasion, my active friend, Alexander von Meyendorff, took the command *à la Russe*, and with this I was not quite satisfied. For, as he knew little of our science, I was necessarily unwilling to have the thing worked out as the Meyendorff Expedition, – both de Verneuil and Keyserling considering me to be their scientific chief.

(Collie and Diemer 2004, p. 34).

Murchison's remarks are pompous, but evidence of their validity is that the 25-year-old Keyserling came under Murchison's spell during the trip; he later described Murchison on their first meeting as '... ein reicher englischer Aristocrat und eine grösse wissenschaftlicher Celebrität' (Taube 1902, vol. 1, p. 135). Murchison would doubtless have been pleased with such a description, although as a Scot, perhaps not the 'englischer'. It was the same for the 22-year-old Koksharov, who wrote later:

я позволю себе напомнить вам о том благотворном влиянии, которое произвел Мурчисон на наших геологов двукратным своим путешествием по России, и о той незабвенной услуге, которую оказал он нам, определив с точностью относительную древность геологических формаций Европейской России и обозначив границы их на карте обширного отечества нашего. Нельзя не удивляться, каким образом мог он достигнуть столь грандиозных результатов в такое короткое время! Только глубокие познания, опытность, энергия и любовь к науке Мурчисона, помощь ученых его спутников – гг. де Вернейля и графа Кайзерлинга... могли привести задуманное предприятие к столь блистательному окончанию.

[I will allow myself to remind you of the beneficial influence that Murchison made on our geologists with his two-time travel across Russia, and of the unforgettable service that he rendered to us by accurately determining the relative antiquity of the geological formations of European Russia and marking their boundaries on the map of our vast fatherland. One cannot help but wonder how he could have achieved such tremendous results in such a short time! Only deep knowledge, experience, energy and love for the science by Murchison, with the help of his scientist companions – Messrs. de Verneuil and Count Keyserling ... could have led the planned enterprise to such a brilliant end.]

(quoted in Shafranovsky 1964, p. 58).

Murchison had learned important lessons on his first three-month long Russian adventure. The first, as Collie and Diemer (2004, p. 5) stress, was that he could not simply accompany another expedition as a guest because this limited his freedom of movement to deviate from the route to see key geological sites, as well as presumably wasting his time on non-geological tasks. Further, he had learned from the first trip to Russia that he could not achieve anything through a small-scale outing by gentlemen naturalists, as he had done in France, Belgium and Germany. For safety, he required a larger group, which should include Russian speakers, and would require official sanction at the highest level to enable him to pass

along roads and through governments (provinces/oblasts) far from St Petersburg, knowing that internal passports and letters of introduction were needed, especially for a foreigner, and to avoid dangers along the road from robbers.

Murchison's leadership ability started with his evident synthetic geological skills, as noted, as well as five other skills: (1) military-style organization of his party to achieve maximum work; (2) working long hours; (3) taking extensive notes of everything; (4) being ready to enjoy every situation, however odd; (5) managing the mapping; (6) managing the fossil identification; and (7) being equipped for every eventuality. We explore these in turn.

Murchison organized his party so they could achieve the maximum work, frequently dividing the team into pairs who would follow different routes to cover more ground. Even though his colleagues were independent naturalists in their own rights, he trained them in what he wanted and gathered information from those who had made side trips. On returning to Moscow after the 1841 expedition, Murchison writes, 'Occupied two days ... in condensing thoughts, comparing notes, and examining Keyserling and Koksharoff ... consulting with de Verneuil and all the party' (Collie and Diemer 2004, p. 406). He treated Verneuil as an equal, but perhaps felt he had to push the other two. He noted about Koksharoff that he was, '... a very good natured, flabby lad, forever asking questions, and, not understanding one word of French out of four, he is therefore of little use', and '... he requires eight hours' sleep at least, and I pull him regularly out of bed. Again, if raspberries are on the road, adieu to rocks' (Collie and Diemer 2004, pp. 46, 331).

Murchison began his fieldwork at 6 o'clock in the morning, at dawn, and continued until dark. He joked that a geologist could work just as well at night as during the day because rocks make three distinct sounds when hit with a hammer: 'piff', 'paff' and 'puff'. The first denotes hard crystalline rocks, the second sandstones and the third clays (Geikie 1875; Vaksman 1991). During the day, Murchison and his companions travelled long distances in a light carriage at a gallop, at a speed of up to 20 km h⁻¹, along postal routes or, at times, barely making their way along side roads while carrying out geological surveys and observations (Geikie 1875; Shatsky and Yanshin 1986; Vaksman 1991).

Murchison took copious notes while in the field. He kept three sets of notebooks (Collie and Diemer 2004, pp. 13–15): logistical, geological and narrative. In his logistical notebooks, he recorded dates, logistical plans, expenses and conversations, often referring back to these months later when interviewing someone he had met before. In his geological field notebooks, he sketched exposures, made measurements and wrote down his current thinking on the key problems of stratigraphy and structure. In the narrative diary, he recorded their route, naming every town and village, his impressions of the scenery, the people he met, curious ethnographic customs, plants, animals and other observations. He frequently re-read all these notes and annotated and corrected them later. The journal was so carefully composed that it required little addition before an amanuensis later transcribed it in a fair hand, from which Murchison had perhaps intended to publish a travelogue, but he never did, and this was finally done by Collie and Diemer (2004).

The party spent the night where they had to: at post stations, in hotels, in peasants' huts, in priest's houses or on the estates of landowners (Geikie 1875). Murchison appreciated the famous Russian mosquitoes; sometimes there were so many of them that they are even found dried up between the pages of his field notebooks – a picture familiar to any geologist who has worked in Russia. But there were much more positive impressions:

One of the pleasantest parts of the journey seems to have been the luxury of tea-drinking, especially after days of long, hot, and dusty travel. To sit in a 'traktir' and sip tea of infinitely finer

aroma than the Celestial Emperor will ever permit to approach the depots of Canton.

(Geikie 1875, p. 297)

Being unfazed by unexpected food and accommodation enabled Murchison and his team to progress without distraction.

Capturing everything on a map would seem to have been an insuperable problem for Murchison. There was no equivalent of the British Ordnance Survey, so no official map of Russia, and Murchison had to rely on the somewhat random array of maps accumulated by the endeavours of previous explorers and geographers, dating from 1800 or earlier through to 1841 (Collie and Diemer 2004, pp. 456–459). While travelling, Murchison noted distances in his notebooks, drew their routes and sometimes added annotations to the published maps he carried with him. However, as we have seen in his journal, he was quite careless about correct spellings of Russian placenames. All the mapping was entrusted to John Arrowsmith (1790–1873), who ran a well-established cartography business and had published the *London Atlas of Universal Geography* in multiple editions from 1835, 1838 and 1840; this included a map of Russia and Poland. Murchison took this map to Russia and commissioned Arrowsmith to engrave the final geological map for the 1845 book. From 1842 to 1845, Murchison was writing to Arrowsmith, asking to see progress, complaining about his procrastination and providing updates to the map. Arrowsmith was expected to provide the topographic base map and Murchison provided the geological boundaries and annotation, including the vertical and cross-sections (Thackray 1978).

Fossil identification was crucial to Murchison's method. He could identify the rock types and place them geographically, but his entire endeavour required reliable identifications of fossils and comparisons with dated rock successions elsewhere. He handed this task entirely to Verneuil and reports only what the French palaeontologist pronounced in his notebooks. This was a clear division of labour.

Murchison was thoroughly equipped for travelling in Russia and carrying out field geological research. He brought his own hammer, compass, goniometer, maps, 'red box for rocks', travel bag, backpack, bag, umbrella, raincoat, hat and box for it, several changes of clothes (including everything from his day-to-day field clothing to a dress uniform with a sword for official visits), a folding iron bed with a mattress, smoking pipes and several boxes of good wine and cigars, as well as novelties such as canned soup from London (Collie and Diemer 2004, pp. 11–12). Sir Roderick remained a real gentleman throughout the expedition:

Всегда одетый во время путешествия с особенной опрятностью (хотя часто должен был действовать молотком, разбивая камни), он неизменно носил на шее лорнет с привешенной к нему лупой и серебряным карандашом, которым записывал в свою записную книжку все виденное и слышанное.

[Always dressed during the trip with special neatness (although he often had to use a hammer when breaking rocks), he always wore a lorgnette around his neck with a magnifying glass attached to it and a silver pencil, with which he wrote in his notebook everything he saw and heard.]

(Koksharoff 1890, p. 13)

The party and their kit required transportation. For his 1840 expedition, Murchison bought a calèche, a light four-wheeled carriage with a pair of seats and a removable hood, and a seat at the front for the driver. He made the purchase in Hamburg (Collie and Diemer 2004, p. 23) and he and Verneuil travelled in it to Berlin and

then Lübeck, where it was loaded onto the steamship for the voyage to St Petersburg. Murchison also used a calèche on his 1841 expedition, although it is hardly mentioned. He notes that when they reached Samara on 21 August 1841, ‘Here we found and packed up our calèche, and abandoned the stout, long-backed tarantasse of the good General Perovski’ (Collie and Diemer 2004, p. 343). Perovski was governor of Orenburg and they had presumably acquired his tarantass a month earlier, as they picture such a vehicle on the road from Orsk to Orenburg (Fig. 9). Collie and Diemer (2004, pp. 12, 342) say that the calèche had been left in the hands of Murchison’s servant Hilder while the party headed through the South Urals, so whether the switch occurred at Orenburg, or presumably much earlier, perhaps at Kazan or Perm, cannot be said. The tarantass was a standard four-wheeled Russian carriage with the wheels set far in front and behind the passenger compartment to reduce jolting on the rough roads. There were often no seats and passengers lounged on straw piled inside, which was changed when it became soiled, so the tarantass could be like a huge travelling hamster cage. Doubtless Murchison installed seats and he clearly had at least a further tarantass behind to carry his extensive baggage and cases of rocks and fossils; Murchison notes they were robbed on their return to Moscow, ‘of our beds and things behind’ (Collie and Diemer 2004, p. 408). Their ‘twenty cases of fossils, which had arrived from our distant points’ must have been dispatched piecemeal along the way. These complex logistics are barely mentioned in the journals.

Overview

Much of Murchison’s demeanour was at core that of a military man: the apparently haughty demeanour and his powers of intense work and organization, all presumably derived from his hard experiences as a boy and young man in the army (Collie and Diemer 2004, pp. 1–4). His ability to grasp large geological questions at the regional scale and to lead and influence other geologists are evident from comments by his contemporaries.

Charles Darwin gave perhaps an honest, somewhat kindly, appreciation of the older Murchison, whom he encountered in the years 1839–42 when he was Secretary of the Geological Society of London and Murchison was President:

The services rendered to geology by Murchison by his classification of the older formations cannot be overestimated; but he was very far from possessing a philosophical mind. He was very kind-hearted and would exert himself to the utmost to oblige anyone. The degree to which he valued rank was ludicrous, and he displayed this feeling and his vanity with the simplicity of a child. He related with the utmost glee to a large circle, including many mere acquaintances, in the rooms of the Geolog. Soc. how Czar Nicholas, when in London, had patted him on the shoulder and had said, alluding to his geological work – ‘Mon ami, Russia is grateful to you’, and then Murchison added, rubbing his hands together, ‘The best of all it was that Prince Albert heard it all’. He announced one day to the Council of the Geolog. Soc. that his great work on the Silurian system was at last published; and he then looked at all who were present and said, ‘You will every one of you find your names in the Index’, as if this was the height of glory.

(Barlow 1958, pp. 102–103)

Mutual love affair

Murchison’s love of Russia and Tsar Nicholas I

Murchison was thoroughly excited about his meetings with the Tsar and the Tsar’s ministers; he was bewitched by both them and by Russia. The Russian–American historian Riasanovsky (1959, p. 3)

wrote in his official biography that ‘Nicholas I came to represent autocracy personified: infinitely majestic, determined and powerful, hard as stone, and relentless as fate’. Tsar Nicholas waged numerous wars against Asiatic states in the 1820s and then the Crimean War (1853–56), which he lost disastrously. However, Murchison’s earlier enchantment with the Tsar meant he promoted the Russian cause even when nobody else in England would support him.

Murchison later wrote:

Such is Nicholas. Let those who criticise him look into his noble and frank countenance, and then let them try to tell me he is a tyrant. No; utter ignorance of the nature of the man has led to this most unjust notion. Nicholas is above all deceit, and squares his conduct on more noble principles than that of any potentate of modern times.

(Geikie 1875, p. 353)

This deep sympathy remained mutual after the two expeditions – for example, Murchison had a long conversation with the Tsar on a short visit to St Petersburg following his Scandinavian expedition in 1844 (Geikie 1875). Then in summer 1845 Murchison specially came to St Petersburg and presented Nicholas I with his *The Geology of Russia in Europe and the Ural Mountains*, with strong expressions of gratitude (Murchison *et al.* 1845, 1849; Geikie 1875; Koksharov 1890; Thackray 1978; Vaksman 1991; Malakhova 2012).

Murchison made sure to acknowledge and flatter Tsar Nicholas at every meeting, through letters and in his written work. In the great book (Fig. 12), the authors explain the roles of the Emperor and his ministers:

... the Count de Cancrine laid before His Imperial Majesty a project for a well-combined additional geological survey of Russia, which being approved by the Emperor, a communication was made to Mr. Murchison by that Minister, the object of which was to secure the services of M. de Verneuil and himself. Under these high auspices, the researches of these geologists were resumed early in the spring of 1841, when, travelling overland to St. Petersburg, they united with their friend Count Keyserling ... On their arrival at St. Petersburg, His Imperial Majesty received the foreign travellers in so marked and cordial a manner, and with such expressions of confidence in their renewed efforts, that they felt doubly anxious to acquit themselves with credit of the task they had undertaken.

(Murchison *et al.* 1845, p. x)

They conclude their Preface with this encomium:

To the illustrious Monarch, then, of the wide realms whose structure they attempt to describe, and to all His loyal subjects with whom they held communication, the authors beg once more to express their sincere attachment and lasting gratitude.

(Murchison *et al.* 1845, p. xvi)

Murchison’s words in the Preface to the Russian edition were even more effusive:

Это исследование было проведено по особому приказу и под покровительством Императора. Иностранные геологи были полностью облечены полномочиями по отношению к губернаторам и главным должностным лицам провинций, находились в данном случае практически на русской службе и за такую безвозмездную службу были удостоены знаками удовлетворения Его Императорского Величества... Для обеспечения предположению полного

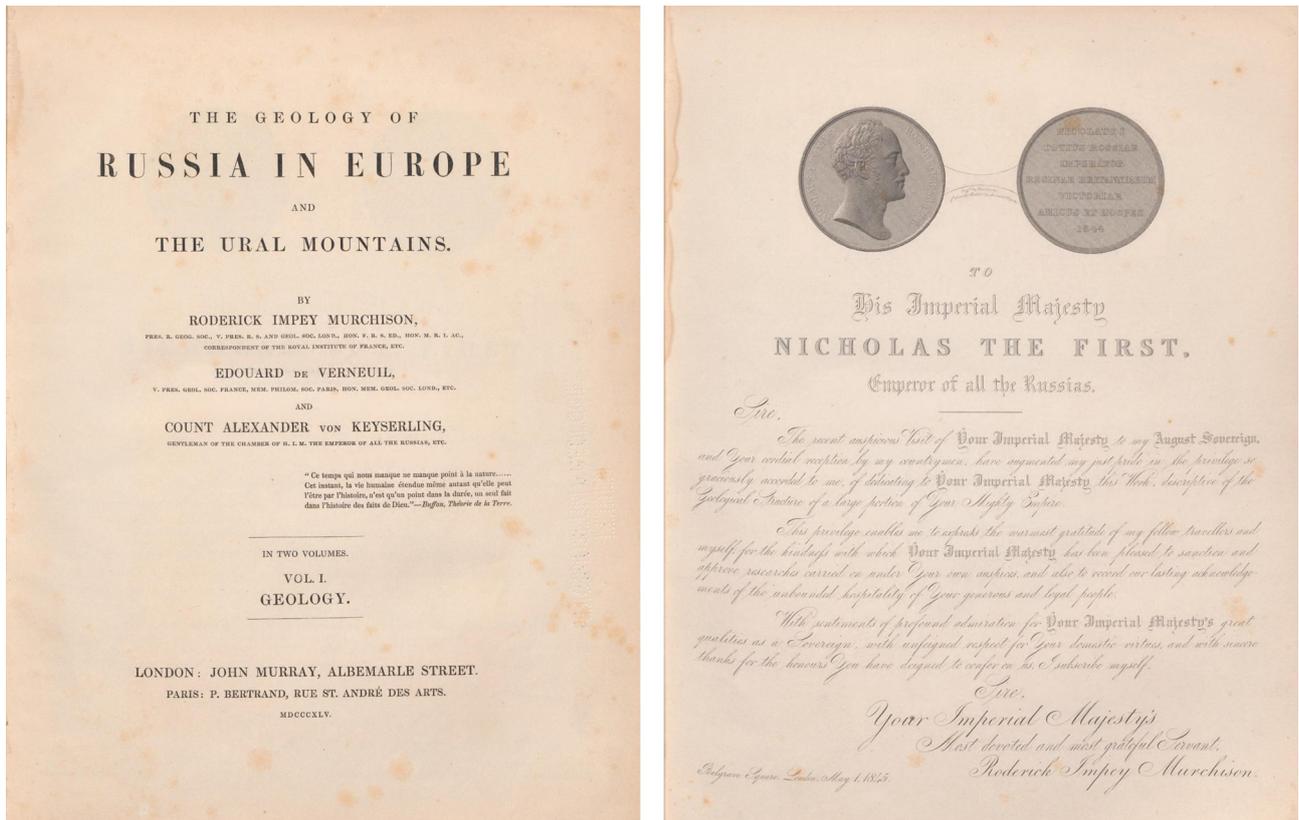


Fig. 12. Title page (left) and dedication page (right) from Murchison *et al.* (1845).

успеха исходатайствовано было ВЫСОЧАЙШЕЕ соизволение. ГОСУДАРЬ ИМПЕРАТОР соблагволил Всемилостивейше одобрить это предположение.

[This research was carried out by special order and under the auspices of the Emperor. The foreign geologists were fully vested with powers in relation to the governors and chief officials of the provinces, and were in this case practically in the Russian service, and were liberally awarded with tokens of satisfaction by His Imperial Majesty ... The HIGHEST permission was requested to ensure the assumption of complete success. THE STATE EMPEROR deigned to most mercifully approve this assumption.]

(Murchison *et al.* 1849, pp. XII, XIV)

In turn, Nicholas I highly appreciated the results of the expedition and, when he was later in London, said to Murchison, referring to his geological works: 'My friend, Russia is grateful to you!' (Barlow 1958, pp. 102–103; Malakhova 2012).

Murchison's thanks to the Tsar's senior advisers were also effusive. He wrote that:

... their efforts could have had no such result, if the wishes of the Emperor had not been admirably put into execution under the directions of his enlightened minister the Count de Cancrin [Kankrin], and by the excellent arrangements made by General Tcheffkine [Chevkin] in his department of the Imperial Corps of Mines.

(Murchison *et al.* 1845, p. xii)

Kankrin 'reacted with great sympathy to the upcoming journey of foreign scientists' ('отнесся с большим сочувствием к предстоящему путешествию иностранных ученых') (Koksharov 1890). Chevkin, having in 1840 worked out, together

with Murchison, a plan for the upcoming journey, 'then made all the necessary orders, communicated with the local authorities of the provinces, which Murchison had to visit with his companions' ('сделал потом все необходимые распоряжения, снесся с местными властями губерний, какие приходилось посетить Мурчисону с его спутниками') (Koksharov 1890). In a report to the Minister of Finance, Murchison wrote:

His Majesty the STATE EMPEROR gave us such a gracious welcome, the entire mining department provided us with so many benefits, and the Russians with whom we had relations during our journey, provided us with such hospitality that we are truly happy, considering ourselves devoted to the benefits of your great people and making every effort for the success of the natural history of Russia ... Our labour was greatly facilitated by the prudent measures of the Mining Administration. Geological, mineralogical and technical maps were presented to us, and the most experienced officers helped us diligently and efficiently. Completely familiar with the nature of the surrounding rocks, they have greatly reduced our work.

(Murchison 1841a, pp. 145–146, 148)

Murchison, the lifelong Russophile

Murchison mentioned his Russian expeditions at all opportunities and these opportunities were many in his roles as President of the Geological Society (1831–33, 1841–43), of the Royal Geographical Society (20 years in total: 1843–45, 1851–53, 1856–69, 1862–71) and of the British Association for the Advancement of Science (1846).

He continued his correspondence with the ministers and geologists he had met in Russia. In particular, he seems to have taken a fatherly interest in Nikolai Koksharov, who was happily received by the British geologist at his home in London: 'Murchison

received me with open arms and introduced me to his wife, who also treated me in a very friendly manner' ('Мурчисон принял меня с открытыми объятиями и познакомил с женой, которая отнеслась ко мне также весьма приветливо') (Koksharov 1890). 'And what a warm welcome always greeted Murchison's Russian friends and acquaintances when, arriving in London, they appeared at the hospitable house at number 16 in Belgrave Square! ('И какой радушный прием всегда встречали русские друзья и знакомые Мурчисона, когда, приезжая в Лондон, являлись в гостеприимный дом под № 16 на Бельгрейв-сквере!') (Helmseren 1872, p. 351). Murchison took Koksharov with him on a geological tour of Ireland, helped him in every possible way in his scientific work in England, and introduced him to English scientists and English society. Their correspondence continued throughout their lives (Koksharov 1890; Shafranovsky 1964; Shatsky and Yanshin 1986). Further, Murchison invited Keyserling to Britain in 1842 and they engaged in long geological tours of the Isle of Wight and then round England and Wales, from May to August of that year (Collie and Diemer 2004, pp. 460–464). The aim was partly to develop their friendly collaboration, but mainly so Murchison could train Keyserling and rely on him to complete parts of the great map that covered areas the expedition had not visited, primarily the Pechora region in the north Urals, which Keyserling visited in 1843 and reported on (Keyserling 1846) without Murchison's direct supervision.

During the two expeditions, Murchison not only learned to love the Tsar and the nobility of Russia, but also the farmers and country people (Murchison 1841a, b; Murchison *et al.* 1845, 1849; Helmseren 1872; Geikie 1875; Koksharov 1890). The hospitality and kindness that he experienced in even the wildest corners of the Empire filled him with a deep sense of affection for Russia and the Russians (Geikie 1875; Koksharov 1890; Radovsky 1956; Shafranovsky 1964). Murchison notes the vigour, intelligence, honesty and desire to help of the ordinary peasants, as well as the intelligence and politeness of officials. In his first report (Murchison 1841c, p. 422), he wrote, 'that spirit of hospitality which characterizes all Russians, and above all the inhabitants of the Ural and Siberia, rendered every enterprise feasible, and enabled us to overcome every obstacle'. Helmseren confirmed this, in writing:

Радушное гостеприимство и бескорыстное содействие, которые он нашел во всех классах общества, глубоко запечатлелись в его памяти, и навсегда осталось в его душе чувство глубокой благодарности.

[The cordial hospitality and disinterested assistance, which he found in all classes of society, were deeply engraved in his memory, and a feeling of deep gratitude remained in his soul forever.]

(Helmseren 1872, p. 351)

Murchison wrote:

Recurring to that distinctive trait of national Moscovite character – a will which admits of no obstacle – they are bound to record, that their own impatient 'forward' was ever cheerfully responded to by the *mojna* [= 'it can be done'] of the natives ... Amidst such a people, no real difficulty could be experienced. If a bridge were broken, it seemed rebuilt by magic ... Wet or dry, hot or cold, no murmur escaped these resolute men, and *mojna* was their only cry.

(Murchison *et al.* 1845, p. xvi)

In an anonymous essay, but whose authorship must have been evident to all, Murchison (1841e) reviewed recent books about

travels in Russia, characterizing the country people in heroic terms, 'Here stalks the erect Russian peasant, by birth a serf and in gait a prince'. Reflecting his own experiences, he describes the peasantry of the northern territories:

He will there find tall, well-featured men, with the front of sturdy yeomen, who, having lived from father to son for centuries upon the soil which they cultivate, acknowledge no lord save the Emperor, or his representative officers. Vexed with no extraordinary exactions, their only cares are to pay a moderate fixed tax to the State, and to furnish their quota of recruits for the army. These *crown peasants* of Russia (*twenty-two millions* of souls) are well lodged, well warmed, comfortably dressed, and seem to enjoy existence as much as the workpeople of many parts of France and England—to say nothing of Ireland, or of various extensive districts in the Scotch Highlands.

(Murchison 1841e, pp. 346, 350)

Murchison writes enthusiastically of the typical hostelries, bedrooms, tea-drinking, meals and customs of Russians of all shapes and sizes.

Murchison's political views are clear: 'With near 50 000 000 of serfs it would indeed be insane to talk of sudden enfranchisement', a theme that was actively discussed at court in St Petersburg. This conservative view would have appealed to the ministers and Tsar. Continuing his theme, Murchison painted a positive portrait of Tsar Nicholas I:

... he is not only the brilliant chief and able administrator ... Nicholas is the pattern of domestic excellence, whether viewed as a son, a father, or a husband. We may express our own belief that Russia has not been governed by a man of so much firmness of purpose since the death of Peter the Great; and as his decisions are influenced by the strongest desire to do justice to the *lower orders*, he is naturally looked up to by them with filial affection. His personal influence over the people has been put to the severest tests, both when he threw himself into the midst of an infuriated mob during the raging of the cholera, and when he quelled the bloody insurrection of the military colonies. On the first occasion he galloped in his *droszki* alone, and unattended by a single soldier, into the centre of a great market-place crowded with the deluded people, who imagined that their food was poisoned. Commanding them to fall on their knees and pray to God, who alone could avert the pestilence, he calmed the tempest, and was followed by the people into the church, where they invoked blessings on the head of their *father* – for so the sovereign is still universally styled and addressed in Russia ... Nicholas is the most galloping personage that ever wore the crown of the Czars ... The vigour and bodily endurance he has occasionally manifested are quite wonderful.

(Murchison 1841e, pp. 348–350)

This feeling of warmth towards the Russian Empire never cooled (Geikie 1875).

Мурчисон остался верным другом России до последней минуты своей жизни. Он постоянно сохранял чувства искренней приязни и благодарности к стране, в которой он встретил полное радушие и гостеприимство.

[Murchison remained a loyal friend of Russia until the last minute of his life. He constantly retained feelings of sincere affection and gratitude for the country, in which he found full cordiality and hospitality.]

(quoted by both [Shafranovsky 1964](#), p. 59 and [Radovsky 1956](#), p. 259)

After 1845, Murchison was known in Britain for his Russian sympathies and this was to prove difficult during the Crimean War (1853–56), when Russia was at war with Britain and France. He gave public speeches in favour of Russian expansionism and to persuade Britain not to enter the Crimean War. He lobbied hard among the leading British politicians, but was generally rebuffed ([Stafford 1999](#), pp. 98–103). He even tried to petition for peace, sending a letter privately to Tsar Nicholas I in September 1854 (British Library Add. 46125, no. 283/6). At the outbreak of war, Philipp von Brunnow had to flee his ambassadorial residence in London at short notice and he wrote a long letter to Murchison (British Library Add. 46125, no. 279–280). They continued to correspond and Murchison met him in the 1850s and 1860s in Germany. On 20 April 1871, not long before Murchison died, Brunnow wrote ‘your true and stalwart old friend Count Brunnow’ (British Library Add. 46128, no. 297). Murchison received the title of Baronet in 1866, probably delayed because of his unfashionable support for Russia during the Crimean War, but it was in his favour that he had held the post of Director of the Geological Survey since 1855, and through that role advised the British government on coal and other supplies for the army in the Crimea.

The Russian response

Just as Murchison loved the Russians, so the Russians responded positively to Murchison. In fact, it is difficult to overestimate the importance of his geological expedition to European Russia and the Urals, where his best qualities as an outstanding scientist and talented leader and organizer were manifested. The 1840 expedition was where Murchison first made his mark, both in terms of leadership and friendly advice.

Murchison was not slow to offer advice to the Russian government, some of which might have been ignored, but most of which was potentially useful. He stressed the importance of the wise exploitation of Russia’s rich mineral reserves and made constant reference to the well-advanced industrialization in Britain when discussing the coal-bearing region of the Donetz:

I may say to you as a geologist, that its numerous beds of coal (bituminous and anthracitic), with its grits and shales, are completely subordinate to the Mountain Limestone series, and represent in no sense the coal-fields of Great Britain, Belgium, and France.

([Murchison 1841c](#), p. 422)

But, in his report to Kankrin, he was more explicit:

что Донецкий край есть единственный... представляющий въ своихъ многочисленныхъ пластахъ горючей материалъ, полезный для металлургии, и мы прямо можемъ сказать, что съ той минуты, какъ ГОСУДАРЬ ИМПЕРАТОРЪ обратитъ на него свое вниманіе и удостоитъ поощрить заведенія, управляемые людьми опытными, этотъ край сдѣляется великимъ центромъ народной промышленности.

[... we are strongly convinced that the Donetz region is the only one ... showing numerous layers of combustible material useful for metallurgy, and we can say clearly that from the minute the STATE EMPEROR turns his attention to it and deigns to encourage establishments run by experienced people, this region will become a great centre of regional industry.]

([Murchison 1841d](#), p. 155).

Murchison was pointed in his comments after dozens of pages describing the Carboniferous of Russia in general, and the coal fields in particular, and making detailed comparisons with the different grades, from bituminous coal to anthracite, throughout western Europe:

... whether mining operations be confined, as at present, to the country where the carboniferous strata crop out, or hereafter extended by deeper shafts to other contiguous tracts, it is obvious that there exists in this region a quantity of coal of good and fair quality, which, if opened out with spirit and industry, will thoroughly justify the anticipation of Peter the Great, that it would benefit his descendants.

([Murchison et al. 1845](#), pp. 199–200)

Murchison had visited the Imperial coal works at Uspensk and Lysychans’k (‘Lisya-Balka’) and was distressed at the chaotic conditions and apparently low-technology approaches to removing coal from near the surface, but not drilling deep for richer reserves. Murchison’s expedition served as the basis for later geological exploration and development in Russia ([Shatsky and Yanshin 1986](#)) and coal production of the Donetz coal field, now in Ukraine, is 40–80 Mt a⁻¹ ([Snihur et al. 2016](#)), confirming his predictions.

Murchison was honoured for his leadership and advice by the Russians – as we saw, the Tsar awarded him the Order of St Anne of the 2nd degree in 1841, and he was elected an ordinary member of the St Petersburg Academy of Sciences, which was a unique exception for a foreign scientist:

24 октября 1845 г. Николай I Указом Правительствующему сенату от 21 сентября за особые заслуги в области геологических изысканий на территории России, обогативших страну новыми открытиями, повелел предоставить Р.И. Мурчисону права и преимущества ординарного академика и считать его на действительной службе при Академии наук.

[On 24 October 1845, Nicholas I, by a decree to the Governing Senate of September 21, for special merits in the field of geological surveys in Russia, which enriched the country with new discoveries, ordered R.I. Murchison the rights and advantages of an ordinary academician and considered him in active service at the Academy of Sciences.]

([Malakhova 2012](#); letters concerning this are provided by [Radovsky 1956](#), pp. 259–262)

Thanks to R.I. Murchison, the specialism of ‘geology’ was included in the list of disciplines of the Imperial St Petersburg Academy of Sciences ([Malakhova 2012](#)).

A third honour came in 1843, when Tsar Nicholas I sent Murchison a huge vase made from Siberian aventurine, measuring 1.2 m (4 ft) high and 2 m (6 ft) in circumference and weighing about 2 t ([Geikie 1875](#), vol. 2, p. 13). This monster stood in Murchison’s home for the rest of his life and then passed to the British Museum. In 1845, after delivering the volumes of his *Geology of Russia* to Tsar Nicholas I, Murchison was invested with the Great Cross of St Stanislaus. But he could not wear these medals and honours in Britain, much to his distress, until Queen Victoria eventually permitted him to do so. The Russian honours were matched by his knighthood in 1846.

Murchison’s work in Russia in the 1840s was part of a long and fruitful scientific cooperation between Russia and the UK in the field of geology ([Geikie 1875](#); [Shatsky and Yanshin 1986](#); [Vaksman 1991](#); [Collie and Diemer 2004](#); [Malakhova 2012](#); [Benton et al. 2017](#)). Indeed, Murchison’s importance for Russia

was first stressed by [Shchurovsky \(1866\)](#), as we saw earlier, and similar remarks were made by [Helmersen \(1872\)](#) and [Koksharov \(1890\)](#), both of these Russian geologists with official positions. [Helmersen](#) commented,

Къ сожалѣнію, нельзя не сознаться, что въ течение двадцатипяти лѣтъ мы не воспользовались примѣромъ, который подаль намъ Мурчисонъ, и не подвинули впередъ задачи, оставленной имъ для насъ. ... Впрочемъ, разрешенія ея нельзя ожидать отъ отдѣльныхъ лицъ или отъ случайныхъ предпріятій; трудъ этотъ можетъ осуществитъ только государственное геологическое учрежденіе, трудящееся по определенному и обдуманному плану, такое учрежденіе, какія существуютъ въ каждой образованной странѣ Европы, какими обладаютъ и Соединенные Штаты Сѣверной Америки и Британская Индія.

[Regretfully, we must admit that in the course of twenty-five years we did not use the example that Murchison gave us and did not move forward the tasks that he left for us ... However, resolving it cannot be expected from individual persons or from random enterprises. This work can only be carried out by a state geological institution, working according to a definite and deliberate plan, such an institution exists in every educated country in Europe, such as the United States of North America and British India possess.]

([Helmersen 1872](#), p. 350)

[Helmersen](#) was well aware that the Russian Empire already had a mineral survey founded in 1700 and produced one of the first coloured geological maps in 1788 ([Burde et al. 2000](#)), but he sought a modernized enterprise covering all aspects of geology. The State Geological Committee of Russia was eventually founded in 1882, with the aim of producing reliable geological maps, 40 years after Murchison had shown the example.

Murchison's support for Russia during the Crimean War was noted by Russians at the time and still resonates to his advantage ([Helmersen 1872](#); [Geikie 1875](#); [Koksharov 1890](#); [Radovsky 1956](#); [Shafranovsky 1964](#); [Shatsky and Yanshin 1986](#); [Vaksman 1991](#)). Since his death in 1871, the Murchison cult in Russia has continued. As [Sennikov \(2020\)](#) summarizes, there have been many books and articles about Murchison by Russian historians and scientists ([Shchurovsky 1866](#); [Helmersen 1872](#); [Koksharov 1890](#); [Shatsky 1941](#); [Radovsky 1956](#); [Shatsky and Yanshin 1986](#); [Vaksman 1991, 2008](#); [Chuvashov 2010](#); [Malakhova 2012](#)). [Chuvashov](#) writes:

Вклад Р. Мурчисона в становление и развитие российской геологии всегда положительно оценивался геологами страны. В военный 1941 г. столетие его путешествия по России было отмечено сотрудниками Горного института в Свердловске.

[R. Murchison's contribution to the formation and development of Russian geology has always been positively assessed by the country's geologists. In the war of 1941, the centenary of his travels across Russia was celebrated by the staff of the Mining Institute in Sverdlovsk.]

([Chuvashov 2010](#), p. 83)

Indeed, [Malakhova \(2017, p. 9\)](#) noted, 'A monograph by [Shatsky](#) about R.I. Murchison was very popular in the USSR as the single Russian source on the achievements of the British geologist in Russia ([Shatsky 1941](#))'. This was all happening in Russia at a time of unimaginable national crisis, when Stalin was directing millions

of Russian soldiers into the costly fight against Hitler's invasion of Russia (Operation Barbarossa, 22 June–5 December 1941).

Then, in 1991, the 150th anniversary of his expedition was celebrated by an International Geological Congress on the Permian System of the Earth, attended by more than 500 geologists and commemorated by a medal ([Fig. 13a](#)). Monuments were erected in Murchison's honour ([Chuvashov 2010](#)), most notably a memorial tablet installed on 3 November 2005 in front of School #9 in Perm, Russia, consisting of a stone base, irregular in form, c. 2 m long and bearing a bronze plaque with the Russian inscription: 'To Roderick Impey Murchison, Scottish geologist, explorer of Perm Krai, who gives to the last period of Paleozoic era the name of Perm' ('Край' may be translated as region) ([Fig. 13b, c](#)). In 2009, the Ural–Scottish Society erected a memorial to Murchison on the banks of the Chusovaya River at the village Chusovoye near Perm ([Fig. 13d](#)). Murchison's name appears in the current literature of the tourist authority of Perm Oblast ('Область' may be translated as province or region) and in a school course about local history of Perm.

Murchison and the divisions of geological time

Murchison's justification of the Permian

Unlike today, in 1840 there was no international agreement about the rules for naming the geological divisions of deep time. Indeed, the key scientific standard today – that to name a time unit, whether local, regional or global, the key is to define the base and a type section that illustrates the base – was not considered by anyone. Murchison and his contemporaries understood the idea of priority and he often quoted exact dates of publication in defending the use of his terms. However, as we saw, his arguments for the use of the term 'Permian' included ideas of the 'typical' nature of the rocks and the size of the area of exposure. Just as he disagreed with the term 'Trias' because the British successions did not consist of three rock units, German geologists for a long time preferred to use the term 'Dyas' because, in Germany, the Permian consisted of two units: the Rotliegend and Zechstein. We explore four issues here: (1) Murchison's justification for the Permian; (2) the Permian–Triassic boundary then and now; (3) Murchison's argument with Phillips over era and system names; and (4) his unhappiness with the Trias and Dyas as stratigraphic terms.

Murchison justified his naming of the Permian using three arguments in his initial report to Count Kankrin: palaeontology, lithology and extent of outcrop. Murchison described the palaeontological evidence:

Of the fossils of this system, some undescribed species of *Producti* might seem to connect the Permian with the carboniferous aera; and other shells, together with fishes and Saurians, link it on more closely to the period of the Zechstein, while its peculiar plants appear to constitute a Flora of a type intermediate between the epochs of the new red sandstone or 'trias' and the coal-measures.

([Murchison 1841c](#), p. 419)

Here, and throughout his journal of the expeditions, he was looking for fossils that identified the Carboniferous on the one hand and the Triassic on the other, and then evidence that his Permian included fossils of intermediate character. Murchison was not a palaeontologist, which is why he relied so much on Verneuil, but he was forever pushing for such fossil evidence. He mentions the proposed new species, *Productus cancrini*, in his letter to Kankrin ([Murchison 1841d](#), p. 157), partly to appeal to the old aristocrat's ego, but importantly also because this was an important indicator of the Permian age of the shell beds on the banks of the Kidash River ([Fig. 8d](#)) and elsewhere.



Fig. 13. Recent commemorations of Murchison in Russia. (a) Commemorative medal in honour of the 150th anniversary of the expedition of Murchison across Russia for the International Geological Congress Permian System of the Globe in 1991. Photograph by E.A. Sennikova. (b) Memorial to Murchison in Perm and (c) close-up of the dedication tablet. Photographs from Wikimedia: D V S, Memorial tablet of Roderick Murchison at the School 9 in Perm, CC BY-SA 3.0. (d) Monument at Chusovoye village, by the Chusovaya River, in the Sverdlovsk region recording Murchison's 1841 expedition and the naming of the Permian. Photograph by D. Solodyankin.

The importance of the palaeontological evidence was clear, even in advance of the 1840 expedition. General Chevkin, in giving the young Koksharov his orders before the expedition, said:

Будьте внимательны и не упускайте из виду всего того, что может быть полезно для усовершенствования Вас в геологии и палеонтологии. Обращайте особенное внимание на окаменелости, которые теперь играют в геологии важную роль. Затем действуйте к чести русского имени и старайтесь быть приятным именитым иностранцам.

[Be careful and do not lose sight of all that may be useful for improving you in geology and palaeontology. Pay special attention to the fossils, which now play an important role in geology. Then act to the credit of the Russian name and try to be

nice to the eminent foreigners.]

(Koksharov 1890, p. 12)

This was emphasized by Murchison and de Verneuil (1842, 1845) and by Murchison *et al.* (1845, pp. 199–228), who devoted an entire chapter to reviewing the Permian fossils, making direct comparisons of the Russian materials with those from the Rotliegend and Zechstein of Germany. As they note, there had been discussion in Germany about whether the Rotliegend might be uppermost Carboniferous or lowest New Red, but that had been decided in favour of the latter. Also, Murchison (1842) still regarded the entire New Red Sandstone as Secondary (= Mesozoic) in age, with the Primary (= Paleozoic) terminating at the end of the Carboniferous, but by 1845 he accepted the modern divisions (Fig. 14) and the evidence was that 'the Permian and Triassic fossils are entirely distinct' (Murchison *et al.* 1845, p. 204).

In discussing the base of the Permian, Murchison *et al.* (1845, p. 203) note that the Rotliegend of Germany, and equivalent red bed

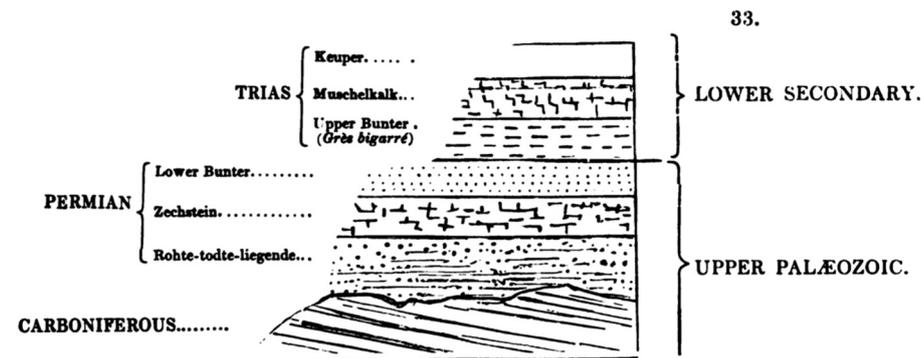


Fig. 14. Murchison's summary of his intentions in dividing the German succession between the Permian and Triassic (Murchison *et al.* 1845, p. 204).

rocks of England, are probably all Permian in age, resting conformably on coal-bearing formations of the Carboniferous, although Sedgwick (1836) regarded some of these red sandstones as Upper Carboniferous. However, these red beds underlying the Zechstein and its equivalents are absent from many places in Russia. This later became a great difficulty for many in accepting the validity of the Permian because its base was not defined. Murchison realized that the fossils from the Russian Permian are rather sparse in number of species and individuals compared with Germany and England, and he argued that this could be because their fieldwork was limited and speedy. However, Verneuil contributes the maxim:

... that the species which are found in a great number of localities, in very distant countries, are almost always those which have lived during the formation of several different systems.

(Murchison *et al.* 1845, p. 216)

This underpins the review of the Russian fossils, demonstrating the uniqueness of many, but that others are common to Russia and the German Zechstein or English equivalents, and that all show intermediate characteristics between the fossils of the Carboniferous and Triassic.

The second criterion to justify the establishment of the Permian was lithological, both the diversity of rock types and their shared qualities. It was stated:

... that the Permian rocks of Russia consist of an assemblage of sandstones, grits, conglomerates and marls, with subordinate bands of gypsum and limestone, which, without exactly following the same detailed mineral sequence as the deposits of similar age in Germany, is bound together by certain natural links; and we are thereby induced to propose the word Permian, to designate a natural group in Europe.

(Murchison *et al.* 1845, p. 204)

The combination of marine and terrestrial deposits and the close matching of very particular lithologies between Russia and Germany (e.g. gypsum, rock salt, copper-bearing sandstones) add to the strength of the lithological evidence of the uniqueness of the Permian.

The third criterion was the extent of outcrop. Murchison *et al.* (1845, p. 220) conclude their review of the fossil evidence, 'the Permian deposits of Russia repose upon Carboniferous strata throughout more than two thirds of a basin which has a circumference of not less than 4000 English miles'. The huge geographical scale of the Russian Permian, according to Murchison, provides great scope for the study of all the rock types and their interrelationships, and this is an important reason to regard these as the type examples for the new system.

In all these writings, Murchison never explains why the Permian could not have been based on the German or English successions – after all, these had both been studied in detail by many geologists and the successions were more complete, especially including the thick red beds between the Carboniferous and the Zechstein or Magnesian Limestone. Abundant fossils had also been reported from many horizons. From today's standpoint, the absence of a defined base for the Russian Permian is a huge deficit, but that was perhaps not such an important consideration in the 1840s. Defining the boundary of the Permian and Triassic was much more in Murchison's mind and this was complicated by the introduction of a new system of era terminology by John Phillips in 1840.

Discriminating eras and systems

The hierarchical nature of the international stratigraphic system is evident today, but it was not in 1840. In his Presidential Address to the Geological Society of London in February 1842, Murchison criticized the proposal by Phillips (1840) of the term 'Paleozoic' for all the rocks from Cambrian to Magnesian Limestone. He first noted that Phillips had adopted the term Paleozoic 'from ourselves', meaning from Murchison himself, and then extended it upwards, and then regrets he does not mention the term 'Silurian':

I ask those geologists who supported me by their approbation throughout my labours, if the name first proposed by him who worked out and defined a system of classification, is to be suppressed ... let us see whether for all the practical purposes of our science, the term Silurian, as first proposed, ought to be preferred, in use, to the term 'Lower Palaeozoic' which is to supplant it ... When subsequently we used 'Palaeozoic' as a comprehensive term for all the older rocks, Professor Sedgwick and myself intended to apply it generally to that great series which embraces the Carboniferous, Devonian or Old Red, Silurian and Cambrian groups.

(Murchison 1842, pp. 647–649)

After some argument about whether the Permian ought to be included in the Paleozoic, as Phillips indicated, Murchison continues:

The perpetuity of a name affixed to any group of rocks through his original research, is the highest distinction to which any working geologist can aspire. It is in truth his monument ...

(Murchison 1842, p. 649)

Murchison misunderstood the possibilities of the era names, thinking that all such terms ought to be based on fieldwork, whereas Phillips (1840) focused on the zoological differences in the fossil faunas between his Paleozoic, Mesozoic and Cenozoic (spelled by him Kainozoic) time divisions. Further, Murchison thought these new terms would be in competition and geologists would choose one or the other system. When he first named the Permian, Murchison (1842) saw it as the first division of the Secondary (= Mesozoic) era, largely because of the reptile bones that he compared with Triassic forms, but he quickly understood how to marry the Phillips and Murchison schemes and stressed that 'the Permian and Triassic fossils are entirely distinct' (Murchison *et al.* 1845, pp. 204), giving examples to show how brachiopods, cephalopods and trilobites declined in the Permian. So, Murchison understood the importance of the massive change in fossils from the Permian to the Triassic, but how could he point to the boundary based on the field evidence in Russia?

Boundary of the Permian and Triassic

In assessing the extensive red beds in Vologda and Kostroma provinces, Murchison cautiously attributed them to the Triassic:

The overlying red deposits which occupy a great basin in the governments of Vologda and Nijni Novogorod, have not as yet been found to contain any organic remains except minute *Cyprides* and badly preserved *Modiolae*; but when we take into consideration their thickness, geological position, and mineral characters, we are disposed to think that they may at some future day be identified with a portion of the 'Trias' of German geologists.

(Murchison 1841c, p. 419)

The ‘Cyprides’ mentioned here are ostracods and ‘Modiolae’ are bivalve molluscs.

Murchison and de Verneuil (1842) clarified that the underlying beds were definitively Permian based on fossils and that Jurassic with fossils lay above in places, but the

... red and green sandstones, marls, marlstones and tuffaceous limestones, which occupy the central parts of the great trough above described; still less can they strictly identify them with the bunter sandstein, new red or trias of West Europe.

(Murchison and de Verneuil 1842, p. 727)

Murchison *et al.* (1845) could not go further:

After thus describing the chief distinctions of these marly deposits, it will be seen, that although they overlie the beds with Zechstein fossils, yet as they agree in position and mineral character with other members of the Permian group of the governments of Perm, Viatka and Orenburg, in which Permian plants and thecodont Saurians occur, we cannot rigorously exclude them from that system. We have not indeed any sort of evidence to prove, that the masses we are describing constitute a portion of the Trias of Europe ... we think we act in the spirit of true observers by leaving this mass under the name of Upper Red Sandstone, thus simply considering it a great and copious cover of the Permian system.

(Murchison *et al.* 1845, p. 182)

von Qualen (1843, p. 595) shared this view, saying:

Es ist übrigens nicht unwahrscheinlich, dass diese obere Gruppe vielleicht später von der Periode des Zechsteins ganz abgetheilt wird, und hier dann Spuren jener mergel- und tuff-artigen Kalksteine erkannt werden, die Murchison im Westen des Kasanschen Gouvernements, Nyschnei Nowogorod und anderen Orten entdeckte, bei Swjask den Zechstein überlagern und vielleicht einem Gliede der Trias angehören.

[... it is not improbable that this upper group will perhaps later be completely separated from the period of the Zechstein, and that traces will be recognized here of those marl-like and tuff-like limestones, which Murchison discovered in the west of the Kazan government, Nizhny Novgorod and other places, to overlie the Zechstein at Sviyazhsk and perhaps belong to a member of the Trias.]

(von Qualen 1843, p. 595)

However, in an example of inspired interpretation, or luck, Murchison identified the Permian red beds he first saw at Vyazniki as uppermost Permian (Fig. 7), based on tracing his consolidating views from 1841–45. First, Murchison and de Verneuil (1842, p. 727) wrote: ‘At only Viasniki on the Kliasma could the authors detect any traces of fossils, and these are minute *Cypridae*, associated with apparently flattened *Cyclades*? which are imbedded in blood-red marl’.

Murchison *et al.* (1845) repeated this opinion:

At Viasniki on the Kliasma and in the ravines to the east of the town, there is a clear section of marls, sometimes slightly micaceous and sandy, with other beds of light red and green colours, very finely laminated, overlaid by blood-red, incoherent sands passing into sandstone, yellowish sands and marls, and variegated, highly calcareous grit. In the light red, variegated marls towards the middle of the cliff, and in a ravine to the north of the high road, we detected a profusion of microscopic crustaceans resembling *Cytherinae*, associated with a small

flattened bivalve shell, having the general form of *Cyclas*.

(Murchison *et al.* 1845, p. 182)

The ‘*Cytherinae*’ are ostracods, and ‘*Cyclas*’ is a bivalve mollusc.

The ‘ravine to the north of the high road is likely Zhukov Ravine, where there are indeed excellent sections through the uppermost Permian and the lowest Triassic’ (Newell *et al.* 2010). The Vyazniki red beds have subsequently yielded ostracods, fossil plants and reptiles that indicate a latest Permian age (Sennikov and Golubev 2006), lying just below the Permian–Triassic boundary. However, the ages of these red beds had remained uncertain until the 1950s, so Murchison cannot be accused of poor analysis and his intuition was right (Benton *et al.* 2010; Sennikov 2020).

In the geological map accompanying Murchison *et al.* (1845), Vyazniki is correctly shown within the area of Permian deposits. In the summary geological profile with the map, Murchison places the Vyazniki deposits at the very top of the Permian System, above the limestones, marls and sands of the section from Nizhny Novgorod to Kazan and below the variegated strata presumably attributed to the Triassic on the Upper Volga near Ples and Yuryevets. On the map, he misses the Triassic around Vologda, Yaroslavl and Kostroma (cf. Fig. 5), but captures the Permian–Triassic contact south of Orenburg, although he connects this across the whole of the north Caspian plain to the Volga and down to Volgograd. There, he correctly identifies Mt Bogdo as largely Triassic:

Looking, therefore, to the ‘facies’ and dominant character of the fossils, and seeing that the limestone in which they lie passes gradually downwards into saliferous rocks which form a part of the Permian system, we are disposed... to think that if not the equivalent of the Muschelkalk, these beds must at all events approach to that age.

(Murchison *et al.* 1845, p. 196).

Establishing the ages of the sedimentary units on Mt Bogdo, but also more widely across the entire Permian–Triassic basin of European Russia, was a slow and difficult process. For example, the ages of the red beds on Mt Bogdo are still debated, the upper portions (Bogdinskaya, Akhtubinskaya svitas) being definitely Triassic, but the underlying Bugrinskaya Svita being either Late Permian (Ochev *et al.* 2004) or Early Triassic (Starodubtseva and Novikov 2018) in age. It also took many years of painstaking search for fossils, especially fish and tetrapods, to provide evidence to separate the Triassic from the Permian elsewhere, around Orenburg and Samara (Soviet name, Kuybyshev) in the south, and Vologda, Vyatka and Kotlas in the north (Starodubtseva and Novikov 2012).

Trias and Dyas

Murchison’s Permian was severely criticized in two monographs, first by Marcou (1859), who suggested the alternative name ‘Dyas’, and then by Geinitz (1861–62), who enthusiastically supported Marcou’s arguments. Marcou (1859, pp. 10–11) justified the term Dyas as a match for Alberti’s Trias, and that the type area should also be in Saxony and Thuringia, and that the two-part German-style Dyas could be matched in England and in the USA. In a lengthy critique of Murchison’s writings about the Russian Permian, Marcou notes the paucity of fossils, the difficulties of discriminating the Russian Permian sediments from the underlying Carboniferous, the impossibility of matching these units with the German Rotliegend, Zechstein and Buntsandstein and, in particular, the likely admixture of a great deal of Triassic red beds into the Russian Permian. Further, the reptiles and plants look more Triassic than Permian. Marcou concludes this critique:

Je ne vois aucune objection à conserver et à se servir du terme Permien pour le dyas si l'on a soin d'ajouter la condition expresse que le type n'est pas en Permie (Russie), mais bien en Allemagne ou même en Angleterre.

[I do not voice any objection to conserving the term *Permian*, for the Dyas if one is careful to add the express condition that the type is not in Perm Province (Russia), but actually in Germany or even in England.]

(Marcou 1859, p. 33 bis)

Marcou (1859, pp. 49–60; 1862) goes on to make a case that his Dyas and Trias in fact form a single system and that there is little difference in the fauna and flora between the two, focusing especially on the plants, vertebrates and molluscs.

Murchison (1862) dismissed Marcou's argument on the basis of the well-established major palaeontological disjunction between the Permian and Triassic, making it clear that the term 'Dyas' had no merit beyond the unfortunate fact that Geinitz (1861–1862) had adopted it. Geinitz (1861–1862, p. xi) does not repeat Marcou's error about the distinction of Permian and Triassic fauna and flora, but prefers Dyas simply because of the bipartite Rotliegend and Zechstein in Germany. He regards the terms 'Permian', 'Thuringian Formation' and others as locally useful terms, and so prefers to adopt the term Dyas as the system name. Murchison (1862) counters that the name only makes sense in parts of Germany, but not elsewhere, and in any case the name 'Permian' was established in 1841 and so his name has date precedence over the Dyas. In his revised Silurian book, Murchison (1872, p. 309, footnote) writes, comfortably, 'I am happy to observe that the mass of geologists prefer [*sic*] the simpler geographical name 'Permian', which, like 'Silurian', involves no theory', referring to the fact that the term 'Dyas' relies on a strict two-fold division, as only seen in Germany.

This was not the end of the dispute, and the Permian v. Dyas conflict flared up again, three years after Murchison's death, when Irving (1882, 1884a, b) applied the term Dyas, or Dyassic, to the British Permian, arguing that 'Permian' could only be applied to the sedimentary rocks in Russia. However, Irving's view would also lead to the rejection of terms such as Cambrian, Silurian, Devonian and Jurassic as geographically based rather than descriptive ('connotative' as he said) terms such as Carboniferous, Cretaceous or Miocene. His view did not make any headway then or later, except that Marcou (1884) was emboldened to update his arguments, especially pointing out how the newer geological maps of Russia differed from that of Murchison *et al.* (1845) in expanding the area of Triassic sediments over much that Murchison had called Permian.

As Lucas and Shen (2018) note, some other names were given to the Permian, including Penéen (1834), Anthracolithic for Carboniferous + Permian (1891), Oklahoman (1896), and Epiric = Permian + Triassic (1928), but these did not gain supporters. Further, the North Americans showed the most reluctance to treat the Permian as a distinct system, even until the 1930s – for example, the United States Geological Survey (USGS) subsumed the Permian into the Carboniferous as a series equal to the Mississippian and Pennsylvanian. An influential event in 1937 finally resolved the problem: the International Geological Congress held in Leningrad, at the height of Stalin's rule of Soviet Russia. The Russian hosts organized an extended field excursion through all the key Permian locations around the Ural Mountains, a remarkable offer at a time when Russia was closed to foreigners. A delegation of American geologists attended, including key leaders of the USGS and university scientists (Williams 1938). In his commentary afterwards, the leading stratigrapher Dunbar (1940, p. 280) wrote about

'the never-to-be-forgotten days of the Permian excursion' in one of the first detailed accounts of Russian Permian geology in English since Murchison *et al.* (1845). The USGS finally accepted the Permian as a system in 1941, the centenary of Murchison's naming act (Cohee 1960; Lucas and Shen 2018).

Murchison's achievement

Murchison was incensed by Marcou's Dyas and fought firmly for the priority of his Permian and other stratigraphic terms. He would have been perturbed to discover that his Permian remained controversial until 100 years after he named it. Indeed, many of the debates in his day, such as about the best name for the two parts of the New Red Sandstone, are not relevant now because it is not expected that one region on Earth is seen as the type for a system (e.g. Germany v. Russia for the Permian). The name to be used is established by date priority; so, Permian beats Dyas because 1841 is before 1859.

Murchison's Permian was in fact only two-thirds of what it is today. Based on the sections in the Urals, Murchison assigned his 'grits of Artinsk' to the Carboniferous, as possible correlates of the English Millstone Grits, so his Permian began at the start of the Kungurian stage, dated at 283.5 Ma. Murchison's Permian was only 32 myr of the total of 47 myr assigned according to the current timescale. Such boundaries are assigned only by international agreement, and all systems today differ from the original intentions.

The 'grits of Artinsk' were identified as part of the type series of the Artinskian stage of the Early Permian by Karpinsky (1889), based on ammonites. The first substantial meeting concerning the Permian of Russia was held at the 1897 International Geological Congress in St Petersburg, when a heroic excursion was organized through Samara to Ekaterinburg, and back to Perm and Nizhny Novogord, using a special excursion train and steamers on the Volga. The main leader was Sergey Nikolaevich Nikitin (1851–1909) and the trips around Nizhny Novgorod were co-led by Vladimir Prokhorovich Amalitsky (1860–1917), who was making great discoveries of fossil reptiles in the Permian sediments along the North Dvina River and demonstrated specimens to congress attendees. Thus Amalitsky determined the age of sediments along the Sukhona and Severnaya Dvina rivers as Permian (Seeley 1899). Daniel Martin, Professor of Geology at Rutgers Female College, was a little dismissive:

Much of this great region has been little studied since the classic researches of Murchison, save that in recent years several Russian geologists have been engaged upon it at various points; but their work is largely inaccessible, and much of it is not yet published.

(Martin 1897, p. 230)

In describing the geology from Samara to Ufa, Martin (1897, p. 232) notes, 'The rocks of this region are principally Permian, but the Russian geologists are not fully agreed as to the details'.

In 1937, a survey of 75 Russian geologists (Williams 1938, p. 775) showed that most of them treated the upper or lower Artinskian as the base of the Permian, whereas others (Ruzhentsev, Nalivkin) included the underlying Asselian and Sakmarian stages, although the Asselian was still generally called 'lower Sakmarian'. It took considerable further study and international agreements to straighten out these components of the Cisuralian (Lucas and Shen 2018).

Now, it is accepted that type sections are established at the stage, not system, level. So, the Triassic is defined by its base, which is the base of the Induan Stage, confirmed at Meishan, Zhejiang Province in China in 1995. Likewise, the Permian is defined by its base, which is the base of the Asselian Stage, ratified in 2006 as the

Aidaralash River section at Novorossiskoye, near Aktobe in the Ural Mountains of Kazakhstan. Further, the whole of the Early Permian, or Cisuralian, is based on Murchison's Russian sections, even though he had shipped many of them downwards out of the Permian.

So, from the present standpoint, the Germans could not name either system because neither the base of the Permian nor the base of the Triassic is definable there in marine sediments. By chance, the Permian therefore remains more Russian than German, which would have pleased Murchison, although its defining base is in Kazakhstan, but that was Russia when he visited, even though he did not travel so far south (it lies 150 km south of his sweep round the southern Urals in 1841). The GSSP sections for the first three stages of the Permian come from the Urals: Asselian (Aidaralash, north Kazakhstan); Sakmarian (Usolka, southern Urals); and Artinskian (Usolka, southern Urals). Until 2004, the remainder of the Permian (Kungurian, Ufimian, Kazanian and Tatarian) were also based on rock sections in the Urals, so the Permian was all-Russian, but the last three are now replaced by marine units from North America (Guadalupian, Middle Permian) and China (Lopingian, Upper Permian).

Murchison (1842, 1843), through his lengthy presidential addresses to the Geological Society of London, sought to show that all the new discoveries, in England, Europe and the world at large, could be understood according to a common stratigraphic scheme. In these essays, he marshalled evidence to justify the validity of the different system names, especially his own, based on their applicability outside Great Britain. For example, Murchison (1843, p. 125) noted that certain gypsiferous deposits and associated limestones from Nova Scotia in Canada are Permian in age, based on shared lithological characters and, more importantly, the contained fossils. He recommended that geologists working in North America should stop equating these rocks with the European 'Zechstein' or 'Magnesian Limestone', 'names which', he argues, 'point to one member only of this complex series as seen in Russia'. He concluded:

I have endeavoured to show, how the order of succession established in our own isles, is now extended eastwards to the confines of Asia, and westwards to the back-woods of America. From such researches, and by contributions from our widely spread colonies, we have at length reached nearly all the great terms of general comparison.

(Murchison 1843, p. 149)

Murchison named large parts of the geological timescale we all use, and this was his intention. As he wrote, later in life:

I claim no other merit on this point for my colleagues de Verneuil and von Keyserling, and myself, than that of having propounded twenty years ago the name of 'Permian' to embrace in one natural series those subformations for which no collective name had been adopted.

(Murchison 1862, p. 70)

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