The resilience of scientific co-operation as a foundational principle of the Antarctic Treaty

David Leary[*] and Julia Jabour[**]

Abstract

This paper explores the resilience of the freedom of scientific investigation as a central pillar of the Antarctic Treaty. We highlight the importance or significance of Antarctic science. Why does it matter? Put simply it matters because science is at the core of the Antarctic Treaty and is at the core of governance more broadly in Antarctica. More significantly, science is of greatest importance because of the contributions it makes to knowledge, and the pointers it provides us in understanding and solving the major environmental challenges of our time. Science is not only the currency or price nation states must pay to have a role in the governance of Antarctica but is also the legitimate reason for presence there. This close alignment between legitimacy as an Antarctic actor and decision-maker and the epistemological validity of scientific research explains why at times the Antarctic Treaty seems challenged by the emergence of new actors in Antarctica. We argue however that this is nothing new and merely a consistent and ongoing theme throughout the history of science in Antarctica. The Antarctic Treaty has always been and continues to be resilient to these pressures. We conclude science and scientific co-operation as one of the four foundational principles of the Antarctic Treaty is in fact very resilient.

Keywords

Science, resilience, Antarctic Treaty.

1 Introduction

Since the very beginning of human exploration of Antarctica, science has been at the heart of human endeavours. To this day science is recognised as a central pillar of governance in the Antarctic Treaty[1] and the other treaties that make up the Antarctic Treaty System. In this paper we explore the central role of science to the past, present and future of Antarctica. Science drove much of the early exploration of Antarctica and the Southern Ocean. In later years science lent credence to territorial exploration, giving a cloak to colonial and territorial ambitions and subsequent claims to territory. More recently, since the start of the Cold War, science has provided a circuit-breaker to the risks of territorial clashes in Antarctica. Perhaps, more importantly, throughout time scientific research in and about Antarctica has been hugely important to our expansion of knowledge about our world's past, present, and future.

[*] Professor of Law, Faculty of Law, University of Technology Sydney, Sydney, Australia. e-mail david.leary@uts.edu.au

** Former Adjunct, Institute for Marine and Antarctic Studies, University of Tasmania, Hobart, Australia

[1] Antarctic Treaty, Dec. 1, 1959, 402 U.N.T.S. 71, hereinafter the 'Antarctic Treaty.'

In this paper we explore the resilience[2] of the Antarctic Treaty and the central role played by science in Antarctica. In the first part of the paper, we outline the challenges raised by science in the context of the Antarctic Treaty. Our analysis in this part first considers the importance or significance of Antarctic science. Why does it matter? Put simply, science is at the core of the Antarctic Treaty and is at the core of governance more broadly in Antarctica. The first part of this paper therefore examines the key provisions of the Antarctic Treaty that embed this role for science, before turning to consider the primary role of the Scientific Committee on Antarctic Research. We then consider some of the main areas of scientific research in Antarctica (the so called 'currency of science') and why these matter in Antarctica and to the rest of the world.

This discussion then leads us to consider the challenges raised by the emergence of new or more engaged actors in Antarctic science. What are the motivations of these new actors and how do they pose a challenge to the resilience of the Antarctic Treaty? What challenges do the differences in capacity between new actors (especially developing countries) and long-established players raise for the resilience of the Antarctic Treaty? Next, we turn to consider how contemporary concerns about protection of the environment and increasing commercialisation of science shape the place of science in Antarctica today.

The second part of paper examines 'science' in the context of the Antarctic Treaty. Discussion here highlights a number of key aspects: science as a foundational principle of the Antarctic Treaty which can be understood through examination of the origins of scientific cooperation in Antarctica, and the linkage of this cooperation to the colonial and post-colonial race to control Antarctica. Here we also consider questions about the quality of scientific research.

The conclusion of the paper then considers the legal adaptability of the Antarctic Treaty, having regard to the role of science throughout its history.

2 The Challenges

2.1 The importance/significance of science: why Antarctic science matters and what is at stake?

Scientific research was given high priority within the 1959 Antarctic Treaty initially, and eventually in the whole Antarctic Treaty System more broadly as it developed. Throughout the negotiating documents for the Antarctic Treaty the primary role of scientific research is acknowledged and there does not seem to have been any substantive discussion or disagreement that science should play a central role in Antarctic affairs. Thus, Article II of the Antarctic Treaty provides:

> Freedom of scientific investigation in Antarctica and cooperation toward that end, as applied during the International Geophysical Year, shall continue, subject to the provisions of the present Treaty.[3]

Further, Article III enhances the priority objective of scientific research, but lays a few ground rules about cooperation and transparency:

---

[2] For the purposes of this paper resilience means "the capacity of a social-ecological system to absorb or withstand perturbations and other stressors such that the system remains within the same regime, essentially maintaining its structure and functions. It describes the degree to which the system is capable of self-organization, learning and adaptation" Resilience Alliance, "Key concepts", accessed January 18, 2023, https://www.resalliance.org/key-concepts.

[3] Antarctic Treaty, Article II.

> 1. In order to promote international cooperation in scientific investigation in Antarctica, as provided for in Article II of the present Treaty, the Contracting Parties agree that, to the greatest extent feasible and practicable:
> (a) information regarding plans for scientific programs in Antarctica shall be exchanged to permit maximum economy and efficiency of operations;
> (b) scientific personnel shall be exchanged in Antarctica between expeditions and stations;
> (c) scientific observations and results from Antarctica shall be exchanged and made freely available.
> 2. In implementing this Article, every encouragement shall be given to the establishment of cooperative working relations with those Specialized Agencies of the United Nations and other international organizations having a scientific or technical interest in Antarctica.[4]

The importance of science to Antarctic governance has also been clearly recognised by the primary role played by scientific research, policy and advisory bodies in the Antarctic Treaty System. The first international scientific or technical organisation to have Observer bona fides within the Antarctic Treaty Consultative Meeting (ATCM) under the Rules of Procedure was the Scientific Committee on Antarctic Research (discussed below). Others have been granted expert status since, including the Intergovernmental Panel on Climate Change (IPCC), the World Meteorological Organization (WMO), Antarctic and Southern Ocean Coalition (ASOC), the International Association of Antarctica Tour Operators (IAATO), the International Group of Protection and Indemnity Clubs (IGP&I Clubs), the International Hydrographic Organization (IHO), the International Maritime Organization (IMO) and the International Oil Pollution Compensation Funds (IOPC Funds).

2.2 The primary role of the Scientific Committee on Antarctic Research

The Antarctic Treaty was negotiated and adopted at the end of a significant period of Antarctic scientific research—the International Geophysical Year of 1957–58. The Special Committee on Antarctic Research (renamed the *Scientific* Committee on Antarctic Research in 1961, hereinafter SCAR) pre-dates the Antarctic Treaty, having been established in 1958 for the 'continuing co-ordination of scientific activity in Antarctica following the International Geophysical Year (IGY).'[5]

There is a direct link to the ongoing role envisaged for SCAR in the Treaty: Article III.2, as mentioned above. A proposal from Chile during the negotiations of the Antarctic Treaty for an "Antarctic Institute of Scientific Research" was not pursued[6] and SCAR has been an Antarctic non-governmental international organisation from the beginning. At the first consultative meeting of Parties to the Antarctic Treaty in 1961 State parties agreed specifically to work to further the objectives of scientific co-operation set out in the Antarctic Treaty and acknowledged the ongoing importance of "the free exchange of information and views among scientists" as well as the importance of SCAR recommendations in relation to ongoing scientific co-operation in Antarctica.[7] State parties specifically acknowledged the important advisory role SCAR has to

---

4 Antarctic Treaty, Article III.

5 William M Bush, *Antarctica in International Law; A collection of inter-state and national documents*, Vol I (London: Oceana, 1982), 23.

6 Bush, Antarctica in International Law; A collection of inter-state and national documents, 54.

7 Antarctic Treaty Consultative Meeting, Recommendation I-IV, Report of the First Antarctic Treaty Consultative Meeting, https://documents.ats.aq/ATCM1/fr/ATCM1_fr001_e.pdf, accessed October 6, 2023, para (1).

play in effectively facilitating "international co-operation in scientific investigation".[8]

Membership of SCAR is open to any country that adheres to the principles of its founding organisation, the International Science Council. Full members must be a national organisation representing the scientific community of that country, and that country must maintain an active and continuing programme of research in the Antarctic Region.[9] Membership is hierarchical, with Full membership available to advanced and developing Antarctic science programs, and Associate membership available to countries interested in Antarctic science but not yet qualified for Full membership.[10] The majority of SCAR's Full members became Associates first. Associate members have no vote in SCAR deliberations.[11]

SCAR describes its mandate as "initiating, developing and coordinating high quality international scientific research in the Antarctic region (including the Southern Ocean), and on the role of the Antarctic region in the Earth system."[12] Its strategic plan 2017–2022 describes SCAR's vision as to be an "engaged, active, forward-looking organization that promotes, facilitates, and delivers scientific excellence and evidence-based policy advice on globally significant issues that are relevant to Antarctica."[13]

The Consultative Parties traditionally request SCAR input through their own national committees. SCAR's provision of scientific and evidence-based policy advice has come in many forms over the years, as a cursory examination of the number and variety of documents it submits to any Antarctic Treaty Consultative Meeting will attest. SCAR's input is usually in the format of Information or Background Papers, but it can also be a contributing author to the more substantive Working Papers from which new Antarctic law is most likely to be made—in the form of legally-binding Measures.[14] The Information and Working papers submitted by SCAR draw on the latest and most accurate scientific research and data, and aim to inform policy making in Antarctica. In that sense, science has a direct input to the formulation of sound policy by Antarctic decision makers. Contrary to this, with scant evidence to support their assertions, one recent study has incorrectly claimed that SCAR has moved beyond its scientific focus and has itself become a political actor pursuing the policy objectives of unspecified powerful Antarctic actors.[15] This is an unfair criticism of SCAR and misses the fundamental point that scientific data often does not support the position advocated by one or more actors in Antarctica. But that does not mean the science is invalid, or in some mysterious way is a 'political' tool of those pursuing a hidden agenda. Instead, it is science doing what world's best practice shows science should do

---

8 Antarctic Treaty Consultative Meeting, Recommendation I-IV, Report of the First Antarctic Treaty Consultative Meeting, para (2).

9 Article of Association of Scientific Committee on Antarctic Research, https://www.scar.org/library/governance/5597-articles-mar21/file/ , accessed October, 6 2023, article 18.1.1.

10 Article of Association of Scientific Committee on Antarctic Research, https://www.scar.org/library/governance/5597-articles-mar21/file/ accessed October 6, 2023 , article 18.1.2.

11 Article of Association of Scientific Committee on Antarctic Research, accessed October 6, 2023, https://www.scar.org/library/governance/5597-articles-mar21/file/ , article 25.1.2.

12 "Welcome to The Scientific Committee on Antarctic Research", Scientific Committee on Antarctic Research, accessed February 3, 2023, https://www.scar.org/.

13 Scientific Committee on Antarctic Research, *Strategic Plan 2017-2022: Connecting and Building Antarctic Research'*, 10 (Cambridge: Scientific Committee on Antarctic Research 2017), 3, https://www.scar.org/scar-library/other-publications/strategic-plans/774-2017-strategic-plan/.

14 At the 2019 ATCMXLII in Prague, for example, SCAR was a single or co-author on five Working Papers, 16 Information Papers and one Background Paper. Available from Antarctic Treaty Secretariat Document Database https://ats.aq/devAS/Meetings/DocDatabase?lang=e accessed February 3, 2023.

15 See Jiayu Bai and Xiaoyu Li, "How SCAR informs decision-making for Antarctic governance: Perspectives from SCAR submissions" *Marine Policy* 155 (2023): 105757.

– inform policy development and good policy-making by State parties to the Antarctic Treaty System. This is especially important in the contested political space that is Antarctic governance.

It is the substance of these papers that best illustrates the importance of Antarctic scientific research and the role that SCAR plays. For example, in its Working Paper titled "Code of Conduct for the Use of Animals for Scientific Purposes in Antarctica" (WP017) in 2019 was first discussed at the Committee for Environmental Protection (CEP) XXII meeting, then in the ATCM, where it was adopted as Resolution 4 (2019)[16]. A Resolution is not new law, *per se*, but it does add to the body of evidence about a particular issue – in this case, ethical biological research.

Other important papers presented by SCAR in 2019 include updates on anthropogenic noise (WP068),[17] biological prospecting (IP053),[18] climate change (IP136)[19] and the state of knowledge of wildlife responses to unmanned aerial vehicles (IP010).[20] These kinds of Working and Information papers contribute significantly to both the dissemination of extant scientific knowledge and the identification of gaps that need filling. The Working Paper on anthropogenic noise, for example, concluded with the remark that "There are significant gaps in scientific knowledge essential to advancing evidence-based policy-making regarding the impacts of noise in Antarctic marine environments" and a recommendation that "Encourages the development of research and other activities…to address gaps in the evidence-base needed to support the development of decision-making and policy regarding the impacts of noise in the Antarctic environment".[21]

2.3 The currency of science

Antarctica is defined by ice and isolation, and this makes it interesting to scientists because of their inherent curiosity about novelty. It also makes Antarctica invaluable to the rest of the world because of what that novelty might reveal. Science is the 'currency of credibility' in Antarctica through its priority status in the Antarctic Treaty. Scientific research 'elevates ordinary contracting states to Consultative (decision-making) states. States use the existence of their scientific research programs as the pathway into Antarctica and for some, also as a hedge against being excluded from future resource development.'[22] The results of scientific research are also

---

16 Antarctic Treaty Consultative Meeting, Resolution 4 (2019) Scientific Committee on Antarctic Research's Code of Conduct for the Use of Animals for Scientific Purposes in Antarctica, accessed February 3, 2023 https://ats.aq/devAS/Meetings/Past/87.

17 Scientific Committee on Antarctic Research, *Anthropogenic Noise in the Southern Ocean: an Update, Working Paper 068* to ATCM XLII, Prague, 2019, available from Antarctic Treaty Secretariat Document Database.

18 Scientific Committee on Antarctic Research, *Biological Prospecting in Antarctica: An update on the review by SCAR, Information Paper 053* to ATCM XLII, Prague, 2019, available from Antarctic Treaty Secretariat Document Database.

19 Scientific Committee on Antarctic Research, *Antarctic Climate Change and the Environment – 2019 Update, Information Paper 136* to ATCM XLII, Prague, 2019, available from Antarctic Treaty Secretariat Document Database.

20 Scientific Committee on Antarctic Research, *An update to the state of knowledge of wildlife responses to unmanned aerial vehicles, Information Paper 010* to ATCM XLII, Prague, 2019, available from Antarctic Treaty Secretariat Document Database.

21 Scientific Committee on Antarctic Research, Anthropogenic Noise in the Southern Ocean: an Update, Working Paper 068, note 11.

22 Julia Jabour, "So What? Using scientific knowledge to inform Antarctic decision-making" *Waikato Law Review Taumauri* 27 (2019): 17-30.

of inestimable value to the global community as we negotiate how to live with significantly changing environmental conditions.

Scientific authors have their work scrutinised by peers expert in the same or a comparative discipline, prior to publishing. This process is normally undertaken in what is called a single-blind review, that is, the reviewer knows the name of the author but the reviewer remains anonymous. Variations on this process include an open review, where the author and reviewer are identified to each other, or double-blind, where neither the author nor the reviewer's names are revealed. There are advantages and disadvantages in each of these three processes that relate to, *inter alia*, the timeliness of reviews, cultural or discipline bias and honesty. Nevertheless, the final product—a paper published in a peer-reviewed journal—is considered a reliable source of scientific information.[23] Although there are many excellent peer-reviewed, discipline-specific journals, the one with the highest impact factor that Antarctic academic scientists mostly aspire to be published by is *Nature*.

Unlike scholarly legal articles, scientific papers often have many authors (e.g. Hindell et al 2020[24] has 81 collaborators). This is an indication of the level of sophistication and collaboration required to investigate complex scientific problems. In Antarctica, collaborative science is common because of the expense of getting there and doing research in a vast, inhospitable environment where it is necessary to share logistics and resources.[25] These collaborations aim to achieve more than each of the individual scientific projects alone could, because of the greater potential for take-up by CCAMLR. CCAMLR could choose to use such data to promote the hitherto problematic establishment of further marine protected areas and/or more strict fishing regulations in areas identified to have a disproportionate concentration of fishing effort relative to marine predation.

A Brazilian paper in *Nature Scientific Reports*[26] describes an investigation into the 'actinobacterial diversity associated with an endemic Antarctic species, *Deschampsia antarctica*,' and the results suggest 'the rhizosphere of *D. antarctica* represents a prominent reservoir of bioactive actinobacteria strains and reveals it as an important environment for potential antitumour agents'. This kind of research illustrates how the novelty of Antarctic organisms is of considerable interest to biological prospectors, with a view to down-stream drug development with global application. The absence of regulation of bioprospecting in Antarctica is not due to a lack of scientific data, but instead due to a failure of policy-makers to respond to the available scientific data.

The availability of scientific data is critical in informing good policy making decisions in many contexts. One of the most obvious is its critical role for decision-making on harvest rules and potentially, marine protected areas, in CCAMLR. For example, krill—*Euphausia superba*, the keystone species of the Southern Ocean—is studied extensively because almost everything

---

23 Jacalyn Kelly, Tara Sadeghieh and Khosrow Adeli, "Peer review in scientific publications: benefits, critiques, and a survival guide" *The Journal of the International Federation of Clinical Chemistry and Laboratory Medicine* 25, no 3 (2014) 227–243.

24 Mark Hindell et al., "Tracking of marine predators to protect Southern Ocean ecosystems", *Nature* 580 (2 April 2020): 87.

25 Gordon Fogg, *A history of Antarctic science* (Cambridge: Cambridge University Press, 1992); see also Jabour, "So What? Using scientific knowledge to inform Antarctic decision-making", 17.

26 Leonardo Jose Silva et al., "Actinobacteria from Antarctica as a source for anticancer discovery", *Nature Scientific Reports* 10 (2020):13870, https://doi.org/10.1038/s41598-020-69786-2.

larger than krill eat krill. In a US paper,[27] the authors discovered that 'delayed sea ice advance may negatively affect growth and reproductive development of overwintering juvenile krill' because of their reliance on sea ice algae for survival and subsequent recruitment.

Science is also vital for uncovering new and emerging problems in Antarctica. For example, a multi-nation co-authored *Nature* paper from 2019 has highlighted a problem nobody wanted to discover in Antarctic waters: pollution from plastics and paint fragments. In the paper,[28] lead Brazilian author, Ana LdF Lacerda, and others from the UK, The Netherlands, Brazil, France and Portugal, discovered—through trawling the surface waters—that most of the plastic and paint fragments found did not originate from latitudes lower than 58º South. This was identified through oceanographic dispersal models over the last seven years. Irrespective of where it came from, this pollution carried bacteria, microalgae and invertebrate groups, with the fragments acting as a substrate, which may in turn increase the 'attractiveness' of these substances to grazing organisms. Ingestion can sometimes be fatal. This is vital information for Antarctic decision-makers, even though they have limited ability to deal directly with pollution that originates from outside the region.

Finally, in a series titled '10 Extraordinary Papers', *Nature* selected an article lauding the discovery of ozone thinning in Antarctica as a seminal work.[29] The lead states:

> The unexpected discovery of a hole in the atmospheric ozone layer over the Antarctic revolutionized science—and helped to establish one of the most successful global environmental policies of the twentieth century.

Describing Farman, Gardiner and Shanklin's surprising 1985 discovery of decreasing ozone levels over Halley and Faraday stations in Antarctica,[30] the author, Susan Solomon, noted the swift response by law-makers, agreeing to—if nothing else—a precautionary approach to dealing with the greenhouse effect caused by thinning ozone. Solomon said the British authors had 'boldly suggested'[31] a link to chlorofluorocarbons (CFCs) used by humans in a variety of ways, including as aerosols and refrigerants, as the probable cause of the ozone thinning. The subsequent development of the Montreal Protocol on Substances that Deplete the Ozone Layer[32] in 1987 (in force 1989) that regulates the production and consumption (and eventual phase-out) of some ozone-depleting substances is a globally significant response to mitigating the problem. However, it is predicted that stratospheric ozone levels will not return to pre-1980 levels until around 2050.[33]

In conclusion, therefore, we can say scientific research in and about Antarctica is extremely important, not just because of the contributions it makes to knowledge but also because

---

27 Kim S Bernard et al., "The contribution of ice algae to the winter energy budget of juvenile Antarctic krill in years with contrasting sea ice conditions", *ICES Journal of Marine Science*, 76:1, January–February 2019, https://doi.org/10.1093/icesjms/fsy145,, 206–216.

28 Ana L d F Lacerda et al., "Plastics in sea surface waters around the Antarctic Peninsula" *Nature Scientific Reports* (2019) 9:3977, https://doi.org/10.1038/s41598-019-40311-4.

29 Susan Solomon, "The discovery of the Antarctic ozone hole", *Nature* 575 (7 November 2019), 46–47.

30 J.C. Farman, B.G. Gardner, and J.D. Shanklin, "Large losses of total ozone in Antarctica reveal seasonal ClOx/NOx interaction", *Nature* 315 (1985), 207–210.

31 See Solomon, "The discovery of the Antarctic ozone hole", 46.

32 Protocol on substances that Deplete the Ozone Layer, Sept 16, 1987, 26 ILM 154 (1987).

33 "Earth Observatory", NASA, "Earth Observatory," accessed February 3, 2023 https://earthobservatory.nasa.gov/world-of-change/Ozone.

of the insights it gives to major environmental challenges of our times. Science informs good policy-making in relation to a wide range of issues and it helps us to identify new issues as they are emerging. It is collaborative, multidisciplinary and verified by processes of peer review.

The continuation of freedom of scientific investigation recognised by Article II of the Antarctic Treaty is therefore essential. The way in which science is conducted, of course, has evolved with advances in technology. Modern technologies such as satellites, drones, underwater autonomous vehicles, computing and revolutions in the biological sciences such as DNA sequencing have all changed how scientific research is conducted in Antarctica. However, the essence of scientific research – the quest for answers and new knowledge – remains unchanged and science continues to evolve, with new developments in technology.

Nevertheless, as the following discussion outlines, there are several key challenges to the central role of science in Antarctica.

2.4 New actors in Antarctic science

While science has always been the currency of Antarctica, the emergence of new scientific actors or the increased engagement of established scientific actors has been met with considerable suspicion by other actors. A prominent feature of debates concerning Antarctica and the Southern Ocean, in the past decade in particular, has been suspicions about the motivation of these actors. A particular focus of concern is China's increased engagement with Antarctica and significant increases in China's scientific research activities there, which some see as a threat to the future of the Antarctic Treaty System.[34] China has conducted 36 Antarctic expeditions and will open its fifth research station in Antarctica by 2022.[35]

Representative of the more extreme critiques of China's enhanced engagement are those who imply that it is China's rapacious quest for resources that really drives its increased scientific research activities in Antarctica. Thus, critics of China's role in Antarctica such as Brady have noted:

> Deciding who can control polar resources is a matter of global political and economic importance. As an energy hungry nation, China is extremely interested in the resources of Antarctica (and the Arctic) and any possibilities for their exploitation. The notion of "resources" has a broad meaning in the Antarctic context…. It includes minerals, meteorites, the intellectual property of Antarctic bioprospecting, locations for scientific bases, marine living resources, and access to the continent for Antarctic tourism. [36]

The implication here is that China wants to exploit all of Antarctica's resources to the maximum extent possible and is using its enhanced scientific research in Antarctica to position itself for future exploitation of these resources.

In contrast, others assert that despite increased scientific research activity in Antarctica, China still has only minimal influence within the Antarctic Treaty System. Liu, for example, recently noted that compared to leading countries such as Australia and the US, China rarely

---

34 Ann-Marie Brady, *China as a Polar Great Power* (Cambridge, Cambridge University Press 2017).

35 Nengye Liu, "Emerging and non-traditional actors at the poles" in Karen Scott and David VanderZwaag (eds) *Research Handbook of Polar Law* (Cheltenham: Edward Elgar, 2020), 169.

36 Anne-Marie Brady, "China's Rise in Antarctica?" *Asian Survey* 50(4) (2010): 759–785.

makes substantive submissions to the ATCM.[37] More significantly to date there is no evidence to suggest that China's activities in Antarctica have involved anything other than the conduct of scientific research.[38]

Even if China does wish to take control of Antarctica's resources, as some of its critics suggest, there are significant institutional impediments in their way. In the case of the mineral resources in particular, the Madrid Protocol[39] imposes an absolute prohibition on mining in Antarctica. Often forgotten in the debates surrounding the perceived 'rush for resources' in Antarctica, the Madrid Protocol requires that ban to stay in force at least until 2048. Any party can request a conference be convened to review the operation of the Protocol under Article 25, but before the mining ban can be lifted all State parties to the Madrid Protocol would have to agree to the terms of the new regulatory regime to replace it. An even less likely scenario might be that all State parties agree to abandon the Madrid Protocol entirely, which is most improbable. Recent state practice, including the 2016 Santiago Declaration on the Twenty Fifth Anniversary of the Signing of the Protocol on Environmental Protection to the Antarctic Treaty[40] and the 2019 Prague Declaration on the Occasion of the Sixtieth Anniversary of the Antarctic Treaty,[41] has confirmed that all states, including China, are still committed to the mining ban.

While there has been significant interest in China's engagement with Antarctica, the growth of interest in Antarctic affairs of the European Union (EU) has also been significant, if less commented upon. Detailed discussion of the growth in EU involvement in Antarctic affairs is beyond the scope of this paper. However, a number of points are worth noting.[42] The EU is not a party to the Antarctic Treaty. However, 11 Consultative Parties to the Antarctic Treaty are also members of the EU. These are: Belgium, Bulgaria, the Czech Republic, Finland, France, Germany, Italy, the Netherlands and Poland, Spain and Sweden (and until Brexit came into force on 1 January 2021, the United Kingdom). Amongst the Non-Consultative Parties, nine states are also members of the EU, namely: Austria, Denmark, Estonia, Greece, Hungary, Portugal, Romania, Slovakia and Slovenia. Given the number of EU member states that are either Consultative or Non-Consultative Parties to the Antarctic Treaty, the sheer weight of numbers would suggest they could be influential if a common EU position were adopted on particular issues. However, contrary to what these numbers suggest, Liu has noted that it is, in fact, 'rare to see the EU trying to coordinate positions of Member States in the annual ATCM and Committee for Environmental Protection meeting.'[43] The authors of this paper agree with Liu's position that there is little evidence to show co-ordinated action by the EU in ATCM's. However, this future

---

37 See Liu, "Emerging and non-traditional actors at the poles", 169.

38 David Leary, "From hydrocarbons to psychrophiles: the "scramble" for Antarctic and Arctic Resources" in Tim Stephens and David L VanderZwaag, *Polar Oceans Governance in an era of Environmental change* (Cheltenham: Edward Elgar 2014), 125–145.

39 Protocol on Environmental Protection to the 1959 Antarctic Treaty, Oct 4 ,1991, 2941 U.N.T.S. 3 hereinafter 'Madrid Protocol'.

40 Santiago Declaration on the Twenty Fifth Anniversary of the signing of the Protocol on Environmental Protection to the Antarctic Treaty, May 30, 2016, accessed February 3, 2023 https://documents.ats.aq/ATCM39/ad/atcm39_ad003_e.pdf (hereinafter 'Santiago Declaration').

41 Prague Declaration on the Occasion of the Sixtieth Anniversary of the Antarctic Treaty, July 8 2019, accessed 17 January, 2023 https://ats.aq/devAS/Meetings/Documents/87?tab=additional (hereinafter the 'Prague Declaration').

42 For detailed discussion of recent developments in relation to the EU and Antarctica, see Liu, "Emerging and non-traditional actors at the poles", 173-180.

43 Liu, "Emerging and non-traditional actors at the poles", 178.

possibility cannot be discounted, given the EU also plays a very active role in CCAMLR, because of its competence in fisheries matters.

Despite this minimal role, it is worth observing that the EU is also a significant funder of scientific research in Antarctica and, in that regard, has an indirect influence over the nature of scientific research and how it is carried out. Under the EU's Multiannual Framework Programmes, the EU and its Member States have provided significant levels of funding to international research activities and polar research infrastructure.[44] In 2019, according to the European Polar Board, there were 32 European research facilities in Antarctica.[45] We see more funding for science in Antarctica as a positive rather than something that challenges the Antarctic Treaty System.

New actors in Antarctic science capacity (developing countries)

Beyond China and the EU, a growing number of states have ratified the Antarctic Treaty but have no active program of scientific research and thus have only become Non-Consultative Parties to the Antarctic Treaty. As Table 1 below shows, a growing number of states, including many developing Asian states, as well as many from Latin and South America, have become Non-Consultative Parties to the Antarctic Treaty over the past two decades. As such, it is no longer fair (if it ever was) to criticise the Antarctic Treaty System as a 'club' of former colonial powers.

Table 1. Non-Consultative Parties to the Antarctic Treaty as at 25 September 2023[46]

State	**Date of Entry into Force of the Antarctic Treaty for that State**
Austria	25 August 1987
Belarus	27 December 2006
Canada	4 May 1988
Colombia	31 January 1989
Costa Rica	11 August 2022
Cuba	16 August 1984
Denmark	20 May 1965
Estonia	17 May 2001
Greece	8 January 1987
Guatemala	31 July 1991
Hungary	27 January 1984
Iceland	13 October 2015
Kazakhstan	27 January 2015
Korea (DPRK)	21 January 1987
Malaysia	31 October 2011
Monaco	31 May 2008
Mongolia	23 March 2015
Pakistan	1 March 2012
Papua New Guinea	16 March 1981

[44] Andreas Rasotnik and Andreas Østhagen, "The EU in Antarctica: An Emerging Area of Interest, or Playing to the (Environmental) Gallery?" *European Foreign Affairs Review* 25(2) (2020) 239–260, 248–249.

[45] Andreas Rasotnik and Andreas Østhagen, "The EU in Antarctica: An Emerging Area of Interest, or Playing to the (Environmental) Gallery?", 248.

[46] Information extracted from Secretariat of the Antarctic Treaty, 'Parties', accessed February 3, 2023, https://www.ats.aq/devAS/Parties?lang=e.

Portugal	29 January 2010
Romania	15 September 1971
San Marino	14 February 2023
Slovakia	1 January 1993
Slovenia	22 April 2019
Switzerland	15 November 1990
Turkey	24 January 1996
Venezuela	24 March 1999

Challenges to the legitimacy of the Antarctic Treaty System from Asian states outside the 'Antarctic club' have all but disappeared. Most notably, Malaysia has now ratified the Antarctic Treaty which entered into force for it on 31 October 2011.[47] Malaysia today it is very much part of the 'Antarctic club' it once railed against. India, which had also questioned the legitimacy of the Antarctic Treaty, nonetheless ratified the Antarctic Treaty several decades ago and is now a full Consultative Party.[48]

However, according to Article IX(2) of the Antarctic Treaty, States can only participate in the decision-making of the Antarctic Treaty Consultative Meeting 'during such time as that Contracting Party demonstrates its interest in Antarctica by conducting substantial scientific research activity there, such as the establishment of a scientific station or the despatch of a scientific expedition.'[49] Active engagement in scientific research therefore acts as the currency to buy the right to participate in Antarctic Treaty decision-making.

The first notification of an acceding state seeking Consultative Party status was received from Poland in 1977.[50] This was followed by a series of notifications throughout the 1980s and 1990s.[51] Today there are currently 29 Consultative Parties to the Antarctic Treaty.[52] However in the last two decades the growth in Consultative Parties has slowed dramatically. Only two states, the Ukraine (2004, confirmed 2005) and the Czech Republic (admitted in 2014) have become Consultative Parties to the Antarctic Treaty in the past two decades. Three other applications in recent years have come from Venezuela (2018), Belarus (2021 and 2023) and Canada (2022 and 2023) and have so far been unsuccessful.[53] Canada requested that its application be deferred

---

47 On the evolution of Malaysia's policy approach to Antarctica see Ahmad Firdaus Ahmad Shabudin et. al, "From ad hoc towards the institutionalisation: An assessment of Malaysia's policy evolution on Antarctica and the Southern Ocean" *Marine Policy* 78 (2017): 1–10. See also Peter Beck, "The United Nations and Antarctica, 2005: the end of the 'Question of Antarctica'?" *Polar Record* 42(3) (2005): 217–227.

48 On India and the 'question of Antarctica' see, for example, Adrian Howkins, "Defending polar empire: opposition to India's proposal to raise the 'Antarctic Question' at the United Nations in 1956" *Polar Record* 44 (228) (2008): 3, 5–44.

49 Antarctic Treaty, Article IX(2).

50 Serge Pannatier, "Acquisition of Consultative status under the Antarctic Treaty" *Polar Record* 30 (173) (1994): 123–129.

51 Serge Pannatier, "Acquisition of Consultative status under the Antarctic Treaty".

52 Antarctic Treaty Secretariat, "Parties", accessed Feb 3, 2023, https://www.ats.aq/devAS/Parties?lang=e

53 In relation to Venezuela's application in 2018 see Antarctic Treaty Secretariat, *Report of the Forty-first Antarctic Treaty Consultative Meeting, Buenos Aires, Argentina* (Buenos Aires, Antarctic Treaty Secretariat, 2018), accessed Sept 29, 2020, https://documents.ats.aq/ATCM41/fr/ATCM41_fr001_e.pdf , paras 32-34.; on the Belarus applications see Antarctic Treaty Secretariat, *Final Report of the Forty-third Antarctic Treaty Consultative Meeting, Paris, France* (Buenos Aires, Antarctic Treaty Secretariat, 2021), accessed Sept 25, 2023, https://documents.ats.aq/ATCM43/fr/ATCM43_fr001_e.pdf, paras 86-87 and Antarctic Treaty Secretariat, *Final Report of the Forty-fifth Antarctic Treaty Consultative Meeting, (Preliminary Report) Helsinki, Finland*, (Buenos

until 2024 noting no change in opinions of states since its original application in 2022.[54]

Concerns following Venezuela's failure to achieve Consultative Party status led some states to suggest at ATCM XXXIX in 2016 that refined criteria should be developed to assist in determining when Consultative status could be granted to a non-Consultative state party.[55] An Intersessional Contact Group (ICG) on criteria for Consultative Status established in response reported back with recommendations on these criteria in 2017.[56] Following the recommendations of the ICG the ATCM XL adopted Decision 2 (2017) *Guidelines on the procedure to be followed with respect to Consultative Party status* which set out the procedure for recognition of Consultative Party status[57] and the information on scientific research activities and facilities of the applicant state in Antarctica.

These guidelines were put to the test in recent ATCM consideration of applications by both Belarus and Canada (mentioned above). At the ATCM held remotely in 2021, consideration of the application by Belarus was deferred because of the "necessity of an in-person meeting to discuss such an important matter, the Parties decided to postpone Belarus's request until it could be discussed formally at ATCM XLIV in 2022."[58] Belarus's request was not considered at ATCM XLIV in 2022. But in 2023, the USA "in its capacity as Depositary Government of the Antarctic Treaty and the Environment Protocol, confirmed that Belarus had complied with the guidelines set out in Decision 2 (2017)". Despite this, some parties stated that Belarus "had not conducted substantial scientific research activity in Antarctica" and therefore the required consensus to approve Belarus's application was not satisfied.[59]

However, it is also worth noting that at the same ATCM, compliance with the requirements Decision 2 (2017) by Canada was also confirmed by the USA as Depository.[60] It is

---

Aires, Antarctic Treaty Secretariat, 2021), accessed Sept 25, 2023, https://documents.ats.aq/ATCM45/fr/ATCM45_fr011_e.pdf , paras 124-126; In relation Canada's application see Antarctic Treaty Secretariat, *Final Report of the Forty-Fourth Antarctic Treaty Consultative Meeting, (Preliminary Report) Berlin, Germany,* (Buenos Aires, Antarctic Treaty Secretariat, 2022), accessed Sept 25, 2023, https://documents.ats.aq/ATCM44/fr/ATCM44_fr001_e.pdf, paras 118-122 and Antarctic Treaty Secretariat, *Final Report of the Forty-fifth Antarctic Treaty Consultative Meeting, (Preliminary Report) Helsinki, Finland,* (Buenos Aires, Antarctic Treaty Secretariat, 2021), accessed Sept 25, 2023, https://documents.ats.aq/ATCM45/fr/ATCM45_fr011_e.pdf , paras 127-130.

54 Antarctic Treaty Secretariat, *Final Report of the Forty-fifth Antarctic Treaty Consultative Meeting, (Preliminary Report) Helsinki, Finland,* (Buenos Aires, Antarctic Treaty Secretariat, 2021), accessed Sept 25, 2023, https://documents.ats.aq/ATCM45/fr/ATCM45_fr011_e.pdf, para 129.

55 Andrew Gray and Kevin Hughes, "Demonstration of "substantial research activity" to acquire Consultative status under the Antarctic Treaty" *Polar Research* 35(1) (2016): 1–12

56 Chile, New Zealand and Uruguay, *Report of the Intersessional Contact Group (ICG) on Criteria for Consultative Status*, WP3, ATCM XL (2017), accessed Jan, 19, 2023, https://www.ats.aq/devAS/Meetings/DocDatabase?lang=e

57 Antarctic Treaty Consultative Meeting Decision 2 (2017), Guidelines on the procedure to be followed with respect to Consultative Party status, Antarctic Treaty Secretariat, *Final Report of the Fortieth Antarctic Treaty, Consultative Meeting* (2017), accessed February 3, 2023, https://documents.ats.aq/ATCM40/fr/ATCM40_fr001_e.pdf, 227-235

58 Antarctic Treaty Secretariat, *Report of the Forty-third Antarctic Treaty Consultative Meeting, Paris, France (2021),* (Antarctic treaty Secretariat, Buenos Aires, 2021), accessed Apr 13, 2022, https://documents.ats.aq/ATCM43/fr/ATCM43_fr001_e.pdft, 35

59 Antarctic Treaty Secretariat, *Final Report of the Forty-fifth Antarctic Treaty Consultative Meeting, (Preliminary Report) Helsinki, Finland,* (Buenos Aires, Antarctic Treaty Secretariat, 2021), accessed Sept 25, 2023, https://documents.ats.aq/ATCM45/fr/ATCM45_fr011_e.pdf, para 125-126.

60 Antarctic Treaty Secretariat, *Final Report of the Forty-fifth Antarctic Treaty Consultative Meeting, (Preliminary Report) Helsinki, Finland,* (Buenos Aires, Antarctic Treaty Secretariat, 2021), accessed Sept 25, 2023, https://documents.ats.aq/ATCM45/fr/ATCM45_fr011_e.pdf, para 128.

unclear why no consensus could be reached on Canada's application. However, in the case of both Belarus and Canada, it is reasonable to suggest that external geopolitical issues are a major factor. Given Belarus's involvement in Russia's illegal invasion of Ukraine in early 2022 and widespread attempts to isolate both nations through sanctions and other measures, the lack of progress of the Belarus application is hardly surprising. A lack of consensus in relation to Canada's application may possibly be due to retaliation by supporters of Belarus's application. But given the lack of detail contained in ATCM reports, this is hard to verify. This suggests that even with the objective criteria of Decision 2 (2017), reaching consensus on applications for Consultative Status remains an inherently political decision. Accommodating the aspirations of a growing number of states with limited scientific capacity and ongoing geopolitical tensions raises new challenges for the Antarctic Treaty and tests its resilience. These are not new challenges for the Antarctic Treaty but it remains to be seen how well it will be able to adapt to these new geopolitical realities.

2.5 Science in conflict with the environment?

Unregulated, free and open science in Antarctica has also increasingly been challenged by another pillar of Antarctic governance, the protection of the environment. The conduct of scientific research in Antarctica is not without environmental impact. The landscape, the Antarctic ecosystem, terrestrial biodiversity, the marine environment and the atmosphere can all be impacted by activities such as the construction, maintenance, operation and decommissioning of research facilities, roads and runways for aircraft operating in Antarctica, and indeed individual scientific research projects. [61]

The provisions of the Antarctic Treaty guaranteeing freedom of scientific investigation must now be read in conjunction with the provisions of the 1991 Protocol on Environmental Protection to the Antarctic Treaty.[62] Article 3(1) of the Madrid Protocol places environmental protection and the conduct of scientific research on an equal footing. In that regard, all activities in the Antarctic Treaty area, including scientific research, must be planned and conducted so as to limit adverse impacts on the Antarctic environment and dependent and associated ecosystems.[63] The Madrid Protocol further provides for environmental impact assessment of all activities, including scientific research which have more than a minor or transitory impact. [64] A key innovation of the Madrid Protocol was the establishment of the Committee for Environmental Protection (CEP) which provides advice and recommendations to State parties in relation to protection of the environment and implementation of the Madrid Protocol.[65]

While on paper the Madrid Protocol provisions appear quite robust, detailed examination of the implementation in practice does not necessarily match its high ideals. As one detailed study has observed

> Overall, there appears to be a range of models of EIA practice throughout the Antarctic and also

---

61 S.T. Brooks, J. Jabour, J. van den Hoff and D.M. Bergstrom (2019) "Our footprint on Antarctica competes with nature for rare ice-free land", *Nature Sustainability* (2) 2, (March 2019, 185–190. This work was also presented by Australia to ATCMXLII as *Information Paper 41, Footprint in Antarctica* (Prague, 2019).

62 Madrid Protocol.

63 Madrid Protocol, Article 3(2)(a)

64 Madrid Protocol, Article 8

65 The CEP was established under Article 11 of the Madrid Protocol and its functions are defined in Article 12.

> in specific regions of the Antarctic. Some Antarctic Treaty states comply adequately with the EIA process in terms of producing EIA documents and taking tangible action on the ground, while others appear to be chronically lagging behind. This is a concern as uneven standards weaken the effectiveness of EIA. Furthermore, some of the inspection reports indicate that there is a risk that the EIA process is downgraded to the bureaucratic procedure of producing an EIA document, which has no practical effect on the way activities are conducted, and ultimately limited effect on the prevention or mitigation of environmental impacts.[66]

The trends discussed above in relation to EIA processes under the Madrid Protocol become more pronounced in the case of environmental impact assessments of scientific research in Antarctica. In the end, it is the proposing State Party which ultimately determines whether or not such research will proceed. Any conditions that are to be imposed to manage environmental impact following EIA are imposed by the approving state in accordance with the requirements of the Madrid Protocol. However, the regulator and the proponent of the research project might be one and the same. The controversy surrounding the Russian proposal for subglacial ice drilling in Lake Vostok provides one example of scientific research in Antarctica that has raised questions about the adequacy of EIA in the Antarctic context.[67] Likewise another recent example highlighting the conflict of scientific and environmental values is Australia's now abandoned proposal to construct a 2700-metre-long paved runway in the Vestfold Hills 4.5km from Australia's Davis Station. Concerns were raised as to the environmental impact of this major project and ultimately the Australian government cancelled the project on environmental grounds.[68] Other similarly controversial projects include China's proposed construction and operation of a new research station in Victoria Land, Antarctica.[69]

2.6 Commercialisation of science

Concerns have also been expressed about the nexus between scientific research and new commercial activities in Antarctica such as bioprospecting. A detailed examination of this issue is beyond the scope of this paper, and in any event has been dealt with in the existing literature. However, in summary it is worth noting these concerns include: the potential conflict between science as advisor in the Antarctic governance system and science as an active commercial actor[70]

---

66 Kees Bastmeijer and Ricardo Roura, "Environmental Impact Assessment in Antarctica" in Kees Bastmiejer and Timo Koivurova, *Theory and Practice of Transboundary EIA*, (Leiden: Martinus Nijhoff, 2007)), 175–219, 206.

67 For further detailed background on the issues relating to Lake Vostok see Martin Siegert and Mahlon Kennicutt, "Governance of the Exploration of Subglacial Antarctica" *Frontiers in Environmental Science* 6 (2018): 103. The Lake Vostok example is also examined by Karen Scott. See Karen Scott, "Scientific Rhetoric and Antarctic Security" in Alan Hemmings, Donald Rothwell and Karen Scott, *Antarctic Security in the Twenty-First Century* (London: Routledge, 2012), 284-306. Inagaki also highlights how these matters can be further complicated when private actors and multiple states are involved. See Osamu Inagaki, "Legal Issues concerning DROMLAN under the Antarctic Treaty System", *The Yearbook of Polar Law* 12 (2020): 61–74.

68 For an overview of this project see Australian Antarctic Program, 'About the Davis aerodrome project', available at https://www.antarctica.gov.au/antarctic-operations/travel-and-logistics/aviation/davis-aerodrome/about-the-project/ , accessed October, 6 2023.

69 For China's formal response to some of this criticism see China Antarctica, *Proposed Construction and Operation of a New Chinese Research Station, Victoria Land, Antarctica, Final Comprehensive Environmental Evaluation*, https://documents.ats.aq/EIES/EIA/02292enFinalCEEofChineseNewStation.pdf , accessed October 6, 2023.

70 Alan Hemmings, "Does Bioprospecting Risk Moral Hazard for Science in the Antarctic Treaty System?" *Ethics in Science and Environmental Politics* 10 (2010), 5.

and delays in publication of valuable scientific data due to patenting and commercialisation.[71]

2.7 What does "freedom of scientific investigation" entail today: A focus on quality?

While 'freedom of investigation' has long been accepted as a fundamental pillar of Antarctic governance, in more recent years debate has emerged as to the extent to which this freedom is qualified by requirements of quality—most notably in a Working Paper reporting on joint inspections of research stations submitted to ATCM XXVIII in Stockholm in 2005. Joint authors, Australia, Peru and the United Kingdom, observed:

> Although some stations were undertaking world-class scientific research into a wide variety of disciplines (though many geared to climate change), a larger number of stations appeared to have relatively modest, or even rudimentary, science facilities. This was particularly so when viewed against the substantial size of some stations' infrastructure. In many situations science programmes appeared to consist of no more than routine data observations involving technicians collecting e.g. meteorological, or tidal measurements. In consequence, stations in close proximity to each other were often collecting similar data on the same parameters. [72]

In essence, what this report was highlighting was the questionable quality of some purported scientific research being conducted in Antarctica. A clear dividing line was arguably suggested between 'good science' and 'very poor science', [73] the logical extension being that conducting good science was consistent with the freedom of scientific investigation recognised by Article II of the Antarctic Treaty. As a first step in working out the difference between the two, the Working Paper, considered at the Stockholm meeting, proposed that SCAR should undertake an "audit of science being carried out in Antarctica." [74]

As Walton was subsequently to observe

> This proposal brought forth the expected cries of protest, asserting the right of sovereign states to organize and fund whatever science they chose as well as questioning the involvement of SCAR in any such assessment…Apparently any suggestion of criticism strikes at the heart of nationalism, that for some at least sovereignty is still far more important than good science (despite over 40 years of the Treaty).[75]

The debate on the 'quality' of scientific research continues to this day. A recent clarification to the guidelines for assessing suitability for Consultative Party status has, for the first time, provided

---

71 Kim Connolly-Stone, "Patents, property rights and benefit sharing issues" in Alan Hemmings and Michelle Rogan-Finnemore, *Antarctic Bioprospecting* (Gateway Antarctica Special Publication Series, Christchurch, 2005).

72 Australia, Peru and the United Kingdom, Report of joint inspections under article VII of the Antarctic Treaty and article 14 of the Environmental Protocol, Working Paper 32, ATCM XXVII (2005), accessed Jan 19, 2023, https://www.ats.aq/devAS/Meetings/DocDatabase?lang=e, 6.

73 David Walton, "Editorial. Judging quality in science" *Antarctic Science* 17(4) (2005): 481.

74 Australia, Peru and the United Kingdom, Report of joint inspections under article VII of the Antarctic Treaty and article 14 of the Environmental Protocol, 6.

75 David Walton, "Editorial. Judging quality in science".

measures of 'quality' when being applied to scientific credentials.[76] Contracting Parties requesting Consultative Party status ('CPrCS') are required to prepare a dossier of their scientific achievements over the previous 10 years, which may include:

> • 'a list of publications related to Antarctica, including both articles in peer-reviewed scientific journals as well as papers to international bodies;
>
> • a list of publications with co-authors from different countries;
>
> • details of citations of relevant papers that scored well in a science citation index;
>
> • details of data contributed by the CPrCS with emphasis on data cited in publications that score well in a science citation index and on data contributed to Antarctic scientific programmes and databases;
>
> • creation of data sets that are accessible to the scientific community; and/or
>
> • examples of research prizes or formal recognition of accomplishments.'[77]

While this list is indicative only, and the Decision itself is not legally binding, the subtext could be that without providing evidence of highly-credentialed scientific work, it would be difficult for a Contracting Party to achieve decision-making status. Other guidelines in the Decision, such as evidence of a Party's ability and willingness to promote international cooperation in accordance with Article III of the Antarctic Treaty,[78] lend weight to the argument that quality counts, more so now than ever before.

2.8 To what extent do interpretations of science in other treaty contexts help to explain the legal meaning of science in the ATS today?

There is acknowledgement throughout the negotiating documents for the Antarctic Treaty that scientific research was to be at the core of the treaty. The central role of science and freedom of scientific investigation is also universally supported in subsequent state practice. But what does science and scientific investigation mean in the context of the Antarctic Treaty? Is the quality of scientific research determinant in relation to whether something is 'scientific' in the Antarctic Treaty context?

In answering these questions, we may turn first of all to basic principles of public international law with respect to treaty interpretation. As Fitzmaurice has observed, there are three broad schools of thought in relation to treaty interpretation: the first looks to the intentions of the parties to the treaty; a second approach looks to the textual or ordinary meaning of the terms of a treaty; while the third school looks to the aims and objects of the treaty.[79] The rules in relation to treaty interpretation have been codified in the 1969 Vienna Convention on the Law of

---

[76] Secretariat of the Antarctic Treaty, "Guidelines on the procedure to be followed with respect to Consultative Party status" Decision 2 (2017) Annex, accessed Feb 3 , 2023, https://ats.aq/devAS/Meetings/Measure/653.

[77] Secretariat of the Antarctic Treaty, "Guidelines on the procedure to be followed with respect to Consultative Party status."

[78] Secretariat of the Antarctic Treaty, "Guidelines on the procedure to be followed with respect to Consultative Party status", point h).

[79] G.G. Fitzmaurice, "The Law and Procedure of the International Court of Justice: Treaty Interpretation and Certain other points", *British Yearbook of International Law* 28 (1951): 1.

Treaties.[80] The Antarctic Treaty, like any other international treaty, should therefore be interpreted in accordance with the provisions of the Vienna Convention.

Article 31 of the Vienna Convention provides that a treaty is to be interpreted 'in good faith in accordance with the ordinary meaning to be given to the terms of the treaty in their context and in the light of its object and purpose'.[81] Article 31(2) of the Vienna Convention goes on to provide rules for determining the meaning of the 'context' of a treaty. Perhaps more relevantly for present purposes, Article 31(3) provides that the following can be taken into account, together with the context:

> (a) any subsequent agreement between the parties regarding the interpretation of the treaty or the application of its provision;
>
> (b) any subsequent practice in the application of the treaty which establishes the agreement of the parties regarding its interpretation; [and]
>
> (c) any relevant rules of international law applicable in the relations between the parties.

Article 32 of the Vienna Convention also allows for recourse to supplementary means of interpretation, including the preparatory work of the treaty and the circumstances of its conclusion to resolve any ambiguous or obscure meaning.[82]

However, as the Antarctic Treaty predates the Vienna Convention its provisions do not apply to interpretation of the Antarctic Treaty.[83] Nonetheless, the Vienna Convention largely reflects customary international law and the same principles apply to interpreting treaties not covered by the Vienna Convention.[84]

We suggest that consistent with these rules regard can be had to two other treaties that many state parties to the Antarctic Treaty are also party to. The two most relevant treaties for present purposes are the 1982 United Nations Convention on the Law of the Sea (LOSC)[85] and the 1946 International Convention for the Regulation of Whaling (ICRW).[86] Interpretations of the meaning of science in other treaty contexts arguably sheds some light on the boundaries of science and scientific investigation but are by no means conclusive. In addition, as we argue in part 3 below the meaning of science in Antarctica can also be understood in light of the historical origins of scientific research in Antarctic.

2.9 The meaning of science under the LOSC and the Whaling Convention.

The LOSC devotes 17 discrete articles to marine scientific research in Part XIII, but it

---

80 Vienna Convention on the Law of Treaties, May. 23, 1969, 1155 U.N.T.S. 331 (hereinafter 'Vienna Convention')

81 Vienna Convention, Article 31.

82 Vienna Convention, Article 32.

83 Vienna Convention, Article 4.

84 Malcolm Shaw, *International Law* (Cambridge: Cambridge University Press, 2014), 655.

85 United Nations Convention on the Law of the Sea, Dec. 10, 1982, 1833 U.N.T.S. 397, (hereinafter 'LOSC')

86 International Convention for the Regulation of Whaling, Nov. 10, 1948, 161 U.N.T.S. 72 (hereinafter 'ICRW')

does not provide a definition of either 'marine scientific research' or 'scientific research'.[87] In fact, how to define such terms had dominated a considerable part of the negotiations of Part XIII of the LOSC.[88] In that regard, the difficulty of distinguishing between 'pure' scientific research and commercial exploration, and to a lesser degree between research for peaceful and military purposes, were key issues that could not be resolved.[89] The debate in relation to the distinction between pure and commercially-focused research continues to this day, with similar issues being canvassed in the context of the current negotiations for an instrument on the conservation of biodiversity in areas beyond national jurisdiction.[90]

It is worth noting that leading scholars in this field have observed:

> On the one hand, the failure to include a precise definition of [Marine Scientific Research]….makes it difficult to establish the scope of what is covered by the legal regulation of [Marine Scientific Research] and has been criticized. On the other hand, the abstention from defining [Marine Scientific Research] leaves room to include e.g. future technological developments and new research methodology or activity. As a minimum requirement an activity qualifying as [Marine Scientific Research] must meet the purposes to increase knowledge on the marine environment. This implies a relevant question, i.e. a specification concerning what kind of knowledge on what issue the activity is directed at.[91]

While no clear definition of marine scientific research or science is provided in the LOSC, in 2014 the International Court of Justice (ICJ) was called upon to consider just what science is and is not in its consideration of the ICRW in the Whaling in the Antarctic Case.[92] Here, the ICJ was called upon to consider the lawfulness of the second phase of Japan's Whale Research program under the ICRW. A key issue in the case was the meaning of the term 'scientific research'. In its arguments before the ICJ, Australia maintained that in the context of the ICRW, scientific research had four essential characteristics

> defined and achievable objectives (questions of hypotheses) that aim to contribute to knowledge important to the conservation and management of stocks; "appropriate methods", including the

---

87 For the detailed discussion of the history of negotiations of UNCLOS and its provisions relating to marine scientific research under UNCLOS see Alfred Soons, *Marine Scientific Research and the Law of the Sea* (Boston: Kluwer, 1982, especially pp 118-131. See also Alexander Proells (ed) United Nations Convention on the Law of the Sea. A commentary, (Munich: CH Beck, Hart Nomos, 2017), 1608-1612.

88 See United Nations Division for Ocean Affairs and the Law of the Sea, Office of Legal Affairs, The Law of the Sea-Marine Scientific Research. Legislative History of Article 246 of the United Nations Convention on the Law of the Sea (New York, United Nations, 1994), copy on file with author. See also discussion on the same point by Soons, *Marine Scientific Research and the Law of the Sea*, 18-119.

89 United Nations Division for Ocean Affairs and the Law of the Sea, Office of Legal Affairs, The Law of the Sea-Marine Scientific Research. Legislative History of Article 246 of the United Nations Convention on the Law of the Sea, 26–38.

90 On this issue see Salvatore Arico and Charlotte Salpin, *Bioprospecting Genetic Resources in the Deep Seabed: Scientific Legal and Policy Aspects, UNU-IAS Report* (Tokyo: United Nations University, 2005). For discussion of the interaction between the proposed BBNJ Treaty and the Antarctic Treaty System see David Leary, "Bioprospecting at the Poles" in Karen Scott, & David VanderZwaag, (eds), *Research Handbook on Polar Law*, (Cheltenham: Edward Elgar 2020), 271–291

91 Alexander Proelss (ed) United Nations Convention on the Law of the Sea. A commentary, 1609.

92 *Whaling in the Antarctic* (*Australia v Japan; New Zealand Intervening*), Judgment of the International Court of Justice, General List No 148 (31 March 2014).

use of lethal methods only where the objectives of the research cannot be achieved by any other means; peer review; and the avoidance of adverse effects on stock[93]

However, the ICJ was 'not persuaded that activities must satisfy the four criteria advanced by Australia in order to constitute "scientific research" in the context of Article VIII' of the ICRW.[94] While the Court did accept the importance of hypotheses to science, [95] it did not see peer review as always needing to be present for research to be regarded as scientific.[96] The court also noted both Japan and Australia accepted that in the context of the ICRW, scientific research must avoid an adverse effect on whale stocks. The Court also accepted that lethal methods can have a place in scientific research. [97]

Following the ICJ's logic in the Whaling Case, peer review is not necessarily essential in determining whether an activity is scientific or not. But as noted in Part 1 of this paper, at least as far as the scientific community is concerned, peer review is an essential component of contemporary scientific practice. In that regard one might argue the legal definition of science accepted by the ICJ is inconsistent with how the scientific community define what they do.

3. Science in the Antarctic Treaty Context.

3.1 Science as a foundational principle of the Antarctic Treaty System

The provisions of the Antarctic Treaty relating to the use of Antarctica for peaceful purposes set out in Article 1, the prohibition on nuclear weapons testing contained in Article V, and the freeze on territorial claims in Article IV represent a package deal. Arguably freedom of scientific research in Antarctica has been the string that has kept this package deal together. Science has aided the quest to maintain peace in Antarctica and successfully helped to diffuse misunderstanding of each State's intentions and tensions around competing territorial claims.

As discussion below highlights, modern concerns about real or perceived motivations of new actors, or the increased engagement of established scientific actors in Antarctica is entirely consistent with historical trends. States active in Antarctica have always been suspicious of other states' activities and motivations. However, these concerns are managed through transparent and robust scientific collaboration. Cooperation rather than conflict has been the *modus operandi* of states in Antarctica.

Therefore, the emphasis on international collaboration in scientific research in Antarctica, that is a key feature of the Antarctic Treaty system, cannot be divorced from the other key pillars of Antarctic governance contained in Articles I, IV and V of the Antarctic Treaty. The achievements of science in the context of other Antarctic achievements are quite remarkable given that the IGY occurred, and the Antarctic Treaty was negotiated at the height of the Cold War. More so, when one considers that Antarctic science was at that time "part of a scientific 'arms-race' where the US and the Soviet governments each continued to invest in work there primarily

---

93 Whaling in the Antarctic (Australia v Japan; New Zealand Intervening), para 74.

94 Whaling in the Antarctic (Australia v Japan; New Zealand Intervening), para 86.

95 Whaling in the Antarctic (Australia v Japan; New Zealand Intervening), para 77.

96 Whaling in the Antarctic (Australia v Japan; New Zealand Intervening), para 84.

97 Whaling in the Antarctic (Australia v Japan; New Zealand Intervening), para 82.

because the other was also doing so."[98] Scientific research in Antarctica during the IGY and beyond was but one part of the wider geostrategic intelligence battle for fighting the Cold War across the globe.[99]

Given the centrality of science to the Antarctic Treaty System, understanding the origins and meaning of science in the Antarctic context is crucial to understanding how States and other actors in Antarctica can and should deal with the challenges for the Antarctic Treaty System identified above. To this end it is useful to explore the origins of scientific cooperation in Antarctica. We argue its origins help to understand its significance and the meaning of 'freedom of scientific investigation' today and into the future. The following discussion highlights the links between the 'heroic age' age of exploration of Antarctica and between the 'heroic age' and territorial claims in the colonial and post-colonial era.

3.2 Origins of scientific cooperation in the International Polar Years (1882–1883; 1932–1933) and the International Geophysical Year (1957–58).

In his comprehensive study of the history of Antarctic science, Fogg observes that 'Antarctic science is not *sui generis* or self-contained but has grown out of mainstream science, on which it still depends completely and to which it contributes knowledge essential for the understanding of our world as a whole'.[100] As such, the origins of scientific cooperation in Antarctica reflects the history of scientific cooperation across the world. Antarctic science, like science more broadly, therefore traces its origins to the legacies of the great thinkers of science in Europe, one of the most notable being Edmond Halley (after whom Halley's comet is named) who was a pioneer in what we now know as the science of geophysics and stellar astronomy.[101] Halley's work in these fields and especially his interest in magnetism, with the support of the Royal Society, led ultimately to the earliest expeditions in the region with a distinctly scientific purpose.[102] Halley's contributions to science and his advocacy for the study of the transit of Venus lead directly to the subsequent exploration of the Antarctic by Captain James Cook.[103] From 1772 to 1775, Cook's exploration resulted in the first delimitation of the Antarctic continent and contributed significantly to the expansion of scientific knowledge about the region.[104]

Cook's exploration of the oceans surrounding Antarctica was followed not long thereafter by the Russian-sponsored expedition lead by Thaddeus Fabian von Bellingshausen in 1819. While science was a feature of Bellingshausen's expedition a key mission of the voyage was also to report back to the Russian Tsar on the activities of other nations in the region.[105] Thus, as early as Bellingshausen's exploration of Antarctica, science was but one of the motivations for interest in Antarctica. The activities of other actors were another motivation for States' engagement with

---

98 Simon Naylor, Martin Siegert, Katrina Dean and Simone Turchetti, "Science, geopolitics and the governance of Antarctica", *Nature Geoscience* 1 (2008): 143–145, 144.

99 Simon Naylor, Katrine Dean and Martin Siegert, "The IGY and the ice sheet: surveying Antarctica", *Journal of Historical Geography* 34 (2008): 574–595, 581–582.

100 Gordon Elliott Fogg, *A History of Antarctic Science* (Cambridge: Cambridge University Press, 1992), 1.

101 Fogg, A History of Antarctic Science, 8.

102 Fogg, A History of Antarctic Science, 10–12.

103 Fogg, A History of Antarctic Science, 17–32.

104 Fogg, A History of Antarctic Science, 22–23.

105 Fogg, A History of Antarctic Science, 34.

Antarctica. Throughout the 19th century other expeditions motivated by scientific curiosity followed, such as those by Sir James Clark Ross in 1839–1843.[106] But these expeditions were largely directed by one nation and it was not until the mid to late 19th century that ideas of international cooperation in polar research emerged.

In 1875 Karl Weyprecht, who had led an expedition to the Arctic while an officer in the Austrian Navy, proposed 'international, cooperative, scientific research of both polar regions'[107] Weyprecht's proposal was considered at the first International Polar Conference in Hamburg in 1879 which endorsed the idea leading to the first International Polar Year (IPY) from 1882–1883.[108] The first IPY involved 11 nations sponsoring 14 research stations and observatories. [109] A key focus of the first IPY was on meteorology and magnetism.[110] While predominately focused on the Arctic, research relating to Antarctica was also included with two expeditions launched to the continent. [111] While the first IPY is significant because it was the largest international research collaboration up to that point, the collation, analysis, and publication of the results of this research were hampered by delays and little in the way of meaningful new developments in science emerged from the endeavour. [112]

Despite the disappointing experience of the first IPY, the idea for a second was put forward by German researchers in 1927, and by 1930 26 states had agreed to participate.[113] A particular focus of the Second IPY was on meteorology, magnetism, atmospheric science and ionospheric physics.[114] Of most interest were the contributions observations in the polar regions could make to weather forecasts in other parts of the world. [115] However, while some 20 research stations were planned south of 50°S, only two were eventually established. The Great Depression meant that most states did not have the financial resources to commit to scientific research in the polar regions.[116]

---

[106] C. Summerhayes, "International collaboration in Antarctica: the International Polar Years, the International Geophysical Year, and the Scientific Committee on Antarctic Research" *Polar Record* 44 (231) (2008): 321–334.

[107] A. Millbrooke, "International Polar Years", in GA Good, *Sciences of the Earth: An encyclopaedia of events, people and phenomena* (New York: Routledge, 1998), 484–487.

[108] Summerhayes, "International collaboration in Antarctica: the International Polar Years, the International Geophysical Year, and the Scientific Committee on Antarctic Research."

[109] Millbrooke, "International Polar Years."

[110] F.W.G. Baker, "The First International Polar Year, 1882-83", *Polar Record* 21(232) (1982) 275–285.

[111] Summerhayes, "International collaboration in Antarctica: the International Polar Years, the International Geophysical Year, and the Scientific Committee on Antarctic Research". For a very detailed analysis of the scientific research carried out during the first International Polar Year see Susan Barr et. al, "The Expeditions of the First International Polar Year", in S. Barr and C. Lüdecke (eds) *The History of the International Polar Years (IPYs). From Pole to Pole*. (Heidelberg: Springer-Verlag 2010), 35–107.

[112] Summerhayes, "International collaboration in Antarctica: the International Polar Years, the International Geophysical Year, and the Scientific Committee on Antarctic Research", 324.

[113] The states were Argentina, Australia, Austria, Brazil, Bulgaria, Canada, Denmark, Estonia, Finland, France, Germany, Great Britain, Hungary, Iceland, Italy, Japan, Mexico, Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland, USSR and the USA. See Baker, "The First International Polar Year, 1882-83", 283.

[114] Summerhayes, "International collaboration in Antarctica: the International Polar Years, the International Geophysical Year, and the Scientific Committee on Antarctic Research", 325.

[115] Summerhayes, "International collaboration in Antarctica: the International Polar Years, the International Geophysical Year, and the Scientific Committee on Antarctic Research", 325.

[116] See Baker, "The First International Polar Year, 1882-83". On the Second International Polar Year see also J.A. Fleming, "The Proposed Second International Polar Year" *Geographical Review* (Jan 1932 22(1): 131–134 and

3.3 Science and territorial claims: Colonial and post-colonial race to control giving context to 'science'

While there is no doubt the quest for new scientific knowledge was a key motivating factor behind the emergence of the first and second IPYs, each respectively book-end the so called 'heroic age' of Antarctic exploration by the likes of Amundsen, Scott, Mawson and Shackleton. As Collis and Stevens have noted

> The 'heroic era' of Antarctic imperialism…left in its wake a legacy of imperial land claims to polar space. By the end of the 1940s much of the continent was subject to national claims, the largest of which was Britain's 1933 'gift' of 42 per cent of the continent to Australia…Antarctica's other national claimants and dates of claim include Argentina (1943), Chile (1940), France (1924 and 1938), New Zealand (1923), Norway (1939) and the United Kingdom (1908, 1917, ad 1962).[117]

Thus, prior to the 1940s—if not well before—Scientific research in Antarctica was tied very much to imperial and colonial ambitions and claims to territory in Antarctica. As one Antarctic scholar has suggested "to paraphrase Von Clausewitz…[i]n Antarctica, science is the continuation of politics by other means".[118] A detailed examination of the history of the respective territorial claims in Antarctica is beyond the scope of this paper.[119] However, it is worth noting that in the immediate period after World War II, simmering geopolitical tensions had emerged in the region due to (i) the clashing territorial claims of the United Kingdom, Argentina and Chile; and (ii) the Cold War tensions between the USA and the Soviet Union.[120] Decolonisation in the Global South was a further dynamic that complicated international diplomacy relating to Antarctica.[121]

The idea for a third IPY (which ultimately became the International Geophysical Year) emerged from a private dinner party hosted by American scientist, James van Allen in 1950.[122] Discussions at this dinner party turned to the possibility of building upon the unrealised legacy of

---

V. Laursen, *Bibliography for the Second International Polar Year 1932–33*, (Copenhagen: International Meteorological Organization Temporary Commission on the Liquidation of the Polar Year 1932–33, 1951).

117 Christy Collis and Quentin Stevens, "Cold colonies: Antarctic spatialities at Mawson and McMurdo station" *Cultural Geographies* 14 (2007): 234–254, 238. On responses to these territorial claims by the non-claimant state USA see Jason Moore, "Tethered to an iceberg: United States policy toward the Antarctic, 1939–1949" (1999) *Polar Record* 35(193) (1999): 125–134.

118 M. Manzoni and P. Pagnini, "Comment. The symbolic territory of Antarctica", *Political Geography* 15(5) (1996): 359–364, 362.

119 For detailed discussion see Shirley Scott, "Universalism and Title to Territory in Antarctica" *Nordic Journal of International Law* 66 (1997): 33–53. Territorial claims of each claimant state are also examined in detail in Christopher Joyner, *Antarctica and the Law of the Sea* (Leiden: Martinus Nijhoff, 2012), especially Chapter 2.

120 Aant Elzinga, "Antarctica: The Construction of a Continent by and for science", in Elizabet Crawford, Terry Shinn and Sverker Sörlin, *Denationalizing Science. The Contexts of International Scientific Practice* (Heidelburg: Kluwer 1993), 85. On the territorial claims of both Argentina and Chile see Adrian Howkins, "Icy relations: the emergence of South American Antarctica during the Second World War" *Polar Record* 42 (221), 153–165.

121 Christy Collis and Klaus Dodds, "Assault on the unknown: the historical and political geographies of the International Geophysical Year (1957–8)", *Journal of Historical Geography* 34 (2008): 555–573, 559.

122 Frank Greenaway, *Science International. A history of the International Council of Scientific Unions*, (Cambridge, Cambridge University Press, 1996), 150. On the origins of the IGY see also Fae Korsmo, "The Genesis of the International Geophysical Year" *Physics Today* 60(7) (2007): 38–43.

the second IPY, especially in relation to the potential for studies of the upper atmosphere.[123] Ideas arising from these discussions were taken forward and the idea of an International Geophysical Year (IGY) from 1 July 1957 to 31 December 1958 was subsequently endorsed by the International Union of Geodesy and Geophysics, the International Council of Scientific Unions (ICSU) and the World Meteorological Organisation (WMO).[124]

Given the complex geopolitical situation at the time, it was not surprising that several key players were initially reluctant to join the international scientific research program of the IGY. For example, the participation of both Argentina and Chile in the IGY (and subsequently the Antarctic Treaty) has been described as 'reluctant collaboration.'[125] As Howkins observes '[s]outh American officials never believed that scientific goodwill was ever more than a façade for the political interests of the great powers", and Britain—their main territorial rival—was a great power.[126] Concerns held by Argentina and Chile were arguably legitimate. As Scott has noted

> Britain was arguably the first state to exploit political capital from scientific research activities when it instituted the so-called 'Discovery investigations' in the 1920s in order to obtain information on whale stocks in the Southern Ocean. Whilst ostensibly a research expedition 'for the benefit of mankind', the Discovery voyages were undoubtedly also designed to support Britain's claim in Antarctica and its regulation and taxation of whaling taking place within the region.[127]

It has likewise been suggested that both Australia and Norway established their Antarctic Scientific Research programs as a direct result of concerns about the activities of other state actors in the region.[128]

4. Conclusion – the resilience of the Antarctic Treaty: Science and Cooperation

This paper has examined the resilience of the Antarctic Treaty and the central role played by science in Antarctica. We began by highlighting the importance of Antarctic science, why it matters and what is at stake if freedom of scientific investigation in Antarctica were to be undermined. We concluded that scientific research in and about Antarctica is important not only because of the contributions it makes to knowledge, but because of the pointers it provides us in understanding and solving the major environmental challenges of our time.

---

123 Korsmo, "The Genesis of the International Geophysical Year", 150.

124 Collis and Dodds, "Assault on the unknown: the historical and political geographies of the International Geophysical Year (1957–8)". On the role of the WMO in shaping the research agenda of the IGY and its part in the name change from the International Polar Year to the International Geophysical Year, see Greenaway, *Science International. A history of the International Council of Scientific Unions*, 151.

125 Adrian Howkins, "Reluctant collaborators: Argentina and Chile in Antarctica during the International Geophysical Year, 1957-58" *Journal of Historical Geography* 34 (2008): 596–617.

126 Howkins, "Reluctant collaborators: Argentina and Chile in Antarctica during the International Geophysical Year, 1957-58"

127 Karen Scott, "Scientific rhetoric and Antarctic security" in Alan Hemmings et. al. *Antarctic Security in the Twenty-First Century: Legal and Policy Perspectives*, (London: Routledge 2012), 284–306, 289. It should be noted though that at times there were tensions between what work the scientists in the field wanted to carry out and UK foreign policy objectives in Antarctica. On this see Klaus Dodds, "The Great Game in Antarctica: Britain and the 1959 Antarctic Treaty", *Contemporary British History* 22(1) (2008): 43–66.

128 Karen Scott, "Scientific rhetoric and Antarctic security", 290.

Science is not only the currency or price nation states must pay to have a role in the governance of Antarctica, it is also the key legitimate reason for their presence there. This close alignment between legitimacy as an Antarctic actor and decision-maker and the epistemological validity of their scientific research explains why at times the Antarctic Treaty seems challenged by the emergence of new actors in Antarctica. Throughout its history the legitimacy of new actors present in Antarctica has been questioned. Are new actors present in Antarctica for legitimate scientific reasons, or does their purported scientific research mask their real objectives of territorial expansion and or hedging their bets for possible future exploitation of Antarctica's resources? These questions have been asked in relation to the motivations of recent new actors such as China and the European Union amongst others, but as our examination has demonstrated similar questions have been asked about most states' activities in Antarctica throughout its history. Modern questions asked about the motivations of China and the EU in Antarctica are exactly the same as the questions raised about the motivations of the early actors such as the United Kingdom, Australia, Chile and Argentina.

These questions cannot be divorced from more recent emphasis on the quality of scientific research and investigation in Antarctica. If, as some have suggested, the real motivation for the presence of a number of actors in Antarctica is purely about territorial expansion and future access to and control of Antarctica's resources, then scientific investigation in Antarctica is nothing more than a cloak to deceive competitors for control of that territory and its resources.

While there is no doubting there is an element of accuracy to such assertions (as there always has been throughout the history of scientific research in Antarctica), it cannot be denied that scientific research and freedom of scientific investigation in particular in Antarctica has been much more than a cloak for nationalistic agendas. The advances in science, the vast expansion of knowledge that it has brought and its contribution to solving pressing global concerns in our view puts beyond doubt the value of freedom of scientific investigation in Antarctica to humanity and the planet.

Resilience—at its core—focuses on the degree to which the Antarctic Treaty is able to 'self-organise, learn and adapt.' In this paper we have highlighted the strong resilience of science and scientific cooperation as one of the four foundational principles of the Antarctic Treaty, precisely because of its ability to self-organise, learn and adapt. Our discussion has highlighted how the Antarctic Treaty has developed its own mechanisms for accommodating the aspirations of new actors while remaining resilient in the maintenance of science as the currency of legitimacy. New actors will only be admitted where they have the capacity to engage in 'real' scientific research of value. Through development of criteria for the admission of new Consultative Parties and a focus on the 'quality' of scientific research the resilience and integrity of the scientific foundations of the Antarctic Treaty have been maintained. But even this resilience of the Antarctic Treaty System cannot hide the—at times—deep suspicions that some states feel towards others. But again, as we have shown, this is nothing new.

The importance of science does not mean of course that such activities are totally uncontrolled. Freedom of scientific investigation in the modern era is now subject to management of its environmental impact under the Madrid Protocol. Freedom of scientific investigation therefore has limits. While regulating the environmental impact of science in Antarctica has raised challenges from time to time, the system has been resilient enough to accommodate the international community's shifts in expectations with respect to the environment. Of course, the resilience of the Antarctic Treaty System is at times tested, as our brief discussion of some of the more recent controversies surrounding the environmental impact of science in Antarctica attest. Nonetheless, none of these examples undermine our conclusion as to resilience and compatibility

of freedom of scientific investigation and the Antarctic Treaty. While some such proposals were abandoned, others were modified to comply with state obligations under the Madrid Protocol.

There are of course emerging stresses raised by the commercialisation of science as we mentioned briefly. If the scale of these commercial activities grows significantly in the future, they may place greater pressure on the resilience of the Antarctic Treaty. How they will interact with or undermine science in Antarctica is still an open question.

Despite this later emerging challenge, we nonetheless conclude science as one of the four foundational pillars of the Antarctic treaty is both robust and resilient. Concerns about the ability of the Antarctic Treaty to continue to maintain its resilience are legitimate. However, everything we know about the history of science, it's central role in human endeavours in Antarctica and its immense potential to do good in the future suggests it will remain a central and essential foundation for decades to come. That does not mean there won't be challenges, but far from seeing the imminent collapse of the Antarctic Treaty as some more pessimistic commentators have suggested, we see a bright future for the Antarctic Treaty with science at its very core as it always has been, and as it always should be.