UNIVERSITY of CALIFORNIA PRESS | GLOBAL PERSPECTIVES

Turchetti, Simone. 2024. "Data Rules: What the History of Scientific Data Can Tell Us about the Asymmetries of Global Governance in the Twentieth Century." *Global Perspectives* 5 (1). https://doi.org/10.1525/gp.2024.121640.

Politics, Governance, and the Law

Data Rules: What the History of Scientific Data Can Tell Us about the Asymmetries of Global Governance in the Twentieth Century

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Keywords: International science, Science diplomacy, Global data infrastructure, CODATA, World Data System, International relations, International scientific collaboration, Cold War, Post-colonialism

https://doi.org/10.1525/gp.2024.121640

Global Perspectives

Vol. 5, Issue 1, 2024

This article explores the history of international scientific data organizations and documents their significance in the definition of new forms of global governance. It focuses in particular on the ancestry of two data organizations now operating under the International Science Council (formerly International Council of Scientific Unions -ICSU): the World Data System and the Committee on Data for Science and Technology. Examination of these organizations reveals that while global data infrastructures have developed considerably in the last century, they have also shaped a noticeable imbalance in the administration of data resources between the scientific organizations of a few scientifically developed countries and the rest of the world. In turn, the article suggests that these disparities are also decisive in implicitly shaping a two-tiered system in global data governance as they have forestalled scientific development in world regions marginalized in these data systems, while hastening that of the few represented within.

Recent scholarly work contends that we have entered an age of data overload fueling planetary concerns such as heightened surveillance, invasive predictive technologies, and even scientific uncertainty in tackling global warming (Goldstein 2022; Mann 2020; Gal 2016; Everts 2016). Yet while the current data deluge might be new, international organizations administering data in general, and scientific data more specifically, have been around for some time. Digging into their past reveals, actually, that over the last century, important *imbalances* in data access and distribution, rather than surplus, have been a key factor affecting their global governance.

That the history of international scientific data organizations can be informative of the emergence of global governance structures should not surprise the reader, especially considering what IR scholars have argued over the last decade. Their work has demonstrated that globalization has shaped a new system of international relations underpinned by the emergence of transnational networks establishing multilateral interdependence in state affairs (Farrell and Newman 2019; see also Keohane and Nye 2000). A galaxy of international organizations, corporations, and nongovernmental agencies has thus defined new ways to administer these affairs, partly as "nonstate actors" in these interdependence networks (see Barnett and Sikkink K 2009; see also Iriye 2004; Katzenstein 1996; Risse-Kappen 1995). Scholars have also investigated public and cultural diplomacy operations implemented by these actors and, more recently, science diplomacy—that is, the shaping of international relations through the promotion of collaborative scientific projects, as informal but powerful means to assert influence in this new IR framework (Ruffini 2017; Royal Society/AAAS 2010; Nye 2004; Adamson and Lalli 2021; Turchetti et al. 2020).

Yet studies discussing these dramatic changes have yet to focus consistently on the role of scientific data in the context of these global transformations. We know that compiling numerical collections conveying information about societal trends became common practice in the late nineteenth century as a statecraft tool to administer modern society (Wiggins and Jones 2023). But the historical analysis of datasets utilized in the sciences has yet to produce a comprehensive narrative. Indeed, scientific data are often understood as basic numerical and digitized "bits" of scientific information that constitute new theories and facts through various steps of data integration. They thus still appear to be *neutral* numerical reflections of the natural world, carrying no agency in human affairs, although several scholars—including, among others, Sabina Leonelli, Elena Aronova, Paul Edwards and Bruno Strasser—have discussed this agency in their research (Leonelli 2014; Strasser 2019; Edwards 2006; Aronova 2017).

This article extends their considerations by looking into the definition of new forms of global data governance con-

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nected to the establishment of international scientific organizations devoted to establishing transnational data networks. In turn, it aims to show that important imbalances have characterized the development of these networks over the last century, shaping a legacy of global inequalities that lives on. As scientometrics studies show, today's scientific infrastructures are "lumpy" from a geographical viewpoint—dense in some world regions but sparser in others (Wagner 2018, 121–40). Data networks are a particularly compelling example of this unevenness since most data repositories are located in the Northern Hemisphere and often feed new research conducted in the research facilities of scientifically developed countries in the Global North while offering fewer opportunities to develop scientific research in those of other nations.

The combination of theoretical assumptions from STS and IR fields allows conjecture on the reasons for this unevenness. The first of these postulations is the STS tenet that technoscientific and social (global) orders are co-produced (Jasanoff 2006, 1–12). The circulation of scientific data is a linchpin of this co-production as it hastens the scientific enterprise globally by making available the building blocks needed to assemble new knowledge and use it in the global scientific enterprise. Hence, the setting up of international organizations regulates anew data flows establishing multilateral interdependence in data supply. Yet recent IR research shows that this interdependence, when applied to state affairs, provides opportunities for redefining the influence that some of the nations in these global networks can hold over others, in turn shaping uneven networks (see Farrell and Newman 2019, 45). This argument can be extended to global data networks as these, too, can be rendered asymmetrical, especially through a selective location of databanks or restrictive membership in organizations responsible for overseeing data supply. In turn, while these networks operate as multilateral facilities serving the global scientific enterprise, their uneven clustering eases control of data production and circulation for some of the state and nonstate actors involved while complicating it for others.

This article thus draws on these theoretical assumptions to sketch the history of international organizations that have set up these transnational data networks. The examination of published and unpublished papers further documents the development of two in particular: the World Data System (WDS) and the Committee on Data for Science and Technology (CODATA), both operating under the nongovernmental International Science Council (known until 2018 as International Council of Scientific Unions, or ICSU).[1] Their establishment followed the definition of a primeval system of data *bureaus* during the imperial era. After World War II, as this article shows, these two organizations shaped not only multilateral interdependence in data supply but also conspicuous asymmetries within the deriving transnational data networks. The WDS materialized a network of databanks located in a few countries alone, whereas CODATA initially welcomed only a select number of national committees as members. Thus, the relevant transnational data networks connected with these organizations catered to a globally uneven supply of data in the geosciences, in physics and chemistry. In turn, the article examines the differences distinctive of global datasets in these scientific disciplines and shows how controlling the data supply by the national research committees of scientifically developed countries had implications for the global transportation, telecommunications, oil, and nuclear industries that their administrations sought to advance. The promotion of a new international economic order led delegates of administrations whose access to these data networks was limited to call for their reformation, especially in the context of UNISIST, a global scientific information system promoted by UNESCO in the 1970s. The article finally focuses on the neoliberal stances in the 1980s that affected the emerging confrontation between data-rich and data-poor countries, also in connection with the spreading of larger data arrays (or "big data") increasingly administered as global commodities.

BUREAUS BEFORE THE BIRTH OF TRANSNATIONAL DATA NETWORKS

Transnational data networks first appeared during the colonial era when the research agencies of a few imperial powers agreed to set up offices devoted to compiling scientific datasets. After World War I, these efforts were more consistently coordinated internationally due to the winning powers' search for durable peace conditions, while also extending colonial rule and instigating an expansion of their trading interests. State officials of colonizing nations looked for new means of international coordination in areas as diverse as migration regulation, work legislation, and global health to promote an ancestral form of global governance falling in line with colonial ambitions (Wu and Sawyer 2024, 6–7). Scientists contributed to shaping it through a primeval network of data bureaus. Understood as a modern scientific infrastructure utilized to accomplish specific research tasks, they also assisted in the expansion of trading and industrial activities to the colonial powers' advantage.

Collecting scientific data internationally had by then been of interest to the scientific organizations of these powers for some time. Data had emerged as a powerful tool of internal state administration in the Enlightenment and had found successful application especially in the context of statistical analyses (Wiggins and Jones 2023, 18–28). Yet it did not take too long to understand that they could also advance colonial and scientific enterprises. Earth data gathered and utilized by geographers and geodesists in-

1 Especially the papers of earth scientist Alan H. Shapley, available at the US Library of Congress in Washington, DC (Shapley was a prominent figure in both the WDS and CODATA) and documents from the CODATA archive in Paris, France.

Figure 1. Classification of data according to scientific areas.

Discipline	Time/location	Reproducibility	Numerical/Non-numerical
Physics and chemistry	Time/location independent	Reproducible	Numerical
Engineering	Time/location independent	Dependent on the history of processing of the materials	Numerical
Earth/Cosmic sciences	Time/location dependent	Nonreproducible	Numerical
Geology/Biology	Time/location dependent	Nonreproducible	Non-numerical

Redacted from ICSU-WDC Memo 10. ICSU Panel on WDC (Geophysical and Solar), 24 August 1971, p. 10 in Panel on World Data Centers, 1969–1972, box 69, Alan Shapley Papers, US Library of Congress, Washington, DC.

formed the exploration and conquest of colonial territories, often in support of colonial forces (Pyenson 2012, 378–79). From the late eighteenth century on, transportation in general, but especially the development of railways, became increasingly reliant on international data coordination, pivotal to the worldwide standardization of time. The Carte du Ciel, an eighty-year-long sky-mapping exercise started in 1887, informed the expansion, globally, of sea navigation. The establishment of a Bureau International de l'Houre consolidated these coordination efforts, especially to assist train travel (Captaine, Baüer, and Débarbat 2022, 45–80).

The development of the League of Nations stirred forward plans for a system of international scientific organizations taking responsibility for data coordination projects. In 1919 the national academies of winning powers joined forces in an International Council for Research (renamed in 1931 the International Council of Scientific Unions, or ICSU), and contingently three international scientific unions for astronomy, geodesy and geophysics, and radio science were set up (Greenway 2006, 19–33). They took responsibility for a network of data bureaus for latitude and longitude, the motion of polar caps, earth tides, and mean sea levels (Schiavon 2021; Alcock 2006; on the polar motion service, see Yokoyama, Manabe, and Sakai 2000).

The international unions of physicists and chemists contributed to these initiatives, although their officials understood data as standardizing universal values instead. These scientists thus focused on the fundamental chemical and physical properties of substances (e.g., density, viscosity, heat of absorption; see Wagman 1992) and, in contrast with astronomers, geographers, and earth scientists, conducted no fieldwork allowing them to put together datasets on the variations they observed across world and sky regions. Hence the scientists in the first group conceived data as space- and time-independent (universal) numerical values, whereas those in the second were eager to compile space- and time-dependent numerical datasets displaying these local and global variations (see figure 1).

The chief reason for assembling standard physical and chemical values of substances was that toward the end of the nineteenth century, industrialization shaped new standardization efforts at the national level. For instance, in 1882 the Swiss Hans Heinrich Landolt and the German Richard Börnstein compiled *Tabellen* with the values of the properties of hundreds of compounds utilized by industry workers. Other scientists completed similar sourcebooks in Britain, France, and the United States (Lide and Wood 2021, 1). Hence, the International Research Council agreed in 1926 to publish the *International Critical Tables of Numerical Data: Physics, Chemistry and Technology* in collaboration with the US National Academy of Sciences. While the sourcebook's contributors could be found in Britain, France, Austria, Denmark, the Netherlands, and Japan, American industrial firms made available the sums needed for the tables' completion (Wagman 1992, 41).

During the 1930s the US federal government invested more than any other country in data standardization. Still tied to the Monroe Doctrine in foreign affairs, the US administration nonetheless foresaw the advantages to be derived from streamlining industrial processes through standard setting, since this allowed the United States to exercise greater influence abroad, especially through the marketing of standardized American industrial processes. The US National Bureau of Standards (established 1901) became an engine in the production of standardized data in physics and chemistry, especially due to expansion of the oil industry. In 1928 US chemist Frederick Rossini created the bureau's Physico-Chemical Research Section to quantify the thermodynamic properties of petrochemical substances, while also liaising with the American Petroleum Institute, a think tank eager to foster foreign trade of petroleum products. Rossini's division assembled the relevant data in coordination with another ICSU union established in 1919, the International Union of Pure and Applied Chemistry (IUPAC), that went on to establish the thermodynamic properties of various classes of hydrocarbons (paraffins, cycloparaffins, olefins, alkylbenzenes, and acetylenes; see Wagman 1992, 38).

Hence, with World War II approaching, new bureaus devoted to the collection and circulation of scientific data in various scientific branches operated internationally in line with the agenda of research organizations working for the imperial powers. Germany's exclusion from this system during the interwar years partly weakened this project, since the country was one of the world's leading scientific powers. The rise of totalitarian regimes further enfeebled these efforts advancing international science, which came to a halt with the beginning of World War II. The reorganization of data exchange after the war heightened multilateral interdependence in data supply, while also defining conspicuous asymmetries in the emerging global data network.

THE EMERGENCE OF AN UNEVEN GLOBAL DATA NETWORK

The end of World War II restarted the international data projects born in the 1920s, hence paving the way to the establishment of new ICSU organizations such as the World Data Center Panel (the World Data System's ancestor) and CODATA. But the imperial networks that had supported the development of these data schemes until the conflict were no longer in place. The imperial powers had lost or were about to lose their colonies abroad since these had recently become, or would soon be, politically independent. While the United States and the Soviet Union were about to extend their influence globally in the context of the Cold War, also establishing Western and Eastern bloc coalitions, they did not wish to impose direct territorial control in the way imperial powers had done. Indeed, their quest for hegemony rested with their ability to gain leadership in international networks shaping multilateral state interdependence. Thus, while departing from opposite ideological tenets, both Soviet and US officials sought to establish new means of international coordination too. The Soviets set a separate international community under the banner of socialist solidarity, while also becoming involved, especially after Stalin's death in 1953, in other international cooperative ventures crossing political divides. The Americans propagandized neoliberal values that also resonated with their efforts to strengthen international networks. Notably, the Mont Pèlerin Society's advocacy for a global free market economy originated from a meeting of the International Trade Organization in Geneva (Plehwe 2015, 11–15). Hence, both US and Soviets sought to establish old and new international coordination projects to assert influence in global networks, including the data organizations about to be set up by the ICSU.

So the reconfiguration and further growth of prewar transnational scientific data networks offered an opportunity to officials from a few scientifically developed countries, including US and Soviet ones, to influence their shaping. From 1945 on, the newly established United Nations worked toward renaming pre–World War II intergovernmental scientific agencies, such as the World Health and Meteorological Organizations, also making them responsible for new data collection projects. The ICSU and the scientific unions under its umbrella reorganized too, and in the postwar years benefited from new funding opportunities through the United Nations Educational, Scientific and Cultural Organization (UNESCO), which in turn allowed restarting of the prewar international data coordination projects (Petitjean 2006, 29–34). For instance, in 1956 the existing ICSU data bureaus became part of an integrated network now known as the Federation of Astronomical and Geophysical Services (FAGS).

UNESCO also sponsored a major international collaborative project, the International Geophysical Year (IGY), shaping, together with the FAGS, the backbone of the World Data System (WDS). The research exercise led to the establishment of an original set of world data centers initially offering support to eleven disciplines within the realm of the geosciences. Conceived to extend globally the knowledge of the earth and its phenomena by executing data collecting activities for eighteen months between July 1957 and December 1958, the IGY produced an incredible amount of new data thanks to the contribution of sixty-six national committees. To be effective, these data collections ought to aspire to widening planetary coverage, which explains why Soviet Russia and communist China were invited to join in (the PRC eventually opted out due to the "two Chinas" controversy; Wang and Zhang 2010). The bulk of data collected from many locations across the planet was stored on various platforms, from paper cards to microfilms, in world data centers with a view to making them available to everyone requesting them. Congenial to a globalizing agenda, the world data centers eventually compiled information useful to transportation and telecommunications services globally and informed the exploration of resources-rich territories such as those of Antarctica. They represented the archetypal transnational data network for future decades (Aronova 2017; Korsmo 2010).

The geographical location of world data centers is telling, however, of the hegemonic ambitions that underpinned their IGY architecture. The ICSU committee responsible for the IGY planning agreed that only the US and Soviet national committees would set up world data centers, naming them WDC-A if located in the United States and WDC-B in the USSR. Hence geoscientific data from the entire planet were amassed in the scientific institutions of these two countries alone, and while made available to nonmembers, too, these could access the datasets only by visiting the centers or when selected portions were published. The ICSU committee also agreed that Japanese, Australian, and a selected group of European countries would host other centers as WDC-C centers. WDC-A, WDC-B, and WDC-C continued to be a fundamental asset in the production and circulation of geoscientific data across the planet when the IGY ended and, in 1964, reorganized as part of the so-called ICSU World Data Center (WDC) Panel (the main precursor of the World Data System; see Korsmo 2010 and Dieminger 1996). Yet the new panel operated a network of databanks located in the few scientifically developed countries hosting them, hence linking the remaining national committees contributing to the IGY to a regime of multilateral interdependence in which they had to reach out to these centers in order to obtain data useful to new scientific research at home.

Meanwhile, the National Bureau of Standards (NBS) continued to be the visible arm of the US administration in global data affairs contributing to shape a similarly asymmetrical transnational data network in physics and chemistry. It is evidence of these hegemonic ambitions that eight of the WDC-A centers located in the United States found a home at one of the NBS research facilities—the Central Radio Propagation Laboratory, in Boulder, Colorado. The establishment of these centers went hand in hand with NBS efforts to put standardization of numerical data useful to chemists and physicists within the context of a new international agency. In 1957 the US bureau lobbied the federal government to set up a national Office of Critical Tables to give furtherance to the standardization project started in the 1920s, and in 1966 the nuclear chemist Harrison Brown—foreign secretary of the US National Academy of Sciences—succeeded in taking it under a new cooperative venture. A newly established ICSU agency, the Committee on Data for Science and Technology (CODATA), started operations under its president, chemist Frederick Rossini. Crucially, membership was extended only to six scientifically developed countries—the United Kingdom, the United States, France, Japan, West Germany, and the Soviet Union—hence excluding others from contributing to numerical data compilation. Nonmembers could access the data as these were published. But they had not the privilege to decide on what datasets should receive priority (and in what fields of investigation) and how the data compilations should be executed. In this respect, CODATA replicated the asymmetrical development promoted in the WDC Panel as only the scientists of these countries directly managed numerical standards informing the global scientific enterprise (Wagman 1992, 45; see also Waddington 1969).

Under this new global data networking mechanism, CODATA took responsibility for two standardization projects. The first, coordinated with the ICSU International Union of Pure and Applied Physics (IUPAP), resulted in the establishment of a working group on fundamental physical constants. The second, jointly administered with the IUPAC, produced a similar setup devoted to key values in thermodynamics. Soviet input was critical to its success, as by then the scientist Lev Gurvich had already compiled a sourcebook on the *Thermodynamics Properties of the Components of Combustion Products*, whose data the NBS scientific personnel wished to be integrated into their collections. Hence, while the Cold War antagonized the superpowers, it also united them with other scientifically developed countries seeking to establish transnational data networks allowing them to control the circulation of new data and restrict access according to their industrial needs. It is telling that the recently established International Atomic Energy Agency joined CODATA (the only intergovernmental organization invited to become a member), since the new datasets compiled as part of the committee's activities informed the export of peaceful nuclear technologies in scientifically developing countries (Lide and Wood 2021, 7–8).

During the 1960s, important projects to promote a new global infrastructure increasing interdependence in data supply in the geo-, physical, and chemical sciences were therefore reaching completion. While fundamentally administered by international scientific organizations, these projects sanctioned the leadership of the national scientific agencies of a few countries, and especially the superpowers, in shaping transnational data networks. Hence, in the 1970s the chief challenge to the architecture of these data governance projects came from those countries that had recently become independent after years of colonial rule and, unsurprisingly, displayed resistance to this dominance.

UNISIST AND THE (FAILED) PROSPECT OF A NEW DATA WORLD ORDER

Beginning in the late 1960s, several governments underrepresented in the WDC Panel and CODATA contested these global data coordination projects and asked to reform them, especially to widen control, and increase access to databanks. The first important challenge came with the Asian-African conference in Bandung, Indonesia, in April 1955. While covering a variety of themes, it countered the posture of industrialized nations and the tenets of the Cold War. It thus advocated the need for countries that had recently become independent to undergo processes of industrial development after years of colonial domination, while setting them on a political path of nonalignment (for African countries, see Meredith 2005). This intent evolved into a more visible (albeit heterogeneous) group of nations unwilling to play a passive role in global affairs, hence shaping new coalitions within the United Nations. In 1964, when the United Nations Conference on Trade and Development was set up, a cohort of underdeveloped and developing nations joined forces under the so-called G-77 group, comprising especially those located in Asia, Africa, and Latin America (Bair 2015, 349–50).

G-77 administrations were particularly eager to reform transnational data networks weaponizing multilateral interdependence, especially when extending the exploitation of natural resources in formerly colonized or underdeveloped countries. For instance, in 1967 they vibrantly opposed provisions under the UN Law of the Sea enabling the use of seafloor data for the extraction of undersea resources, while also claiming a more active role in the International Oceanographic Commission (IOC) (see Friedman and Williams 1979, 557–58). Established in 1961 as a UNESCO agency, the IOC took over the management of oceanographic data collections put together during the IGY, hence developing them under an intergovernmental regime. The organization compiling these IOC datasets was the International Oceanographic Data and Information Exchange (IODE). Less developed countries wished to join the new setup to assert their influence on proceedings regarding sea data exchange and increasingly could get access. However, marine scientists of developed countries with extensive ties to navy organizations and transnational marine corporations initially ostracized them, portraying their participation as a hindrance to data gathering and thus indirectly establishing selective access to oceanographic datasets. It took some time for the IOC to address this bias (Hamblin 2005, 139; Robinson 2021, 158). Furthermore, even when data were made available to IOC members and nonmembers (via publications), only a few countries had the infrastructure to use the data for natural resources purposes.

G-77 representatives were also resentful that developed countries had played dominant roles in global data gathering projects such as the IGY, also controlling their data output. They thus called for new schemes offering different data sharing provisions, rather than data collection projects intensifying the exploitation of natural resources available in their territories. Asymmetries in the administration of global data infrastructures continued to dominate fields as diverse as atomic energy and parasite eradication (Robinson et al. 2023; Macekura 2015, 144).

The creation of UNESCO's Regional Offices for Science and Technology (ROST) overseeing the collection of scientific information partly sought to redress these imbalances. In 1952, the first four of these offices opened in Montevideo, Cairo, Jakarta, and New Delhi. Three years later, the first African office was set up in Nairobi, Kenya. Their proliferation in the 1960s did not, however, result in wider circulation of data and technical information, as these offices did not have connections to the ICSU data networks (Hilling 2006, 73).

The simmering tensions between developed and less developed countries, also because of the shaping of data networks, paved the way instead for the 1974 UN New International Economic Order (NIEO) resolution proclaiming that previously colonized countries did not benefit enough from science and technology. The declaration emphasized the beneficial returns of technological progress, "providing a solid potential for improving the well-being of all peoples." At the same time, the resolution denounced the uneven distribution of this knowledge, as "the benefits of technological progress are not shared equitably by all members of the international community." It therefore urged attuning international cooperation to principles of "equity" while urging "restitution and compensation" for previous episodes of colonial exploitation.[2]

US officials viewed these demands with some anxiety and judged most NIEO tenets objectionable to a degree (Adler 2017, 674). The proceedings for a UN International Scientific Information System (UNISIST) display this approach with regard to global data governance. Outlined as a pilot study in the same year that CODATA was set up, UNISIST featured as a flagship UNESCO project jointly sponsored with the ICSU. In its configuration, the study recognized the need for widening interchange of scientific information and data at a global level and therefore integrating data supply in measures for country development. A central committee elaborated the study, but US officials took the lead in the execution phase as the NAS foreign secretary Harrison Brown, who had played a pivotal role in setting up CODATA, now featured as the study convener. So, in outlining the proposal for a new information system, the UNISIST study group focused on technical issues while deliberately overlooking the problem of geographical distribution of scientific datasets. When elaborating further on what kind of data provisions should be considered in the context of the UNISIST scheme, it acknowledged the recently established CODATA as the worldwide authority on data (notwithstanding, as we have seen, its club-like membership and exclusive focus on physics and chemistry). It therefore stipulated that the study would direct data networking issues to the committee (UNISIST 1971). Concerning developing countries, the pilot study did not stress the need of data building capacity at the national level. UNISIST therefore promised little to G-77 countries and delivered even less, making suggestions on setting up information and bibliographic centers, while CODATA would manage other data issues (UNISIST 1971, 32).

Unsurprisingly, delegates of G-77 countries were not pleased with these propositions. On 4–8 October 1971, the UNISIST conference brought together those interested in data and information systems at UNESCO headquarters in Paris. Brown was now elected conference president (through cross-bloc nominations by Soviet-allied Poland and US-allied Japan). The representatives of eighty-three countries attended the conference, and some were particularly forthright, agreeing on a draft resolution (DR15) pledging that "UNESCO assigns priorities to the needs of developing countries, and that substantial long term assistance programs should be undertaken to help them in developing their manpower and infrastructure." The US delegation judged these expectations as "unrealistic" and adding to the fiscal burden of industrialized countries. The UNESCO director-general, René Maheu of France, mediated between opposing stances so that the conference could approve the launch of UNISIST. The final resolution paid lip service to less developed UNESCO countries and approved a generic call for supporting capacity building.[3]

UNISIST as a system agency eventually focused mainly on aspects of international coordination regarding scientific referencing and bibliographic information. However, CODATA took on the strand of initiatives regarding data networking and assembled a project under its newly set up task group on accessibility and dissemination of data (ADD). The group came up with the proposal of establishing a world data referral center, hence shifting the agenda further away from asymmetries in transnational data networks.[4] It is worthy of notice that by 1975, CODATA was still considerably exclusive as an international organization, as only twelve national groups were members and their number grew to twenty only in the 1990s. These committees were either US or Soviet allies in the Northern Hemisphere; no African or Latin American country had joined the organization yet. India did but struggled to play a prominent role. The club-like membership of CODATA (and the WDC Panel) was also in stark contrast to ICSU's membership,

2 Declaration of the Establishment of a New International Economic Order, UN Resolution 3201 (S-VI), available at http://www.un-documents.net/s6r3201.htm.

3 UNESCO, Intergovernmental Conference for the Establishment of a World Science Information System, 4–8 October 1971, Paris, UNESCO, accessed 10 October 2023, archive.org/details/ERIC_ED061952/page/n61/mode/2up?view=theater&q=data, pp. 62–64.

4 CODATA - Statement on Long-Term Program, May 1975, in CODATA 75, box 33, Shapley Papers, pp. 12–15.

which by then extended to forty-five national committees. It was true that nonmembers could easily access datasets made widely available through CODATA publications, but they had no voice on data compilation or on the selection of disciplines and areas to prioritize.

The Japanese physicist Masao Kotani, president of Tokyo Science University and Japanese representative to CODATA, chaired the UNESCO-sponsored ADD feasibility study. The crystallographer David Watson of the University of Cambridge, the Indian chemist Chintamani Rao, and the NBS official Stephen A. Rossmassler took responsibility for completing the surveys that led to the final report submitted in September 1975. Its recommendations indicated the advantages of setting up a world data referral center without, however, tying its establishment directly to measures addressing scientific underdevelopment.[5] A month later, the *CODATA Bulletin* published the ADD study completed with the UNISIST-UNESCO grant. The study displayed a technocratic approach to accessibility and dissemination, also overlooking the scientific development agenda. The lower density of data centers in developing and underdeveloped countries entailed that its researchers more regularly faced issues of accessibility to scientific resources. But rather than considering measures to increase this density, it highlighted that the developed countries' "academic necessities" of gathering new data in the tropical regions and the Southern Hemisphere offered opportunities to facilitate cooperation and exchange. Indeed, researchers in developing countries had an opportunity to "eliminate the isolation" when those in developed ones committed to setting up a new research center closer to their (seemingly unreachable) locations.[6]

More generally, the *CODATA Bulletin* offered little more than vague proposals regarding assistance to development, suggesting pilot studies on data productivity and run-of-the-mill provisions for financial and technical assistance. It said nothing about establishing criteria to reform transnational data networks, or about widening participation, hence recognizing geographical isolation as a curse rather than the result of historical decisions that had made existing databanks less easy to reach and consult.[7] Item 22 of the *Bulletin* recalled the distribution of a "General Booklet on the Role of Data" that CODATA had jointly agreed to publish in the context of the UNISIST project commissioned by UNESCO, which would have ideally given opportunities, globally, to know more about the existing data networks. Yet the leaflet returned a distinctive image of data collection as something exclusive to those countries that could set up expensive libraries and powerful computing facilities. The answer provided to the question "What is being done to provide scientific data collections?" at the end of the leaflet confirmed lack of balance in data governance by recalling that "major national data programs are ongoing in France, FRG, UK, US, USSR and Japan."[8]

CODATA thus continued to elaborate initiatives that affected the global scientific enterprise but prioritized the agenda of scientifically developed countries over the integration of other countries that had yet to develop scientifically. It is a further confirmation of this tendency that in 1974 the US national committee responsible for CODATA instigated a review to establish the merits of the organization. In this review, an evaluation of whether CODATA was "enough bang for the US buck" took center stage, and the issue of asymmetrical development in international data coordination was conversely overlooked again.

Arnold Aaron Bondi, of the research laboratory of the oil giant Shell in Emeryville, California; the IBM research laboratory director Michael E. Senko; and the Los Alamos–based nuclear physicist Richard F. Taschek of the US National Academy of Sciences concluded that CODATA was good value indeed for the US taxpayer. The international organization helped the US economy to develop by taking responsibility for global scientific data collection matters in a time when access to reliable data had become the most important task for researchers working in US industry. Only 0.1 percent of known chemical compounds had the relevant data available in the literature and foreign literature relied on often-unreferenced reference standards. Hence, the international CODATA saved a considerable amount of time and money for specialized scientists in the United States and also standardized data literature internationally.[9]

Recent information floated in the meeting room regarding the connections between data setting and standard accreditation revealed an additional advantage. US officials working in CODATA used the standard elaborated in that context to "strengthen the US position" in other international forums vital for US industry. As the NBS representative astutely noted, scientific unions had "only permissive ties" with the International Organization for Standardization (ISO)—the organization setting technical industrial specifications to be adopted globally. Hence, US bodies involved in numerical data setting within CODATA could act as liaison channel and supply these data to the ISO.[10] This focus on US returns in the CODATA enterprise further reveals that in the second half of the 1970s, the challenges

5 Feasibility Study of a World Data Referral Centre, 1975 (prepared under UNESCO contract by ADD-CODATA), in CODATA 75, box 33, Shapley Papers.

6 *CODATA Bulletin*, no. 16 (October 1975), p. 24. Copy in CODATA archive.

7 *CODATA Bulletin*, no. 16 (October 1975), pp. 30–31. Copy in CODATA archive.

8 CODATA pamphlet. Undated. Copy in CODATA archive.

9 A. A. Bondi, Estimates of the Value of CODATA Membership to the United States, in CODATA, 1974–77, box 37, Shapley Papers.

10 NDAB, Minutes of Meeting, 1 July 1974, in CODATA, 1974–77, box 37, Shapley Papers.

that scientifically underdeveloped countries presented to the shaping of transnational data networks were comprehensively defeated. As we shall now see, neoliberal stances further heightened the inequality ingrained in the fabric of these data networks.

THE DEFINITION OF A (BIG) DATA MARKET

With the end of the Cold War approaching, scientific data increasingly featured as commodities rather than resources made selectively available internationally, which further extended the asymmetrical development of transnational data networks of the 1960s and 1970s. Now preexisting international networks supporting the growth of global science visibly downsized, leaving data resources in the hands of private interests. Multilateral interdependence in data provision was thus increasingly secured through a combination of public and private structures operating internationally. In turn, international data agencies such as the WDC Panel, CODATA, and FAGS became more alert to opportunities to market data products. Yet the growing challenges that these organizations faced in the neoliberal age made their officials more alert to the need to protect existing international scientific datasets from privatization trends.

In 1978, the debt crisis united with the lack of enthusiasm of the world's leading countries for development reforms sank the NIEO aspirations. Neoliberal economists now rejected earlier arguments about supporting development projects, advocating the austerity programs introduced by the International Monetary Fund (Adler 2017, 691). This approach famously paved the way to the Washington Consensus—that is, the neoliberal approach claiming a lineage with the Mont Pèlerin Society but in fact encouraging unregulated liberalization and privatization across the world (Bair 2015, 348). The failed approval of a UN Code of Conduct regulating the intervention of transnational corporations in sovereign states empowered these companies to extend their operations globally, now unbridled. The US administration fully embraced deregulation while withdrawing from a new round of UN Law of the Sea negotiations in 1983 and leaving UNESCO in 1984. US officials blamed anti-Western bias and the overwhelming influence of developing countries for these departures (Bair 2015, 370–77).

The rise of neoliberal thinking had profound implications for the development of the sciences globally since some of the international datasets weaponizing interdependence were now privatized or more frequently produced by private agencies for marketing purposes. In the United States, the 1980 Bayh-Dole Act propelled the commercialization of knowledge produced at federally funded research organizations and the patenting of genetic materials (Drakopulos 2022, 118). This affected the understanding and uses of databanks, too, as they increasingly featured as commodities integrated in trading and industrial activities. This neoliberal trend affected meteorological studies, for instance, as it encouraged "weather traders" eager to purchase and sell meteorological data, and enabled companies to supply data for weather market derivatives. Full-scale privatization of public meteorological offices did not take place, but some of their components, databanks included, were now more regularly put on the market (Randalls 2010, 714–16).

These tensions existed in UNESCO/ICSU data agencies, too, especially as the WDC Panel, the FAGS, and CODATA underwent a phase of financial instability. From 1978 to 1982, the second largest worldwide inflationary spike since the end of World War II hit at the value of UNESCO grants. It emptied CODATA reserves and forced the committee administrators to reduce activities while encouraging its constituencies to diversify the sources of income (indirectly advocating solutions through new market schemes).[11] Above all, UNESCO and ICSU staff now more vigorously advocated merging data networks. By 1978 an integration between the FAGS and the WDC Panel appeared very likely indeed, as by then some of these astronomical and geophysical services were already integrated as C-type centers coordinated by the WDC Panel (Dieminger 1996, 821). By contrast, a merge with CODATA appeared to be a distant prospect given its administrators' fundamentally different way of conceiving data. "It's a complicated business," as the WDC Panel geophysicist Alan Shapley stated in a handwritten report in 1978. CODATA had only facilitated "cooperation in the area of evaluated data in physics and chemistry," while the physicists and chemists wished to dominate international data organizations as "the tail that wags the dog."[12]

CODATA's tight finances led Shapley and others operating at the committee's fringes to seek to challenge this dominance, not to remove existing asymmetries underlying the global distribution of data but rather in an effort to empower those (largely Western) groups of scientists that displayed openness toward the prospect of marketing datasets. On 17–18 February 1977, Shapley organized a meeting with funds from the Canadian government to propel new research on time- and space-dependent data (see figure 1). In so doing, he involved in this project another international organization, COGEODATA, which had by then more swiftly prompted data marketing.[13] Set up by the ICSU International Union of Geological Sciences, COGEODATA was similar to other data agencies available to scientific unions, but offered data storage, processing, and retrieval services. It had also liaised with the IAEA in designing an Interna-

11 David G. Watson, Financial Situation for 1981 and 1982, in CODATA 1980–81, box 34, Shapley Papers.

12 Shapley to Edit, undated (1978), in CODATA 1978, box 33, Shapley Papers.

13 Roger Tomlinson to A. Shapley, 4 March 1977, in CODATA, Task Group on Space Time Data, 1977, box 36, Shapley Papers.

tional Uranium Information System—a major enterprise for global uranium data mapping—and produced maps for the oil industry sector.[14] In the end, the CODATA task group on time- and space-dependent data was ostracized by the committee's officials and never achieved what Shapley had hoped for.[15] Yet this work paved the way for a number of important projects that brought ICSU's scientific data organizations more in line with neoliberal trends.

The WDC Panel meanwhile attempted to align itself with the neoliberal push for marketing available data. In 1978, the Japanese WDC-C collecting ionospheric data took the lead on marketing efforts by selling selected clusters of datasets to private interests. The US WDC-A on rockets and satellites followed shortly, agreeing on a similar strategy.[16] Their initiatives were grounded on a significant reconfiguration of data gathering and storage techniques in the earth sciences that catered to wider data production and circulation. Digitally stored data could now be more easily sold and distributed. New satellite-based sensors allowed the continuous observation of the earth and returned a conspicuous amount of new data that could be stored in computers. Importantly, though, satellites operated as sensory platforms for various defense, private, and public agencies. They thus accommodated a range of research priorities through various equipment and functionalities, as shown in the case of the NASA SeaSat (Turchetti 2018, 132–36).

The quest for broader planetary coverage in the provision of (marketable) satellite data was instrumental in the reopening of scientific relations with the Chinese Academy of Sciences. These had broken up, as we have seen, just before the beginning of the IGY. Given the quest for larger satellite datasets, the officials of the WDC Panel now agreed to negotiate new global data gathering activities with Chinese geoscientists with the understanding that PRC territory occupies 6.3 percent of the earth's landmass.[17] Talks with the WDC Panel materialized a PRC accession in 1987. Interestingly, the WDC Panel now agreed that the Chinese Academy of Sciences would take responsibility for establishing nine new D-type world data centers (WDC-D), notwithstanding that the exclusive right to establish world data centers had thus far been reserved to the national committees of just a few scientifically developed countries. In turn, the accession paved the way for further earth data concentration, now in China too, while again neglecting other countries.

New technologies allowed the rapid transfer of data across transnational data networks, too, thus going against these marketing projects to an extent. For instance, the PRC integration in satellite-based data collections offered previously nonexistent opportunities for global environmental monitoring that materialized, ever since 1987, efforts to map environmental change through the International Geosphere Biosphere Program (IGBP). While replicating in many ways the principles of international collaboration pioneered by the IGY, the IGBP innovatively aimed to focus on the interlocking of biological, chemical, and physical processes and their change over time. Beginning in 1993, a bespoke Data and Information System thus provided a one-kilometer land cover dataset charting variations in vegetation on the planet, and, as a tribute to the storage technology of the day—the compact disc—the widely transferrable dataset was named DISCover (Loveland and Belward, n.d.). Completed in 1997, DISCover not only was released outside the now expanding global data market domain, but it also assisted in understanding the degree of human-induced environmental change, hence exploring its impacts in various regions of the world.

In the 1990s CODATA officials also opposed neoliberal trends represented from within the World Intellectual Property Organization (WIPO), advocating against legal restrictions on the free exchange of scientific data, and kick-starting a debate within UNESCO on the merits of Open Access (Lide and Wood 2021, 35, 52). Moreover, while some of the core elements of CODATA's mission never changed—for instance, in relation to the outlining of fundamental values associated with chemical substances and physical processes—the committee now encouraged programs seeking to advantage previously marginalized national committees. In 2000 two CODATA workshops in Senegal tackled the issue of reliable scientific data in Africa, while in 2005 a data source for sustainable development in South African countries group was established (Lide and Wood 2021, 38, 48). Hence, while neoliberal trends largely affected the shape of major international data organizations in the sphere of scientific collaboration, they also instigated the search for new policy provisions that could mitigate these trends.

CONCLUSIONS

This article has documented how, during the twentieth century, transnational scientific data networks have played a vital role in shaping multilateral interdependence in data supply and advantaging scientifically developed countries in these interdependence networks. While this examination situates the historical ascendancy of these networks in a nongovernmental diplomacy space administered through the ICSU scientific agencies (and their predecessors), these infrastructures have informed global affairs by establishing mechanisms regulating global data flows anew—an item of

14 Report of the IUGS to CODATA for 1978–1980, Ottawa, June 1980, in CODATA 1980–81, box 34, Shapley Papers.

15 CODATA President Edgar Westrum to A. Shapley, 12 February 1981, in CODATA, Task Group on Space Time Data, 1977, box 36, Shapley Papers.

16 A. H. Shapley, Report to CODATA by ICSU Panel on World Data Centers, 21 March 1978, in CODATA, 1978, box 33, Shapley Papers.

17 Third after Russia and Canada. China is also third in terms of overall earth surface with 1.9 percent (fourth if one considers Antarctica). In 1976 the 16th ICSU General Assembly had agreed that scientific unions should consider the admission of PRC committees.

growing importance to national scientific development, especially in the postcolonial era. The article has emphasized how availability of scientific data contributed to advance science globally, but a selective approach to data provision—either through geographical distribution of data centers or membership in data organizations responsible for this provision—put the global governance of contemporary science on an uneven path. At times, publications mitigated this data inequality and broadened access to those who did not have membership in international data organizations while extending, however, a restrictive control on the elaboration and distribution of datasets. We have seen these imbalances taking shape especially in the second half of the twentieth century, when a few countries manifested an interest in single-handedly managing datasets and data setting provisions, also in light of their implications for the advancement of a number of industries they wished to foster and control.

Overall, the article has shown how the administration of these transnational data networks has co-produced technical-scientific order globally, through their implementation as chief devices to advance global science, and global (societal) order, through the definition of new power relations internationally, associated with the administration of data and databanks. Imperial powers had already established data bureaus after World War I in the hope of coordinating their industrial and trade interests. But it is especially since the 1950s that a new world order of multilateral interdependence has typified global science. The WDC system, and later the WDC Panel, united the Cold War superpowers and a selected number of Western countries in the administration of world data centers so as to concentrate geoscientific databanks in a few countries. In 1966 the establishment of CODATA extended this selective coordination to the provision of data useful to industrial physics and chemistry by welcoming only a selected number of national committees as members. Challenges to this exclusive management of global data affairs had little impact on UNESCO diplomacy, as shown by the UNISIST case. From the 1980s onward, the spreading of neoliberal policies encouraged the marketing of scientific data, thus removing further from the global governance agenda the issue of how to produce more evenly distributed and inclusive transnational data networks.

While this is only one of many planetary concerns that data currently shape, it is important nonetheless that we reflect on the impacts of global data distribution associated with the history of data networks. If the current production of inequality through algorithmic systems and predictive technologies based on large datasets is a new phenomenon (especially with reference to Google and Facebook, see Farrell and Newman 2019, 53; see also Wiggins and Jones 2023, 7–8), then we now know that the establishment of transnational data networks during the second half of the twentieth century had already set the circumstances for an uneven distribution of datasets across world regions. One might even speculate that since these systems are by and large private, they may even represent a further evolution from the neoliberal private-public administration of the 1980s that contributed to market datasets from that decade. If so, the real novelty would not be in their producing inequality anew, but rather in taking over from preexisting international organizations that originally set these imbalances.

At least in the sciences, these asymmetries are a legacy of twentieth-century organizations shaping transnational data networks. While much remains to ascertain about the history of global data governance, the article makes it plain to see how the asymmetrical development of these networks played a key, and yet to be understood, role in shaping postcolonial relations of dependence. It deprived countries that had recently achieved independence of key resources needed to develop scientifically. Exclusive control of data networks contributed to what Damiano Matasci and others have termed "imperialism of knowledge"—the protracted withholding of infrastructural information that caters to a country's development (Matasci 2020). In transnational data networks, this control resulted from exclusive membership in international agencies responsible for scientific data. Efforts by officials of less developed countries to ensure a more balanced system of data administration—for instance, at UNISIST meetings—did not succeed partly because officials of developed countries labeled their requests unrealistic.

These "data asymmetries" help us not only to see today how scientific relations shaped past forms of global governance in subtle but important ways, but also to reconsider some of the scholarly tenets of IR studies reiterating the fundamental role of the Cold War in shaping postwar international relations. Indeed, through an analysis of "science diplomacy" ties shaping transnational data networks, one could argue that while the Cold War competition was fully at play, less visible forms of international coordination united the United States, the Soviet Union, and a few other Western states. In other words, an examination of global scientific data governance allows us to see geopolitical synergies resonant with the divisions between Global North and South, rather than those between monolithic Cold War blocs dividing East and West.

Of course, much has changed in the shape of this global information infrastructure over the century. Digitized databases have now replaced data-filled paper cards, photographic films, and sourcebooks; satellite-mounted instrumentation makes data available in much larger sets; and finally, the internet allows rapid transmittal of data collected in one part of the world to many other locations, hence reducing considerably the problem of data availability. While it is undeniable that these changes in data collection practices have comprehensively transformed transnational data networks (a topic deserving further exploration in the future), the asymmetries discussed in this article live on in the twenty-first century. In 2007 the WDC Panel still comprised fifty-one centers sited in only twelve countries, with the whole of Africa and Latin America excluded (although three "mirror" sites were by then set up in these regions; see Clark, Minster, and Kihn 2007, 2–3). This was the situation just before the creation, two years later, of the

ICSU World Data System (WDS), through the integration of the FAGS and the WDC Panel.

What else can we learn, then, from the history of transnational data networks? In recent years, we have seen more scientists emphasizing the need to make data more accessible. In turn, this has led to a number of initiatives emphasizing that scientific data should be FAIR (findable, accessible, interoperable, and reusable). New platforms such as the European Open Access Cloud (EOAC) are now available to make science open through the availability of the relevant data. These aspirations are undoubtedly commendable and certainly go in the direction of offering wider distribution of scientific data. That said, the historical evidence presented in this article casts new light on the significance of power relations within the data infrastructure setting multilateral interdependence in the global scientific enterprise. It thus indirectly calls for *different* data collections strategies, too, aligned to the priorities of developing nations, also through a more accurate assessment on these countries' data needs (Turchetti and Lalli 2020). While new schemes promoting collections of this kind would probably not support scientific development enough, they would certainly fall in line with a new agenda addressing the imbalances that decades of uneven distribution of data resources, centers, and facilities have produced.

We therefore wonder if, for the last century, researchers around the world *really* had to "eliminate the isolation" separating them from these data structures, or if instead a few science administrators from Western countries should have stopped speaking for the planet in naming as "world" data centers facilities that were just too distant for them to reach.

ACKNOWLEDGMENTS

This article is part of a project that has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme – NEWORLD@A: Negotiating World Research Data–A science diplomacy study (Grant agreement No. 101021098).

COMPETING INTERESTS

No competing interests exist.

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Submitted: October 18, 2023 PDT, Accepted: June 20, 2024 PDT

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