The British Journal for the History of Science (2024), **57**, 99–112
doi:10.1017/S0007087423000936

RESEARCH ARTICLE

Scientizing the 'environment': Solly Zuckerman and the idea of the School of Environmental Sciences

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Abstract

In 1960 Sir Solly Zuckerman proposed the idea of an interdisciplinary department of 'environmental sciences' (ENV) for the newly established University of East Anglia (UEA). Prior to this point, the concept of 'environmental sciences' was little known: since then, departments and degree courses have rapidly proliferated through universities and colleges around the globe. This paper draws on archival research to explore the conditions and contexts that led to the proposal of a new and interdisciplinary grouping of sciences by Zuckerman. It argues that the activities of Zuckerman and other scientists in Britain during the Second World War and in the post-war period helped to create fertile conditions for a new kind of scientific authority to emerge as a tool of governance and source of policy advice. In particular, the specific challenges of post-war Britain – as addressed through scientific advisers and civil servants – led to the 'environment' becoming both the subject of sustained scientific study and an object of concern.

In 1968, the School of Environmental Sciences (ENV) at the University of East Anglia (UEA) opened its doors in Norwich, welcoming the first cohort of students onto its new 'Environmental Sciences' degree, founded on the principles of interdisciplinary research and learning. At the time, it offered an environmental sciences degree which combined 'geophysics, geology, oceanography, and meteorology'.[1] Other historians have demonstrated the long history of environmental challenges and concerns but relatively little attention has been paid to the process through which different branches of science came together in order to focus on understanding the 'environment' as a global object of scientific and political interest. In this paper I engage specifically with twentieth-century 'environmental sciences' as they emerged at the intersection of science policy, higher education and the new 'environmental' challenges.[2]

However, to illuminate the significance of the historical argument that this paper puts forth and to clarify what this new approach to the environment entailed, it is worth briefly reflecting on what the 'environment' was during the long 1960s.[3] Histories of

[1] Michael Beloff, *The Plateglass Universities*, Madison, NJ: Fairleigh Dickinson University Press, 1968, p. 109.

[2] Christophe Bonneuil and Jean-Baptise Fressoz, *The Shock of the Anthropocene: The Earth, History and Us*, London: Verso, 2017; Etienne Benson, *Surroundings: A History of Environments and Environmentalisms*, Chicago: The University of Chicago Press, 2020.

[3] The long 1960s span from late 1950s to the early 1970s, as proposed in Jon Agar, 'What happened in the sixties?', *BJHS* (2008) 41(4), pp. 567–600.

the modern environment have become very popular in recent years, as scholars have detailed the multiple sociopolitical contexts in which different understandings of the environment came to emerge.[4] In particular, the meaning of the term was shifting in the post-war period: instead of referring to a localized set of surroundings or circumstances, it was increasingly used to reference a wider, planetary-sized system that was becoming a global object of concern.[5] This shift was important for two key reasons. First, ontologically, a global 'environment' that was now recognized to be shaped and impacted by actions across the planet made it easier for a newly emerging global political and scientific research community to coalesce, underscoring the importance of global communities, infrastructures, planning and knowledge in the post-war period. Second, for the historical actors in this paper, the 'environment' represented a nascent policy and scientific challenge which was still poorly defined and could therefore be moulded in specific epistemic and political directions by scientists, scholars and civil servants, while at the same time remaining robust enough to be understood as a common referent amongst Western communities. This shift enabled new innovations and practices in knowledge making, like the 'environmental sciences' to be understood, shared and taken up by research institutions and universities.

But how did seemingly disparate sciences, each of which was approaching the 'environment' in different ways, become unified under the 'environmental sciences' umbrella?[6] This paper argues that the 'environmental sciences' in the United Kingdom emerged as a result of the changing role of science in government policy, and, in particular, through the increasing authority of scientific knowledge in guiding national planning, a process in which Zuckerman and other colleagues, such as Roger Quirk, played an essential part. It was under these conditions that the 'environment' came to be framed and understood by researchers, politicians and policy makers, and institutionalized through new higher-education initiatives and teaching.[7]

Solly Zuckerman, war and environmental destruction

Solly Zuckerman (1904–93) became the UK's first chief scientific adviser (CSA) in 1964 but had been a constitutive member of government circles since the Second World War.[8] Zuckerman was a vocal and influential advocate for the use of scientific knowledge to help support and guide government policy. His approach to these matters can be traced back to his early career, including his work with primate sociology, where he became known as a cross-disciplinary thinker who engaged widely, both formally and informally, with a broad range of problems.[9] Critically important to his later role, however, was his

[4] The 'environment', 'environmental sciences' and 'environmental challenges' are presented in quotes here to demonstrate how their definitions and uses are contingent and defined by the contexts in which they emerge in this paper. See Benson, op. cit. (2); Paul Warde, Libby Robin and Sverker Sörlin, *The Environment: A History of the Idea*, Baltimore: Johns Hopkins University Press, 2018.

[5] Philip Conway, 'The historical ontology of environment: from the unity of nature to the birth of geopolitics', PhD thesis, Aberystwyth University, 2019, p. 10.

[6] Warde, Robin and Sörlin, op. cit. (4).

[7] Sheila Jasanoff, 'Future imperfect: science, technology, and the imaginations of modernity', in Sheila Jasanoff and Sang-Hyun Kim (eds.), *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power*, Chicago: The University of Chicago Press, 2015, pp. 1–34.

[8] Jon Agar, 'Science policy since the 1960s', in the British Academy (eds.), *Lessons from the History of UK Science Policy*, 2019, pp. 21–31, at www.thebritishacademy.ac.uk/documents/243/Lessons-History-UK-science-policy.pdf (accessed 21 September 2023).

[9] Solly Zuckerman, *The Social Life of Monkeys and Apes*, London: International Library of Psychology, 1932; Ian Burney, 'War on fear: Solly Zuckerman and civilian nerve in the Second World War', *History of the Human Sciences* (2012) 25(5), pp. 49–72; Solly Zuckerman, *Monkeys, Men and Missiles (1945–1988)*, London: Collins, 1988; Jonathan

https://doi.org/10.1017/S0007087423000936 Published online by Cambridge University Press

work during the Second World War. The contributions and the connections he made during this period were essential groundwork for his later engagement with the developing scientific strategy of the UK government. He has been described as one of the 'giants' of the period due to the authority and command he held as an adviser to the UK government between the 1940s and the 1970s and the far-flung reach he had with political contacts throughout the West.[10] Individuals like Zuckerman and other intellectual figures became well known in public circles, as scientific advice became a highly sought-after tool for government strategy and planning in the post-war period.[11] The phrase 'Send for Solly!' was often used in the British press to answer any difficult scientific or strategic decision the UK government faced.[12] But it is important to note that Zuckerman's authority was initially grounded in his operational research on munitions and other contributions to the war effort, which both had demonstrated the benefit of mobilizing scientific expertise in governance and would encourage him to develop a broader, multidisciplinary sense of what 'the environment' might mean.

Critical to this work was his awareness of the impact that particular incidents (bombings, for example, or chemical releases) would have on local surroundings. From the implications of the loss of key points of infrastructure for communications or transport, to the contamination of water bodies, to the relationships between rapid growth of population and resource consumption, the broader consequences of particular events or processes became a central part of Zuckerman's thinking about the social life and development of populations. In fact, his work with the Bombing Analysis Unit during the Second World War was an important form of early environmental knowledge making. Zuckerman explicitly set out to understand how local surroundings reacted to particular styles and velocities of bombing, and – crucially – what the socio-economic and emotional consequence of this would be on those living within the area. For Zuckerman, the environment was a key factor that determined the social life and actions of humans; therefore, introducing drastic change to the environment – in the case of his work with the Bombing Analysis Unit, through maximum atmospheric and biological terror – would also create extensive damage to the social and economic systems of the enemy.

Zuckerman began his career as a scientific adviser for the Bombing Analysis Unit in 1944.[13] Amongst the various tasks of this unit was that of determining the possible effects of bombs directed at key points of infrastructure and enemy communications – for example, high-traffic rail and roadways, airfields and submarine pens – with the hope of catalysing wider socio-economic collapse and extinguishing the German threat.[14] But the overlapping tasks of different departments and units that made up Britain's wartime governance meant that expertise in one area might well be reapplied in beneficial ways elsewhere. For instance, in early exploratory work, Zuckerman noted a flaw in bombing research that he also found in animal sociology: evidence that claims were based on anecdotal observation and conjecture.[15] At this point, knowledge about both bomb guidance and preventive measures for bomb blasts was based only on anecdotal experience from

Burt, 'Solly Zuckerman: the making of a primatological career in Britain, 1925–1945', *Studies in History and Philosophy of Biological and Biomedical Sciences* (2006) 37(2), pp. 295–310.

[10] Formally until 1971. Philip Gummett, *Scientists in Whitehall*, Manchester: Manchester University Press, 1980

[11] John Sheail, 'Nature protection, ecologists and the faming context: a UK historical context', *Journal of Rural Studies* (1995) 11(1), pp. 79–88.

[12] 'The last of the moguls', *New Scientist*, 29 October 1964, front cover.

[13] Solly Zuckerman to Headquarters Allied Expeditionary Air Force, RAF, 'Formation of the Bombing Analysis Unit', 24 September 1944, Zuckerman Archives, University of East Anglia, Norwich, UK, SZ/BAU/1.

[14] Zuckerman, op. cit. (13); Solly Zuckerman, 'Analysis of the effects of attacks on railway communications', 8 October 1944, Zuckerman Archives, SZ/BAU/1.

[15] Burney, op. cit. (9).

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the Spanish Civil War. Since Zuckerman viewed 'science' as being the beacon of 'truth' in a newly perceived civic agnotology, this was not acceptable, particularly since public and political speculation was being fuelled by the absence of more reliable knowledge.[16] As a result, wielding science as the bearer of truth and logic, Zuckerman worked alongside those with military experience and authority to ground strategy plans in empirical data and inductive reasoning. By applying scientific logic, method and rationality to the problems they faced, he was in effect trying to reduce warfare to a subject of scientific investigation. Zuckerman wrote, for example, about aiming attacks only at those bridges that would take the longest to repair (steel would take an estimated three weeks) or of surveying the traffic of in-use rail cars, daily frequency and cargo held before selecting the ultimately preferred target.[17] Zuckerman's overarching goal was to show that scientific approaches to bombing could support the 'dissolution of a state and a society' in Germany and 'not just a series of bomb explosions here and there'.[18]

It is questions and suggestions of this sort – which aimed to align the technical capacity of the available weaponry with the social and economic factors that would maximize the impact of its use on the enemy in order to facilitate declining morale and eventual social collapse – that indicate Zuckerman's interdisciplinary approach to method and process. If populations and their social frameworks were dependent on a range of external phenomena or infrastructure, in this case the economy and public morale, then the destruction of such phenomena would cause much more insidious and long-term community damage than might be assumed from the sheer number of individual human casualties. Zuckerman's way of surveying the challenges around him from many different perspectives was a core reason behind the growth of his reputation as a thorough, comprehensive, rational thinker grounded in empirical work. This was one key reason why his ideas and advice were highly sought after by decision makers.[19]

Zuckerman viewed science as a tool that could be put to work in instrumental and linear ways for the normative aims of government. The complexities and entanglements between different forms of science, social order and government were yet to be identified, but the cultural value and authority of science and of the 'expert' were beginning to surface in response to the perceived effectiveness of science and operational research during the Second World War. Not only did Zuckerman's involvement in the war mean that he personally became more embedded in the UK government machine, but also his bombing research helped to create the conditions in which nascent awareness and concern for the environment and its destruction could begin to emerge. The environment, at this stage, was rarely discussed in public discourse; if it was mentioned at all, then neo-Spencerian understandings of the term were prominent – for example, that it simply referenced the surroundings of human and non-human life.[20] Zuckerman's focus on the long-term economic, cultural and physical implications of damage to key points of infrastructure and natural resources marked a change in his thinking.[21] Whilst not yet discussing matters in terms of 'the environment', scientists were beginning to move beyond an approach that focused on the immediate local context and towards a broader recognition of the world as operating as a 'global' environment comprising multiple systems, and an apprehension that these processes were all interrelated, with multiple points of connection between human and non-human networks. Damage to the 'system' – in this case, physical

[16] Burney, op. cit. (9).
[17] Zuckerman, op. cit. (14).
[18] Solly Zuckerman, letter to HQ of Allied Expeditionary Air Force, 25 September 1944, Zuckerman Archives, SZ/BBRM/1.
[19] John Peyton, *Solly Zuckerman: A Scientist out of the Ordinary*, London: John Murray, 2001.
[20] Herbert Spencer, *The Principles of Psychology*, London: Longman, 1855; Benson, op. cit. (2).
[21] Zuckerman, op. cit. (18).

https://doi.org/10.1017/S0007087423000936 Published online by Cambridge University Press

infrastructure – would lead to a cascade of cataclysmic damage for everything that was dependent on that infrastructure. Notably, after seeing the destruction and ruins of Cologne in 1945, Zuckerman planned to write a book tentatively titled *The Natural History of Destruction* that would document his involvement, understanding and analysis of the relationship between environmental catastrophes, war and strategic bombing.[22]

This book was never written.[23] But the concept remained with Zuckerman as he moved from wartime operational research to becoming a science adviser in government. Particularly cogent here was his growing awareness of the dynamic relationship between humans and their local surroundings and how this played out in wider 'environments'. Human actions could not just alter the immediate surrounding environment but also reshape the possibility of further actions in the environment in which they are situated. Zuckerman's ability to traverse and circulate between different boundaries of disciplinary competence helped him to see both the promises of cross-expertise thinking and the practicalities of doing collaborative research. His involvement in the Second World War was foundational to his contribution to the later development of the idea and vision of the 'environmental sciences' in several ways. Conceptually, his recognition of the 'environment' as a space that enables and (re)shapes human systems, actions and behaviour meant that altering its state could lead to significant economic, political and cultural change (in this instance, defeat of the wartime enemy). Practically, Zuckerman was able to build and retain many important military or political connections in the UK and beyond during his time in operations research.

The section above has demonstrated how Zuckerman's wartime involvement in operational research was significant in creating an authoritative space in government for his expertise, ideas and vision, enabling him to enter government circles in the post-war period in a more official capacity. It has also shown how his empirical work in relation to the destructive power of bombs and other weapons of war cultivated an early environmental concern and understanding on his part.

Send for Solly! Zuckerman in government

When the Second World War ended, many of the scientists involved, including Zuckerman, were kept on as technical advisers to government officials at various levels.[24] This suited Zuckerman, who by now was a long-standing advocate of the use of science to support social progress. Scientific knowledge, Zuckerman claimed, was always social, because of the role it plays in social progress and the transformative effects on 'the environment within which it was distilled'.[25] Akin to his operational research work in the Second World War, Zuckerman believed, the challenges faced by society could be solved by science's theoretical and practical power. Knowledge could, and should, be used to shape order. Science could be applied to identify the state's problems – both at present and in the foreseeable future – to survey and understand empirically possible causes and courses of action, and map the many possible intended and unintended consequences.

This linear, one-way view of science feeding into society and governance is symptomatic of Zuckerman's (and other intellectuals') belief in the power of empiricism, inductive

[22] Bonneuil and Fressoz, op. cit. (2).

[23] Zuckerman's title, *On the Natural History of Destruction*, was eventually taken up by writer and UEA academic W.G. Sebald, for a treatise on the absent presence of the destruction of German cities and societies in post-war German literature.

[24] Solly Zuckerman, 'Scientific advice during and since World War II', *Proceedings of the Royal Society of London: A. Mathematical and Physical Sciences* (1975) 342(1631), pp. 465–80.

[25] Solly Zuckerman, 'Liberty in an age of science', *Nature* (1959) 184, p. 136.

https://doi.org/10.1017/S0007087423000936 Published online by Cambridge University Press

thinking and the performance and authority of what they considered to be the scientific programme. As Zuckerman, alongside other scientists, became more involved in advising ministers or government officials, they became more aware of the known – and forecast – challenges for Britain. Consequently, the social agency of scientists began to change as they became more tightly integrated into the machines of government as sources of technocratic planning and future-making.

Many committees, many concerns

In post-war Britain, a range of advisory committees were created in order to survey existing knowledge, identify present and future challenges, and advise ministers on possible courses of action. Zuckerman was involved in a number of these between the 1940s and 1970s. Most notably, Zuckerman was involved with the creation, and was appointed deputy chair, of the Advisory Council for Scientific Policy (ACSP). The ACSP was created to guide the government's scientific policy from 1950 to the mid-1960s. Zuckerman's role initially was to act as a member who could 'speak authoritatively on behalf of the biological sciences'.[26] The Barlow Committee on Future Scientific Policy proposed setting up the ACSP to support the Lord President of the Council, the minister responsible for the Agricultural Research Council, the Medical Research Council and the Department of Scientific and Industrial Research, in modernizing their operations for future challenges in science, government and policy. They argued that Britain needed a group that was able to survey the current strength of science in Britain and recommend action for future scientific policy, to collect and maintain up-to-date statistics, and, where necessary, to advise on an ad hoc basis on scientific challenges and orchestrate scientific advice for the relevant government departments.[27] Consequently, the ACSP was intended to be a key body of knowledge making, problem solving and advice for the government machine. The ACSP, from its inception, embarked on a range of exploratory work to build a picture of Britain's current scientific, technological and industrial capacity. Over the course of its existence, it created numerous subcommittees (Research and Productivity, Poisonous Substances, Scientific Manpower, Toxic Substances in Consumer Goods, Foreign Seaweed, and so on). These topics coalesced around and coincided with a major concern in Zuckerman's mind: a future of increasing population growth and the challenge of preserving natural resources and managing the livelihoods and health of larger populations.[28]

This interest was not unique to Britain or to Zuckerman, but was also a major concern for the USA and other Western states. New ideas of global order and community were emerging through the construction of the United Nations and its various agencies and other transnational agreements as a move to implement some form of international environmental planning.[29] Many new forms of interrelated challenges were surfacing amongst the interconnectivity of a globalized world, including the uneven resource consumption, population growth and toxicology of an industrialized world that moved beyond the more localized 'environmental' concerns of the early twentieth century. The spatial and temporal dimensions of the consequence of human impacts on their

[26] Privy Council Office to Zuckerman, 23 January 1946, Zuckerman Archives, SZ/FSP/2. The Barlow Committee also had a membership of top scientists, including Bernal.

[27] 'Need for a science secretariat', 16 September 1945, Zuckerman Archives, SZ/FSP/2.

[28] Future growth of world population, papers by Professor Solly Zuckerman, 1960, The National Archives, London, CAB 124/2844.

[29] Clark Miller, 'Globalizing security: science and the transformation of contemporary political imagination', in Jasanoff and Kim, op. cit. (7), pp. 277–99; Perrin Selcer, *The Postwar Origins of the Global Environment: How the United Nations Built Spaceship Earth*, New York: Columbia University Press, 2018.

https://doi.org/10.1017/S0007087423000936 Published online by Cambridge University Press

surroundings and the wider planet were gaining traction in scientific and government circles.[30]

Zuckerman, with his wide networks and connections with key individuals across Western research communities, became aware of these emergent concerns whilst involved with the ACSP. Zuckerman argued in many different forums that the future success of the British state depended on multidisciplinary science.[31] He wrote about this essential requirement in magazines, academic journals and newspapers, detailing the need for the recruitment of new scientists, engineers and technologists; for new specialist teachers to match the changing educational needs of the country; and for the geopolitical importance of not falling behind the USA, the Soviet Union or even continental Europe itself in the perceived science and technology race.[32] Zuckerman believed that collaborative practice, sharing expertise and trading perspectives to generate new knowledge and train new students would provide a context in which the solutions needed for the emergent challenges in Britain in an increasingly global world could be found. One obvious way to enact this in very concrete ways was the construction of new universities with new experimental degrees.

New universities in a scientific Britain

Zuckerman was involved in the discussions of many higher-education reforms that led to the emergence of the University of East Anglia (UEA) and, subsequently, to the School of Environmental Sciences (EVA) in the 1960s.[33] To put this in the context of the history of higher education in the UK, after the First World War student numbers had been boosted by studentships covering the cost of tuition and accommodation for those who had served.[34] The provision of these studentships was not intended as recompense, but to aid in national rebuilding and to support individuals' reintegration into post-war life.[35] In this era, many institutional bodies concerned with increasing higher-education opportunities, such as the University Grants Committee (UGC), had come into existence, as governments began to realize the importance of research, science and higher education for the war effort.[36] After the Second World War, Britain found itself in a similar position. There were scores of soldiers returning to the UK with no jobs and little (from the

[30] Martin Chick, 'The changing role of space and time in British environmental policy since 1945', *Revue française d'histoire économique* (2015) (1), pp. 72–88.

[31] Correspondence with Fairfield Osborne, Zuckerman Archives, SZ/CF/1; Solly Zuckerman, 'Population in relation to non-creatable biological resources', 1954, World Population Conference, Rome, Zuckerman Archives, SZ/WPC/1.

[32] Solly Zuckerman, 'Scientists and technologists in USSR', *Times Educational Supplement* (30 December 1955) 2119, p. 1331; Zuckerman, 'A survey of world resources: the social and political aspects', *Progress* (1956) 45, pp. 76–83; Zuckerman, 'We need more scientists and technicians', *Bourneville Works Magazine* (1956) 54, p. 268; Zuckerman, 'Technological universities', *University of Birmingham Gazette* (1956) 9, p. 11; Zuckerman, 'The supply, recruitment and use of scientists and technologists', condensed paper in discussion (1956), Manchester Joint Research Council; Zuckerman, 'Scientific education: growing demand on schools and universities', *The Times*, 5 March 1957, p. 9; Zuckerman, 'The national need for self-sufficiency in agriculture', *Farmers Weekly* (1958) 48, p. 37; Zuckerman, 'Education and manpower, with special reference to problems of the future', *Education* (1958) 111, p. 100; Zuckerman, 'National demand for scientists and technologists', *Proceedings of the Biennial Conference of University Appointments Secretariat* (1959) 5, p. 15.

[33] The other new universities included Essex, Kent, Lancaster, Sussex, Warwick and York.

[34] Georgina Brewis, Sarah Hellawell and Daniel Laqua, 'Rebuilding the universities after the Great War: ex-service students, scholarships and the reconstruction of student life in England', *History* (2020) 105(364), pp. 82–106.

[35] Brewis, Hellawell and Laqua, op. cit. (34).

[36] Tomás Irish, *The University at War, 1914–25: Britain, France, and the United States*, Basingstoke: Springer, 2015.

https://doi.org/10.1017/S0007087423000936 Published online by Cambridge University Press

government's perspective) to do, and there were scores of potential students who had enlisted in military service before pursuing their degrees.[37] Meanwhile, prominent political thinkers and intellectuals were deeply engaged in speculation about, and discussion of, technocratic visions of British futures.[38]

As the role of science and technological development became more evident and more central to the future of Britain, it became clear that the current size of the workforce of trained scientists and technicians was insufficient for both immediate and future scientific needs. To understand what was needed, a committee (of which Zuckerman was a member) was established in 1944 by the minister of education, Rab Butler, to assess the needs for higher technical education and the capacity of existing institutions and disciplinary programmes to meet the challenges of a scientific and technological Britain. The committee's report, published in 1945, included concerns about the poor application of science in industry linked to an inadequate capacity in training, the ineffectiveness of existing educational programmes, and the uneven recognition and respect accorded to university and technical-college courses.[39] Specifically, concern arose about a predicted increase in industrial demand for workers and the need for scientists 'who can administer and organise and apply the results of research to development'.[40] Britain was in a difficult position: it would need to train and prepare a significant proportion of its population, including large numbers of returning soldiers, for the new science, technology and industrial era, and there was little room at existing institutions to do so. The report painted a clear picture: 'industry must look mainly to universities for the training of scientists, both for research and development and of teachers of science; it must look mainly to Technical Colleges for technical assistants and craftsmen'.[41] The report explicitly criticized existing university degrees' narrowness, with undergraduate courses being 'too short and too specialised'.[42] It was thought that existing universities were growing stagnant in their disciplines and curricula, casting doubt on the capacity of their graduates to respond effectively to new technological and scientific developments and industrial innovation. The post-war boom was, in fact, taking 'place against the background of a vigorous and continuing debate on the appropriateness of the courses on offer to a swiftly changing industrial society'.[43]

Not only was society rapidly changing, with scientific knowledge becoming increasingly regarded as a core avenue for the achievement of societal and development goals, but the very nature of disciplinary knowledge was also coming under question. Historians of knowledge have underscored how transformations in knowledge systems emerge when the social apparatus holding them together as legitimate and useful forms of knowledge begins to wane.[44] In this particular instance, the new social relevance of scientists and their work was emerging through new interventions and ways of working in post-war Britain that were based on attempted emancipation from existing disciplinary silos to solve current challenges and assure the possibility of new expertise for emergent challenges.

There were also more practical concerns surrounding the capacity for student numbers for the existing universities. A post-war boom in university enrolment saw a 50 per cent

[37] The Percy report, *Higher Technological Education Report*, London: HMSO, 1945, pp. 1–31.
[38] Harold Wilson, 'Labour's plan for science', Leader's speech to the Labour conference in Scarborough, 1963.
[39] The Percy report, op. cit. (37).
[40] The Percy report, op. cit. (37), p 5.
[41] The Percy report, op. cit. (37), p 6.
[42] The Percy report, op. cit. (37), p 15.
[43] Roy Lowe, *Education in the Post-war Years: A Social History*, London: Routledge, 1988, p. 159.
[44] Jürgen Renn, *The Evolution of Knowledge: Rethinking Science for the Anthropocene*, Princeton: Princeton University Press, 2020.

https://doi.org/10.1017/S0007087423000936 Published online by Cambridge University Press

proportional increase in those choosing to study science (7,600 in 1939, 19,400 in 1956) and a 30 per cent increase in those studying technology (5,300 in 1939, 12,300 in 1956), and a doubling of science graduates over the pre-war figures had been achieved just a few years later.[45] As this paper noted earlier, the capacity of existing UK higher education to support a growing scientific workforce had been critically assessed by the report of the Barlow committee. Concern was growing over extant universities' ability to match society's need for scientists, engineers and technologists. Existing universities were thought to be struggling to construct new 'science' buildings to match the growing increase and to be falling short in providing appropriate residential facilities for new students and staff. This assessment paved the way for a more practical conversation that focused on the prospect that not just expanding universities, but constructing new ones, might be the best course of action to take in order to solve the workforce gap.[46]

Zuckerman was deeply involved in confronting these challenges, integrating the acknowledgement of the need for new universities with his vision of a society guided by science.[47] The post-war embedding of scientific advisers in government in the UK and elsewhere in the West had emphasized the role that science and technology would play in supporting social and economic development. For Zuckerman, universities were the conduit through which this could be achieved, in that they would provide new graduates in the form of scientific citizens who could match the present and future demands of British society.

But, critically, alongside these concerns for a capable scientific workforce to implement and guide a technocratic future, new concerns for the environmental effects of intensifying agriculture, resource depletion, urbanization and population growth were surfacing, both in the UK and abroad. In many ways, this represented yet another example, or acknowledgement, that existing knowledge systems and institutions were becoming ineffective to deal with modern society and the challenges both of accelerating industrial development and economic growth and of dealing with their environmental consequences. In both cases, it was possible to argue that new universities and new courses would support solutions to the emergent problems. In this vein, the University of East Anglia, alongside a number of other institutions at York, Warwick, Kent and elsewhere, was established in the 1960s with creative freedom to establish innovative courses. Amongst these, at UEA, were the environmental sciences courses proposed by Zuckerman.[48]

Problem fields, new 'environmental' challenges?

In the same period, as noted previously, Western concerns for the environment were beginning to be recognized as having both global and local resonance. Zuckerman was acutely aware of this, and of the emergent consequences both worldwide and locally within the UK itself. New challenges of natural-resource conservation, population growth management, toxicology of chemicals and land use organization were identified as problems for its population by the UK government, and Zuckerman was amongst those tasked with defining and constructing a new research council that could respond to these.[49] This

[45] Draft note on the university expansion programme, European productivity – Project No. 412 Agency, The National Archives, CAB 124/2040.

[46] Committee on Higher Education Papers 1–5, 1961, The National Archives, ED 117/1.

[47] Zuckerman, 'We need more scientists and technicians', op. cit. (32).

[48] Jon Agar, 'Science and the new universities', in Miles Taylor and Jill Pellew (eds.), *Utopian Universities: A Global History of the New Campuses of the 1960s*, London: Bloomsbury, 2020, pp. 121–41.

[49] Paul Warde and Sverker Sörlin, 'Expertise for the future: the emergence of environmental prediction *c.* 1920–1970', in Jenny Andersson and Eglé Rindzeviciute (eds.), *The Struggle for the Long-Term in Transnational Science and Politics: Forging the Future*, Abingdon: Routledge, 2015, pp. 38–62.

https://doi.org/10.1017/S0007087423000936 Published online by Cambridge University Press

task was a formative moment in the history of the emergence of the 'environmental sciences' in the UK. The term, I argue, first emerged in discussions about the new research council but remained in Zuckerman's mind. It would go on to inform his contributions to the structure and curricula of the new University of East Anglia.

Zuckerman had been given the opportunity to review the then extant research councils dealing with broadly biological research by the ACSP to determine whether existing institutional arrangements were suitable for the new group of challenges, loosely defined at this point as being natural-resource issues.[50] Biological research, in this case, was thought to include, broadly, fisheries, geochemical processes, natural resources and overseas research on ecology.[51] However, it swiftly became evident that the challenges didn't neatly fit into the existing organization of biological research, nor was biology deemed a wholly appropriate discipline through which to view or face these challenges.[52] The Nature Conservancy, the government agency interested in ecological science, had already been ruled out of the task of forming a new research council, due to its small size when compared to the existing research councils and its lack of specialized expertise. It was thought by policy makers to be unable to subsume responsibility for researching the new areas of concern without undergoing appropriate and rapid expansion of research capacity.[53]

Zuckerman's task was complex, not least because in planning for the creation of the new research council he needed to decide not only on the council's intellectual remit, but also on the kind of researcher who might be the appropriate recipient of funding from that council. It was recognized that universities and other institutions were unlikely to make a move on their own to study the emergent natural-resource challenges without the 'backing and financial support of a body with governmental authority'.[54] He had to identify a name that would both signal the intent and direction of future research and at the same time enable the future recipients of funding to identify themselves as appropriate consumers for that council. To do so, he and his colleagues had to map the extent to which natural resources as an umbrella term either included or excluded possible current knowledge gaps, for example water supplies and conservation, town and country planning, nitrogen fixing, soil quality or biostatistics. Notably, the diversity and extent of the perceived gaps in knowledge further confirmed the lack of existing institutional arrangements and the ineffectiveness of existing knowledge making along disciplinary lines.

Zuckerman, along with E. Max Nicholson, consulted with numerous civil servants such as Edward Playfair, Otto Clarke and, most importantly, Roger Quirk, who had been involved in various science policy matters with Zuckerman during the 1950s. Together with a zoologist named James Gray from Cambridge, they discussed the draft proposals for a 'Natural Resources Research Council'.[55] Nicholson, who had been a director of the Nature Conservancy and a key figure in the development of Britain's conservation strategy, was one of the pioneering environmentalists of the mid-twentieth century. Like Zuckerman, Nicholson strongly believed that scientific knowledge would be instrumental in bringing focus and efficiency to issues of planning and management (particularly in

[50] E.M. Nicholson, 'Review of organization in biological research', 22 December 1959, The National Archives, FT 22/16.

[51] Nicholson, op. cit. (50).

[52] Nicholson op. cit. (50).

[53] E.M. Nicholson, 'The Nature Conservancy as a research council', 3 March 1959, The National Archives, FT 22/16.

[54] E.M. Nicholson, 'Proposed Natural Resources Research Council', 17 February 1960, The National Archives, FT 22/16.

[55] Solly Zuckerman, 'Proposed Natural Resources Research Council', 2 March 1960, The National Archives, FT 22/16.

https://doi.org/10.1017/S0007087423000936 Published online by Cambridge University Press

relation to Britain's emerging conservation programme) and was sympathetic to the idea of a new research council. Quirk had been a civil servant, a scientist by training and a keen archaeologist who had worked closely both with Zuckerman during his time in the ACSP and with Nicholson in the Nature Conservancy.[56]

The purpose of their debates was to produce a 'synthesis that would be acceptable' and could be distributed to Zuckerman's 'various correspondents'.[57] As part of this, in 1960 Quirk sent a highly significant memo to Zuckerman. In it, Quirk suggested 'Environmental Sciences Research Council' as a more inclusive term for the new body, based on the interdependent, physical and earth sciences work of the International Geophysical Year (IGY, 1957–8), which had focused on what Quirk labelled the 'natural environment'. As Quirk wrote,

> The sciences dealing with the natural environment of water, air and the earth have come into prominence recently, through such activities as the International Geophysical Year, the basic theme of which was the interdependence of a wide range of sciences in this sphere – geophysics, geology, meteorology, oceanography, glaciology, marine biology, astronomy. Interest in space research and radioastronomy has drawn attention even beyond the atmosphere. But, concurrently with this increase in interest, there have, in recent years, come to the notice of the ACSP, and the Office of the Minister for Science, a number of deficiencies in the equipment, organisation and financing of many of the relevant fields of science.[58]

Quirk here notes the numerous advances in sciences of the 'natural environment' that had not been of immediate government concern, but which might benefit British science and research through the pursuit of a new environmental research council. The IGY had, in fact, demonstrated a new way of doing science on an international scale, framing interrelated natural sciences in new ways to bring knowledge about, within and 'beyond the atmosphere' together as global knowledge for a global Earth. This way of understanding the planet as a series of interconnected environments that enveloped planet Earth was epistemologically and – according to Quirk – discursively novel.

The IGY came to fruition from post-war recognition of the need to integrate the interconnected and thus international aspects of studying the atmosphere and the oceans with the existing and comparatively narrower ways of practising interdisciplinary earth sciences. The two were aligned on the practical level by a shared ontology of the environment which facilitated an interdisciplinary methodology and toolset, and on the conceptual level by the globalization of the 'environment' as an object of concern amidst Cold War tensions between the US and Soviet Union.[59] The earth sciences were not alone in the internationalization of science. The World Meteorological Organisation also made a concerted effort to improve international collaboration and sharing of data, tools and

[56] N. Kurti, M. Gowing, M.J. Pye and H.R. Ellis, 'The archives of twentieth-century scientists and technologists', *Aslib Proceedings* (1971) 23(3), pp. 118–32.

[57] Letter from R.N. Quirk to Solly Zuckerman, 6 July 1960, The National Archives, FT 22/16.

[58] Quirk to Zuckerman, 'Proposed environmental sciences research council', 6 July 1960, The National Archives, FT 22/16.

[59] Jessica Lehman, 'Making an anthropocene ocean: synoptic geographies of the international geophysical year (1957–1958)', *Annals of the American Association of Geographers* (2020) 110(3), pp. 606–22; Andrew Barry and Georgina Born, 'Interdisciplinarity', in Barry and Born (eds.), *Interdisciplinarity: Reconfigurations of the Social and Natural Sciences*, Abingdon: Routledge, 2013, pp. 1–56; Silke Beck, Tim Forysth, Pia M. Kohler, Myanna Lahsen and Martin Mahony, 'The making of global environmental science and politics', in Ulrike Felt, Rayvon Fouché, Clark Miller and Laurel Smith-Doerr (eds.), *The Handbook of Science and Technology Studies*, Cambridge, MA: MIT Press, 2017, pp. 1059–86.

https://doi.org/10.1017/S0007087423000936 Published online by Cambridge University Press

techniques concerning atmospheric and meteorological science.[60] For Quirk, the UK urgently needed to develop its institutional and scientific capacity if it was to participate fully in these newly emerging global environmental sciences. If the 'environmental sciences' were to materialize as a response to these nascent challenges to society and future-making, then the infrastructure to support this needed to be in place – with the new research council being one step towards this.[61] But why choose 'environmental sciences', rather than 'natural resources', to describe the new configuration of conceptual, practical and political questions? As Edward Playfair noted, framing the problem as one of 'natural resources' could damage the whole premise, not least because it did not accurately describe the council's proposed remit:

> The general idea seems to be a very worthwhile one, but I confess that I am rather disappointed by its presentation. I cannot help feeling that by building it round the concept of 'natural resources' you greatly weaken it and make it appear rather artificial. For one thing, you do not really cover an important proportion of the country's natural resources in the true sense [coal, iron ore, agricultural products].[62]

Quirk's link between the IGY and the environmental sciences was originally not clearly related to the more geographically oriented, biologically challenging, or surroundings-based challenges of toxicology, land use and resource consumption that were troubling Zuckerman and ministers. However, Quirk used this to his advantage in his debate with Playfair and others.

Playfair, in contrast, was arguing that creating a Biological Research Council, and framing the entire project from the biological perspective, would strengthen the proposal. It would help it appear more rational and inclusive of the emergent problem areas in the UK, such as microbiology, while still being able to draw on the familiar disciplinary structures of biology in organizing new knowledge and research. Other committee members, such as Gray, were not averse to using the label 'natural resources', while noting that fisheries were not a natural resource in the conventional sense and should be dealt with via a relevant committee.[63] As a result of these divisions, Quirk continued to push for a broader term, 'the environmental sciences', that would include biology and the troublesome aspects of fisheries as interdisciplinary, constitutional components:

> there is a coherent scientific whole (and also, as it happens, a number of 'problem' fields) in the field of what, ponderously, are, I suppose, called 'Environmental Sciences', covering the land, the sea, and the atmosphere of the planet, and the biological assemblages in, and on, the air, the water and the land. This seems to me both a scientifically viable concept and, taking it as a whole, an area where it is rather important for a lot of things to be tidied up and pepped up.[64]

Quirk illustrates the capacity of a new term, 'environmental sciences', to be used as a conceptual or epistemic umbrella under which to create the research council, which would be

[60] Clark Miller, 'Scientific internationalism in American foreign policy: the case of meteorology 1947–1958', in Clark Miller and Paul Edwards (eds.), *Changing the Atmosphere: Expert Knowledge and Environmental Governance*, Cambridge, MA: MIT Press, 2001, pp. 167–218; Paul Edwards, *A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming*, Cambridge, MA: MIT Press, 2010.

[61] Niels Güttler, '"Hungry for knowledge": towards a meso-history of the environmental sciences', *Berichte zur Wissenschaftsgeschichte* (2019) 42(2–3), pp. 235–58.

[62] Letter from Edward W. Playfair to Solly Zuckerman, 7 June 1960, The National Archives, FT 22/16.

[63] Letter from James Gray to Solly Zuckerman, 9 June 1960, The National Archives, FT 22/16.

[64] Letter from Roger N. Quirk to Solly Zuckerman, 6 July 1960, The National Archives, FT 22/16.

empowered to deal with the wide-spanning research and strategic challenges of the national and – eventually – global environment. The concerns around current and potential gaps in knowledge vis-à-vis pollution, conservation (of resources and the natural world), toxicology and the use and effects of chemicals all cut across many scientific disciplines (for example atmospheric physics, ecology, chemistry) and many spaces (for example the atmosphere, farmland, urban areas), to note only the examples that Quirk mentions as 'problem fields'.[65] Importantly, the idea of the environmental sciences would group the plethora of spaces in which challenges emerge and the multiple disciplines that would make knowledge about these challenges in a novel way, beyond disciplines and beyond local spatial interest. Thus the idea of a new way of doing science was born.

This memo highlights the ways in which multiple understandings of the environment emerged in the 1950s as well as suggesting some of the ways in which Zuckerman was made privy to them and responded to them. This contact then shaped his later thinking about grouping together the sciences of the environment for both local and global concerns in a department of the environmental sciences. It also illustrates the collective nature of the emergence of the 'environmental sciences' idea. Rather than being the responsibility of a single individual such as Zuckerman, the idea came about through governmental responses to growing socioscientific challenges in the UK, the internationalization of science and its community, the need for new institutional and scientific training for graduates, and many conversations with civil servants and academics.

The memo by Quirk precedes Zuckerman's proposal of the School of Environmental Sciences to Christopher Ingold within UEA's Academic Planning Board. I contend that it is the first recorded use of the term 'environmental sciences' in the UK, a term which, over fifty years later, has become a critical and important way in which we understand the world. Zuckerman's response to Quirk's suggestion with regard to the council's name and remit is absent from the archives, but amidst the suggested names, in a later draft document, Nicholson calls it the 'Nameless Research Council', which would suggest a rejection. Nonetheless, the ideas about the interconnection of different facets of science are retained in a core summary by Zuckerman.[66] This research council would eventually emerge as the Natural Environment Research Council (NERC), coming into existence in 1965. Graham Sutton, originally from the UK's Meteorological Office, was the initial chair of the council, and is credited with suggesting the substitution of 'resources' with 'environment' in the title. In this way a compromise was achieved between the competing proposals.[67]

To sum up, Quirk's memo reveals one of the earliest, if not the earliest, documented uses of the term 'environmental sciences' in an official capacity. I contend that this helped provide Zuckerman with conceptual terms and the language to interrelate the previously diverse set of challenges in science and for the state, aiding his vision of the environmental sciences that he would propose for UEA later that year. Zuckerman was also well aware of the need to train graduates in science to study, understand and solve the challenges of an increasingly global future. However, there was no environmental science for scientists to be trained in yet. As Zuckerman moved through and interacted with various aspects and actors in science and higher-education policy, the ways in which he began to discern and imagine how science might be used in the future moved from the realization of more immediate goals to longer-term visions of transformative change. Zuckerman identified

[65] Quirk, op. cit. (64).

[66] E.M. Nicholson, 'The nameless research council', 18 August 1960, and Solly Zuckerman, unnamed document, 23 August 1960, The National Archives, London, FT 22/16.

[67] John Sheail, *Natural Environment Research Council: A History*, Swindon: NERC, 1992.

https://doi.org/10.1017/S0007087423000936 Published online by Cambridge University Press

the space for and possibility of creating a new school of science that stemmed from the new funding arrangements coming from the new NERC, and which would make a new generation of environmental scientists that produced environmental knowledge, a new way of organizing scientists and thus creating an entirely new sector in post-war technoscientific industrial Britain. This can be discerned as the origin of the 'environmental sciences' both as a form of new knowledge making and as a normative aim for the future. The idea of an interdisciplinary environmental sciences eventually came to fruition when Zuckerman suggested the idea to the UEA Academic Planning Board.

Conclusion

As a result, the environmental sciences in ENV, at this moment, was a prospective tool that could make new knowledge about (and respond to) the shift from local to global environmental concerns – both in the UK and beyond at the time. The environmental sciences were a considered response by Zuckerman and colleagues to the social and technological change emerging in the UK and for its workforce, rather than just a means of bridging knowledge gaps, or 'borderline problems', in science.[68] Notably, Zuckerman's proposal for ENV emerged through the mutual construction of UK science and higher-education policy, the mobilization of scientific advice and expertise in government, and growing belief that interdisciplinary working was the way forward. UK government operations and planning began to be channelled through scientific advice and experts: as new challenges emerged, or existing ones became more complex, further expertise and scientific advice were sought by ministers and advisers themselves. The world of scientific advice and policy that had been created undoubtedly prioritized and favoured the institution of science for knowledge making and planning in government, which was a product and success on behalf of the normative aims of Zuckerman and colleagues in the war period. The newly embedded position of the scientific adviser in Whitehall, cemented by Zuckerman's CSA appointment, favoured scientific ways of seeing and acting in the world on a national level, with the global environment emerging as an object of concern to be known and understood on more national scales through scientific knowledge.

Acknowledgements. This work has been generously supported by a University of East Anglia Faculty of Science PhD studentship. Thank you to the archivists who helped make this research possible, particularly Justine Mann and Bridget Gillies at UEA, who offered tremendous help with the Zuckerman Archive during the COVID-19 lockdown period. This paper has also benefited massively from conversation with, and support from, Martin Mahony and Jason Chilvers. I would also like to thank Amanda Rees, who has provided stellar and encouraging editorial guidance throughout all stages of peer review. I also thank the two anonymous reviewers for their helpful and constructive comments on earlier drafts.

[68] Renn, op. cit. (44).

Cite this article: Honeybun-Arnolda E (2024). Scientizing the 'environment': Solly Zuckerman and the idea of the School of Environmental Sciences. *The British Journal for the History of Science* **57**, 99–112. https://doi.org/10.1017/S0007087423000936