Pey-Yi CHU, *The Life of Permafrost. A History of Frozen Earth in Russian and Soviet Science*

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REFERENCES

Pey-Yi CHU, *The Life of Permafrost. A History of Frozen Earth in Russian and Soviet Science*, Toronto : University of Toronto Press, 2021, 288 p.

- 1 Thawing permafrost acting as a time bomb for humanity became a familiar image and topic of debate during the last decade. The prospect of sudden, massive releases of methane leading to higher temperatures and thus to an acceleration of global warming put permafrost at the centre of attention in the context of climate change in the last years. This is particularly true for Russia, where more than 60% of the territory is constituted by permafrost. The recent oil spill in Norilsk of July 2020, probably a consequence of the thawing of permafrost, is a case in point. Pey-Yi Chu's brilliantly written book on the hitherto unexplored history of permafrost in Soviet and Russian science is thus very timely. By investigating the scientific debates and developments around the phenomenon from a history of science perspective, she helps us go beyond the dominant image of permafrost as hostile. As she embeds the story of permafrost into a historical context, she points to the complex entanglements of science, culture, politics and history in Russia and the Soviet Union.
- 2 The focus of the book is to uncover how the term *permafrost* entered scientific and popular parlance and how it came to suggest a change in the understanding of frozen earth. The overall argument is that the Russian empire and its successor, the USSR, profoundly shaped global ideas about frozen earth. But Pey-Yi Chu covers more than the history of ideas. By historicizing permafrost in the context of Russian and Soviet science, she also examines how the Soviet science apparatus worked and how scientists

engaged in the social and cultural context of scientific production. Instead of treating science and ideology separately, she underlines their symbiotic relationship and demonstrates how they did not only put constraints on Soviet scientists but also provided a range of opportunities and resources. While “speaking Bolshevik” was certainly required to advance one’s ideas, ideology, she argues, helped at times to promote creativity and discussions because it imposed a framework within which scientists had to creatively navigate. One of her central arguments is that Stalinism did not prevent systems thinking, a mode of thought that approaches political, social and natural phenomena as complex totalities rather than in terms of their component elements. David Jarovsky and others have argued that systems thinking was repressed during Stalinism in favour of dialectical materialism, but Pey-Yi Chu posits that this was not the case in permafrost research, where systems thinking persisted. On the contrary, she writes, “Stalinism provided opportunities for the development of Earth systems science” (p. 18). Although her book shows in the end that frozen earth was institutionalised not as a process within a system but as a structure, she reveals how systems thinking continued despite ideological constraints.

- 3 Pey-Yi Chu unpacks and structures her history of permafrost in Soviet and Russian science through the image of a butterfly’s life cycle: egg, larva, pupa and adult. As such, during its first stage as an egg, permafrost evolved from an everyday phenomenon for the people in Siberia to a scientific object that increasingly needed to be mapped, documented and studied. In the context of these studies, permafrost received multiple names such as *Boden-Eis* and *Eis-Boden*, which reveal the varied understandings of the phenomenon as a substance or a realm of the earth. They formed the initial basis of the dialectic inherent to permafrost. The thesis consisted of understanding permafrost as part of the earth’s system – a space, process, or condition, while the antithesis entailed treating permafrost as a physical-geographical structure. The epistemological and ontological evolutions of this dialectic between systems – meaning that permafrost is connected to other elements of the planet – and structure – a distinct object – spin a red thread through the book and thus draw continuities through centuries and different political systems. The dialectic, she writes, “consisted of an interplay between different ways of conceiving the essence of permafrost that arose from different motivations of studying the phenomena” (p. 164).
- 4 In the second chapter, which focuses on frozen earth as an object of engineering, Pey-Yi Chu argues that it was the imperative of building large-scale infrastructure in the late tsarist and early Soviet regimes that motivated research into frozen earth and shaped its understanding. While permafrost in its egg phase was studied by zoologists and geologists, it then drew the interest of civil engineers and soil scientists, who contributed different conceptions of frozen earth, appellations, and classification methods. Given the nature of their scientific interests in engineering and earth, this phase strengthened the antithesis in the dialectic: approaching permafrost, *merzlot* as it was then called, as a structure, as ground. But ambiguity remained as genetic soil scientists considered system elements such as climate or the interplay between ground and the atmosphere, approaching frozen earth thus as a manifestation of a process.
- 5 At the pupal stage in the life of permafrost, Pey-Yi Chu shows how knowledge was produced and circulated in the Soviet Union, and what determined the acceptance of certain intellectual ideas over others. Towards the end of the 1920s, two conceptions of frozen earth coexisted. Scientist Mikhail Sumgin defined it as a continuously lasting

physical structure and his rival, soil scientist Sergei Parakhomenko approached it through the process by which it formed, disagreeing on permanence as a characteristic. Sumgin's terminology was widely accepted and he himself was praised for having popularised the discipline *merzlotovedenie*, while Parakhomenko and his ideas faded from the academic landscape. Pey-Yi Chu argues that it was the historical, social and political contexts of Soviet science that determined which conception won over the other. As such, Sumgin's ideas "resonated with broader elements of revolutionary culture, invoking a relevant mode of dialectical materialism, populism, and promises of eternal life" (p. 101). While both scientists appealed to dialectical materialism, it was Sumgin who posited a "struggle" between frozen earth and water as opposed to the systems approach. "Struggle" was a trope that appealed to the general, non-specialist audience and frequently appeared in public discourse. Moreover, Sumgin's term *vechnaia merzlota* [eternal frost] was also considered more accessible and accorded with the broader Soviet aim to bring science closer to the people.

- 6 Extending on the pupal stage in the life cycle of permafrost, Pey-Yi Chu then explores more broadly the frozen earth scientists' interactions with Soviet society during the 1930s. She very convincingly shows how they adapted to Soviet ideology while at the same time contributing to new understandings of the human / non-human relationship. She reveals that popular scientific publications differed largely from the actual work Soviet scientists undertook in the field and the laboratory. Sumgin and his colleagues cast *vechnaia merzlota* as the key enemy to be defeated and conquered, a natural phenomenon with a powerful destructive agency. But in concrete practice, Pey-Yi Chu argues, scientists adapted to frozen earth and actually advocated its preservation. She sees these procedures not in terms of a struggle between humans and nature, but as "a process of learning to adapt" (p. 122). Realising how scientists operated within the constraints of the environment, Pey-Yi Chu suggests that instead of focusing on conquest or environmental degradation, it is worth exploring how humans learn about and negotiate the constraints presented by nature.
- 7 Covering the post-war years, the last chapter explores the intellectual travels of *vechnaia merzlota* towards its direct English translation *permafrost* and its international recognition as a scientific object. Military construction and resource extraction in the Arctic also triggered a desire for knowledge on frozen earth in the United States and Canada, where Siemon Muller translated Soviet works on *vechnaia merzlota* or, now, *permafrost*, for the first time. At the same time, while the English translation created a lasting emphasis on the idea of permanence as a feature of frozen earth, Soviet scientists began to reconsider the prevailing concept of frozen earth and approach it as a space of heat exchange, the "cryolithozone", which underwent changes and was thus nothing "permanent". Pey-Yi Chu shows that this scientific acceptance of *merzlota* as a process had not only to do with the careerism of certain individuals but also with semantics, ontology and epistemology, as well as with ideological commitments that were a response to the new politicisation of science beginning in 1948. At the time, the party had launched the campaign of "creative discussions", which forced scientists to rethink certain concepts in their fields. Seeing this campaign as an opportunity, Pey-Yi Chu suggests that not only could scientists use it to advance their career by complying to the political demands, but it also sharpened theoretical and terminological debates. However, the new ideas did not survive. Sumgin's terminology remained for its

“euphoniousness and cultural resonance” (p.157) and because of its increasing significance to construction and economic development.

- 8 Pey-Yi Chu’s book covers a wide range of important questions pertaining to Russian and Soviet histories of science and environment. Her study of frozen earth and its changing ontology points to the social and cultural character of science by showing how permanence was, or was not, deemed a feature of frozen earth depending on the necessity and spirit of the time. Within environmental history, the book contributes to the debate about nature’s agency and raises a range of other questions.
- 9 For instance, the example of frozen earth research shows that systems thinking did not stagnate during Stalinism and that Vladimir Vernadsky’s ideas were reused and continued to unfold. Systems thinking often also includes interdisciplinarity, and in this case it would have been interesting to learn more about the extent to which the systems approach also entailed scientific collaboration with scientists from other disciplines. At a few instances, Pey-Yi Chu mentions climatologists and the significance of global climatic change for the state and the science of frozen earth. How did this knowledge about climate and frozen earth circulate between Soviet scientists? Was it the well-known compartmentalisation of the Soviet science apparatus that prevented joint research in this regard or was there no interest to further explore the environmental changes of a supposedly permanent phenomenon for economic purposes?
- 10 The latter point leads to another set of questions left unanswered. The role of economic decision making certainly receives some attention, but the practical implications of Sumgin’s terminology of frozen earth for the Soviet economy in Siberia and more importantly, the role of the state, remain unclear. While Pey-Yi Chu makes a strong case of how Soviet ideology helped scientific progress, she leaves out the extent to which it may also have hindered frozen earth studies. She mentions, for instance, that the concept of time was central to Soviet culture and she argues that conquering *vechnaia merzlot*a also meant “to struggle against spontaneous, undisciplined time” (p.115). But what significance did the notion of permanence have for the Soviet economy? Was Sumgin’s terminology not also successful because it complied with the objectives of the Soviet command economy to build fast and cheap? Building on ground that was officially unpredictable would have meant greater building costs and construction time. As a solution, one could argue, it was the notion of permanence that promised security and stability, which served as perfect conditions for large construction projects.
- 11 Finally, the book is very strong in analysing the ontological and epistemological developments of permafrost and its science in connection to ideological demands from the state. More analysis of the political decisions concerning the science apparatus could however have been welcome. For instance, INMERO was taken out of the Academy of Sciences system in the 1960s, the Moscow branch was closed and moved to Siberia. While we are told what this meant for Petr Shevtsov’s concept of “cryolithozone”, a broader historical and political contextualisation of those decisions would have contributed an additional layer of analysis. The removal of INMERO to the periphery at a time when a new understanding of permafrost was built and when climatologists discovered global warming is a vein worth further exploring.
- 12 However, these are more questions for a debate than points of criticism. The well-researched book, based on extensive archival documents, forms an important contribution to Russian and Soviet environmental and science histories as it illustrates

on different levels how science was shaped by the priorities and values of the Soviet Union and how scientists navigated their work within the given constraints.

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