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Science, the state, and international society

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SCIENCE, THE STATE, AND INTERNATIONAL SOCIETY

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By

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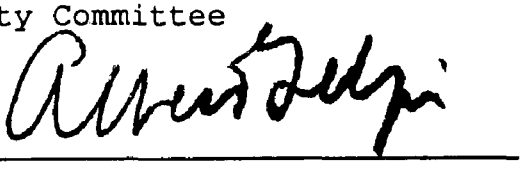

SCIENCE, THE STATE, AND INTERNATIONAL SOCIETY

Martha Finnemore, Ph.D.
Stanford University, 1992

Most explanations for state expansion and the creation of new state bureaucracies locate the cause of change in the conditions or characteristics of states. State conditions create some functional need for the new bureaucracy which is taken up by one or more domestic groups who then succeed in changing the state apparatus. However, in the case of one organizational innovation recently adopted across the international system, namely science policy bureaucracies, I find that state conditions are not correlated with the pattern of adoption. States create these science bureaucracies in a pattern unrelated to the size of their domestic science establishments, their levels of economic development or perceived security threats.

To explain this phenomenon I turn to a set of theoretical arguments that I have termed "societal" because of their common reliance on the social features of international politics--norms, shared beliefs, intersubjective understandings--as causes of state action. While they differ in their quarrels with more conventional paradigms, these approaches share an understanding that state preferences not firmly wedded to state conditions or apparent functional need.

Rather, preferences are malleable and are shaped by the international society in which states are embedded. States may be socialized or taught to accept preferences that are not related in any obvious way to state conditions or functional needs.

In this case I argue that states were socialized to accept a new understanding of the appropriate relationship between science and the state that entailed creation of this new bureaucracy. Specifically, an international community of experts (scientists), working through two international organizations (UNESCO and the OECD), taught states the value of science policy organizations and established the coordination of science as an appropriate, even a necessary, role for the modern state. Thus, the organizational innovation was supplied from outside states, by the international community, rather than being demanded from inside states in response to state conditions and needs, as more conventional theories would suggest.

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Jarvinen, and his staff was invaluable in locating some of the more obscure correspondence files from the early UNESCO science missions. At the OECD, Candice Stevens generously arranged useful introductions and Gabriel Drilhon provided background information about the early science activities of that organization. During both my trips to France, Daniel Sherman provided a place to stay and hot meals when they were much needed. Kurt Taylor Gaubatz helped me make sense of the graphics program resident on the Stanford mainframe computer. The Center for International Security and Arms Control at Stanford together with The MacArthur Foundation supplied funding and a supportive, collegial atmosphere in which to complete this project.

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TABLE OF CONTENTS

TABLES AND FIGURES

TABLES

FIGURES

Introduction

Recent years have seen a growing interest in social features of the international system--norms, beliefs, and institutions. The reason for this interest is empirical; it has become increasingly difficult to explain certain kinds of international interaction within the conventional theoretical frameworks developed by contemporary political science. Patterns of regularized and cooperative behavior have continued into the 1970s despite hegemonic decline and increased collective action problems that should thwart behavior, according to neorealist theory. While some have offered conventional interest-maximizing explanations for these occurrences,[1] a widening circle of scholars have begun turning toward societal approaches for at least partial explanation of these phenomena. The literature on international regimes and the more recent work of what have variously been called "reflective" or "institutionalist" scholars are only the best-known examples of a variety of theoretical arguments that identify norms, institutions,

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[1] Robert O. Keohane, After Hegemony: Cooperation and Discord in the World Political Economy (Princeton: Princeton University Press, 1984.)

intersubjective understandings and other social features of the international system as affecting state behavior.[2]

This empirically-motivated shift raises serious theoretical issues. The notion that states are "socialized" into certain patterns of behavior by a larger international community implies a quite different relationship between states and the international system than has generally been understood or acknowledged. Conventional international relations theories, and particularly neorealism, speak of states as being constrained by the international system; states want to do something but are prevented from (or severely punished for) doing so, hence they choose alternative courses of action. Socialization implies a different process. It implies, not that they are prevented from acting as they would otherwise wish, but that their wishes and preferences, themselves, are altered. Socialization implies changing

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[2] Stephen D. Krasner, ed. International Regimes (Ithaca, N.Y.: Cornell University Press, 1983); Richard Ashley, "The Poverty of Neorealism," in Neorealism and its Critics, ed. Robert Keohane, (New York: Columbia University Press, 1986), 255-300; David Dessler, "What's at stake in the agent-structure debate?" International Organization 43 (1989): 441-473; Ernst Haas, When Knowledge is Power: Three Models of Change in International Organizations (Berkeley: University of California Press, 1990); Friedrich Kratochwil, Rules, Norms and Decisions (Cambridge: Cambridge University Press, 1989); Friedrich Kratochwil and John G. Ruggie, "International Organization: a state of the art on art of the state," International Organization 40 (1986): 753-775; Alexander Wendt, "The agent-structure problem in international relations," International Organization 41 (1987): 335-370.

actors' preferences rather than constraining them from acting on those preferences.

This, at bottom, is the major claim of the various societal arguments and their challenge to conventional theories--that state preferences are malleable and that preferences are shaped by the international society in which states (an other actors) are embedded. These arguments do not assume that actors know what they want. To at least some extent, actors are "taught" what they want by the international system or society of which they are a part. Preferences are thus endogenized in these arguments.

This stands in stark contrast to the treatment of preferences in conventional international relations theory. There, preferences are understood to be inherent in states, something growing out of objective material characteristics and not subject to manipulation by international systemic or societal level forces. This understanding allows preferences to be treated as exogenous. Conventional explanations of international politics are all structured around pre-specified actors pursuing their pre-specified preferences. Indeed, specification of actors and preferences <u>a priori</u> is essential to the "scientific" claims of these theories to explain and predict.

Thus far, the persuasiveness and practical utility of societal arguments in the study of international politics have been severely limited by their inadequate or at least

inconsistent ability to address two issues. First, some clear test must be devised which will allow us to distinguish between action based on inherent or internally-generated preferences versus action generated by preferences that are taught or externally-supplied by international-level actors. There must be some answer to the question: how do we know socialized action when we see it. Second, the mechanisms whereby socialization and preference change occurs must be clearly specified. All too often, researchers in this vein are content to posit that some norm or belief-system or institution exists and simply trace its effects. Left unspecified in are answers to basic questions like: "What prompts the socialization of states?" and "How, precisely, does this socialization occur?"

This study addresses both of these issues. It constructs an empirical test whereby the two sources of preferences can be distinguished and then traces the evolution of one socialized preference from its origins through its transmission to states by international actors.

The specific empirical problem investigated is that of state expansion: why do states take on new tasks and create new bureaucracies to carry out those tasks? Conventional explanations for this locate the immediate impetus for the new bureaucracy inside states, in demands by domestic groups. Some change in a state's objective material conditions creates a functional need for the new bureaucracy which is then taken

up by one or more domestic groups who succeed in changing the state apparatus. However, these explanations do not account for certain organizational innovations adopted by most states in recent decades. This study explores one such widespread organizational innovation, the development of science policy bureaucracies.

The development of science policy as a state undertaking is not adequately explained by these conventional, internal-demand theories. As this study will demonstrate, quantitative indicators of objective conditions and functional need for these entities are not statistically correlated with the pattern of their adoption. Finding internal demand-driven explanations to be on weak ground, the study turns to alternative societal explanations for this phenomenon. Using focused case studies to complement the foregoing quantitative analysis, I present evidence that states' preference for a science bureaucracy was supplied from outside states rather than being rooted in objective conditions and internal demand. Specifically, members of an epistemic community (scientists) working through international organizations (UNESCO and the OECD) "taught" states the value of science policy organizations and established the coordination and direction of science as an appropriate and necessary role for the modern state.

I have chosen to study state expansion for theoretical reasons. It is a form of state action that, in turn,

redefines the actor. In deciding what they do states also, in a sense, decide what they are. What forces drive the evolution of the state should be of concern to a discipline in which states are central actors.

My reasons for choosing science policy as an instance of state expansion are logistical as well as theoretical. Theoretically, science is one of the few issue areas that is relevant to both economic and military preferences of states and so allows us to look at the motivations of states broadly. From a more pragmatic point of view, science is also one of the few issue areas about which reasonably good quantitative data exist on national science establishments (and hence on functional need and internal demand) across a large number of countries. Such data are essential to the statistical tests of conventional, inherent-preference explanations, described in Chapter Two.

The term "science policy bureaucracy" is discussed at length in Chapter One, but it may be useful to provide a summary definition here. For purposes of this study, I follow the UNESCO definition of science policy bureaucracies. These are organs of the state which have as their central mission the task of coordinating, organizing and planning scientific and technological activities at the national level. The National Science Foundation is such a science policy-making bureaucracy in the United States.

Plan of the Study

This study begins with a discussion of the sources of state preferences and the theoretical implications of those preferences being internally-generated or simply imputed versus externally-supplied. As was indicated earlier, demonstrating that preferences are supplied externally, from the international community to states, is essential to the claims of societal arguments just as demonstrating internal origins or inherent preferences is essential to the more conventional "scientific" theories.

The theoretical discussion in Chapter One yields some competing expectations about the two arguments that are tested quantitatively in Chapter Two. The statistical correlations presented there between objective conditions related to science and the timing of the creation of science policy bureaucracies provide little support for internal-demand argument and direct the study toward societal alternatives. Chapters Three and Four are case studies of the international organizations in which I argue a new understanding of the appropriate relation between science and the state was developed. The task of these chapters is to investigate the origins of this new understanding at the international societal level and to specify the mechanisms whereby states were socialized to accept it. Chapter Five then explores some theoretical implications of the study.

Chapter One

SOURCES OF STATE PREFERENCES IN INTERNATIONAL RELATIONS THEORY

The structure of states is continually evolving. Since their establishment in Europe some 500 years ago and, in particular, since World War I, states have grown both in terms of the variety of tasks they perform and the organizational apparatus with which they perform these tasks.

This study investigates the causes underlying this process of state change in the case of one recently adopted set of state bureaucracies, those designed to coordinate scientific research. In the last 50 years science policy-making organizations have sprung up in virtually all of the developed and in most of the developing countries. Most explanations for the appearance of these new pieces of state machinery found in political science or economics describe this development as demand-driven. Some domestic group perceives a problem to which a science policy bureaucracy is the solution. Social groups such as producers of science (eg. scientists) or consumers of science (eg. technology-intensive businesses) may come to perceive that state coordination and direction of a growing science establishment is in their interest. State officials may come to perceive that the intimate relationship between science and security makes control of science in the national interest. Depending upon

the perspective adopted, one would predict different configurations of science bureaucracies serving different interests, but in all cases the impetus for creating these organizations would be demand by state or societal actors that the government direct and control science.

This project tests these demand-driven hypotheses quantitatively by correlating a variety of indicators of domestic demand with the timing of adoption of science policy bureaucracies. The results provide little support for any of the demand-driven hypotheses. States create these bureaucracies at wildly different levels of science capability, economic development and perceived security threats. Further, these science bureaucracies are created in states that have virtually no science to coordinate, where economic structures are not at all technology-intensive, and where military establishments are minuscule.

Since demand-driven explanations for the spread of this bureaucracy appear to be on weak ground, an alternative explanation is investigated, one in which the bureaucratic innovation is supplied from the outside by other states and international organizations rather than being demanded from within. Early in the diffusion of this bureaucratic innovation several international organizations took up science policy as a cause and promoted it among member states. The United Nations Educational Scientific and Cultural Organization (UNESCO) and the Organization for Economic

Cooperation and Development (OECD) in particular, actively "taught" states the value and utility of science policy organizations and pushed for their creation in member countries. In doing so, these international organizations changed the prevailing conception of how international science was to be organized.

Previously, the prevailing understanding was that international science was a transnational, non-governmental enterprise run by scientists. It was a collective good; all would benefit from increasing the world sum of scientific knowledge and from permitting access to that knowledge without regard to national boundaries. This view persisted through the Second World War, Hiroshima and the founding of both UNESCO and the OECD.[1] However, by the mid 1950s, this view was being replaced by another. States began to treat science as a national resource, to be harnessed by individual states for their own wealth and security. The uniformly accepted method for accomplishing this was to create a bureaucracy which would control and direct science--a science policy bureaucracy. Chapters Three and Four tell the story of how international organizations effected this change and document the spread of these new bureaucracies to virtually all states, even those having little or no science to coordinate.

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[1] Specialized branches of physics, engineering and materials science that were essential to atomic weapons programs in the 1950s were exceptions to this organizing principle, but for the great majority of scientific research, this principle prevailed.

The finding that this change in the relationship between science and the state was caused primarily by international stimuli has important implications for the ways in which we think about, not only state expansion, but state action generally. Specifically, the fact that states were taught this new understanding of science by outside actors raises questions about how state preferences are formulated.

Much of international relations theory rests on the assumption that states know what they want. Preferences of states are treated as inherent in states; they come from within the state as a result of internal conditions. The changes detailed in this study suggest, however, that preferences may not be inherent in states and may not be wedded to internal conditions. Instead, state preferences may be quite malleable. States may not always know what they want and so are receptive to teaching about what are appropriate and useful actions to take.

The first part of this chapter is devoted to exploring what forms this international teaching of preferences might take and how we should think about it theoretically. The chapter argues that a world in which state preferences are malleable and change concurrently to reflect prevailing understandings of appropriate or useful behavior held by other state- and system-level actors is more compatible with theoretical understandings that conceive of states as embedded in an international society rather than states as autonomous

agents. These "societal" understandings of international politics vary widely in their conceptions of what the society looks like and how it works. They share, however, a willingness to endogenize preferences. Rather than taking preferences as inherent in states and deducing system-level outcomes from unit-level interactions of states, these societal frameworks allow for the possibility that the international system (or society) may shape preferences and even actors, themselves. Causal flows in this direction, from international society to actors (as opposed to actions), are less easily accommodated by conventional international relations theories.

After outlining the theoretical implications of malleable preferences, the second part of this chapter briefly discusses an alternative set of preferences about science that were not chosen by states. As was noted earlier, there existed an alternative to science policy bureaucracies as a means of organizing science which was eclipsed by the spread of these organizations. The chapter concludes with a discussion of the study's dependent variable, of precisely what is a science policy bureaucracy, and provides some examples of what these bureaucracies look like in different countries.

Where do preferences come from?

Preferences inherent in states. Most theoretical approaches in international relations share one or both of two assumptions in their treatment of preferences. First, they

may assume that preferences are unproblematic; that is, they may assume actors at both the state and sub-state levels know what they want. Second, they directly or indirectly locate the source of state preferences inside the state. Changes in preferences or the appearance of new policy preferences are understood as responses to changes in conditions and characteristics of states. To the extent that this response mechanism is elaborated, it is tied to from demands by domestic actors. Some change in material conditions reconfigures the interests of actors inside the state such that they are prompted to demand a shift in state policy. In this way, the proximate source of state preferences is located inside the state rather than outside.[2]

Comparativists and many foreign policy analysts tend to make the second of these two assumptions but not the first. They often allow policy preferences to be problematic by specifying state decision-making about policy preferences to be the dependent variable in their research design. They then go on to provide detailed accounts of the internal demand-

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[2] This is true even when the conditions in question are external to the state, for example when they concern state security and the power relations among states. Security preferences are understood as the result of domestic actors demanding policy changes in response to changing conditions in that it is only through the perceptions and demands of internal actors, usually state and military officials, that changing power relations are translated into state preferences and actions. More detailed examples of these internal demand-driven arguments are provided in Chapter Two.

making and politicking by social groups and state officials that go into the formulation of those preferences.

However, these scholars make the assumption about internal demand based on objective conditions as the source of preferences implicitly by choosing single country research designs. At one level, this kind of design simply creates problems of emphasis. By focusing research on actions in a single state, they reduce the likelihood of detecting international systemic or international societal influences. But the problem in single country research designs is more fundamental. Specifically, such research designs run afoul of Galton's problem, the problem that findings based on the analysis of causal relationships within states (or other units of analysis) may be distorted by inter-state (or inter-unit) communication and diffusion. Single country designs, focused on unraveling causal relationships within a country implicitly assume that individual countries constitute independent observations. To the extent that diffusion processes operate and that countries learn from the international environment, findings based only on the analysis of causal relationships within countries may be unreliable.[3]

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[3] Comparativists, in particular, are aware of this problem, although their concern about it seems to ebb and flow. For an excellent discussion in a research context similar to this project see, David Collier and Richard Messick, "Prerequisites versus Diffusion: Testing Alternative Explanations of Social Security Adoption," American Political Science Review 69 (1975): 1299-1315.

Theoretical approaches used by international relations scholars outside the area of foreign policy analysis tend to make both of these assumptions about preferences and make them explicitly. They assume both that actors know what they want and that these preferences are readily deducible from the characteristics and conditions of actors.

Making these assumptions is, at least in part, a consequence of the aspirations of this subfield to conduct research in a manner that is "scientific" in the Lakatosian sense.[4] Simply assuming or imputing preferences as essential characteristics of the actors is a necessary part of the foundation on which these deductively-derived arguments must rest. Without specifying a priori and exogenously both actors and their preferences, these theories cannot explain and predict international interactions.[5]

All of the major international relations paradigms rest on a similarly-structured foundation that allows them to engage in "scientific" research. All begin by specifying

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[4] Imre Lakatos, "Falsification and the Methodology of Scientific Research Programmes," in Criticism and the Growth of Knowledge, ed. Imre Lakatos and Alan Musgrave (Cambridge: Cambridge University Press, 1970), 91-180.

[5] The tendency of these theorists, particularly neorealists, to simply impute or assume preferences on the basis of objective conditions without specifying the internal process of domestic demand and preference formation has produced charges by comparativists and foreign policy analysts that these theories simply turn the state into a "black box" of decision-making. However, as the following discussion shows, these simplifying assumptions are essential to the scientific claims of these paradigms.

three things: who are relevant actors, what are the capabilities of those actors, and what are the preferences of those actors. All then go on to explain international interactions as the result of relevant actors using their capabilities to pursue pre-specified preferences.[6]

Neorealism is by far the clearest and most self-conscious example of this theoretical structure. Waltz lays out his point of departure for theorizing clearly and explicitly specifies states as relevant actors, measures capabilities in terms of power and specifies preferences in terms of maximizing capabilities.[7] But as Gilpin and Krasner describe them, the other major theoretical frameworks in the field share a similar structure. Radical or Marxist scholars are said to identify social classes as relevant actors and specify capabilities and preferences in terms of control over the means of production. Scholars from a more liberal or pluralist perspective may be concerned about a variety of relevant actors pursuing their preferences--firms pursuing

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[6] This character of international relations theories is most clearly evident in the well-known summaries of these theories given by Gilpin and Krasner. In these summaries, each of the major paradigms is dissected to reveal a common structure that includes assumptions about preferences. See, Robert Gilpin, U.S. Power and the Multinational Corporation: The Political Economy of Direct Foreign Investment (New York: Basic Books, Inc., 1975) ch. 1; Stephen D. Krasner, Defending the National Interest: Raw Materials Investments and U.S. Foreign Policy (Princeton: Princeton University Press, 1978) ch. 1.

[7] Kenneth Waltz, Theory of International Politics (New York: Random House, 1979).

profits, interests groups pursuing their special interests, national leaders pursuing a place in history.[8]

These assumptions about preferences are essential to the explanatory dynamic of all of these theories. In all cases, pursuit of these pre-specified or imputed preferences is what prompts and directs action. In all these theories, actors are driven by a dynamic of utility-maximization. Again, neorealists are very clear that states are power maximizers. However, the dynamic in the other paradigms is similar; social classes maximize control over production, firms maximize profits, individuals maximize whatever their pre-specified preferences have been stated to be.[9] Thus, in all of these

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[8] The form of "liberalism" under discussion here is based on neoclassical economics and exemplified by the work of Richard Rosecrance. I am not referring to the philosophical liberalism discussed by Immanual Kant and others. These issues of how philosophical liberal principles may influence international affairs have been taken up by Hartz and, more recently, by Doyle. See, Richard Rosecrance, The Rise of the Trading State (New York: Basic Books, 1986); Immanuel Kant, "Perpetual Peace" [1795], reprinted in On History, ed. Lewis Beck White, 85-135, The Library of Liberal Arts, (Indianapolis, Ind.: Bobbs-Merrill, 1963); Louis Hartz, The Liberal Tradition in America (New York: Harcourt, Brace, 1955); Michael Doyle, "Kant, Liberal Legacies, and Foreign Affairs," Philosophy and Public Affairs 12 (1983): 205-234.

[9] Despite the fact that Marxism is frequently characterized in this manner by non-Marxist international relations scholars (eg. Gilpin, US Power and the Multinational Corporation and Krasner, Defending the National Interest), such characterizations are not consistent with the theoretical core of the paradigm. Theoretically, the overarching logic of Marxism is not utility maximization but the unfolding of a dialectic through history. However, as a guide to research in international relations this has proved intractable and Marxists have instead focused on the more immediate and visible features of class conflict, the logic of which is much

paradigms, macro-level political outcomes are understood to be the result of micro-level utility maximization (or pursuit of preferences) by whatever relevant actors.

The assumption of internal sources for state preferences is clearly important to both the single-country researchers and to the aspirants to theoretically scientific research. For the comparativists and foreign policy analysts, state preferences must be the result of internal demands in order to justify these researchers' focus on single country case studies. To the extent that the sources of state preferences lie outside the state and are not rooted in internal demands and internal conditions, their research designs are faulty and their research agenda is misdirected.

For the aspirants to scientific theory, preferences must be derivable from functional needs dictated by state conditions if these theories are to explain and predict in a Lakatosian and cumulative manner. The notion that states can be supplied with new preferences externally and that those preferences may be unrelated to state conditions or functional need (as they appear to be in the case under study here) poses problems for these theorists.

There might be some adherents to these theories who would argue that one could accommodate externally-supplied

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like state or interest-group competition. Since this study is concerned precisely with the usefulness of paradigms for research, it is this more pragmatic manifestation of Marxist thinking that I describe here.

preferences by simply taking new preferences, incorporating them into the state's utility function, and proceeding with analysis-as-usual. However, to do so would be "ad hocery" of the first order. If preferences and actors cannot be specified exogenously, before analysis begins, then all utilitarian claims to explain and predict in a parsimonious fashion disappear into post hoc rationalization. These researchers would then be reduced to looking at outcomes and constructing the utility functions or specifying the preferences that produce them.

Preferences supplied externally. As mentioned earlier, the research presented in subsequent chapters suggests that states' preferences for state control of science in the form of a state science bureaucracy did not, in most cases, originate inside states. Instead, it was supplied to states from outside, by international organizations and experts working through those organizations. How could one explain this kind of process theoretically?

Adherents to an internal demand-driven view of state preference formation might argue that the "learning" of preferences documented here can be explained perfectly well within the more conventional theoretical frameworks. The international system is, after all, an environment full of uncertainty and states, like most actors, suffer from bounded rationality. Boundedly-rational actors operating in environments of uncertainty frequently look for solutions to

their problems in the solutions tried by other, apparently successful actors. Imitation, in a world of uncertainty, is often a perfectly rational strategy to adopt.

Hugh Heclo documents an imitative learning process of this kind in his study of the creation of social welfare bureaucracies in the UK and Sweden.[10] There, state officials wrestling with social welfare problems deliberately reviewed the policies and bureaucracies of other states, particularly Germany, in crafting solutions of their own. Heclo describes trips to Germany by key British officials in this policy area (Sir William Beveridge and Lloyd George) to examine that country's social insurance system. He also describes the influence of the German example on Sweden's Adolf Hedin and Hedin's, eventually fruitful, proposals for social reforms.[11] He further notes the influence of the Danish and New Zealand experiences on British social policy-makers as well as the influence of Britain's Canon William Blackley on early Swedish proposals concerning social insurance programs.[12]

However, the process Heclo documents and the one I document in this study are not the same. The difference is that, in the former case, state officials are prompted to

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[10] Hugh Heclo, Modern Social Politics in Britain and Sweden (New Haven and London: Yale University Press, 1974.)

[11] Heclo, Modern Social Politics in Britain and Sweden, 177-182.

[12] Heclo, Modern Social Politics in Britain and Sweden, 310-311.

examine foreign experiences because they are under pressure to solve some already-identified policy problem. In Heclo's account there are clearly domestic groups making strong demands on state officials for the creation of or changes in social welfare programs.[13] The problem for state administrators is simply how to respond to these demands. Thus, the impetus for action comes from within the state, even if the solution does not.

By contrast, in the case of science policy bureaucracies, state officials in most cases appear not to be responding to any pressing demands or obvious science crisis. They were not

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[13] One of Heclo's findings is that these demands usually arose, not only in response to domestic social welfare conditions but also in response to failures of existing social welfare policies. Perceived failures of existing policies place a subject on the political agenda and prompts elected officials and civil servants to search for solutions, in Heclo's analysis.

In this way Heclo can account for the fact that, in many instances, Sweden adopted more dramatic and far-reaching social welfare policies earlier than Britain despite the fact that the latter industrialized earlier. Existing policies (which were quite different in the two countries) were widely perceived to have failed at roughly the same time, however, the policy-making processes responding to those failures were quite different. Heclo credits the Swedes' policies to that country's more sophisticated and more rational administrative processes. Whereas British policies had to be produced through partisan conflict, the Swedes made extensive use of investigatory committees (utredning) to provide information and analysis on which policies could be based.

For purposes of this study, the critical feature of Heclo's analysis is that it is domestic factors--electors, parties, interest groups and what he calls "socioeconomic development" factors--that determine when policies have failed and put items on the political agenda. The search by civil servant administrators for new policies becomes important as responses to this. See, Heclo, Modern Social Politics in Britain and Sweden chapter 6, esp. p.304.

looking for a solution to a problem. Both the "problem" and the solution were supplied to states by outside actors. Prior to the actions of UNESCO in particular, most states, especially LDCs, had no notion that they needed or wanted a state science bureaucracy. It was the actions of UNESCO and its consultant experts that taught states both that coordinating science was a necessary task of states and that a state science bureaucracy.

The difference between the process Heclo describes and the spread of science bureaucracies might be characterized by the difference between teaching and learning. In the first case, states learn from one another (or, potentially, from non-state actors such as international organizations), but the impetus for the learning process lies inside the states. What is causal in this process lies at the state or sub-state level. There are no active teachers in this process. To the extent states are taught, they are self-taught. In the second case, however, there are active teachers with well-defined lesson plans for their pupils. Other actors are setting agendas and defining tasks for states. In the science case, international organizations and the experts they employed taught states that they wanted or needed a science bureaucracy. What is causal in this process lies outside states.

Receptivity to the teaching of preferences implies a more social character for states than is generally acknowledged in

international relations theory. It implies that the international environment is more than a "billiard table" constraining state action. It implies that states are embedded in a social structure and are "socialized" to a degree not allowed for by the more conventional, self-contained conceptions of the state.

Structure versus agents

The debate between theoretical frameworks in which states are autonomous and self-contained versus those in which they are embedded in social structures is an old one and reflects the more general agent/structure debate that has been bubbling through social science for some years.[14] At issue here is essentially what is at issue there, and that is whether, analytically, one treats actors (i.e. agents), capabilities and preferences as given and derives social structures from their interaction, or whether one takes the social structures as given and treats actors, their preferences and powers, as defined by the social system(s) in which they are embedded.

Political science as a whole has been dominated by actor- or agent-oriented approaches. Analysis generally proceeds by positing both preferences and powers for some group of actors, be they voters, Congressmen, firms, social classes or nation-

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[14] For recent discussions of this problem in international relations, see Alexander Wendt, "The agent-structure problem in international relations," International Organization 41 (1987): 335-370; and David Dessler, "What's at stake in the agent-structure debate?" International Organization 43 (1989): 441-473.

states. Macro-level political outcomes are then derived from the sum of micro-level behaviors by these actors pursuing their pre-specified preferences. In international relations, neorealism proceeds in this way. While Waltz in his Theory of International Politics argues the constraining force of international structure on state actors, the structure itself is an epiphenomenon of the preferences and powers of the constituent states. It has no independent ontological status.

A structural or what I would call a "societal" approach,[15] by contrast, treats international social structures as causal variables. They are given independent ontological status. Norms of behavior, moral principles, and shared beliefs extant in the international system provide states, individuals and other actors with understandings of what is important or valuable and of what are effective and/or legitimate means of obtaining those valued goods. Thus, in this structure-oriented or "societal" approach, states may be supplied with both preferences and strategies for pursuing those preferences.

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[15] Kinship with the structure side of the structure-agent debate at first suggests the name "structural" for approaches of this kind. However, the fact that this term has already been appropriated by both Marxists and realists for different purposes I believe makes further use of it in this context both confusing and inappropriate. I have chosen the term "societal" instead because it appears to be descriptive without suffering from so many competing applications.

Three types of societal approaches

Just as there are a large number of different forms of agent-or actor-oriented approaches (neorealism, liberalism/pluralism, even microeconomics), so, too, there are a large number different ways in which one can conceptualize social structure or society and the ways in which it might influence actors. Many of these approaches are not yet well-developed and lack coherent research programs.[16] However, surveying the field of international relations, there appear to be at least three existing strains of research which locate causality in international social structures.

The reflective approach. The most well-known of these in mainstream American political science is what Robert Keohane has called the "reflective" approach.[17] As Keohane describes

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[16] The lack of well-organized research programs is not necessarily looked upon negatively by partisans of these approaches. Because, as will be discussed below, many of them reject the "scientific" claims of the agent-oriented approaches, they also reject the necessity of structuring research activity around the Lakatosian "hard core" and "protective belt" of any paradigm. These scholars view such research programs as misdirected because they focus researchers on oddities and minutia and lead researchers away from the issues and realities of the world in which we live. The fundamental issues in this current debate over the "scientific" nature of political studies are well-known, and some of the best treatments of these issues are not new. See, for example, Klaus Knorr and James Rosenau, eds. Contending Approaches to International Politics (Princeton: Princeton University Press, 1969,) esp. articles by Hedley Bull ("International Theory: The Case for a Classical Approach") and Morton Kaplan ("The New Great Debate: Traditionalism vs. Science in International Relations.")

[17] Robert O. Keohane, "International Institutions: Two Approaches," International Studies Quarterly 32 (1988): 379-396.

it, scholars working from this perspective stress "the role of impersonal social forces as well as the impact of cultural practices, norms and values that are not derived from calculations of interests."[18] They emphasize the importance of "intersubjective meanings" in structuring the ways in which actors understand what kinds of actions are valuable, appropriate and necessary. Thus, these authors part ways with the more conventional actor-oriented (or what Keohane calls "rationalist") approaches in that they elevate socially-constructed variables--commonly-held philosophic principles, norms of behavior, or shared terms of discourse--to the status of basic causal variables which shape preferences, actors and, consequently, outcomes. In this way, they endogenize preferences. Preferences "are affected by institutional arrangements, by prevailing norms, and by historically contingent discourse."[19] He includes in this group such authors as Hayward Alker, Richard Ashley, Friedrich Kratochwil, and John Ruggie.

While the work of these scholars is probably the most well-known of the various perspectives emphasizing the causal nature of social structures, it is also probably the most amorphous and least well-defined. As Keohane's discussion indicates, social structure can take many forms in reflectivist research--institutional arrangements, norms,

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[18] Keohane, "Two Approaches," 381.

[19] Keohane, "Two Approaches," 382.

discourse. It is not at all clear how these different types of social structures are related to one another. Can these different structures exist, one without the other? Or do they tend to appear together, as a collection and if so can they be conceived of as facets of a single structure? Similarly, it is not clear how these different types of structures influence preferences and actors and whether they exert influence in similar or dissimilar ways.

In addition, social structures as described by these scholars tend to be limited in scope, usually to one issue area. These authors discuss social structures in the plural. None of them asserts or even explores the possibility of a single coherent social structure or international society that coordinates international interaction along coherent and predictable lines (as do some other scholars working within other societal frameworks, described below.) Instead, they tend to focus on a particular social framework in which interaction takes place in discrete issue areas and try to show how this social content--these shared beliefs, norms and discourse--shapes actors and preferences.

For example, Ruggie elevates "legitimate social purpose" to the same level as hegemonic power in explaining postwar economic order; he elevates social structures to causal status by arguing that recognition of the fact that liberal norms and values were "embedded" in U.S. hegemonic power is essential to

understanding outcomes.[20] Similarly, Puchala and Hopkins argue that recognizing the existence of superstructures of norms is decisive for understanding colonialism and international interactions over food.[21] Kratochwil has argued that the norm-laden character of language, itself, guarantees that systems of norms and social conventions will circumscribe any calculations of rational utility maximization in important ways.[22] Ernst Haas has focused on cognitive processes more broadly and points to the shared experiences and commonly-held understandings developed within international institutions as determinants of outcomes.[23]

Each of these authors identifies a different socially-constructed variable as causal and describes the causal process in a slightly different way. However, they all share a willingness to make social structures causal as well as a

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[20] John G. Ruggie, "International Regimes, Transactions, and Change: embedded liberalism in the post-war economic order," in International Regimes, ed. Stephen D. Krasner (Ithaca, N.Y.: Cornell University Press, 1983) 195-232.

[21] Donald J. Puchala and Raymond F. Hopkins, "International Regimes: lessons from inductive analysis," in International Regimes ed. Stephen D. Krasner (Ithaca, N.Y.: Cornell University Press, 1983) 61-92.

[22] Friedrich Kratochwil, Rules, Norms and Decisions (Cambridge: Cambridge University Press, 1989).

[23] Ernst Haas, When Knowledge is Power: Three Models of Change in International Organizations (Berkeley: University of California Press, 1990); and "Words can hurt you; or, who said what to whom about regimes," in International Regimes, ed. Stephen D. Krasner (Ithaca, N.Y.: Cornell University Press, 1983), 23-59.

belief that these structures mould preferences in important ways. Liberal norms and principles shape US preferences about how, precisely to exercise its power. Norms about self-determination and avoidance of starvation shaped state preferences in the areas of colonialism and food. In this way, preferences are endogenized in the theories rather than treated exogenously.

The English School. A second approach to social structures as causal variables can be found in what has been called the English School, best exemplified by the work of Hedley Bull.[24] Despite debates in recent years over whether this collection of scholars can legitimately be called a "school,"[25] these authors certainly share methods and perspectives which distinguish them in the context of the debates under discussion here. Methodologically, they explicitly espouse holism and posit the "international

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[24] Other scholars working in this vein include Martin Wight, Charles Manning, Michael Donelan, F.S. Northedge and Robert Purnell. While Bull was not the founder of this school (Wight and Manning probably deserve that honor) his work is best known to Americans and most directly engages the debates outlined here. For that reason, I use him as exemplar.

The term "English School" is somewhat misleading since two of the principal proponents are South African (Manning) and Australian (Bull.) A more appropriate term might be "the LSE School," since the London School of Economics has been the institution at which most of these scholars came together.

[25] Roy E. Jones, "The English School of International Relations: a case for closure," Review of International Studies 7 (1981): 1-13; Sheila Grader, "The English School of International Relations: evidence and evaluation," Review of International Studies 14 (1988): 29-44; Peter Wilson, "The English School of International Relations: a reply to Sheila Grader," Review of International Studies 15 (1989): 49-58.

society" of states as the focus of their studies. Thus, their position on the "structure" (as opposed to "agent") side of the debate could not be clearer. They are also explicit in their rejection of the notion that international politics can or should be treated as a "science" in the manner that adherents to agent-oriented approaches might wish.[26]

Second, these scholars share a belief that some principled or moral content underlies and shapes the international society (or social structure.) In Bull's work, this content stems from his philosophical examination of the moral implications of order. From the notion that order is a relational concept in that things must be ordered to some particular end, Bull derives three common ends of all societies, including the international society: security against violence, ensuring that promises will be kept, ensuring that property will be secure.[27] Elsewhere, both

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[26] See, for example, Martin Wight, "Why is there no international relations theory?" in Diplomatic Investigations: Essays in the Theory of International Relations, ed. Herbert Butterfield and Martin Wight (Cambridge: Harvard University Press, 1966), 17-34; and Hedley Bull, "International Theory: The Case for a Classical Approach" in Contending Approaches to International Politics, ed. Klaus Knorr and James Rosenau (Princeton: Princeton University Press, 1969), 20-38.

For a discussion of whether this rejection of science and the use of methodological holism are related to phenomenological strains of thought in the English School, see Roy Jones, English School: case for closure, 3.

[27] See the following works by Hedley Bull: The Anarchical Society (New York: Columbia University Press, 1977); "The Grotian Conception of International Society" in Diplomatic Investigations: Essays in the Theory of International Relations, ed. Herbert Butterfield and Martin Wight (Cambridge: Harvard University Press, 1966), 51-73; and

Bull and Wight make more historical arguments that the content of international society comes from the liberal principles of Western European democracies and became internationalized with the expansion of the West.[28] All of these scholars acknowledge a debt and kinship with Grotius and an interest in natural law, although none actually characterizes his own work as based on natural law.[29] Again, what interests these scholars is the ways in which social structure--the shared

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"Society and Anarchy in International Relations" in Diplomatic Investigations: Essays in the Theory of International Relations, ed. Herbert Butterfield and Martin Wight (Cambridge: Harvard University Press, 1966), 35-50.

[28] Bull and Watson, Expansion of International Society (Oxford: Clarendon Press, 1984.) Also, Martin Wight, "Why is there no international relations theory?" in Diplomatic Investigations: Essays in the Theory of International Relations, ed. Herbert Butterfield and Martin Wight (Cambridge: Harvard University Press, 1966), 17-34.

[29] Hedley Bull does use the term "Grotian" to describe an approach similar to his own. Bull, "The Grotian Concept of International Society." However, in his later work, The Anarchical Society, he explicitly states that he is not making a natural law argument, therefore his argument cannot be completely Grotian.

Note, that the way Bull and the English School use the term "Grotian" is rather different from the way the term has become incorporated into American political science. In Krasner's discussion of international regimes, "Grotian" is construed so broadly that it is used to describe the broad range of approaches described earlier as "reflective." Since the reflectives have no interest in natural law, which is, after all, the main focus of Grotius work, I believe this appellation is misapplied. Bull, Wight, and their companions are, I believe, much more faithful to Grotius in their characterization of his work and their use of his name. See, Stephen D. Krasner, ed., International Regimes, 1-21 and 355-368.

moral and philosophical environment in which states exist--shapes and tempers state preferences and actions.

The institutionalists. A third approach to social structures as causal variables has been developed in sociology under the label "institutionalist" by John Meyer and his colleagues.[30] In the institutionalists' view, social structure is constituted, not by an international society of states, but by an expanding and deepening world culture.[31] The content of that culture is not unlike the Western values discussed by Bull, Watson and Wight, but the institutionalists are much more explicit in their discussion of the logic underlying this cultural expansion. They argue that the modern international system is governed by a powerful set of worldwide cultural rules whose core is the Weberian (and Western) notion of rationality. These Western rationalizing rules created the modern state, a political entity based on rational-legal authority rather than earlier traditional and charismatic forms of authority. In the current international system, these rules continue to shape states as system subunits, both by providing them with "rational" goals, such as the pursuit of "modernity" and "progress," and by defining

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[30] Other scholars working in the framework include Albert Bergesen, John Boli, Francisco Ramirez, and George Thomas.

[31] Christopher Chase-Dunn has used the term "global culturalism" to describe this approach. Chase-Dunn, "Theoretical Approaches to World-Systems Analysis." Paper presented at the annual meetings of the American Political Science Association, San Francisco, September 1990.

the "rational" institutions by which those goals will be achieved, for example markets and bureaucracies.

The institutionalists' approach represents the most comprehensive and explicit formulation of an argument in which social structure is causal. Unlike the reflectives, social structure in this view is coherent and all-encompassing. In the institutionalists' view, all of the various little social structures identified by reflectives can be linked to an overarching system of Western rational values. Unlike the English School, which takes states as the primary actors and understands international society to be a society of states and is primarily concerned with social influences on state actions, the institutionalists focus on a much broader range of actors. World culture can and does influence all sorts of organizations and individuals as well as states, in their view. Thus, the global social structure of Western rational culture clearly has ontological primacy over any component actors, including states, in the institutionalist view. World culture defines and empowers actors, including states, sub-state organizations and even individuals.[32] International politics is understood, not as the result of interaction among

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[32] John Meyer provides for a discussion of the ways in which Western world culture has defined the individual as a social unit and endowed it with rights and worth not previously recognized. John W. Meyer, "Self and Life Course: Institutionalization and its Effects" in Institutional Structure: Constituting State, Society, and the Individual, ed. George Thomas et al. (Newbury Park, Calif.: Sage, 1987), 242-260.

actors but as an outgrowth of the structure of worldwide Western culture.[33]

The three approaches described above illustrate the variety of different ways in which international social structures can be conceived of and treated as causal variables. They are not presented as competing views. In fact, it is not at all clear that can compete since it is not clear that they are mutually exclusive. For example, the logic underlying the institutionalists' arguments subsumes the other two approaches and their findings within the institutionalist framework. In institutionalist terms, the "society" of states described by the English School and the norms and understandings identified by the reflectives can simply be understood as manifestations of much larger and more comprehensive world cultural forces. From an institutionalist perspective, the other societal approaches are not wrong so

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[33] The structure of the institutionalists' argument is similar in many ways to that of Immanuel Wallerstein. Like Wallerstein, the institutionalists understand the existing international system as an outgrowth of a historically unfolding dialectic which has its roots in medieval or early modern Europe. The critical difference is that the dynamic force in Wallerstein's argument is material and economic; capitalism and markets drive change. The dynamic force in the institutionalist argument is cultural and normative; rational rules about progress and modernity create not only capitalism and markets, but also bureaucracies and other distinctive features of modern politics. Immanuel Wallerstein, The Modern World-System, vol. I (New York: Academic Press, 1974); and "The Rise and Future Demise of the World Capitalist System," Comparative Studies in Society and History 16 (1974): 387-415.

much as they are incomplete; they do not go far enough in imparting causality to social structure. Similarly, Ruggie's embedded liberalism analysis is not incompatible with the understandings of international society put forward by Wight and Bull, but it is only a single example of a much more widespread phenomenon.

My purpose in this study is not to test these societal approaches, one against the other. Rather it is to test them collectively against the more conventional actor-oriented approaches. My purpose is to try and locate the source of states' preferences about their role in science: does that source lie inside or outside the state?

Making this distinction is possible because expectations about state action are different depending upon where the source lies. If preferences are formulated by internal demand, one would expect states with different characteristics and different functional needs to act differently. Similar actions in the face of different conditions or characteristics would simply be anomalous. However, from an international "societal" perspective such similar action would have an obvious cause. International norms, shared beliefs, culture and other social structures may make uniform behavioral claims upon dissimilar actors. They may shape and define the preferences of actors in ways not related to internal conditions, characteristics or functional need.

The study tests these two predictions in two steps. The first part of the project investigates the source of state preferences by relating state actions to internal state conditions. Chapter Two presents a large-N analysis which looks for statistical relationships between indicators of internal demand that have been argued to be relevant in the area of science, and the pattern of adoption of these new science bureaucracies. Finding such relationship would obviously support more conventional views that preferences have their origins inside states. However, a non-finding, the finding of no statistical relationships between objective conditions and the pattern of adoption, can only suggest that a more societal explanation might be relevant. A non-finding cannot tell us very much about exactly what international social structures might be influencing states or how that influence was exerted. For this reason, I follow the large-N analysis with case studies tracing the way in which international social structures, specifically international organizations, effected state preferences in this particular case.

Why science policy bureaucracies?

Before going further with my discussion of how I tested these competing expectations about sources of state preferences, a few words should be said about why I chose to test in the case I did. State expansion, or state structural change generally, is a form of state action that, in turn,

redefines the actor. In deciding what they do, states also, in some sense, decide what they are. Thus, state expansion potentially provides a doubly interesting case in that, in addition to shaping preferences, international social structures may indirectly be shaping the actors themselves.

I have chosen to investigate the creation of science policy bureaucracies as my specific instance of state expansion for two reasons. First, science is relevant to the formulation of both economic and military policy preferences and so allows me to test these actor-oriented or demand-driven arguments about state preferences broadly conceived. Modern warfare is a technology-intensive business, hence science should clearly be relevant to states' policy preferences concerning security matters. At the same time, science and its technological manifestations are critical to economic competitiveness and so should be of concern to states in formulating economic or development policy.[34]

Second, the coordination and direction of science is an area where states' internal conditions and functional needs are clearly different. States presumably only need to coordinate science if they have some amount of science activity to coordinate or if actors in some other non-science

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[34] Applicability to both military and economic policy preferences of states is particularly important as realists have begun increasingly to link "security" to economic prowess and competitiveness. See, for example, Paul Kennedy, The Rise and Fall of Great Powers: Economic Change and Military Conflict, 1500-2000 (New York: Vintage Books, 1989.)

sphere of activity (for example the military or technology-intensive businesses) press demands for state intervention in science. As will be elaborated in Chapter Two, demand-driven arguments locate the cause of states' interest in science in some change in state conditions, specifically in some change in military threat, economic development levels or the size of domestic science establishments. Since state vary widely on these dimensions, they presumably also vary in their domestic demands for the coordination of science. Thus, science bureaucracies provide an instance where "agent-driven" and "international societal" approaches would make different predictions. The former would expect the pattern of bureaucracy creation to vary with varying internal conditions and internal demand; the latter would expect creation to coincide with international or societal level stimuli.

An alternative model of science organization

Like so many things, the ubiquitousness of national science policy bureaucracies at first glance seems unremarkable precisely because these bureaucracies are ubiquitous. What is seems somehow necessary or inevitable. It does not need explanation or justification. Science, after all, is generally considered to be a good thing, something positively valued and therefore sought after. That states would expand and create bureaucracies charged with harnessing science seems obvious. Thus, we do not ask why these things

exist; we would more likely ask why anyone would think that they should not exist.

One reason these bureaucracies should not exist has been noted earlier: the pattern of their creation does not conform to existing understandings of how and why states expand. The appearance of these entities does not correspond with domestic science or other conditions in any obvious way.

Another reason to question the inevitability of this system of national science policy-making establishments is that there were, in fact, other ways to organize science and distribute its results around the world. One purpose of this dissertation is to show why those alternatives were not chosen.

The most important of those alternatives was the one which had been prominent in both the 19th century and the inter-war period, received widespread acceptance immediately following World War II, and which the current system of national science policy bureaucracies replaced.[35] In that schema science was viewed, not as a national enterprise to be directed by individual state governments, but as a transnational enterprise run by scientists. Science was understood to be an international collective good. All would benefit from increasing the world sum of scientific knowledge

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[35] This understanding is explored more fully in Chapter Four, below.

and access to that knowledge without regard to national boundaries.

What was necessary to the growth of science, in this view, was the creation of international organizations and supports for research. Prior to World War II, there was also a preference that these organizations be non-governmental as well as international. International "unions" of scientists in various disciplines were formed and convened regularly beginning in the mid-19th century. Even when the international organizations became governmental, like UNESCO after World War II, the emphasis was on programs to serve science and scientists rather than states, for example, the establishment of international research centers and projects to translate and disseminate research results.

The notion underlying these activities, that science is an international resource, is very different from the notion implicit in science policy, that science is a national resource to be harnessed by individual states for their own wealth and security. In fact, in this alternative understanding, extensive state involvement in science (as happens when a state science bureaucracy is created) was not viewed as particularly desirable. State interference was thought to stifle creativity and so diminish the world sum of scientific knowledge available to the international community. In addition, science following World War II was recognized as a powerful force. The reason for internationalizing science

and bringing it under UN auspices in the first place was precisely to free it from the meddling and exploitation of self-interested (and self-aggrandizing) states.[36]

This alternative international mode of science organization has clear liberal roots in a philosophical sense. It is predicated on the belief individual scientists, rather than states, are the best arbiters of what is best for science and that states' and scientists' interests are in harmony--that both want more and better science. In practical terms, it was understood that what would most contribute to the advancement of science was free flow of scientific information and scientists around the world. Thus, the role of states was simply to facilitate this, to internationalize science. The best possible scientific results and the fastest possible advances would be gained by tearing down barriers to information flows. Thus, cross-national and multi-national research collaboration, international research centers and research projects were seen as the most likely avenues to promote science and therefore the appropriate arena for state activity. States had no reason not to contribute to this international science effort because they would have free access to all fruits of this research. In this way, science would be a international resource rather than a national one.

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[36] Science was not originally supposed to be a part of UNESCO or any other UN organization. For a more detailed discussion of how the "S" came to be added to UNESCO and how science came to be a part of UN concerns, see Chapter Four, below.

This alternative mode of organizing science was abandoned in the mid-1950s. At that time states began appropriating the responsibility for directing science for themselves, arguing that science was a national resource to be channeled to further each states' own "national interest." Their preferred method of accomplishing this was to establish a science policy bureaucracy. How states came to perceive this responsibility as theirs and why they chose this bureaucratic form to meet it is the subject of subsequent chapters.

What is a science policy bureaucracy?

Another topic that requires some prefatory discussion is the dependent variable in this study, the organizations I am calling science policy bureaucracies. For purposes of this study I define a science policy bureaucracy as an organ of the state whose primary mission is the coordination, organization and planning of scientific and technological activities across disciplines at the national level. I exclude from my definition the following types of organizations: a) non-state organizations (such as privately-run scientists' professional societies); b) organizations dealing with only one branch of science (such as the National Weather Service or medical and health organizations); c) educational organizations whose primary mission is to train scientific and technical personnel rather than to coordination activities broadly; and d)

research organizations whose primary mission is to conduct research rather than to make policy.[37]

While the analysis in Chapter Two focuses on the moment at which the first science policy bureaucracy was created in a country (ie. the moment at which the state clearly accepted the coordination and direction of science as a state responsibility,) these bureaucracies have, not surprisingly, been enlarged and elaborated over time. In many, probably most, countries there is now more than one body which fits the above definition of a science policy bureaucracy. Thus, even within this definition there are a wide variety of possible forms these science policy establishments can and do take. To provide some insight into both the common characteristics of these entities and the range of variation in them, the following section presents a brief discussion of the science policy establishments in four countries. This group of states represents a variety of different geographic regions, development levels, levels of scientific capacity, and were chosen to illustrate the variety of ways that science policy-making can be organized.

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[37] This definition is based on UNESCO's own definition used in compiling its world directories of national science policy-making bodies which provide much of the data for the large-N analysis in Chapter Two. See UNESCO, World Directory of National Science and Technology Policy Making Bodies (Paris: Unesco, 1984), viii. The second edition of this directory (1990), also used in this analysis, uses the same definition.

France.[38] The science policy establishment in France mirrors much of the rest of the French state's structure in that it is a relatively centralized and pyramidal bureaucratic structure. The French government began establishing state-run laboratories and research institutes as early as the late 18th century and established the well-known Centre Nationale de la Recherche Scientifique (CNRS) in 1939. However, the CNRS and its predecessors were set up with the mission of doing research, not of coordinating science nationally or developing a national policy for science. This latter step was not taken until 1953 when the Commission de la Recherche Scientifique et Technique was created. Its mission was to "propose to the government measures which will assure the maximum development, cohesion and efficiency of both public and private research efforts."[39] The Commission was reorganized and expanded

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[38] See, Ministère de la Recherche et de la Technologie, "Ministère de la Recherche et de la Technologie" pamphlet, 1990; Ros Herman, The European Scientific Community (Harlow, Essex: Longman, 1986); UNESCO, La politique scientifique et l'organisation de la recherche en France, Science Policy Studies and Documents, no. 24 (Paris: UNESCO, 1971); UNESCO, National Science and Technology Policies in Europe and North America, Science Policy Studies and Documents, no. 43 (Paris: UNESCO, 1979); UNESCO, World Directory of National Science and Technology Policy Making Bodies, Science Policy Studies and Documents, no. 71 (Paris: UNESCO, 1990.)

Note that all of the country reports contained in the UNESCO series "Science Policy Studies and Documents" are written by science policy officials of the country in question, not by UNESCO secretariat members. Thus, these reports reflect assessments by the nationals of the countries in question, not by UNESCO.

[39] UNESCO."La Politique scientifique et l'organisation de la recherche en France," Science policy studies and documents, no. 24 (trans. mine.)

several times, notably twice in the 1970s and again in the early 1980s. The structure of the science policy establishment following the 1980s reorganization is described briefly below.

The science policy-making process in France is overseen by a Minister for Research and Technology who reports directly to the Prime Minister.[40] The duties of the Minister for Research and Technology are first, interministerial coordination of science and research activities and, second, preparation of an overall research budget for the country, the Civil Research and Development Budget (BCRD). It is through its influence over this overall national science budget that the Ministry exercises its strongest control over the direction of French science policy. In addition to formulating the national research budget, the Ministry receives and administers the lion's share of that budget. In 1991 the BCRD was approximately 48.7 billion francs of which the Ministry for Research and Technology received 53.5%.

Working with the Research Minister are two other policy bodies: the Interministerial Committee on Scientific Research and Technology (Comité interministériel de la recherche scientifique et technique, CIRST) and the Advisory Committee on Scientific Research and Technology (Comité Consultatif de

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[40] The Ministry of Research and Technology was created in 1981 and reorganized in 1988. It is located at: 1, rue Descartes, 75231 Paris CEDEX 05.

la recherche scientific et technique, CCRST.) The Interministerial Committee (CIRST) is composed of the various cabinet-level Ministers whose ministries have a hand in the administration and management some aspect of scientific research (eg. the Minister of Agriculture, the Minister of Defense.) This group meets twice a year to coordinate activities both among themselves and with overall state plans for social and economic development. The Research Minister chairs the Committee.

The Advisory Committee is composed of 16 people chosen for their competence in scientific and technical fields. They serve for two year terms, renewable once. They give advice to the Research Minister and issue reports on the substantive direction science policy should be taking.

The Ministry bureaucracy, itself, is divided into three operational divisions.

(1) The General Directorate of Research and Technology (DGRT) actually implements national research policy. In 1989 the DGRT reported having a staff of 350 of whom 180 were professionals in the sciences. Its annual budget was approximately 21 billion francs.

The DGRT is composed of:

- 10 scientific departments, each supervising a different research sector. Approximately 150 project managers, scientists and researchers are employed to staff these departments.

- A Delegation for Scientific and Technical Development and Regional Innovation whose mission is to support research in industry by granting tax incentives to firms and to liaise with the regional research centers.

- A Delegation for Scientific and Technical Information that operates the country's technical information service.

(2) The Directorate of Research Administration and Finance (DARF) is charged with personnel inventories and policies regarding employment and training of research personnel, formulating the general outlines of tax incentive plans to stimulate research in industry, and, preparation of the research budget.

(3) The Delegation for International Affairs supervises international research contacts.

Federal Republic of Germany.[41] The German science policy establishment differs significantly from the French in that it is much more fragmented. This is partly a result of federalism but also because the country has a tradition of

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[41] Ros Herman, The European Scientific Community (Harlow, Essex: Longman, 1986); National Science Foundation, The Science and Technology Resources of West Germany, NSF 86-310 (Washington D.C.: U.S. Government Printing Office, 1986); H. Geimer and R. Geimer, Research Organisation and Science Promotion in the Federal Republic of Germany (New York: K.G. Saur, 1981); UNESCO, National Science and Technology Policies in Europe and North America, Science Policy Studies and Documents, no. 24 (Paris: UNESCO, 1979); UNESCO, World Directory of National Science and Technology Policy-making Bodies, 2nd ed., Science Policy Studies and Documents, no. 71 (Paris: UNESCO, 1990.)

Note that this description does not reflect changes that may have occurred as a result of German unification.

strong and relatively independent universities and research institutes which are the site of much of the country's research, rather than state-run research centers or government laboratories.

As in France, the state in Germany has a long history of support for science. However, in Germany this early support has primarily been channeled into science education and support for universities rather than into setting up state research centers. In 1825 the first technical university opened at Karlsruhe; in 1887 the Physikalische Technische Reichsanstalt was established as the supreme authority in the field of weights and measures; and in 1907 the Imperial College of Science and Technology was founded.

While the Nazis certainly drew on scientists and their expertise as part of the war effort, national and cross-disciplinary science policy-making apparatus in Germany did not appear until 1962 when the Federal Ministry for Atomic Energy became the Federal Ministry for Scientific Research. In 1969 this became the Federal Ministry for Education and Science but in 1972 a separate ministry, the Federal Ministry for Research and Technology (Bundesministerium fur Forschung und Technologie or BMFT,) was created. In 1989 it employed 610 staff members of whom 228 were professionals in the sciences and had a budget of approximately 7.1 billions DM.

The Federal Ministry for Research and Technology draws on recommendations from a number of advisory bodies to decide

direction and provide support for research in universities, industry and non-university research institutions at the national or federal level. In 1979 roughly 53% of the Ministry's budget was spent on research projects carried out primarily in the industrial sector (although some were located in universities and non-university research establishments.) Thirty-five percent was allocated to basic financing of non-university research establishments and institutes such as the Max-Planck Institutes, the Fraunhofer Society and the 13 national laboratories or big science establishments (grossforschungseinrichtungen.)[42] Eleven percent went to international scientific organizations.

Government support for universities and university-based research is provided primarily through the Federal Ministry of Education and Science (Bundesministerium fur Bildung und Wissenschaft, BMBW). The BMBW does not, itself, carry out research but is responsible for ensuring a sufficient supply of qualified scientists and researchers as well as adequate facilities to support university research. S i n c e universities are run by the Lander, rather than the federal government, the Bund-Lander Commission for Educational

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[42] In addition to the state, a number of large industry groups provide substantial research support in Germany, notably the Volkswagenstiftung, financed by the firm, Volkswagenwerke, AG; the Arbeitsgemeinschaft industrieller Forschungsvereinig (AIF) and the Stifterverband fur die Deutsche Wissenschaft.

Planning and Research Promotion provides a vehicle for coordinating actions at the two levels of government.

The other important source of science funding, besides the Ministry for Research and Technology, is the quasi-autonomous German Research Society (Deutsche Forschungsgemeinschaft or DFG.) The DFG operates no research centers of its own but is a primary source of support for all university- and institute-based research through its administration of large amounts of funds allocated in peer-approved grants. According to a 1976 agreement, half of the DFG's grant funds are supplied by the Lander, half by the Bund or federal government.

In developing countries, science policy establishments are rarely so elaborate as the French or German bureaucracies. In some LDCs, there may be only one science bureaucracy in which virtually all government science deliberation is focused. Often these bureaucracies are linked to or emerge from larger government bureaucracies, usually either the education bureaucracy or the state planning bureaucracy. The two examples below illustrate each of these two types of linkage.

Chile.[43] The principal science policy bodies in Chile are linked to universities and the Ministry of Public Education. The National Commission of Science and Technological Research (Comisión Nacional de Investigación Cientifica y Technológica or CONICYT,) which is the highest government body dealing science was created in 1967 and is located within the Ministry of Public Education. In 1989 CONICYT reported having a staff of 64 of whom 40 were professionals in the sciences and an annual budget of 1.7 billion pesos (approximately 6.3 million $US.)

CONICYT's main functions are:

a) to advise the President and other ministries on matters relating to science and technology;

b) to provide and maintain specialized information services for the country's scientific community;

c) to promote and expand science activity;

d) to establish national development plans and to ensure that these are carried out.

CONICYT has four subdirectorates which correspond (albeit loosely) to these missions--a Directorate for Information and Documentation, a Directorate for Development, a Directorate

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[43] UNESCO, Informes nacionales y subregionales de política cientifica y tecnológica en America Latina y el Caribe, Science Policy Studies and Documents, no. 54 (Paris, UNESCO, 1983); Latin American Newsletters Limited, Science and Technology in Latin America (New York: Longman Press, 1983); UNESCO, World Directory of National Science and Technology Policy-making Bodies, 2nd ed. Science Policy Studies and Documents, no. 71 (Paris: UNESCO, 1990.)

for Planning, and a Directorate for International Technical Assistance.

CONICYT is primarily a policy and planning body. Below it in the organizational hierarchy are a series of organizations which actually carry out scientific research. These are located primarily in the university sector but also in both state and private technological institutes. The university research sector has its own apex organization, the Science and Technology Commission of the Council of Rectors of Chilean Universities (Comisión de Ciencia y Tecnológia del Consejo de Rectores de las Universidades Chilenas.) This body helps to coordinate the work of the 380-odd research units located within the national universities. The state research institutes generally focus of applied research in such areas agriculture, marine resources, forestry, mining, energy production, and manufacturing. They are generally dependent, not on CONICYT, but on the relevant ministries in that substantive area. The private research organizations are generally directed toward the country's major industries--mining, forestry, chemicals--and are often run by state companies or large private companies operating in those sectors.

Senegal.[44] Senegal first got into the business of making science policy in 1966, following a UNESCO science policy mission in 1965. The initial entities created (with the help of UNESCO experts) were an Interministerial Council for Scientific and Technological Research (Conseil Interministériel de la Recherche Scientifique et Technologique or CIRST) and an Office for Scientific and Technological Affairs (Bureau des Affaires Scientifiques et Technologiques) which was attached to the Office of the President. The interministerial council, CIRST, has continued to exist as a forum for cross-ministerial debate and coordination, however the executive body for science policy has changed many times. During the 1970s it was reorganized and renamed almost annually but was consistently kept within the Ministry of Planning until 1980 when a cabinet-level science ministry was formed.

The Secretariat of State for Science and Technology Research (Secretariat d'Etat à la Recherche Scientifique et Technique or SERST) is attached to the Prime Minister's office and, during the 1980s has maintained a staff of approximately 160 of whom 100 are science professionals as well as a budget

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[44] UNESCO, Comparative study on the national science and technology policy-making bodies in the countries of West Africa, Science Policy Studies and Documents, no.58 (Paris: UNESCO, 1986); UNESCO, World Directory of National Science and Technology Policy-making Bodies, Science Policy Studies and Documents, no. 59 (Paris: UNESCO, 1984); UNESCO, World Directory of National Science and Technology Policy-making Bodies, 2nd ed. Science Policy Studies and Documents, no. 71 (Paris: UNESCO, 1990.)

of approximately 300 million francs CFA (roughly 1 million $US.) SERST is responsible for the planning, programming and budgeting of all scientific and technological research activities in Senegal. Under its direction are a number of other technical and administrative bodies focusing on specific technological tasks, for example the Directorate for Agricultural and Agro-Industrial Research, the Directorate for Medical and Pharmaceutical Research and the National Science and Technology Documentation Centre.

Outline of the Study

The theoretical question raised in this chapter has been whether the impetus for the creation of these science policy bureaucracies came from inside or outside states. As was discussed earlier, the location of the source of this interest in or preference for the new science bureaucracy has implications for international relations theory. Most widely-used theoretical frameworks locate the source of state preferences inside states. Actors at both the state and substate level are assumed to know what they want and it is their pursuit of known preferences that shapes international politics. Conventional arguments about the creation of new state bureaucracies have thus been "demand-driven." The new bureaucracies are created in response to demands from one or more domestic groups who perceive the new bureaucracy to be useful or necessary.

There is, however, another way of understanding state preferences which locates the source of those preferences outside, rather than inside states. In this view, which I have called an international society or "societal" approach, states are understood to be embedded in an international structure or international society that not only constrains them, but also shapes them. Embeddedness in an international society shapes state and substate actors' preferences; it shapes their understandings of what is important and valuable and of what are legitimate and effective means of obtaining those preferred or valued goods. From this kind of theoretical perspective, states may create a new bureaucracy, not because it is demanded from within, but because it is supplied from without. They may be taught by system- (or society-) level actors that they want or need a science bureaucracy and create one in response to that teaching.

This project tests these competing proposals for internal versus external sources of states' preferences for science bureaucracies in two stages. Chapter Two provides a large-N test of the more conventional arguments for internal or domestic sources of demand for these bureaucracies by looking for statistical relationships between quantitative indicators of various internal conditions that have been argued to be relevant in the case of science and the pattern of creation of these science bureaucracies across the globe. The analysis shows that, in fact, indicators of functional need and

internal conditions are not correlated with the pattern of adoption of this innovation in any obvious way. Failure to find any of the expected relationships suggests that internal demand and internal conditions are unlikely causes for the adoption of this innovation.

Since conventional explanations seem to be on weak ground, I turn to societal alternatives. The data in Chapter Two show that roughly 70% of these science policy bureaucracies were created between 1955 and 1975. Beginning in the early 1950s two international organizations, specifically the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the Organization for Economic Cooperation and Development (OECD), took on the promotion of science policy among their member states as a mission. The commencement of theses activities followed by widespread adoption of this bureaucratic innovation suggests a causal connection. I therefore explore the proposition that these international organizations somehow taught states the value and appropriateness of coordinating science and prompted the creation of these new bureaucracies.

Chapters Three and Four are case studies of the promotion activities of these two international organizations. They detail how and why it was that these organizations got interested in teaching states to coordinate science and what kinds of promotion activities were undertaken. The evidence presented suggests that a community of international experts

(scientists) working through these two international organizations taught states that coordinating and directing science was a valuable activity for states and that creating a new state science bureaucracy was the effective and appropriate means of doing this.

Chapter Five explores some of the theoretical implications of the quantitative findings and the two case studies. The research presented here suggests that states are more social entities than is recognized by traditional international relations theory. What states want is not inherent in the state itself. Rather, preferences are influenced by systemic factors, not as traditional theories would hold, through simple constraint and coercion, but through teaching and socialization. In this case, states were socialized[45] to accept the promotion and direction of science as a necessary and appropriate role by international organizations and experts. Chapter Five explores the theoretical options for treating this external supply of preferences, both inside the field of international relations and elsewhere and suggests avenues for further research that might help us to choose among these options.

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[45] See G. John Ikenberry and Charles A. Kupchan, "Socialization and Hegemonic Power" International Organization 44 (1990) 283-315 for an alternative perspective on socialization of states in which hegemons rather than international organizations are the socializing force.

Chapter Two

TESTING FOR INTERNALLY GENERATED STATE PREFERENCES

As was discussed in the previous chapter, most explanations for the creation of new state bureaucracies locate the impulse for this action inside states. They trace the origins of new bureaucracies to some change in material conditions which, in turn, reconfigures the interests of actors within the state so that the new bureaucracy becomes the solution to somebody's problem. Functionalists might regard such a change in conditions as both necessary and sufficient for the new bureaucracy to appear. Others, less sanguine about the efficacy of political systems in meeting all needs or fulfilling functions or demands, would regard change in domestic conditions as a necessary condition only and look to the process by which demands are actually voiced and, once voiced are realized, for sufficient conditions. But in either case, some change in domestic conditions must prompt the demand-making process to set events in motion. Thus, in all of these arguments, one would expect to see some relationship between relevant domestic conditions and the appearance of these new bureaucracies.

This chapter tests for these relationships. The first section of the chapter outlines the domestic conditions which have been argued to be relevant to the creation of science

bureaucracies. The next section describes quantitative indicators of those conditions to be used in testing and what behavior one would expect from these indicators if the "agent-driven" or domestic preferences arguments are correct. The third section of the chapter presents the results of this analysis. The chapter concludes with a discussion of the implications of these results for the debate over domestic versus international or "societal" sources of state preferences outlined in Chapter One.

Internal Conditions Relevant to Science Bureaucracies

In general terms, three kinds of internal conditions have been argued to be relevant in the creation of new state bureaucracies. The first could be termed **issue-specific conditions**. In these arguments it is conditions in the issue-area particularly relevant to the new bureaucracy that prompts its creation. Applied to science, this argument links the creation of a state science policy-making apparatus to the growth and strength of the domestic science community.

An argument of just this type has been made by Dickson to explain the origins of science policy-making in the United States.[1] In his view, the growth of the domestic science establishment prompted the creation of a state science policy apparatus in two ways. On the one hand, scientists saw such an organization as a potential conduit for state aide and

[1] David Dickson, The New Politics of Science, (New York: Pantheon Books, 1984) 25-27.

benefits. On the other hand, state actors saw a science policy bureaucracy as an opportunity to exploit science for their own purposes.

In Dickson's account, it is scientists and the scientific and technical community that take the lead in lobbying the state to create a science bureaucracy in the United States. An electrical engineer, Vannevar Bush, former dean of engineering at the Massachusetts Institute of Technology and then president of the Carnegie Institution, persuaded Roosevelt that "despite their apparent remoteness from practicality" scientists working in university laboratories could make important contributions to the country's military and economy during and after World War II if adequately funded by the government. Further, he convinced the president that scientific contributions would be realized most effectively if scientists, themselves, were left to decide how these resources should be distributed.[2]

Thus, in this argument scientists presented Roosevelt with an investment opportunity and FDR, as a rational calculator, took it. However, the credibility and appeal of the scientists' the arguments--that scientists, given resources and autonomy, will provide good return on these

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[2] Dickson's abbreviated account misses much of the politicking surrounding the establishment of the National Science Foundation, particularly over this issue of control and accountability of the new bureaucracy. More details can be found in the account of that process given in Chapter Three, below, and in the sources cited there.

investments--is predicated on the existence of some critical mass of scientists competent to produce carry out useful research. Absent a scientific community actively engaged in research, Roosevelt would have no reason to provide funds or create a bureaucracy since promises of return would be unconvincing. More to the point, without a substantial and active science community, scientists would lack the basis for their claim to a state support and the demand on the state for the new bureaucracy would not have been made in the first place.

Loren Graham also locates the impetus for creation of an independent Soviet science policy organization in the demands of scientists. In his analysis the very visible successes of Soviet research scientists, particularly space scientists, in the 1950s greatly enhanced their prestige both at home and abroad. They were then able to use this prestige as a tool to pressure state actors for a separate science bureaucracy, one not controlled by engineers and dedicated to industrial applications as they perceived the existing Academy of Sciences to be. Opposition came, not only from engineers, but also from Party ideologists who stressed Marxism's principle of the need to unite theory and practice (in this case, research and industrial applications.) The success of scientists in winning their own organization and resource base is attributable, in Graham's view, to the political capital

gained by scientists through their visible research successes.[3]

Generalizing beyond these two cases, this kind of argument would tie creation of science bureaucracies to the growth of domestic science communities and their increased ability to offer useful services to state actors in exchange for resources. This argument would therefore predict adoption of science policy organizations to be highly correlated with domestic levels of science activity, for example the number of scientists in the country or the amount of research and development (R&D) spending.[4]

The next two types of internal state conditions focus on consumers rather than producers of science. **Development** or **modernization** levels are argued to prompt the creation of science policy entities through the actions of the economic consumers of science, particularly technology-intensive industries. The idea here is that as a state's economy develops it will become more technology-intensive and so

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[3] Loren R. Graham, "The Development of Science Policy in the Soviet Union" in T. Dixon Long and Christopher Wright, ed. Science Policies of Industrial Nations (New York: Praeger Publishers, 1975) 12-58.

[4] One variant on this thesis would be that, particularly in LDCs, creation of science policy bureaucracies might be a response to rapid growth in the science establishment rather than absolute size. It would be interesting to test this hypothesis but data on science activity prior to the creation of science bureaucracies, particularly in LDCs, are far too sketchy to allow calculation of growth rates in science activity in this early period.

require more scientific support. Economic actors[5] therefore put pressure on the state to organize and supply this support and a new science policy organization is the result. According to this thesis, indicators of economic development such as GDP/capita, should predict the creation of a science policy organization.

Security conditions have been argued to prompt the creation of science policy bureaucracies through the actions of military consumers of science. In the modern era of warfare, scientific prowess has been clearly linked to military success. Thus, states perceiving threats to their power and/or security will be pushed to find new and more effective technologies to meet those threats. Militaries in these states will demand that the state organize and support the scientific establishment for reasons of national defense.

The timing of science bureaucracy creation in Britain (during the First World War) and the United States (immediately following the Second World War) has led a number of scholars to draw causal connections between security concerns and science policy. Jean-Jacques Salomon, Harvey Sapolsky and Sanford Lakoff all point to these wars, as well as another perceived security threat--the launching of Sputnik--as the catalysts for government interest in harnessing science to achieve national objectives in the

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[5] In many mixed economies these actors may be <u>state</u> economic actors. What is important in this argument is that the purpose of the demand-making is economic.

United States and Europe. Having organized science to meet security threats during wartime with apparent success, these wartime institutions were then redeployed by states to meet peacetime objectives.[6]

Robert Gilpin makes a more detailed and broader security argument based on his investigation of French science. He argues that France's creation of science policy organizations was the direct result of a perceived threat to French influence and independence from a preponderance of U.S. power immediately following World War II. At one level, this threat was understood militarily and led the French to use their science community to help establish a separate nuclear strike force. But threats to influence and security in the French view were not limited to the military sphere. The French were also concerned about loss of economic dominance. American economic strength following World War II was viewed with trepidation, and American direct investment in France was viewed as a form of imperialism by a foreign power. The French spoke of a "technology gap" which they must bridge by

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[6] Jean-Jacques Salomon, "Science Policy Studies and the Development of Science Policy" in Science, Technology and Society: A Cross-Disciplinary Perspective ed. Ina Spiegel-Rosing and Derek de Solla Price (London: Sage Publications, 1977), 43-70; Sanford Lakoff, "Scientists, Technologists and Political Power" in Science, Technology and Society: A Cross-Disciplinary Perspective, ed. Ina Spiegel-Rosing and Derek de Solla Price, 355-392; Harvey Sapolsky, "Science, Technology and Military Policy" in Science, Technology and Society: A Cross-Disciplinary Perspective ed. Ina Spiegel-Rosing and Derek de Solla Price, 443-472.

harnessing French science in the service of French industry to protect French economic independence and integrity.[7]

Security understood in this sweeping way, as any threat to influence and independence, could operate in so many arenas that developing tidy objective indicators to test for its presence is probably impossible.[8] The narrower arguments about security threats understood in a military context are somewhat easier to test for. If armed conflict or the threat of armed conflict is critical, indicators of perceived military threat, such as defense spending as a percentage of GNP, should be correlated with the creation of science policy organizations.[9] States perceiving military threats should be among the first to adopt science policy and, conversely, relatively secure states should be clustered among the late adopters.

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[7] Robert Gilpin, France in the Age of the Scientific State (Princeton: Princeton University Press, 1968.)

[8] For example, in the French case, threats to influence and independence extended to cultural matters and led France to pursue a number of foreign policy initiatives aimed at preserving and extending French language and culture in other states.

[9] Obviously defense spending measures only one facet of "influence" but it is an important one. States fearing loss of influence may also try to build up economic and other kinds of power bases but rarely do they do so at the expense of military might. Gilpin describes French concerns about economic competitiveness vis a vis the US but these concerns were coupled with defense spending of 11.0% of GNP when it created its science policy bureaucracy in 1953. Further discussion of the military spending variable appear in the next section of this chapter.

Each of these explanations posits an internal demand created by state conditions that in turn pushes the state to adopt new tasks and to create new bureaucracies to carry out those tasks. While it would be impractical to investigate the efficacy and success of the demand-making process over a large number of countries, it is quite simple to check on the existence of conditions said to be prerequisite to those demands.

To carry out this check, I identified rough quantitative indicators of each of the relevant internal state conditions such as were suggested in the foregoing discussion. As an indicator of size or power of the domestic science establishment I looked at both the number of scientists and engineers employed in research and development jobs as well as the percentage of GDP spend on research and development. As a rough indicator of development levels I looked at GDP/capita and as an indicator of perceived military threat I examined defense spending as a percentage of GNP. None of these indicators perfect. They are all rough, but I believe they are all reasonable and that over a large number of countries more conventional demand- or agent-driven explanations would expect to see some relationship between one or more of these indicators and the pattern of adoption of science policy

bureaucracies. The next section discusses the data used in this analysis in more detail.

Data and Sources

Science policy bureaucracies.

a) Definition. In its World Directory of National Science Policy-making Bodies UNESCO defines these to be organizations whose "central policy making function [is]...national level... planning, organization, or co-ordination of scientific and technological activities. Organizations such as Ministries or Departments of Science and Technology, National Research Councils, and Academies of Science, as well as other bodies with similar overall responsibilities, have thus been included in the new Unesco directory; bodies whose responsibilities are limited to specific sectors of the economy or particular fields of science and technology have, on the contrary, not been included."[10]

Two ambiguities arose in the coding of this variable having to do with definitional issues. The first concerns generalized state planning agencies whose responsibility is to plan all aspects of the economy. If these plans include science, do they qualify as science policy-making bodies? The

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[10] UNESCO, World Directory of National Science Policy-making Bodies, Science Policy Studies and Documents, no. 59 (Paris: UNESCO, 1984), viii. See also the definition in the earlier directories, listed in the bibliography. The definition in the second edition of this directory (1990) is identical to the 1984 definition.

1984 directory is silent on this point but the earlier directories of the 1960s specifically exclude entities with such general responsibilities. I have done the same in requiring that these organizations have science as their central concern.

The second ambiguity concerns the status of national academies of science. For theoretical reasons, made clear in Chapter One, I am interested only in state organizations, and not all academies are part of the state apparatus. In the United States, for example, the National Academy of Sciences is a private professional society. However, in many countries academies enjoy some amount of state support and in the Soviet Union and Soviet-style states academies are constituted in such a way as to make them difficult to distinguish from the state apparatus. In such cases, the active policy-making and advising role played by academies might very well be considered the first state science policy-making organization.

To determine whether or not academies should be counted as state science policy bureaucracies I deferred to the UNESCO "Science Policy Studies and Documents" series.[11] These were written by officials of the countries under study. If they presented their academy as their first science policy organization, as Cuba does, then it was coded as such. If they treat the academy as a forerunner of the "real" science

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[11] See citations in Bibliography and discussion in Chapter Four, below.

policy-making apparatus, as the USSR does, then it was not coded.

One final feature of this coding process should be noted. I coded as initial science policy-making bureaucracies only those bureaucracies which actually initiated an ongoing government shouldering of responsibility for science policy. A few states, for example fascist states in the inter-war period such as Spain, Portugal and Italy experimented with science bureaucracies but dissolved the bodies within ten years.[12] These earlier short-lived efforts were not coded for this analysis, although they might well be worthy of study in some other context.[13] [14]

b) Date of creation of initial science policy bureaucracy. These dates were obtained primarily from

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[12] As Table 2-1 indicates, all three of these countries got back into the business of making science policy after World War II and created ongoing bureaucracies for that purpose.

[13] The related problem of how to deal with countries that create science policy bureaucracies, dismantle them, but never get back into the science policy business in an ongoing way is made moot by the fact that I found no instances of this behavior.

[14] An exception to this coding rule was made in the case of the People's Republic of China which disbanded its science policy bureaucracy (along with many other state bodies) for three years during the Cultural Revolution. This discontinuity was brief compared to the 30-plus year discontinuities in the fascist states.

UNESCO's "Science Policy Studies and Documents" series.[15] Most items in that series are analyses of science policy activity in a region or UNESCO member country and usually include a brief history of science policy activity in member countries. Often countries have experienced a series of science policy-making organizations as different governments have reorganized their bureaucracies. Ambiguity about which of these might be the first science policy-making organization was resolved by deferring by the nationals of the country or region in question, who had authored these studies. This is clearly preferable to some coding that allows UNESCO bureaucrats (or other parties) to designate the first organization which qualifies as a science policy body.

A list of countries with the dates and names of their initial science policy bureaucracies can be found in Table 2-1.

Science data. Data on the number of scientists and engineers involved in research and development (SEINRD) and the amount of spending on research and development as a percentage of gross domestic product (RNDGDP) in the year science policy organizations were created were obtained from the UNESCO Statistical Yearbooks. Not all countries collect science data in all years. Less developed countries in

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[15] Other sources were used in some cases, primarily to confirm uncertainties or to resolve ambiguities in the "Science Policy Studies and Documents" account. These are noted in Table 2-1 which lists the dates of creation of initial science policy bureaucracies.

TABLE 2-1

FOUNDING DATES OF FIRST SCIENCE POLICY-MAKING BUREAUCRACIES

Country	Founding Date	Name of First Science Policy-making Bureaucracy
AFGHANISTAN	1979	National Commission for Science and Technology
*ALGERIA	1973	National Council for Scientific Research
*ARGENTINA	1958	Consejo Nacional de Investigaciones Cientificas y Técnicas
AUSTRALIA	1926	Council for Scientific and Industrial Research [a]
*AUSTRIA	1967	Austrian Research Council[1] [a]
*BANGLADESH	1977	National Council of Science and Technology
BARBADOS	1977	National Council for Science and Technology
*BELGIUM	1959	Conseil National de la Politique Scientifique
BENIN	1976	Directorate for Science and Technology Research
BOLIVIA	1977	Direccion de Ciencia y Tecnológia
BRAZIL	1951	Consejo Nacional de Investigaciones
*BULGARIA	1962	Comité d'Etat pour la Science et la Progrès Technique
BURKINA FASO	1978	Centre National de la Recherche Scientifique et Technologique
BURUNDI	1983	Direction Générale de l'Enseignement Supérieur et de la Recherche Scientifique
*CAMEROON	1965	Office National de la Recherche Scientifique et Technique
CANADA	1916	Conseil National de Recherche

CENTRAL AFRICAN REPUBLIC	1983	Conseil Supérieur de la Politique Scientifique et Technologique
*CHILE	1967	Comisión Nacional de Investigación Científica y Tecnológica
CHINA	1956	State Science Planning Commission[2]
COLOMBIA	1968	Fondo Colombiano de Investigaciones Científicas y Proyectos Especiales
*CONGO	1963	Conseil National de la Recherche Scientifique
COSTA RICA	1972	Consejo Nacional de Investigaciones Científicas y Tecnológicas
*CUBA	1974	Two bodies created simultaneously: - Consejo Nacional de Ciencia y Tecnológia - Academia de Ciencia de Cuba
CZECHOSLOVAKIA	1962	State Commission for the Development and Coordination of Science and Technology[3]
*DENMARK	1965	Danish Science Advisory Council
DOMINICA	1980	Dominica Council of Science and Technology
DOMINICAN REPUBLIC	1974	Departamento de Ciencia y Tecnológia
*ECUADOR	1979	Consejo Nacional de Ciencia y Tecnológia[4]
EGYPT	1939	Fouad I National Research Council[5]
EL SALVADOR	1962	Departamento de Ciencia y Tecnológia
ETHIOPIA	1975	Ethiopian Science and Technology Commission
*FINLAND	1963	State Science Council
*FRANCE	1953	Commission de la Recherche Scientifique et Technique[6]

*GERMANY, FRG	1962	Federal Ministry for Scientific Research
GERMANY, DR	1968	Ministry of Science and Technology
*GHANA	1958	National Research Council
*GREECE	1977	Three bodies created simultaneously: -Comité Ministériel pour la Recherche Scientifique et Technique -Conseil Consultatif pour la Recherche Scientifique et Technique -Délégation Générale à la Recherche Scientifique et Technique
GRENADA	1982	National Science and Technology Council
*GUATEMALA	1966	Consejo Nacional de Investigaciones Cientificas y Tecnicas
GUINEA	1968	Secrétariat d'Etat à la Recherche Scientifique
GUYANA	1972	National Science Research Council
HAITI	1979	Unité de Science et de Technologie Appliquées
HUNGARY	1948	Conseil Scientifique
ICELAND	1940	National Research Council [a]
*INDIA	1956	Scientific Advisory Committee[7]
INDONESIA	1962	Ministry for National Research
IRAN	1973	Center for Science Policy
*IRAQ	1963	Supreme Council for Scientific Research
*IRELAND	1967	National Science Council
ISRAEL	1949	Research Council of Israel
ITALY	1962	Ministère de la Recherche Scientifique et Technologique[8]
IVORY COAST	1971	Ministry for Scientific Research
JAMAICA	1960	Scientific Research Council

JAPAN	1919	Science and Research Council[9]
*JORDAN	1964	Jordanian Scientific Research Council
KENYA	1977	National Council on Science and Technology
*KOREA, Rep. of	1967	Ministry of Science and Technology
KOREA, Dem Rep	1961	Committee of Science and Technology of the State
LAOS	1981	Comité d'Etat des Sciences et Techniques
*LEBANON	1962	Conseil National de la Recherche Scientifique
*MADAGASCAR	1961	Comité Nationale de Recherche Scientifique et Technique
MALAWI	1974	National Research Council of Malawi
MALAYSIA	1975	National Council for Scientific Research and Development
MALI	1962	Conseil Supérieur de la Recherche
MAURITANIA	1973	Commission National de la Politique Scientifique
*MEXICO	1971	Consejo Nacional de Ciencia y Tecnológia
*MONGOLIA	1966	Research Coordination Council
MOROCCO	1959	Conseil Universitaire de la Recherche Scientifique
NEPAL	1976	National Council for Science and Technology
*NETHERLANDS	1965	Science Policy Council[10] [(a)]
NEW ZEALAND	1926	Department of Scientific and Industrial Research
NICARAGUA	1977	Dirección de Ciencia y Tecnológia
NIGER	1968	Conseil National de la Recherche Scientifique et Technique

*NIGERIA	1966	Council for Scientific and Industrial Research
NORWAY	1949	Two bodies established same year: - Joint Committee of the Research Councils - Norwegian Research Council for Science and the Humanitites [a]
*PAKISTAN	1962	National Science Council
PARAGUAY	1963	Instituto Nacional de Tecnológia y Normalizacion
PERU	1968	Consejo Nacional de Investigación
*PHILIPPINES	1958	National Science Development Board
*POLAND	1960	Committee on Technology
*PORTUGAL	1967	National Board for Scientific and Technological Research [a]
ROMANIA	1965	Counseil National de la Recherche Scientifique
RWANDA	1975	Direction de l'Enseignement Supérieur et de la Recherche Scientifique
SAUDI ARABIA	1977	Saudi Arabian National Center for Science and Technology
SENEGAL	1966	Counseil Interministériel de la Recherche Scientifique et Technique
SIERRA LEONE	1978	National Commission on Science and Technology
*SINGAPORE	1967	Science Council of Singapore
SPAIN	1958	Commission Conseil de la Recherche Scientifique et Technique
*SRI LANKA	1968	National Science Council
*SUDAN	1970	National Council for Research[11]
*SWEDEN	1962	Government Research Advisory Board [a]
SWITZERLAND	1944	Commission pour l'encouragement des Recherches Scientifiques

SYRIA	1958	Supreme Council of Sciences
TANZANIA	1972	National Scientific Research Council[12]
THAILAND	1956	National Research Council
TOGO	1965	National Institute of Scientific Research
TRINIDAD & TOBAGO	1976	National Council for Technology in Development
TUNISIA	1968	Direction de l'Enseignment Supérieur et de la Recherche Scientifique
*TURKEY	1963	Scientific and Technical Research Council
UGANDA	1970	National Research Council
UNITED KINGDOM	1915	Department of Scientific and Industrial Research
*UNITED STATES	1950	National Science Foundation[13]
URUGUAY	1961	Consejo Nacional de Investigaciones Cientificas y Tecnicas
*USSR	1961	State Committee for the Coordination of Scientific Research[14] [a]
*VENEZUELA	1967	Consejo Nacional de Investigaciones Cientificas y Tecnológicas
VIETNAM	1959	Comité d'Etat pour la Science et la Technologie
*YUGOSLAVIA	1957	Federal Council for Scientific Work
ZAIRE	1967	Office National de la Recherche et du Developpement
*ZAMBIA	1967	National Council for Scientific Research

Sources: Unesco, Science Policy Studies and Documents
OECD, Reviews of National Science Policy

* indicates was used as part of the subsample of 44 countries used in subsequent analyses.

[a] OECD, Reviews of Science Policy also used to determine founding date of initial science policy bureaucracy.

1. The Austrian Research Council was originally proposed as early as 1950, however political squabbling held up its creation for a full decade. The Council was finally established in 1960, not as an initiative of government, but of the Academy of Sciences acting with the Universities. It did not become an organ of the state, as required in this study, until 1967. See, OECD, Reviews of Science Policy: Austria.

2. This body was briefly disbanded during the Cultural Revolution, 1969-71, but was reestablished after that time. See, Unesco, Science Policy Studies and Documents no. 52.

3. A Czechoslovak National Research Council was formed in 1924 in connection with Czechoslovakia joining the International Research Council, however this was disbanded during the Second World War. See, Unesco, Science Policy Studies and Documents no. 2.

4. Unesco, Science Policy Studies and Documents no. 29, the report from the Montevideo meeting in 1971, mentions a "subcomision de ciencias" in Ecuador but gives no founding date. This body is not mentioned in any other report made by the Ecuadorans to Unesco.

5. As described in Chapter Three, this body was reorganized with Unesco's help in 1956 into the Science Council. Further changes and reorganizations are described in Unesco, Science Policy Studies and Documents no. 31.

6. As discussed in the previous chapter, the Centre National de la Recherche (estab. 1939) was and is a research institute. Its primary mission is to do research, not to make government policy.

7. Nehru set up an ad hoc advisory committee to coordinate scientific activity as early as 1948, however a formal bureaucracy was not established until 1956. See, Unesco, Science Policy Studies and Documents no.27.

8. In connection with joining the International Research Council, Italy created a National Research Council (Consiglio Nazionale delle Recerche) in 1923 however, it was disbanded prior to the outbreak of the Second World War.

9. Like so many other national research councils, this one was set up explicitly to allow Japan to participate in the activities of the International Research Council during the interwar period. I count it here as the country's first science policy-making body because, 1) it was a governmental body and 2) unlike most others, it has been followed by a continuous stream of government science bureaucracies. The Council itself survived the Second World War and was reorganized (rather than

being abolished) into the Science Council of Japan and the Scientific and Technological Administration Council in 1948. See Unesco, Science Policy Studies and Documents no. 8.

10. The Netherlands Organization for Applied Research (TNO), established 1930, and the Netherlands Organization for Pure Research (ZWO), established 1950, both predate the Science Policy Council but, according to Netherlands governmental representatives, did not have the making of government policy as a mission. For this reason they were not considered the initial science policy body in this study. See Unesco, Science Policy Studies and Documents no. 17.

11. A National Council for Scientific and Technological Research was enabled by legislation in 1968 but was never established. See, Unesco, Science Policy Studies and Documents no. 38.

12. Enabling legislation for this body was apparently passed in 1968, however funding for its establishment did not become available until 1972.

13. Many earlier bodies such as the National Research Council (1917) were funded privately, not by the state. Others, such as the Office of Scientific Research and Development (1941) were explicitly oriented toward military tasks. The National Science Foundation is consistently cited by U.S. government officials as the initial science policy-making bureaucracy in OECD and UNESCO reports.

14. The earlier body, the State Scientific-Technical Committee, was oriented toward investigating foreign science and acquiring foreign technologies rather than directing and coordinating the national science establishment. See, OECD, Science Policy in the USSR.

particular collect these data only sporadically. Where SEINRD and RNDGDP figures were not available for the year of creation, the figure for the closest year available was used. In two cases (Chile and Tanzania), research and development spending figures were unavailable; thus the RNDGDP analysis has been done on a sample of 42 rather than 44 countries.

The Statistical Yearbooks contain extensive discussion of UNESCO's data collection techniques and of its definitions of "scientist," "engineer," and "research and development" used in compiling their data. Following is a brief summary of relevant features of these data.

The data were compiled from survey forms completed by officials in member states, not by UNESCO secretariat members. "Scientists and engineers" are defined to be people who have completed tertiary level training in the relevant disciplines. "Research and development" is defined to included both fundamental (ie. "pure") and applied research activities and specifically excludes scientific training or teaching, technical information services, general-purpose data collection, and routine testing activities. Fields of activity included in these data are the natural sciences (including mathematics and computer science), engineering sciences, medical sciences, agricultural sciences, and social sciences. Since the state capacity in the social sciences is not obviously related to the theoretical arguments being testing in this study, I have subtracted these amounts of

personnel and expenditure from the total figures. "R&D expenditures" include both capital and labor expenditures in both public and private sectors. The number of scientists and engineers similarly includes personnel in both private and public sectors.

Development data. Gross domestic product per capita in constant 1980 U.S. dollars in the year the science bureaucracy was adopted (GDPCPAD) was used as a rough measure of development. These data were not readily available in constant dollars of the same base year for the relatively large span of years under study here; they had to be calculated from the International Monetary Fund's International Financial Statistics Yearbooks. Where necessary, conversions from one base year of $US to $US(1980) was made using producer price indexes found in the Statistical Abstract of the United States. Populations figures were taken from the UNESCO Statistical Yearbooks. For countries not members of the IMF, gross national product per capita figures from the U.S. Arms Control and Disarmament Agency's World Military Expenditures and Arms Trade (Washington DC: U.S. Government Printing Office) were substituted.[16]

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[16] In general, the difference between GNP and GDP is that GNP includes transactions only among national citizens, whereas GDP includes transactions conducted within the national territory regardless of the citizenship of the participants. Consequently, the two figures differ most in countries having high rates of foreign investment. For a more extended discussion see Bornischier, Chase-Dunn and Rubinson, "Cross-national Evidence of the Effects of Foreign Investment and Aid on Economic Growth and Inequality: A Survey of

Security data. Defense spending as a percentage of gross national product (DEFGNP) in the year of science policy creation was used as a measure of perceived security threat. These figures were obtained from the U.S. Arms Control and Disarmament Agency's World Military Expenditures and Arms Trade (Washington DC: U.S. Government Printing Office) when available for the necessary years. In cases where science policy organizations were created prior to 1963 (when the Arms Control Agency began collecting these data) DEFGNP figures were obtained from national statistical abstracts.

Defense spending is only a rough measure of perceived security threat since there are a host of domestic reasons why states may spend on defense, having to do with maintaining stability of governments. However, since these distortions generally increase, rather than decrease defense spending they should make us suspicious of false positive findings rather than false negatives. That is, they should increase the probability of seeing support for the domestic demand hypothesis when security from foreign threats is not, in fact, strong rather than the reverse. Thus, if the data revealed a correlation between high defense spending and creation of

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Findings and Reanalysis," American Journal of Sociology 84 (1978): 655.

However, countries who are not members of the IMF are generally East Bloc countries that are (or were) also not integrated into the world market economy. The way these countries calculate national economic activity is sufficiently different from that of other countries that the difference between GNP and GDP is largely obscured by the differences in these national accounting methods.

science policy institutions, we would want to look further at our defense figures. The fact that even with these distortions, states create science institutions at consistently low levels of defense spending supports rather than undermines societal arguments.

Coding the data

Since the dependent variable in this analysis is the year in which each state created its first science policy bureaucracy, the other variables were coded with the values obtaining in the year the science policy bureaucracy was created in that country. Thus, for the United States, the founding of the National Science Foundation in 1950 was coded as the initial appearance of a state science bureaucracy. Consequently, for the United States what was coded was the number of scientists and engineers employed in R&D jobs in 1950, the amount of R&D spending as a percentage of GDP in 1950, GDP/capita in 1950, and defense spending as a percentage of GNP in 1950.[17]

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[17] Ideally, one would have preferred to collect and analyze both cross-sectional and longitudinal data on each country, that is to collect values for science, development and security variables at three- or five-year intervals throughout the entire period for every country in the sample. Using a discrete hazard model one could then analyze the rate of change in each of these variables and its effect on the probability of a country's adopting a science policy bureaucracy at any given point in time. See Nancy Brandon Tuma and Michael T. Hannan, Social Dynamics: Models and Methods (Orlando: Academic Press, 1984) for a general discussion of these methods and David Strang's analysis of decolonization for an example of how this method can be used, albeit in a slightly different case. David Strang, "The Grammar of Sovereignty" (Ph.D. diss., Stanford University,

These data were compiled for a sample of 44 countries chosen to be globally representative in terms of both geography and development levels. The sample contains roughly 28 LDCs and 16 industrialized nations.[18] Countries in the sample are mixed geographically as follows:

8	Africa
7	Asia
7	Latin America
5	Middle East
11	West Europe
4	East Europe[19]
1	North America.

Countries used in the subsample analysis are indicated with an asterisk in Table 2-1.

The reason for using a sample of countries rather than all countries in doing this analysis was lack of data. Many states, particularly developing states, did not begin to

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Stanford, Calif., 1988.)

Unfortunately, data on many of these variables are simply not available for many countries over such a long period. Science data are rarely collected in any country for more than a few years prior to the establishment of a science policy bureaucracy. (Not surprisingly, it is usually one of the earliest missions of these bureaucracies to collect these data.) Even after these bureaucracies are created, science data are not collected frequently in many LDCs.

[18] This, perhaps generously, counts eastern European states (specifically Poland, Yugoslavia and Bulgaria) as industrialized nations and, perhaps pessimistically, counts Korea and Singapore as LDCs. One could reverse the two groups and say the ratio was 29 LDCs to 15 industrial nations.

[19] While the difference between East and West Europe seems to be disappearing rapidly in contemporary European affairs, it was still very important during the period in which these science bureaucracies were being founded. For that reason, I treat the two regions separately.

collect science data until after their science bureaucracy was created for the simple reason that the new bureaucracy was the first entity to take an interest in these data. As a consequence, science data for the year of bureaucracy creation are not available for these states. In these cases, science data do not become available until after, sometimes years after, the creation of the new bureaucracy.

Analyzing the data

Table 2-1 shows the date of creation of the first science policy bureaucracy as well as the name of that initial bureaucracy in 109 countries. States not appearing on the list either had no science policy bureaucracy as of the late 1980s, when UNESCO complied its most recent directory,[20] or did not respond to UNESCO's questionnaire for some other reason.[21]

Two things are immediately apparent from this table. First, the great majority of states, in fact, have these bureaucracies.[22] Second, the majority (roughly 70%) of them

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[20] UNESCO, World Directory of National Science and Technology Policy Making Bodies, 2nd ed., Science Policy Studies and Documents Series, no. 71 (Paris: UNESCO, 1990.)

[21] South Africa, for example, is not a member of UNESCO and so did not participate in UNESCO surveys.

[22] States that appear not to have one of these science policy bureaucracies as of the most recent directory include: Albania, Antigua and Baruda, Angola, Bahamas, Bahrain, Cape Verde Islands, Chad, Comoros, Cook Islands, Cyprus, Djibouti, Fiji, Gambia, Kampuchea, Kiribati, Kuwait, Lesotho, Liberia, Libya, Luxumbourg, Maldives, Monoco, Nauru, Oman, Papua New Guinea, Qatar, San Marino, Sao Tome and Principe, Seychelles, Suriname, Swaziland, Tonga, United Arab Emirates, the Vatican,

acquired this apparatus in a twenty year period, between the years 1955-1975. Extending the period by five years to include the years from 1976 to 1980, the percentage rises to 84.4.

This period of rapid proliferation of science policy activity is easy to see in Figures 2-1 and 2-2. Figure 2-1 shows the number of states creating these bureaucracies in five-year time periods and clearly shows the rapid rise in bureaucracy creations after 1955. Figure 2-2 simply shows the cumulative version of this process; it shows the total number of states having a science policy bureaucracy in five year periods. The steepness of the curve in the period 1955-1980 corresponds to the same period of rapid activity evident in Figure 2-1. Following 1980 the curve flattens out, creating overall the classic S-shape of curves associated with diffusion processes over time.[23] Since diffusion is an

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North and South Yemen.

[23] The classic S-curve is formed on a plot of cumulative proportion of the population adopting versus time in the following way. At time zero none or the first of the population have adopted the innovation. Adoption proceeds slowly in early time periods producing a relatively flat curve as initial instances of the innovation are established. Following these initial adoptions, is a period of rapid diffusion of the innovation in which a large percentage of the population adopts and the curve rises rapidly forming the center of the S. Eventually, a saturation stage is reached in which most of the population has already adopted the innovation. The rate of adoption slows and the curve flattens out. In different contexts, the various stages of this process have been interpreted in different ways, depending upon the nature and relationship of adopting agents. For a more complete discussion of S-curves and innovation diffusion using examples from a variety of social science contexts, see

FIGURE 2-1

Number of countries creating science bureaucracies

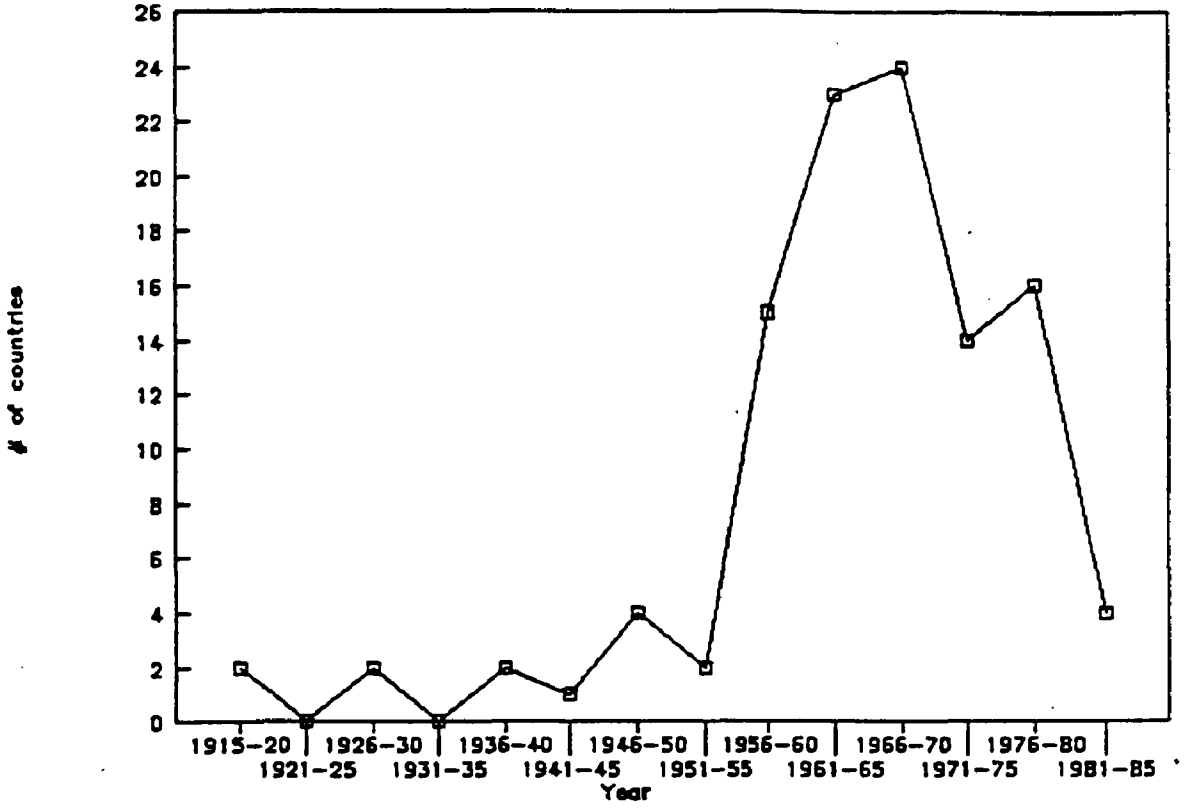
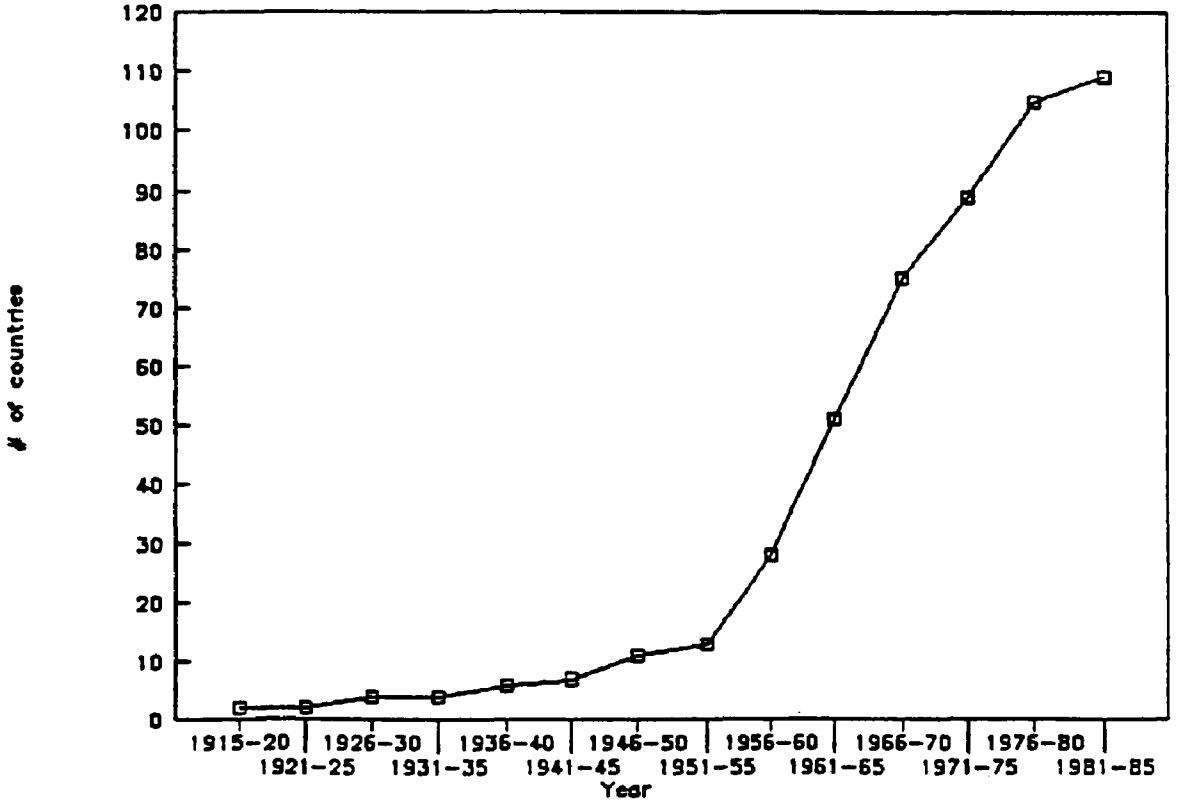


FIGURE 2-2

Total # countries having science bureaucracies



externally-prompted process (things diffuse from the outside environment or society to actors,) the S-curve of the adoption pattern alone suggests (but certainly does not confirm) a societal or external source of supply for this innovation.

Another feature of the data suggesting that some kind of contagion may be at work is the fact that members of what could be called "reference groups" of countries show some similar behaviors despite different domestic conditions. For example, the four earliest adopters of this bureaucracy are all English-speaking British Commonwealth members--the United Kingdom (1915), Canada (1916), Australia (1926) and New Zealand (1926.) Similarly, the Soviet bloc countries (with the exception of Hungary) all adopt in rapid succession, within eight years of each other. Each of these groups of countries is in close communication; each has political and/or cultural reasons to take cues from other members of the group; yet domestic conditions of each country within the group vary widely.

Moving beyond this simple data on the overall pattern of adoption of these bureaucracies, the data on science, development, and security conditions inside the subsample of 44 countries provides further insight into possible relationships between these conditions and the creation of science bureaucracies. As was discussed above, the arguments

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Lawrence A. Brown, Innovation Diffusion: A New Perspective (London: Methuen and Co., Ltd., 1981.)

claiming that internal conditions are the impetus for the creation of these science bureaucracies would all expect to see some relationship between the values of these indicators of internal conditions and the pattern of bureaucracy adoption.

These expectations could take one of two forms. First, it might be that there exists some minimum threshold level of these internal conditions below which no adoptions occur, suggesting a necessary but not sufficient condition for adoption of these bureaucracies. In other words, it might be that a country needs some critical mass of scientists or some minimum level of development or security threat in order to create the demand for the innovation but that there is variation above this level reflecting the varying levels of success demanders have in getting their demands met.

Alternatively, there might be some level of science, development or threat which acts as both necessary and sufficient condition for creation of this new bureaucracy. In this case, states would tend to adopt science bureaucracies at more or less the same level of one or more of the domestic conditions--science activity, development or security threat.[24]

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[24] One variant on these hypotheses might be that, particularly in LDCs, adoption of science bureaucracies is a response to rapid growth in one or more of these variables rather than achievement of some critical size of science or defense establishment or some critical development level. It would be interesting to test this hypothesis but unfortunately the data on science activity, particularly in LDCs, are far

The histograms in figures 2-3 through 2-6 show the range of values for each of these indicators of internal conditions at the time science policy bureaucracies were created. A quick look at these figures reveals that none of the patterns corresponds to the patterns described above. If any of these conditions were both necessary and sufficient, there were be a large cluster of adoptions on the histogram at that necessary and sufficient value. Instead, the adoptions appear to occur at a very wide range of values on all four of the variables. No single value of any variable appears likely as a necessary and sufficient condition for adoption.

In fact, countries adopt these science bureaucracies at wildly different levels of all of these domestic conditions. Some elaboration from the raw data make the extremely wide range of variation in values even clearer.

o Countries create these bureaucracies when then have as few as nine scientists employed in R&D (Congo) or as many as half a million (US, USSR.)

o Research and development spending as a percentage of GDP can range from 0.01% at the time of adoption (Bangladesh) to 1.5% (France.)

o Gross domestic product per capita in constant dollars can be anything from $118/year (Pakistan) to more than $9000 (Denmark) at the time these bureaucracies are created.

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too sketchy to allow calculation of growth rates in science activity.

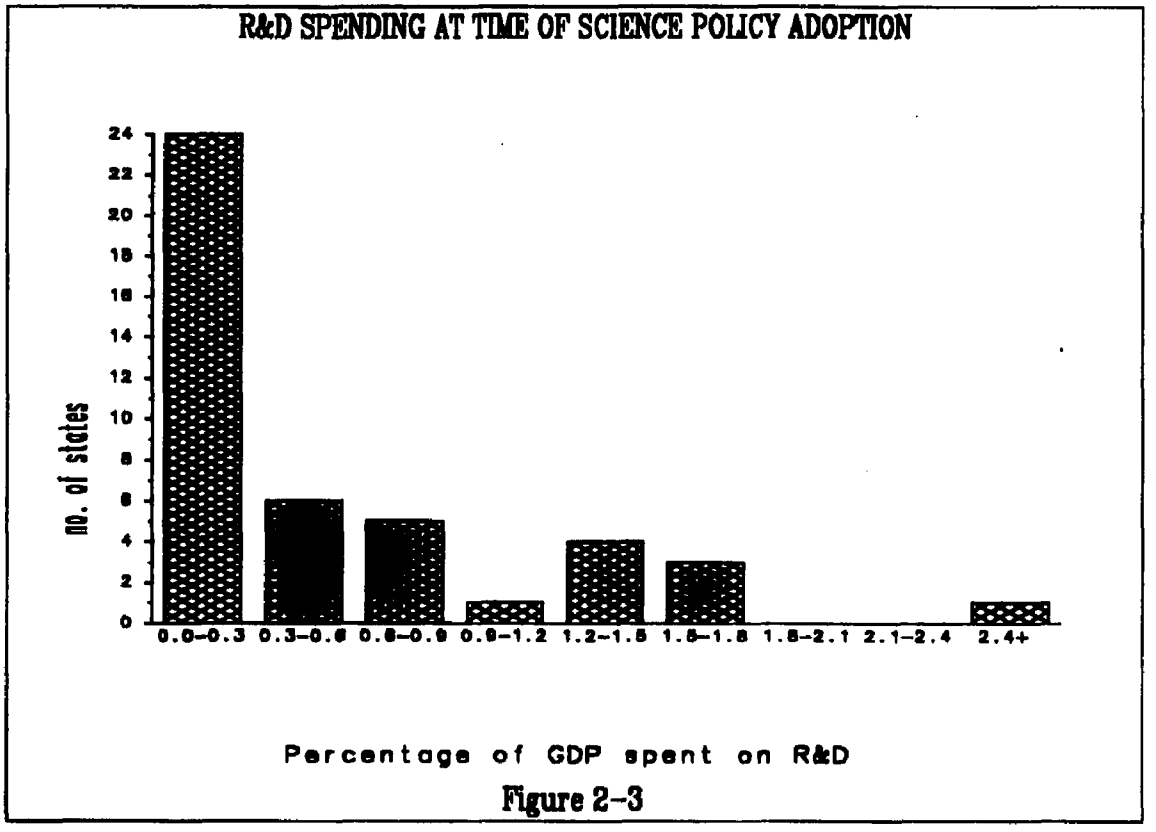

Figure 2-3

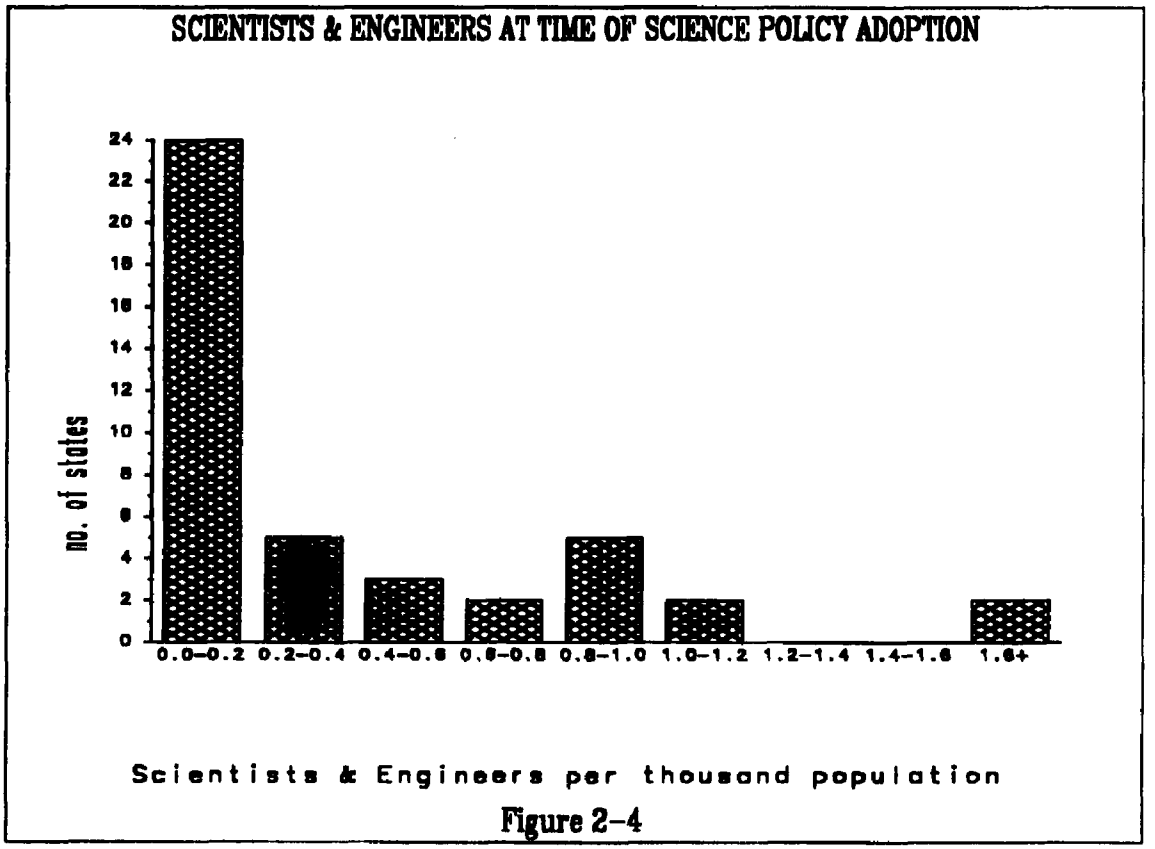

Figure 2-4

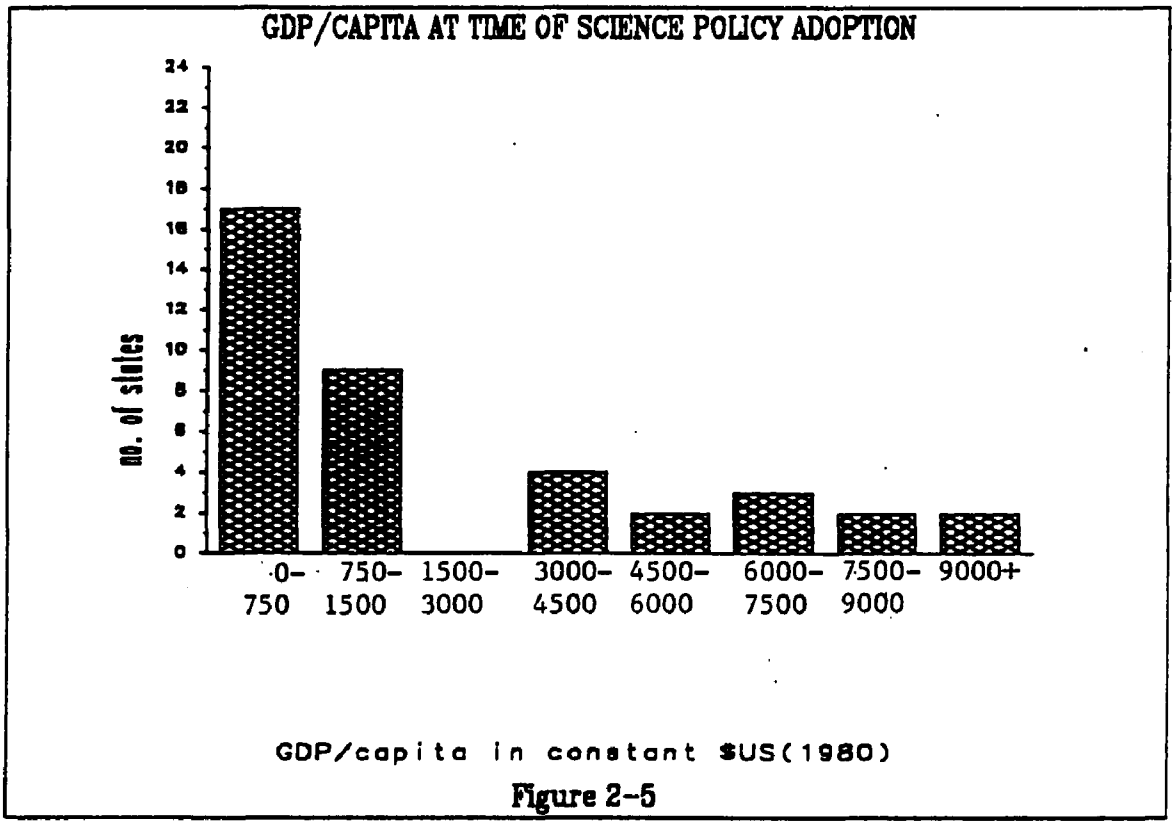

Figure 2-5

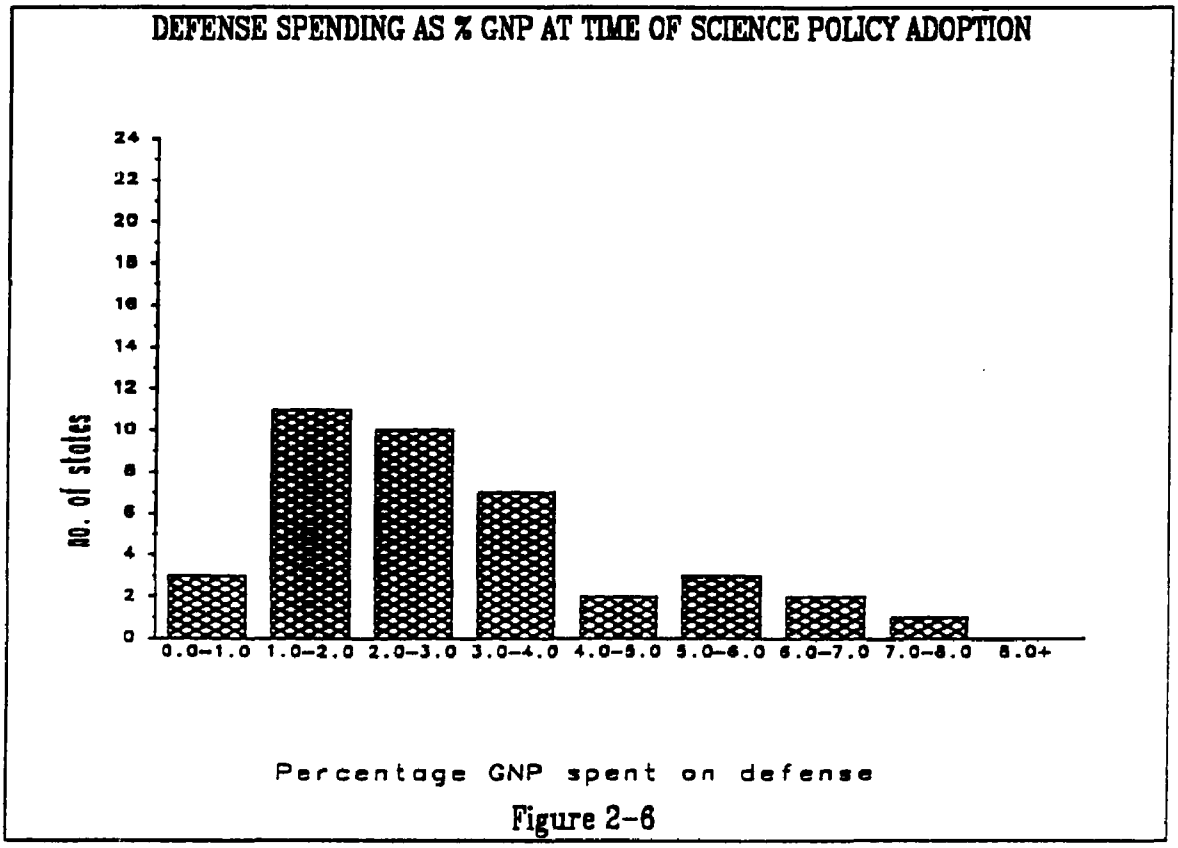

Figure 2-6

o Defense spending as a percentage of GNP can range from 0.7% (Sri Lanka, Mexico) to more than 10% at the time of adoption (France,[25] Iraq, Jordan, USSR.)[26]

The range of variation on the defense variable is more than a factor of 10; the range of variation on all of the other variables is a factor of 100 or more. Ranges of variance this large do not readily suggest any causal connection between sufficient internal conditions and the adoption of science bureaucracies.

Similarly, the histograms provide little support for the proposition that there is some minimum threshold value of these variables which triggers demand for the bureaucracy. If such a value existed, we should see very few (or no) adoptions at the low end of the value range of one or more of these variables; all values would be spread across the upper end of the range. Again, the far-flung distribution of values revealed in these figures and elaborated in the text, above, does not readily support this proposition. Rather than clustering at the upper end of these value ranges, there actually seems to be a concentration of values at the low end,

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[25] At the time it created its science policy bureaucracy (1953) France's military spending (relative to GNP) was much higher than it is now. The security aspects of the French interest in state science are described in more detail by Gilpin in France in the Age of the Scientific State and are referred to elsewhere in this dissertation.

[26] Although it was not part of this sample, Costa Rica created its science policy organization while spending 0.0% of GNP on defense.

particularly on the science variables. This is clearly not a bunching that would support the existence of a necessary and sufficient condition since the bunching in each case is accompanied by a large number of data points at the high end of each scale. Instead, it appears to be a strong negation of any necessary-but-not-sufficient condition. If arriving at some at some minimal threshold level of these variables is supposed to trigger demand for a science policy bureaucracy, that threshold must be so low as to have very little explanatory power.

Again, some elaboration from the raw data helps to illustrate this tendency to create science bureaucracies at very low levels of science, development and military threat. Guatemala, for example, created its Consejo Nacional de Investigaciones Cientificas y Tecnicas in 1966 when it reported having only 14 scientists employed in research and development jobs. It spent only 0.01% of its gross domestic product on research at that time, as compared with the roughly 1.5% being spent by countries like France, the United States and the German Federal Republic when they created their science bureaucracies. The country's low level of economic development is reflected in the fact that GDP/capita was $806 for 1966. Further, the economic base of the country was primarily agricultural, not industrial and not technology-intensive. Agricultural production 28.5% of the country's gross national product in this period; manufactured goods of

all kinds (including technologically unsophisticated manufactures) accounted for half that percentage (14.9%.)[27] The country faced no serious military threats from its neighbors or anyone else and, indeed, military spending was only 1.07% of GNP in that year.

The Congo and Cameroon were equally unlikely candidates for a science bureaucracy. The Congo created its Conseil National de la Recherche Scientifique in 1963 when it reported having only 9 scientists engaged in research and development jobs and when spending on R&D was only 0.11% of GDP. Gross domestic product per capita was only $253 that year. Total manufactures accounted for only 10.3% of the county's GNP, providing a further indication of the lack of technological sophistication of the economy. No serious military threats faced the Congo at that time, and military spending accounted for only 2.04% of GNP.

Cameroon created its Office National de la Recherche Scientifique et Technique in 1965 when it reported employing only 80 scientists in research jobs and spending only 0.16% of its gross domestic product on research. Gross domestic product per capita was $334 for that year. The country's low level of economic development is further confirmed by the fact that total manufactures accounted for only 6.1% of its GNP.

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[27] Figures on percentage of GNP accounted for by agriculture and manufactures obtained from World Bank, World Tables, 1976 (Baltimore: Johns Hopkins University Press, 1976.)

Military threats facing the country were negligible and Cameroon spent only 2.3% of GNP on defense.

A cursory glance at Table 2-1 reveals that a large number of small, poor, technologically unsophisticated and militarily unthreatened countries, like Guatemala, the Congo and Cameroon, created these bureaucracies in the 1950s and 1960s. It is this group that accounts for the clustering of data points at the low end of figures 2-1 through 2-4.

To investigate this low-end clustering a little further I examined the relationship between values on these internal conditions variables and when, in the pattern of adoption, a country created this new bureaucracy. Figures 2-7 through 2-10 plot the date of adoption of a science policy bureaucracy against each of the internal conditions variables.

From the regression line fitted through each set of points it is clear that in all four cases, the overall relationship among the two variables is negative. This overall relationship is confirmed by the negative signs on the zero-order correlations between each variable and the date of adoption variable, (which is also the slope of the regression line.) The correlation coefficient between R&D spending as a percentage of GDP (RNDGDP) and the adoption year is -0.391 (0.011); the coefficient between the number of scientists and engineers per thousand population (SEPERPOP) and the adoption year is nearly identical, -0.387 (0.001). As the histograms would suggest, the negative relationship for the defense

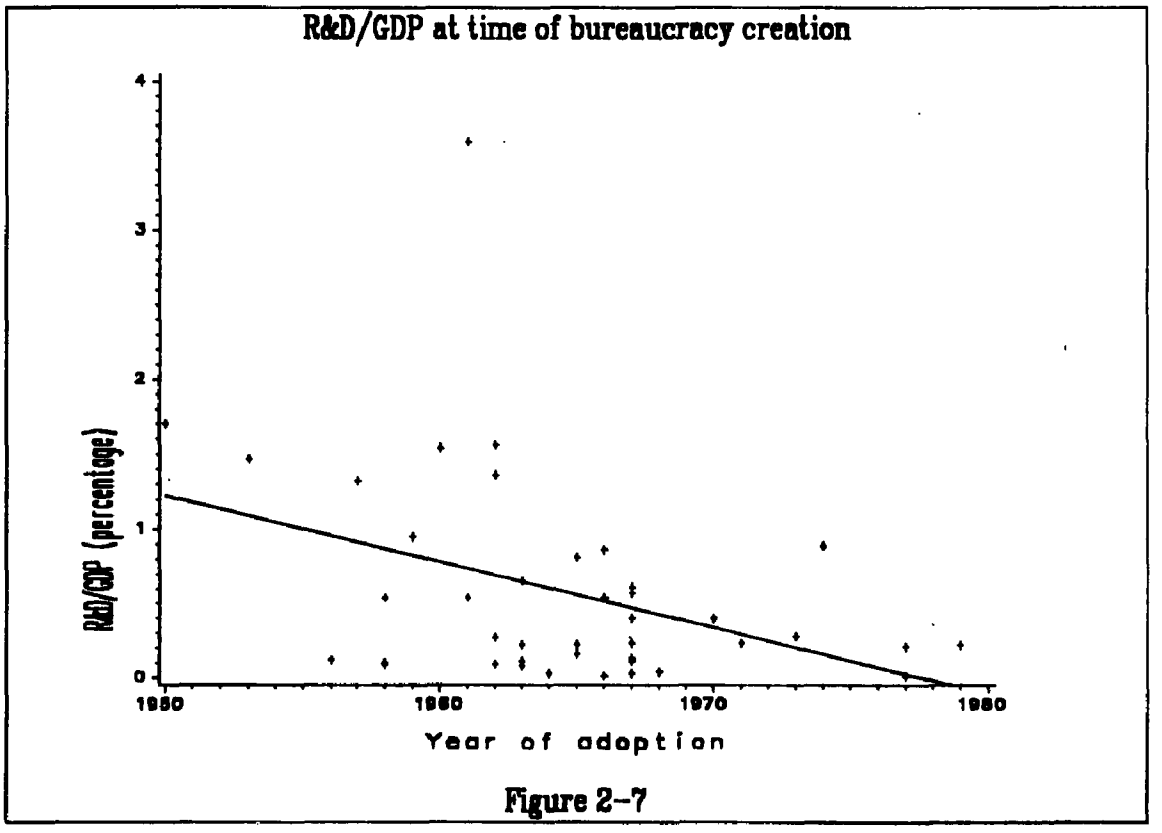

Figure 2-7

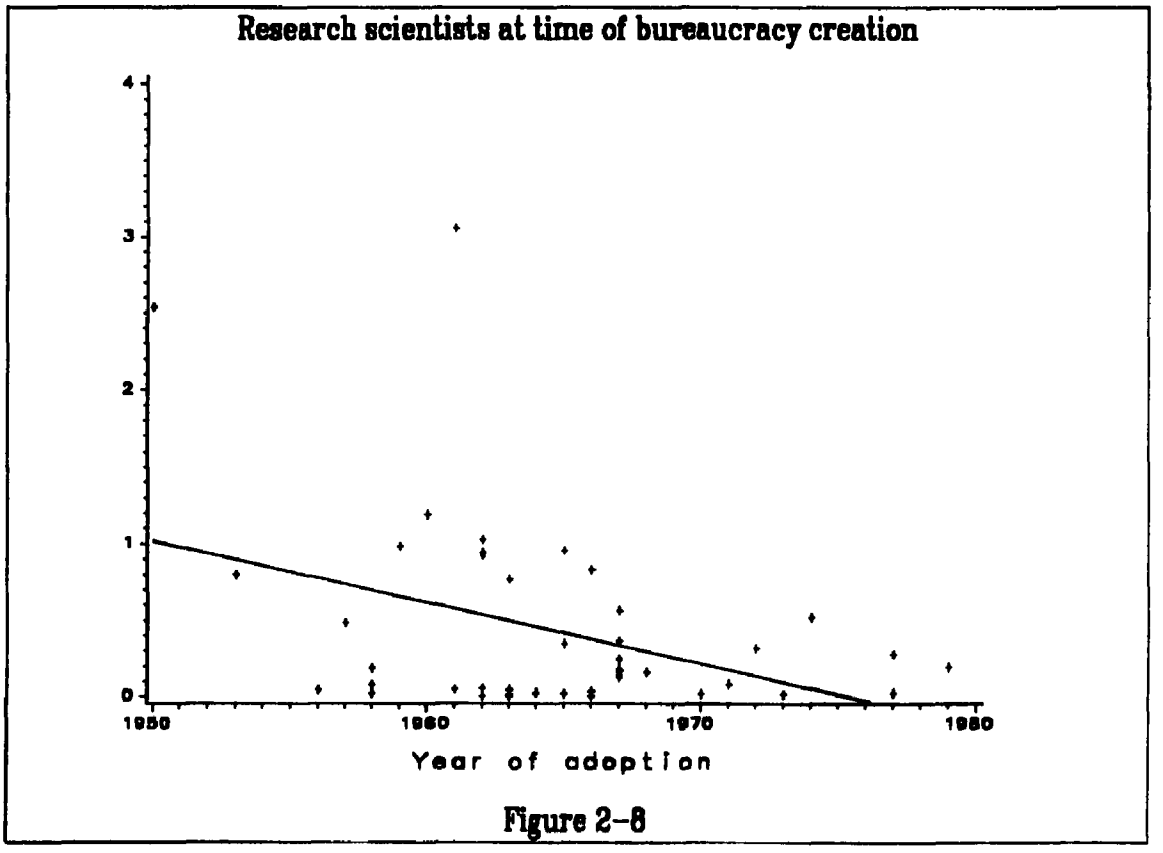

Figure 2-8

GDP/capita at time of science bureaucracy creation

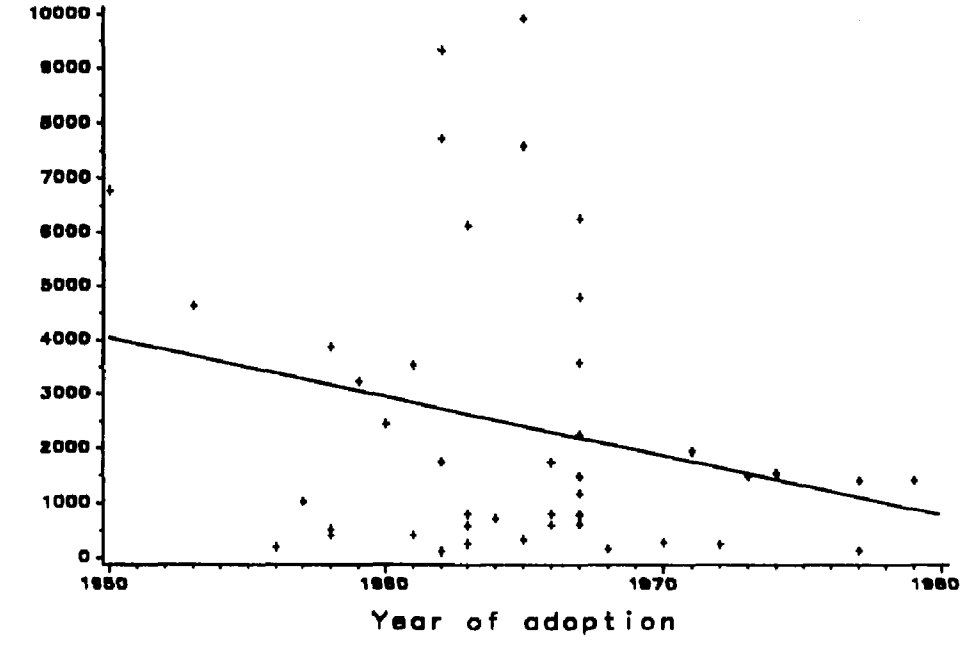

Figure 2-9

Defense spending at time of bureaucracy creation

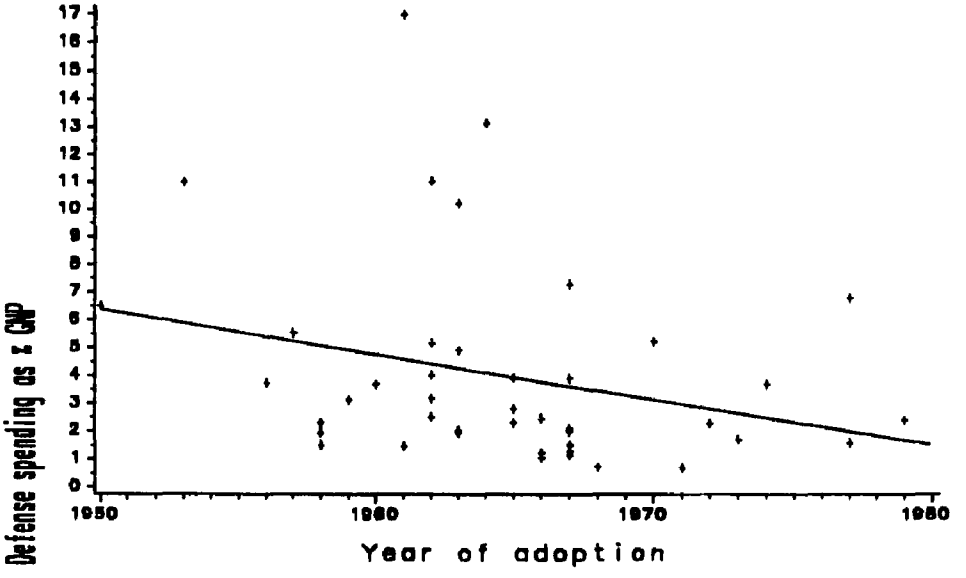

Figure 2-10

(DEFGNP) and development (GDPCPAD) variables is slightly less strong, -0.278 (0.068) and -0.248 (0.004) respectively.[28]

One cause for concern about these negative slopes in figures 2-7 through 2-10 is that the two science plots show outliers that may be exerting undue influence on the direction of the curve. The plot of R&D spending shows one extreme value of 3.59% of GDP spent on research at the time of bureaucracy adoption (the USSR); the plot of scientists and engineers shows two extreme values, one at 2.54 scientists per thousand population (the US) and another at more than 3 scientists per thousand population (again, the USSR.)

The insure that these outlier values were not driving the slope of these curve, these values were temporarily deleted from the data set and the slope curves (or correlation coefficients) were recalculated. In both cases, the negative slopes remain. The scientists correlation declines slightly to -0.250 (0.111). The R&D correlation, with the outlier deleted, actually strengthens to -0.454 (0.003).

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[28] Correlations reported are Pearson correlation coefficients as generated by the SAS statistical package. SAS's "GPLOT" procedure was also used to fit regression lines onto the scatterplots of data in figures in figures 2-7 through 2-10.

Numbers in parentheses are significance levels indicating the probability of obtaining the stated correlation coefficient from this data distribution if, in fact, there is no relationship between the two variables (ie. if the null hypothesis is true.) The fact that the significance levels are all quite low suggests that we can view these correlation coefficients with some confidence.

This apparently robust finding of negative correlation indicates that over time, states create these new organizations at lower and lower levels of all four domestic conditions. Early adopters of these bureaucracies consistently adopt at higher levels of science capacity, development and military spending than do later adopters.

Again, a look at the raw data and some individual cases sheds light on this finding. As will be discussed in more detail in Chapter Three, internal demand-driven explanations may, in fact, fit some of the earliest adopters of science policy bureaucracies. Great Britain, the first adopter, clearly created its Department of Scientific and Industrial Research in 1915 for security reasons, to counter German advances in chemicals and machinery that were directly supporting the German war effort.[29] The establishment of the National Science Foundation in the United States in 1950 was explicitly related to concerns about military and industrial competitiveness and was strongly influenced by the creation of the atomic bomb.[30] French science policy, as chronicled by Gilpin, seems to have been prompted by security and competitiveness concerns, albeit of a more general nature

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[29] Peter Alter, The Reluctant Patron: Science and the State in Britain, 1950-1920 (Oxford, Berg, 1987), 201ff. Britain is not included in the quantitative analysis above because science data for that country in 1915 are unavailable.

[30] Bush, Vannevar Science: The Endless Frontier (Washington DC: U.S. Government Printing Office, 1945); David Dickson, The New Politics of Science (New York: Pantheon Books, 1984.)

since the French seem to have been concerned about loss of "influence."[31]

But how do we explain the creation of science policy organizations in nearly 100 other states, covering the extremes of science capacity, development levels, and military situations in the subsequent twenty years? Countries as dissimilar as Bulgaria, El Salvador, Germany (Federal Republic), Indonesia, Italy, Lebanon, Mali, Pakistan, Sweden and Czechoslovakia all created their first science policy bureaucracy during the peak adoption year of 1962.[32]

It will argued below that these two phenomena, the apparent responsiveness to internal conditions in a few early-adopting states followed by a pattern of adoption uncorrelated to internal conditions, can be reconciled in the following way. Science policy bureaucracies appeared as an innovation in the international system in response to clear domestic demands in a few prominent developed countries. It was then picked up and popularized by two international organizations. During the 1950s, officials at both the OECD and UNESCO formulated and forcefully articulated new understandings of the essential role of science in social and economic development. One necessary corollary of these understandings was that the state--all states, regardless of existing science

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[31] Gilpin, France in the Age of the Scientific State.

[32] "Peak adoption year" in this case means the single year in which the largest number of states created these science policy bureaucracies.

capacity, development level, or security conditions--must take responsibility for harnessing science to contribute to these development efforts. Both organizations agreed that the appropriate way for states to do this was to create a new science bureaucracy, and both took it upon themselves to teach states how to set up (or, in a few cases, to improve) these bureaucracies.[33]

The following two chapters describe how these new understandings of the appropriate relationship between science and the state came into being in each organization and how the international experts staffing the organizations acted to spread this understanding. Since the new view of science emerges among the more industrialized countries (where these science bureaucracies are first established,) the activities of the OECD are presented first, in Chapter Three. That chapter argues that the new relationship between science and the state was formalized and institutionalized among industrialized countries as part of the more generalized

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[33] Tolbert and Zucker report a similar pattern of innovation spread in their study of the adoption of municipal civil service reforms in the United States early in this century. The key difference between their case and the one under scrutiny here is that in the science policy case, international organizations play a critical role as engines of change, actively spreading the innovation. Tolbert and Zucker's account reports no analogous mechanism for change. See, Pamela S. Tolbert and Lynne G. Zucker. "Institutional Sources of Change in the Formal Structure of Organizations: The Diffusion of Civil Service Reform, 1880-1935," Administrative Science Quarterly 28 (1983): 22-39.

enthusiasm for state planning which accompanied the Marshall Plan and the reconstruction of Europe following World War II.

Chronologically, however, UNESCO was not far behind the OECD and its predecessor, the Organization for European Economic Cooperation (OEEC), in promoting science policy-making. As a result of changes internal to UNESCO in the 1950s, UNESCO began promoting science policy bureaucracies among its members as early as 1955. Because of the much more diverse membership of UNESCO, it is in that organization's activities that we see the most striking examples of these bureaucracies being created in countries having radically different internal conditions.

Chapter Three

EARLY SCIENCE POLICY BUREAUCRACIES AND THE WORK OF THE OECD

Evidence presented in the previous chapter suggested that the global spread of science policy bureaucracies may be a two-stage process. The earliest adopters of this innovation appear, in large part, to do so at relatively high levels of the internal conditions that might prompt domestic demand for the bureaucracy; the earliest adopters all create these bureaucracies at relatively high levels of science, development and military spending. In this way, they conform with the more conventional explanations of why new state bureaucracies appear. However, following this initial wave of adoptions, subsequent adopters of science bureaucracies during the 1960s and 1970s appear to do so at much lower levels of all three of the putatively relevant internal conditions.

The argument of this dissertation is that, while these science policy bureaucracies initially appeared in the system for very conventional reasons, in response to security concerns as well as demands by technology-intensive industry and a growing science community, the subsequent spread of these bureaucracy to states showing few or none of these internal conditions was driven by a different set of concerns. After the initial creations of these bureaucracies, science policy-making became institutionalized as a necessary and

appropriate function for all states. Thus, later adopters created these bureaucracies, not in response to internal demand, but because they were taught that these bureaucracies were useful and good. Thus, their preference for this bureaucracy was supplied externally rather than springing from internal or domestic sources.

This chapter investigates the first stage of this process. It focuses on the origins of science policy-making as a state activity among its earlier adopters, most of whom are in Europe and North America. The chapter proceeds in two parts. First, since the evidence of the previous chapter gives us reason to believe that domestic demands may well be important in these early adoptions, the chapter examines some of these early-adopting countries to explore the relative importance the various demand-producing factors. The chapter then examines the way in which these industrialized nations' own organization, the Organisation for Economic Cooperation and Development (OECD) drew on the experience of these early adopters to elaborate a generalized rationale for science policy-making which it then actively disseminated it to all its members.

The chapter argues that, while it was military concerns that first focused states' attention on science, sustained interest in harnessing and directing science was fueled by economic concerns. The advent of chemical weapons of the first World War and of nuclear weapons in the second were

important catalysts for Great Powers such as Britain, France and the United States to become involved in science, but they were not critical in the evolution of state science bureaucracies in the majority of European and North American states.

What was critical was a developmentalist ideology of state-managed growth coupled with innovations in economic thinking about how this growth could be achieved. Specifically, post-war economic thinking about growth shifted from thinking about growth as the result of changing capital-labor ratios and began to incorporate some previously exogenous elements (for example, changing technologies) into economic models. In this way, science, as the mother of technology, came to be seen as a form of economic investment rather than a merely academic enterprise.

This developmentalist ideology was articulated and disseminated within the context of post-war European reconstruction, specifically within the Organization for European Economic Cooperation (OEEC.) It was within the OEEC and its successor, the Organization for Economic Cooperation and Development (OECD,) that the developmentalist goals which came out of the Marshall Plan were linked up with the new thinking about science as an economic investment. During the 1960s scientists and economists, working through the OECD, articulated and promoted the notion that coordinated and directed investments in science would yield the technological

payoffs required to achieve the very high rates of economic growth dictated by the developmentalist ideology, and they explicitly pushed for the creation of science policy-making bureaucracies as the appropriate means of carrying out this coordination and direction.

The chapter begins with brief accounts of the origins of science policy-making bureaucracies in two influential early-adopting countries--the United Kingdom and the United States. In both cases, it will be argued, the genesis of these science bureaucracies can be traced back to very straightforward demands made by domestic groups as a result of one or more of the conditions we have been considering. Ideas about science-state relations and models for organizing those relations supplied from outside these two states were of tangential importance, if they mattered at all.

The chapter then goes on to examine the emergence of another mechanism by which states were prompted to set up science bureaucracies. It examines the ways in which thinking about science and public policy changed during the 1950s in Europe, how having a science bureaucracy came to be viewed as necessary for states, and how the OEEC and OECD began "supplying" or teaching this new view to members.

The discussion of the emergence of an alternative "supply" mechanism begins with a background examination of the effects of World War II and the subsequent reconstruction of Europe on the role of science, with particular attention paid

to the emergence of rapid growth goals for states. Next, the discussion focuses on the origins and purposes of the OEEC as part of the reconstruction plan and the way in which political events redefined the OEEC's role such that promoting science policy-making as a means to growth became an important mission for the organization. The final section examines the tools used by the OEEC, and later the OECD, to convey to member states the urgency of creating a science bureaucracy to harness science and to teach member states the best and most efficient ways to run their science bureaucracies.

Genesis of Science Policy Bureaucracies in Early Adopters

United Kingdom. The British Department of Scientific and Industrial Research (DSIR) was the first state science policy-making bureaucracy founded (in 1915) that meets the criteria used in this study. Its establishment was, not surprisingly, connected to the First World War but not in the most obvious ways. The war neither gave rise to the idea of a science policy bureaucracy, which had been in circulation for some time, nor did it prompt military officials to take the lead in demanding the new bureaucracy. What the war did do was create shortages and other conditions in domestically influential and technology-intensive industries which prompted spokesmen of those industries, together with their allies in government, to press successfully for a new government body to provide scientific and technological assistance.

The notion of a governmental science body was not new in Britain when the war broke out. Suggestions for some kind of government science body had been put forward by both scientists and government officials since the late 19th century.[1] However, none of these suggests was for anything on the scale of the DSIR and none received much support until after the war broke out. Christopher Addison, then head of the Board of Education who drew up initial proposals for the DSIR was explicit in admitting that many of the ideas embodied in the proposals were not new: "men in office and people outside it have been asking for similar things for years but it has needed a war to show how right they are."[2]

What was new with the outbreak of the war was tangible evidence of Britain's technological dependence on key German manufactured goods. Suddenly a whole range of goods became unavailable to British industrialists that were essential to their operations--synthetic drugs, photographic developers,

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[1] One frequently used forum for these suggestions was the British journal, Nature.

In addition, the idea that a "Council of Science" and even a Minister of Science might be useful had come up during the Devonshire Commission's discussions in the 1870s concerning existing facilities for scientific teaching and research. Proposals for bodies similar to the DSIR were made both by Norman Lockyer, in a speech to the British Association for the Advancement of Science in 1903 and by Lord Haldane at the founding of the British Science Guild in 1905. See Peter Alter, The Reluctant Patron: Science and the State in Britain, 1850-1920 (Oxford, England: Berg, 1987), 207.

[2] As quoted in Roy McLeod and E. Kay Andrews, "The Origins of the D.S.I.R.: Reflections on Ideas and Men, 1915-1916," Public Administration 48 (1970): 27.

chemicals and optical glassware, technical and scientific apparatus, and, most important, aniline (synthetic) dyes essential to the well-entrenched British textile trade.[3]

Local manufacturers lacked the ability to fill this void. Compared with Germany, industrial research and integration of scientists into industry was still in its infancy. German industry employed approximately 4,000 chemists in 1902, 84% of whom had university of polytechnic training. British industry was only employing 1500 chemists in the same year of whom 34% were similarly qualified. These ratios had changed little by 1914.[4]

The war further aggravated this situation by created serious shortages of scientifically trained personnel available to fill this, albeit limited, number of industrial jobs. British government recruiting into the various military services was indiscriminate and did nothing to keep those with scarce technical training at work, even in industrial sectors clearly important to the military effort. Almost a quarter of the chemical and explosive industries' employees had been

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[3] Roughly 76% of the annual value of dyes used by British industry were imported from Germany. "The Government and Chemical Research," Nature 95 (13 May 1915): 295. Drawing on other sources, Peter Alter puts British domestic dye production capacity at only 20% of total use. Alter, The Reluctant Patron, 191-192. Further data can be found in Ian Varcoe, "Scientists, Government and Organized Research in Great Britain 1914-1916: The Early History of the DSIR," Minerva 8 (1970) p.192, notes 1-3.

[4] Varcoe, "Scientists, Government and Organized Research," 193-4. Varcoe gives similar evidence about the overall number of scientists being trained in each country.

allowed to enlist in the early years of the war. A similar proportion had gone from electrical engineering, and over 20% had gone from the various metal trades.[5] During the first year of the war, entire critical sectors of industry became seriously undermanned.

Awareness of these problems quickly became widespread and spurred both industrialists and government officials to action. In late 1914 and early 1915 several small-scale measures were taken to address aspects of these problems. By the end of August 1914 the Board of Trade, which of all ministries maintained the closest contacts with industry, had appointed a Chemical Products Supply Committee, comprised of scientists, civil servants and industrialists. Its job was "to consider and advise as to the best means of obtaining for the use of British industries sufficient supplied of chemical products, colours and dyestuffs of kinds hitherto largely imported from countries with which we are presently at war".[6] In the spring of 1915, the government attacked the aniline dye problem specifically by setting up a new company, British Dyes Limited, the majority of whose starting capital was provided by the Treasury. In both cases, suggestions and aid from industry, particularly from the Midland textile industries,

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[5] McLeod and Andrews, "The Origins of the D.S.I.R.," 25. Unfortunately, more detailed statistics on the levels of training of the individuals enlisting are unavailable, so precisely which employees from these industries left and what their level of technical training was is unknown.

[6] As quoted in Alter, The Reluctant Patron, 193-4.

were welcomed, and indeed actively sought, by the Board of Trade.

However, these limited measures were inadequate to address the larger structural problems of marrying industry and science that were perceived to face the nation during the war. The impetus for creating a larger, more encompassing government structure to address these problems came from the Board of Education and, particularly from one man, Christopher Addison.[7]

Addison had been a scientist, specifically a professor of anatomy at Sheffield and London, before becoming a Liberal MP in 1907. He had developed a close relationship with Lloyd George while working on the National Insurance Bill and had been instrumental in setting up the Medical Research Committee (in 1911), whose function it was to oversee and coordinate national medical research. At the time the war broke out, Addison was the parliamentary secretary to the Board of Education.

Addison's political position and connections, his scientific background, and his recent experience in establishing another governmental coordinative body (the

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[7] For more on Addison, see his diaries from this period which have been published under the title, Four and a Half Years: A Personal Diary from June 1914 to January 1919, 2 vols. (London: Hutchinson and Co., Ltd., [1934].)

The following analysis of Addison's contributions to the founding of the DSIR also draws on the accounts of his activities given in McLeod and Andrews, "Origins of the D.S.I.R." and Alter, The Reluctant Patron, 202-213.

Medical Research Committee) came together in his efforts to create a coordinating research council. Building on the work of Board of Education and filtering through existing proposals from both the scientific and industrial community, Addison put together a proposal for a "Central Advisory Committee on Research" that focused mainly on extending secondary and university science training. He submitted a preliminary draft of the proposal to Lloyd George (then chancellor of the exchequer and of the lord chancellor) and was told that its only fault was that the program was "not ambitious enough."[8]

Addison was easy to persuade on this point. His next proposal went further and added a component designed to encourage scientific research in industry by establishing Research Associations that would carry out cooperative research programs. As the proposal worked its way through the Cabinet and Parliament, a number of changes were made, most notably that new body was moved out of the Board of Education's control and allocated directly to the Privy Council.

Within a year of its establishment, and before it was fully operational, the Advisory Council was reorganized as a part of a sweeping governmental restructuring undertaken by Lloyd George when he became prime minister. As a result of Lloyd George's enthusiasm for this project, discussed earlier, the Advisory Committee was expanded into an entire

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[8] McLeod and Andrews, "Origins of the D.S.I.R.," 27.

governmental department, the Department of Scientific and Industrial Research (DSIR), in 1916.[9]

The DSIR as reorganized in 1916 had four principal functions. First, it provided science advice to the government and attempted to formulate long-term plans for national research. Second, it provided grants and long-term financial support for research projects by individuals, learned societies and universities. Third, it operated several special research institutions, among them the National Physical Laboratory and the Geological Survey. Finally, it followed through with one of Addison's initial visions; it set up autonomous research associations whose purpose was to marry science and industry and so foster industrial research. Half of the cost of these associations was borne by the DSIR; the other came from industry. By 1921 there were 21 research associations that had been created, largely on the initiative of industry.[10]

For purposes of the this study, several features of the British experience in creating the DSIR stand out. First, demands for government action to create this body were overwhelmingly made on behalf of industry and the economy. Certainly the fact that many of these industrial sectors had

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[9] Creation of an even larger Ministry of Science and Industry was also considered, although eventually rejected. Alter, The Reluctant Patron, 209.

[10] These existed in photography, scientific instruments, engine manufacturing, iron, glass, and radio technology. Alter, The Reluctant Patron, 212-213.

military significance was important. But the arguments went beyond national security and winning the war. In presenting its initial proposal for the new science body, the Board of Education's memorandum explicitly emphasized that the new state institution was not only a response to the immediate demands of war but was also intended to be a more permanent solution to long-standing industrial problems after the war.[11]

Second, the role of scientists and the formal science community in the establishment process was rather limited. The various scientific societies, the Royal Society and the Chemical Society, were not a part of the drafting of proposals and were not consulted in the amendment and reorganization process. Their role seems rather to have been to provide a backdrop and intellectual ammunition to later reformers. As noted above, Addison clearly stated that the ideas in his proposals were not new. He drew those ideas from elsewhere, many from the scientific community.

Important for this study is the fact that virtually all of those ideas were home-grown. When deliberation over the founding of the DSIR were going on, the reigning foreign model of science and scientific organization in Britain, the German model, had just been discredited by the war. As Norman Lockyer wrote in Nature in September of 1914:

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[11] Alter, The Reluctant Patron, 206.

> Many of us have been great admirers of Germany and German achievements along many lines, but we have now learned that her "culture" and admirable organisation have not been acquired for the purpose of advancing knowledge and civilisation, but, in continuation of a settled policy, they have been fostered and used in order that a military caste in Germany, with the Kaiser at its head, shall ride roughshod over Europe.[12]

The deliberations about the new science bureaucracy thus took place in a virtual void of foreign models. The British were forced to innovate.

What ultimately seems to have made the DSIR happen was the combination of these demands, against a backdrop of ideas, in the hands of a competent, energetic and well-positioned civil servant. Addison's critical contribution was to assemble a politically marketable package of proposals and then know when, where and how to launch them in the political arena.[13]

United States. While World War I also produced some science mobilization in the United States, it did not create a permanent governmental science policy structure as it did in Britain. Certainly conditions in the U.S. at that time were

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[12] As quoted in Alter, The Reluctant Patron, 199.

[13] Given the emphasis in this study on international "teaching," it is worth noting that the British began a science policy "teaching" effort of their own within the Commonwealth shortly after creating the DSIR. British officials were active in supplying both information and resources to counterparts in Australia, Canada and New Zealand so that those states could set up science bureaucracies analogous to the DSIR and participate in Commonwealth science conferences organized by the British. OECD, Reviews of National Science Policy: Australia (Paris: OECD, 1977); Alter, The Reluctant Patron 210.

quite different from those which underlay the founding of the British DSIR. Limited U.S. involvement in the war and lower U.S. trade dependence meant that U.S. industries were not faced with the kinds of shortages threatening their British counterparts. Further, industrial research was more widespread and widely used in the United States than in Britain. By 1914 a number of major U.S. firms had already established research laboratories--American Telephone and Telegraph, Eastman Kodak, Dupont, Corning Glass Works and Westinghouse. General Electric's lab, founded in 1910, even went so far as to declare its mission to be the pursuit of basic rather than applied research.[14]

Instead of the state taking action to harness science, American scientists themselves, working through the National Academy of Sciences organized a National Research Council (NRC) whose purpose would be to bring about cooperation between government, universities and industry in strengthening the national defense. However, despite cooperation with government, the NRC, like its parent organization, the Academy, remained a private and privately funded entity. Funds came primarily from the Carnegie and Rockefeller

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[14] U.S. Congress. House. Committee on Science and Technology. Task Force on Science Policy. A History of Science Policy in the United States, 1940-1985. Science Policy Study Background Report No. 1. 99th Cong., 2d sess., 1986. Serial R, p.10.

Foundations and after the war the NRC continued to be an adjunct to the Academy.[15]

These weak links to the government made it neither an effective government advisor on science nor an effective coordinating agency for the larger science community in the years following the war.[16] In large part, the scientific community, itself, was responsible for this outcome. Leaders of that community were suspicious of government involvement in science and did not want science to become dependent on federal funds. Rather than demanding government involvement in science, they actively discouraged it.[17]

Government interest in science reawakened in the 1930s when Franklin Roosevelt created the Science Advisory Board in 1933 as part of his response to the Great Depression. However, the Board received no Federal funds, working instead within the National Academy, and did not survive its initial two year authorization period. Its replacement, the National Resources Board (later renamed the National Resources Committee, later renamed the National Resources Planning

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[15] A. Hunter Dupre, Science in the Federal Government, (Cambridge: Harvard University Press and Belknap Press, 1957), 306ff.

[16] Dupre, Science in the Federal Government, ch. 17. Daniel J. Kevles, The Physicists: The History of a Scientific Community in Modern America, (New York: Alfred A. Knopf, 1978) 155ff.
U.S. Congress. Task Force on Science Policy. A History of Science Policy in the United States, 1940-1985, 11-12.

[17] Bruce Smith, American Science Policy Since World War II (Washington D.C.: The Brookings Institution, 1990), 30.

Board) was directed toward devising employment schemes rather than coordinating science broadly. Its major mission was to devise a plan for scientific work, but with the proviso that "90% of the amount expended must go to direct labor paid to persons taken from relief rolls."[18] This effectively doomed any ambition by Board members to coordinate science, and the Board did not survive the Second World War.[19]

Following these false starts, it was World War II and, more specifically, the activities of Vannevar Bush,[20] that moved the U.S. toward establishing a permanent science policy body. Over lunch at the Century Club in New York in May 1940, Bush and a small group of science notables brought together by the Carnegie Corporation devised a proposal for a National

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[18] Memorandum, F.D. Roosevelt to Secretary of the Interior, February 12, 1935; cited in Dupre, Science in the Federal Government, 357.

[19] Dupre, Science in the Federal Government, 357. For more on science activity in the 1930s see, Lewis Auerbach, "Scientists in the New Deal: A pre-war episode in the relations between science and government in the United States," Minerva 3 (1965): 457-482.

[20] Vannevar Bush was a scientist by training, having earned a doctorate in electrical engineering in 1916 from a joint Harvard/Massachusetts Institute of Technology program. He was part of the MIT faculty for twenty years before moving to Washington in 1938 to become president of the Carnegie Institution which at that time was the largest private research organization outside of a university in the country. His career in government began in 1939 when he was appointed chairman of the National Advisory Committee on Aeronautics (NACA.) For more on the ways in which this initial experience at NACA influenced Bush and, consequently, the shape of the future National Science Foundation, see Sam Bass Warner, Province of Reason (Cambridge: Harvard University Press and Belknap Press, 1984), 196-7.

Defense Research Committee (NDRC) to aid the government in the face of increasing security threats.[21] Through his friendship with Harry Hopkins,[22] Bush managed to see Roosevelt, present his proposal and quickly received presidential approval. Bush was named the organization's first chairman in June 1940.

The formal mission of new NDRC was limited in scope: it was to supplement research of the army and navy on military weapons. It quickly became apparent to Bush that this mandate was inadequate since it prohibited the organization from involving itself in production. Consequently, he succeeded in expanding the NDRC into the Office of Scientific Research and Development (OSRD) which was to coordinate all types of research, including medical and military research, under

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[21] Bush's companions at this luncheon included James B. Conant, president of Harvard University and former head of the National Resources Planning Board, Frank B. Jewett, president of the National Academy of Sciences and chairman of the board of the Bell Telephone Laboratories, Bethuel M. Webster, a New York lawyer, and Irvin Stewart, chairman of Carnegie's Committee on Scientific Aids to Learning. J. Merton England, A Patron for Pure Science: The National Science Foundation's Formative Years: 1945-1957 (Washington D.C.: The National Science Foundation, 1982) 4.

[22] J. Merton England, the official historian of the National Science Foundation, points out that this friendship seems "unlikely" since Hopkins, "the prince of New Dealers," consistently advocated social reforms abhorrent to the conservative Bush whose idol was Herbert Hoover. See, England, Patron for Pure Science, 4.

civilian direction.[23] Again, Bush was the OSRD's chief and, since the OSRD was situated within the Office of the President, Bush had direct access to the president and became his principal science advisor.

While it was clear to all involved that the OSRD would not last beyond the War, the visible contributions of science and scientists to victory as well as the growing scale of scientific research projects created a strong consensus that some kind of continuing government science body was needed.[24] Scientists had become dependent upon federal funds from research contracts let during the war to support research both inside and outside universities. Industry was already reaping benefits from wartime government-sponsored research in the areas of electronics, optics, heavy machinery and aviation, to name a few. The military had seen their efforts bolstered by technological innovations from the bomb to synthetic rubber. Thus, the post-war debate concerned, not <u>whether</u> government would make policy would make science policy, but over how it would do so and what this new science policy bureaucracy would look like.

Two camps quickly developed. The first centered around Vannevar Bush and consisted of scientific insiders, "a small

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[23] Atomic weapons research was kept separate from the NDRC and OSRD, first in Roosevelt's <u>ad hoc</u> Uranium Committee, established in 1939, and later under the Army's Manhattan Project.

[24] See, Smith, <u>American Science Policy Since World War II</u> 36ff for more on this consensus.

'inner' group closely allied with a few powerful institutions and large corporations (where most wartime research was conducted.)" A second group was more loosely arrayed around the proposals of Senator Harvey Kilgore, a populist Democrat from West Virginia, and consisted of "a larger group of scientists with interests widely spread throughout the nation and with a desire to avoid--insofar as possible--the concentration of research and the power to control it."[25]

There were two principal issues of contention between the two groups: 1) the organization of the new body, and 2) patenting policies.[26] Of these three, the organizational issues were the most contentious. Bush's proposal, contained in his widely circulated Science--The Endless Frontier[27] was motivated by a concern that scientific research be insulated from the pull and tug of politics. He therefore advocated a body controlled by a strong National Science Board made up of part-time people, eminent scientists and industrialists who were not holders of other government positions. The board

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[25] Both quotations from J. Donald Kingsley to John R. Steelman, December 31, 1946; as excerpted in Penick et al. The Politics of American Science (Cambridge: MIT Press, 1965), 121.

[26] The two also split over whether the new organization should include the social sciences. The Kilgore group was in favor; the more conservative Bush group, opposed. This discussion was less vehement than the other two, however, hence I do not discuss it here. Penick et al. The Politics of American Science, 120ff for more details on the social sciences debate.

[27] Washington D.C.: US Government Printing Office, 1945.

would appoint the organization's director, establish policy and oversee the administration of grants. The Kilgore group was suspicious of the lack of accountability in this arrangement and viewed it as an attempt by the scientific "haves" to keep the benefits of federal funding to themselves. They proposed a strong director, appointed by the president, and a National Science Board that would serve only in an advisory capacity.

Positions on patents were predictable from these political configurations. The Bush group argued that private parties should continue to be able to patent the results of research funded wholly or partly by federal money. Elimination of those patent rights would eliminate incentives to transfer the fruits of research to the production line. The Kilgore group favored a patent policy that made the results of federally funded research available to all, not patentable by individuals or corporations.[28]

The Truman administration came down on the side of the Kilgore group on most issues, but particularly on the organizational issue. Truman wanted control of the new organization to lie squarely with the President and used the Bureau of the Budget as chief advocate of this position. At hearings on the proposed legislation for the new science body,

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[28] England gives an extended discussion of these debates in A Patron for Pure Science. Penick et al. provide extended excerpts from relevant documents of the time in The Politics of American Science.

director of the Bureau of the Budget, Harold Smith, argued, "If the government is to support scientific research, it should do so through its own responsible agency, not by delegating the control of the programs and turning over the funds to any non-governmental agency."[29]

After two years of controversy and heated debate, Congress passed the National Science Foundation (NSF) Act in 1947. The bill essentially followed the Bush position. Even though he supported establishment of the Foundation, Truman vetoed the bill because of his concerns over the organizational issue. It took three more years to hammer out a compromise. The 1950 NSF legislation eventually agreed upon gave Truman the control he sought, allowing him to appoint both the NSF director and the 24 member board, with the consent of the Senate, but forced him to make concessions on other points.[30]

The U.S. experience differs in a number of ways from the British. Whereas industrial concerns were the clear motivating force behind the founding of the DSIR, they were more tangential in the American case. U.S. industry had a long tradition of developing practical applications for

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[29] As quoted in U.S. Congress, Task Force on Science Policy, A History of Science Policy in the United States, 1940-1985, 26.

[30] For example, the social sciences occupied a very peripheral place in the new Foundation. They were not elevated in status until the late 1960s.

science and, as noted above, had establish industrial research labs far earlier than their British counterparts. Rather than creating a wide-spread impression of the technological inadequacy of U.S. industry, wartime performance demonstrated the health and competence of industry. Thus, the sense of fear and gloom about industrial performance pervading the British debate was largely absent in the American debate.

The most vocal demanders of a post-war science bureaucracy in the U.S. were scientists, not industrialists. The war had created an extensive system of research contracts between the government and universities and had produced large flows of federal dollars to universities (and other kinds of research institutes) to carry out that research. Scientists quickly saw that a post-war Science Foundation was the best way to ensure the continuation of these resource flows. Certainly industry stood to benefit indirectly from this any possible applications of federally funded research, but for the scientists, this federal funding was their livelihood. The debate over the organization of the NSF was largely a debate among scientists over how that federal largess would be distributed.[31]

The American experience is similar to the British, however, in that the ideas about whether to have a science

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[31] The heavy involvement of scientists in the debate is clearly seen from the account of those debates given in England, A Patron for Pure Science, 3-106 and some of the excerpted documents in Penick et al. The Politics of American Science, 102-137.

bureaucracy and what it should look like were produced internally. While the British debate occasionally referred to and then rejected a popular foreign model of science (the German,) the American discussion is even more insular. To the extent that the designers of the National Science Foundation drew on a model, it was a domestic model; Vannevar Bush was greatly impressed with many features of the National Advisory Committee for Aeronautics when he was chairman of that body in 1939 and carried those features over both into the new science bodies he created during the war and to his proposals for the National Science Foundation.[32]

A New International Understanding of Science and the State

The United States was by no means the only country in which attitudes toward science were changed by the Second World War. During the 1950s, interest in science and involvement in the scientific establishment by governments became widespread in Europe. The reasons for this new-found interest were not primarily military, as one might guess from the fact that war was a proximate cause of their appearance. Instead, the interest in science was linked to new understandings of its connections to economic growth. New ideas about science emerged during the process of European

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[32] Bush was particularly impressed with the way in which the NACA had been insulated from political influence through the use of nongovernmental part-timers. England, Patron for Pure Science 4, 79; also Sam Bass Warner, Province of Reason, 196-7.

reconstruction immediately following the war. However, reconstruction in Europe was very much an internationalized process, marked by extensive trans-Atlantic as well as intra-European collaboration. The innovations in economic theory that elevated science to a prominent place in government policy were produced, not within individual states, but within an international organization, the Organization for European Economic Cooperation (OEEC), which was charged with coordinating much of this inter-state collaboration. The OEEC worked actively to spread these notions about science's essential contributions to economic growth to its members during the 1950s and 1960s, thus ensuring that countries creating science bureaucracies during this period would do so, not in an vacuum, but with the support of and with advice from international experts and international organizations.

This section begins with a brief examination of the effects of the war on militaries and argues that these effects were limited to a small number of countries and even there effected only a small part of the science establishment and state bureaucracy. Following is an examination of an alternative avenue whereby science could and did gain a place on the policy agenda of states, through its contribution to post-war reconstruction, particularly its contributions to achievement of the unprecedented growth goals states set for themselves during that process. The chapter examines the way in which political events redefined the OEEC role, from the

engine of integration envisioned by the Americans to a more much more narrowly focused role as purveyor-of-aid and technical advisor. Once focused on the more technical problems of growth, OEEC staff members identified science and technological issues as essential components of growth and began articulating the notions about science as an "investment" and a "national resource" that led to establishment of science bureaucracies. Finally, the chapter looks at the ways in which the OEEC and later the OECD worked to "teach" states, both that they needed science bureaucracies if they were to create growth and what, precisely, those bureaucracies should look like.

Effects of the war on science in militaries. The Second World War was a watershed in science-state relations in several ways. Its most obvious effects were on militaries. Scientists and the new technologies they helped to develop were critical components of the Allied war effort. The development of radar in the Battle of Britain and the work of Cambridge University scientists and mathematicians in breaking Nazi codes established the importance of military applications of science early on in the war.

However, it was the spectacular demonstration of the power of nuclear weapons at Hiroshima that brought science to the attention of state decision-makers in a way no other event has, before or since. The fact that scientists could create such a weapon brought new respect for the power of science in

political and military circles. Perhaps more important, the event was a demonstration of the ability of the state to control and direct science. The first atomic weapon was not, after all, a product of academic science. The Manhattan Project was an unprecedented collaboration between scientists and politicians at the highest levels of government in which the latter (together with the military), not the former, who directed the show. Government set the agenda, outlined the task for scientists and provided the resources for research. It was able to harness science for a clearly specified and vital task as never before.

The advent of atomic weapons focused the attention of militaries on science, particularly the militaries of Great Powers having global interests and aspirations. The British, French, Soviet and American defense establishments all moved quickly to duplicate and expand the capabilities demonstrated at Hiroshima and Nagasaki. All constructed government laboratories, let research contracts to universities or hired scientists away from universities as part of new nuclear defense programs in which science would be the central focus.

While these rather spectacular military applications of science caught world-wide attention, they do not explain the sweeping shift toward state-directed science and science policy-making documented in earlier chapters. These large state-run scientific enterprises were designed to meet specifically military goals. Consequently, they focused

narrowly on a few scientific specialties, notably nuclear and high-energy physics, and directed the efforts of those scientists toward problems of uranium processing and nuclear fission. Los Alamos, the first of the federal weapons labs, was occupied solely with building uranium weapons like the ones dropped on Japan. The operation at Oak Ridge was dedicated to uranium processing, ie. extracting U238 from U235 at a reasonable price. Lawrence Livermore was built with the mission of constructing the hydrogen bomb. Thus, these labs were not general research facilities. They were directed to harness specific sectors of the state's science community for national defense. They did not attempt to direct science for the national good in any broader sense; they did not make science policy.[33]

Further, these large state science establishments existed in only a few countries. They became prominent in the United States, Britain, France and the Soviet Union and absorbed significant portions of the scientific research efforts in those countries. However, they do little to explain the post-war interest in science policy-making that overtook the rest of Europe, including those countries lacking large defense establishments such as Belgium, the Netherlands, Switzerland, Sweden, Norway and Denmark. It will be recalled that the data

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[33] Michael B. Stoff et al. eds., The Manhattan Project: A Documentary Introduction to the Atomic Age (Philadelphia: Temple University Press, 1991;) also Stephane Groueff, Manhattan Project: The Untold Story of the Making of the Atomic Bomb (Boston: Little, Brown and Co., 1967.)

presented earlier indicate that these countries created science policy bureaucracies very shortly after their Great Power neighbors but did so in the absence of high levels of military spending. Indeed, these countries have consistently avoided militarization in the twentieth century, yet they quickly jumped on the science policy bandwagon.

The post-war military interest in science was too compartmentalized in the military apparatus of the state and too localized among Great Powers to explain a world-wide move toward science policy-making. The move toward science policy after World War II came instead from the economic side, specifically from the reconstruction of Europe. As will be discussed in the next section, that monumental economic reconstruction effort redefined the role and goals of states in ways that made state involvement in science both legitimate and necessary.

Reconstruction and "Growthsmanship." The importance of European reconstruction is most often discussed in terms of the material changes it produced. European economies achieved and maintained unprecedented rates of economic growth in the years immediately following the war. The aggregate gross national product of Western Europe as a whole, measured in constant prices, was more than two and a half times higher in 1963 than it had been in 1938. The index number for Western European industrial production (with 1958 as 100) rose from about 50 on the eve of the war to roughly 130 in 1963.

Compound annual growth rates in gross domestic product from 1948 to 1963 averaged 4.5% for Western European countries; rates of growth of output per head of population averaged roughly 3.6%. Value of European exports rose from an index of 40 in 1948 to 138 in 1962 (1958=100.)[34] Europe not only avoided a 1930s-style depression; it achieved American-style prosperity in less than two decades.

But what was remarkable and unprecedented about post-war European recovery was not the material change in conditions itself, but the new policies and goals that lay behind that material success. What distinguishes the post-war era from other periods of economic history is the extent to which this economic growth was orchestrated and planned. In all European countries economic growth became a primary goal of state economic policy and common expectation of European publics. States began to engage in what Postan has called "growthsmanship."[35]

State intervention in the economy was nothing new. Interventionist policies had been legitimated and widely adopted prior to the War as a result of the Depression and the subsequent Keynesian revolution. But growth-oriented policies

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[34] M.M. Postan, An Economic History of Western Europe, 1945-1964 (London: Methuen & Co., Ltd. 1967), 11. Average figures for Gross Domestic Product, output growth per capita and value of exports calculated from tables 1, 2 and 9 respectively.

[35] Postan, Economic History of Western Europe. The subsequent analysis and the term "growthsmanship" draws on this work.

of the post-war recovery went beyond Keynesianism. Keynes' General Theory provided only a recipe for full employment; its policies did not promise or even predict continuous growth of national income. What Keynesianism did do was legitimate state activism in the economic arena. It created large state apparatuses designed to intervene in the economy. That machinery then got put to other growth-promoting uses in the post-war period.

If the means to carry out growth-oriented policies had their roots in Keynesianism, the goals of rapid growth came primarily from the Americans. The U.S. transmitted these goals in at least two ways. One was simple example. Close contact with Americans during the wartime alliance and postwar reconstruction made Europeans painfully aware of the immense productivity achieved by American industry during the war and of the abundance and wealth this industrial machine was able to bring to average U.S. citizens in the post-war era. European publics became increasingly aware of this elevated American standard of living with the invasion of U.S. popular culture in the 1940s and 1950s and responded with expectations that their own governments provide them with similar amenities of life.

The other means of promoting growth were more consciously crafted. This popular pressure for emulation of American economic success was strongly and directly supported by U.S. government policy. U.S. use of what Charles Maier has called

the "politics of productivity" to achieve its own foreign policy goals has been amply documented elsewhere.[36] While these scholars disagree over some aspects of interpretation, the outline of the story they tell is clear and well-known.

At the close of the war, U.S. policy-makers identified two problems as paramount for post-war American foreign policy. First, the U.S. needed to eliminate the sources of animosities within Europe once and for all. They were keenly aware of their failings on this score after World War I and were determined not to make the same mistake again. Second, the U.S. needed to defend itself and the rest of the West against the growing power and apparently aggressive intentions of the Soviet Union.[37]

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[36] Charles S. Maier, "The Politics of Productivity: Foundations of American International Economic Policy after World War II," in Between Power and Plenty: Foreign Economic Policies of Advanced Industrial States, ed. Peter J. Katzenstein, (Madison: University of Wisconsin Press, 1978), 23-49. Also, Alan S. Milward, The Reconstruction of Western Europe, 1945-1951 (London: Methuen and Co. Ltd., 1984); Michael Hogan, The Marshall Plan: America, Britain, and the Reconstruction of Western Europe, 1947-1952 (Cambridge: Cambridge University Press, 1987); M.M. Postan. An Economic History of Western Europe, 1945-1964.

[37] Whether Soviet intentions were actually aggressive or simply defensive is, of course, the subject of much debate. See, inter alia, [Kennen, George.] The Sources of Soviet Conduct. Foreign Affairs 25 (1947): 566-582; Arthur Schlesinger, Jr. "Origins of the Cold War." Foreign Affairs 46 (1967): 22-52; Walter LeFeber, America, Russia and the Cold War (New York: Wiley, 1980); John Lewis Gaddis, Strategies of Containment (Oxford: Oxford University Press, 1982); Deborah Welch Larson, Origins of Containment: A Psychological Explanation (Princeton: Princeton University Press, 1985.)

Conveniently, there was one policy that served both ends and that was promotion of the rapid economic recovery of Europe to be achieved through economic integration.[38] Prosperity would mute many divisive political issues in Europe. Most important, it would deprive class conflict of its fuel and replace it with a consensus on growth.[39] But to achieve this growth the Europeans had to cooperate. The individual national markets within Europe were too small to achieve the economies of scale necessary for successful competition with the United States. Following the old logic of customs union theory, Americans reasoned that European states should reduce tariffs and barriers to factor movements creating one integrated European economy. The economic efficiencies and productivity achieved in this way would quell domestic dissent, keeping Europe firmly in the capitalist

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[38] The degree to which political integration was also envisioned at this early stage is a matter of dispute. The Americans were certainly interested in political as well as economic reconstruction. After all, the wartime regimes, not just in Germany and Italy, but also in occupied France, had been eliminated and needed to be replaced. But a politically unified Europe was not a goal articulated or pursued by American policy-makers in the 1940s. Efforts instead focused on using economic ties to bind politically distinct states. See Milward, The Reconstruction of Western Europe, chs. 2-5.

[39] Both Maier and Hogan argue that this policy used in post-war Europe of submerging struggles over shares in the pursuit of overall prosperity has distinctly American roots. Maier traces it to the New Deal. Hogan places its origins further back, with Herbert Hoover's associationalism. Both agree, though, that the notion that political problems (struggles over relative gains) could be transformed into economic ones (the need to increase output) was an American creation that was transplanted to Europe after 1945. Maier, "Politics of Productivity;" Hogan, The Marshall Plan.

fold, while the economic, political and social interdependencies created would banish the specter of inter-European aggression.[40] Economics thus came to be seen as the best defense, both against Communism and against the inter-European squabbling that had dragged Americans into two costly wars.[41]

The American-sponsored European Recovery Program was specifically designed carry out this policy and meet these goals. It did not offer aid to individual European states. Rather, its architects required that the aid recipient be a group of cooperating European states. Indeed, this was the only significant requirement for aid articulated in George Marshall's Harvard commencement speech.[42] This decision, to

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[40] Burying the hatchet permanently between Germany and France was of particular concern in constructing these plans since their continuing animosity accounted for much of the continental bloodshed in modern times. This history, together with the size of these states, guaranteed them a special place in the post-war reconstruction plans.

[41] More comprehensive treatments of the political motivations for the Marshall Plan, including the very powerful domestic reasons for it, can be found in Jones 1955; Hogan 1987; and Gaddis 1982. Indeed, the political usefulness of this plan probably had more to do with its popularity than the economic reasoning on which it was based. For a critical analysis of whether European integration would actually promote world-wide multilateralism, see Charles P. Kindleberger, "European Economic Integration" in Money, Trade and Economic Growth: Essays in Honor of John Henry Williams (New York: The Macmillan Company, 1951), 58-75. See also, Milward, The Reconstruction of Western Europe, 58-60.

[42] Milward, The Reconstruction of Western Europe, 56. The full quotation from Marshall's speech is as follows: "It is already evident that, before the United States government can proceed much further in its efforts to alleviate the situation and help start the European world on

provide aid only on a multilateral basis through a European organization, was consequential to the subsequent path of European recovery but not always in the ways the Americans intended.

International organizations as agents of economic reconstruction. The American plans for providing aid to western Europe as an integrated bloc rather than to individual countries were met with something less than great enthusiasm by the Europeans.[43] The French were deeply unhappy that the coordinated reconstruction project put aid to Allies under the same umbrella as aid to Germany and voiced suspicions about a British-American agreement to revive German industry. The British Foreign Secretary, Ernest Bevin, complained that the scheme meant that Britain would now be "just another European country." Without special aid from the Americans, Britain

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its way to recovery, there must be some agreement among the countries of Europe as to the requirements of the situation and the part those countries themselves will take in order to give proper effect to whatever action might be undertaken by this government. It would be neither fitting nor efficacious for the government to undertake to draw up unilaterally a program designed to place Europe on its feet economically. This is the business of the Europeans. The initiative, I think, must come from Europe. The role of this country should consist of friendly aid in the drafting of a European program and of later support of such a program so far as it may be practical for us to do so. The program should be a joint one, agreed to by a number of, if not all, European nations." George C. Marshall, "Address at Harvard Commencement, 5 June 1947." In Present at the Creation: The Fortieth Anniversary of the Marshall Plan, ed. Armand Clesse and Archie C. Epps (New York: Ballinger, 1990), xviii.

[43] Much of the following discussion of the European response to American reconstruction plans is based on Milward, The Reconstruction of Western Europe, ch.2.

would be unable to play her accustomed special role in Europe and would be unable to discharge her responsibilities in Germany. The plan, Bevin claimed, would deprive the British of the "little bit of dignity we have left."[44] Neither country at this stage was particularly interested in surrendering any significant portion of the sovereignty they had so recently saved at so high a cost to American visions of an integrated Europe.

Despite these concerns, both the British and French desperately needed the assistance being offered. Their response, therefore, was to seize the initiative in creating the new European organization requested by the Americans. By taking control from the outset, they hoped to blunt the force of American interference and turn the organization into something less threatening to both British and French aims in Europe.[45] To this end, Bevin and the French Foreign Minister, Georges Bidault, met in Paris immediately after Marshall's speech and hammered out the basic structure of what

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[44] Both quotes from Milward, The Reconstruction of Western Europe, 62-3.

[45] It is not clear that this Anglo-French collaboration was based on any clear alternative vision of what the future Europe should look like beyond the fact that it should be strongly influenced by the two most powerful European states, ie. themselves.

was to become the Organization for European Economic Cooperation (OEEC.)[46]

The Anglo-French structure proposed by Bevin and Bidault for both the Paris organizing conference and for the organization itself was rested on two principles. First, the collaborative work of the organization was to be carried out in a collection of "technical committees" whose responsibilities would be limited to specialized problems such as working out the details of Europe's dollar deficit and dealing with production problems in the areas of transportation, energy, food and agriculture, and iron and steel. Compartmentalizing recovery work into these narrow technical committees eliminated any forum in which wider issues of European integration (which interested the Americans) could be discussed. In this way, the British and French managed to turn the American penchant for tabling politics in favor of technical problems of production to their advantage.

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[46] The publicized purpose of this initial meeting was to consider the terms on which an invitation to join the cooperative venture might be offered to the Soviet Union. Certainly this was discussed, but lack of interest in Soviet participation on all sides made resolution of this issue fairly straightforward. The greater part of the two day meeting was spent structuring plans for the grand European conference from which the new organization would emerge to mutual British and French satisfaction. One historian sums up the transparency of the meeting this way: "Had Mr. Bevin travelled to Paris with a staff of experts to talk with M. Bidault for two days so that they could send and invitation to Mr. Molotov to join them?" D. Wightman, Economic Cooperation in Europe (London: Stevens, 1956), 34.

The second significant feature of the Anglo-French structure was that these technical committees were to be overseen by a much smaller executive committee which would coordinate the whole and liaise with the Americans. This executive committee was designed to ensure Anglo-French control. It consisted of five members, two of which were Britain and France. The third, chosen by Britain and France, was the Netherlands which could be counted upon to show reluctance concerning American plans for rapid reconstruction of Germany at (as they perceived it) the expense of the European Allies.[47] Despite repeated attempts and some cosmetic changes, the U.S. was never able to break the Anglo-French hold on the organization nor was it able to persuade these or any other European states to accept its vision of political and economic integration.[48]

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[47] The fourth member was Italy, at the Americans' insistence since they believed Italy would be sympathetic to U.S. policy aims. The fifth was Norway.

[48] To the extent that the OEEC contributed to the creation of the European Economic Community, it did so only in a negative sense; it united European states in rejection of the grand-scale (and high-risk) framework for integration that would be sponsored and supervised by the U.S. Initial moves toward integration and supra-nationalism would instead come through much smaller-scale and lower risk ventures, such as European Coal and Steel Committee. That these ventures grew out of the narrowly defined technical committees of the OEEC, initially thought to be politically innocuous, is ironic.

See Milward, The Reconstruction of Western Europe, chs 2 and 5 for an extended analysis of ways in which the U.S. and the Europeans used the Committee of European Economic Cooperation (CEEC) and its successor, the OEEC, to further their own policy aims and how this conflict influenced the organization.

This created the rather ironic situation that the OEEC, which was demanded by the Americans so that they could submerge European political issues in technical issues of productivity, was instead captured by the Europeans who used it to submerge trans-Atlantic politics (and the American domination they feared) in the technical issues of productivity. Thus, the Europeans turned the American tool of integration on its head; it became a mask behind which Europeans could placate the Americans and sidestep pressures for integration.

Science and the OEEC

Early "technical assistance" from the OEEC. The failure of the OEEC as an engine of integration left the organization, with its staff of more than 1000, focused solely on the technical committees dealing with problems of economic coordination and production. However, the connection between these problems and science was not immediately made. Attacks on problems of reconstruction and production instead began with something called "technical assistance," provided by the United States to Europe. This was not technology transfer as we now know it. Instead of teaching Europeans applications of scientific knowledge to industrial problems, this early technical assistance program was designed to stimulate "greater efficiency in [European] industrial production" through the introduction of American production techniques, styles of business organization and labor-management

partnership.[49] Thus, it was techniques of organization and management, not technology, that were transferred.

These technical assistance programs were first introduced by the Anglo-American Council on Productivity, a nongovernmental body of British and American industry and trade-union representatives, and were aimed at transferring information to Britain only. Following their lead, the Economic Co-operation Administration or ECA (the U.S. agency set up to administer reconstruction operations under the Marshall Plan) organized a technical assistance program in 1948 designed to disseminate American industrial know-how more broadly across Europe.[50] Less than a year later, productivity promotion in this form moved across the Atlantic and was incorporated into the OEEC.

In early 1949 the OEEC set up its Working Party No. 3 on scientific and technical information. The mission of the group was to assess the potential contribution of new technological information to the process of re-equipping European industry. The Working Party concluded, however, that at that particular period of European reconstruction, when capital was so very scarce, scientific research and even technical innovation had little to offer in the immediate

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[49] Hogan, The Marshall Plan, 142.

[50] Hogan provides a more detailed analysis of the corporatist nature of these assistance policies and the corporatist American vision that underlay them. Hogan, The Marshall Plan, 142ff.

future. Instead, the Working Party reached conclusions similar to those of the ECA and Productivity Council--that what was needed were new forms of industrial organization, rather than new technologies. "Scientific" forms of management were considered to be more valuable than either science or technology, themselves.[51]

It was through the Working Party that what came to be known as the "productivity movement" began to take hold. Initially, the group sponsored a number of productivity studies, initiated discussions on productivity measurement in particular industrial sectors, and sent international productivity teams to visit the U.S. to learn from American industry. Within a year, however, the Working Party began taking steps to give its productivity concerns a firmer base. First, through the OEEC Council, it recommended that constituent governments establish national productivity centers in each country. Further, it secured U.S. funds to support these centers, and finally, it succeeded in creating in 1953 (again with U.S. funds) the European Productivity Agency (EPA) as an organ of the OEEC. In this way,

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[51] Alexander King, "Science in the OECD," in Ministers Talk About Science: A Summary and Review of the First Ministerial Meeting on Science, October 1963, ed. Emmanuel Mesthene, (Paris: OECD, 1965), 17-24.

productivity promotion became institutionalized in all Member countries.[52]

Despite the initial emphasis on improving techniques of industrial management, the Working Group (which later came to be known as the OEEC Committee,) the European Productivity Agency and the various national centers did maintain an interest in scientific research. The OEEC did sponsor three Technical Missions as early as 1951 to undertake studies of applied research in the U.S., Canada, Europe and did recommend formulation of national research policies by member states.[53]

In addition, the OEEC Committee sponsored a special Committee for Applied Research (CAR) until the creation of OECD in 1961. Since scientific research was considered of long-term significance and so of limited use in solving

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[52] King, "Science in the OECD."

The officially-stated task of the European Productivity Agency was "to stimulate productivity, and thereby raise European standards of living, by influencing not only Governments but also industrial, agricultural and research organisations, private and collective enterprises and public services. One of its primary aims is to convince management and workers alike of the benefits of productivity and to enlist their cooperation." OEEC, The Organisation of Applied Research in Europe: Proceedings of the Conference held at Nancy, 11th-13th October, 1954 (Paris: OEEC, 1955), frontispiece. Science and scientific research was thus only a small part of its mandate and area of concern.

[53] There were also two follow-on conferences to these missions, one in London in 1951 and another in Nancy in 1954. The latter was sponsored by the then-functioning European Productivity Agency. See OEEC, The Organisation of Applied Research in Europe, the United States and Canada,: Report of Technical Assistance Missions Nos. 81-82-83 (Paris: OEEC, 1954); Alexander King, Science and Policy: The International Stimulus (Oxford: Oxford University Press, 1974.)

pressing short-term problems (compared to organizational means of improving productivity), CAR remained a small and somewhat neglected part of the OEEC. On meager resources CAR did, however, manage to encourage a number of programs designed to serve the European science research community. For example, it oversaw publication of the "European Technological Digests" in many languages. It also established a European Translation Center aimed specifically at making research results from behind the Iron Curtain available to researchers in Western Europe. But, in keeping with the general OEEC perspective on science, the CAR spent as much of its energy on problems of how research was administered and organized as it did on the content of that research.[54]

Changes in economic theory. Interest in science research per se arose in the OEEC as part of the shift in economic thinking about the sources of productivity and the nature of investment. During the 1950s and the process of European recovery, thinking of economists and policy makers about the means to productivity began to shift. Prior to the war, the causes of economic growth were understood in terms of capital-to-labor ratios, and capital was conceived of in rather narrow terms--as fixed machinery and other tangible production inputs. However, during the 1950s economic theory about the

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[54] King, "Science in the OECD."

nature of capital and capital investment shifted to include a much broader range of intangibles.[55]

Until the 1950s, economic theory had largely ignored the technological and social framework in which economic activities occur. Changes in that framework were regarded as exogenous, and their influence was eliminated from explicit consideration by the traditional assumption of "other things being equal." However studies of the kinds of changes that were taking place in the post-war economies were increasingly revealing that these economic models left out as "residual" much, if not most, of what was causing change.[56]

Chief among these intangibles were education and technology. Both of these came to be seen as essential factor inputs for industry and funding of these came to be justified increasingly in terms of economic payoff. Terms like "human capital" and "R&D investments" came into common usage. Further, both of these were seen as factor inputs that could

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[55] Christopher Freeman, Raymond Poignant, and Ingvar Svennilson, "Science, Economic Growth and Government Policy," in Ministers Talk About Science: A Summary and Review of the First Ministerial Meeting on Science, October 1963, ed. Emmanuel G. Mesthene (Paris: OECD, 1965), 95-119.

[56] Freeman et al. elaborate as follows: "Most attempts to assess the influence of changes in the principal factors of production on economic growth in mature industrial countries show that the rise in capital/labor ratios accounts for only a small part of the long-term increase in productivity, while the traditionally exogenous variables, usually grouped together under the heading of 'technical progress,' account for up to 90 per cent of increases in real product per person employed." Freeman et al. "Science, Economic Growth and Government Policy," 96.

and should be manipulated by the state for national benefit. Once it was accepted that social and technological context were essential to growth, questions about what shaped social and technological context led quickly to the state. State responsibility for education in Europe was longstanding and the strength of the nation's technological establishment was directly related to the education system, specifically to universities (which are mostly state institutions in Europe) and the numbers of scientists and researchers being produced by those universities.

Obviously, education and research were not completely distinct types of "investments." Much of the interest in the 1950s was in educating more researchers and scientists and it was in this context that the OEEC began to rethink its approach to science. A number of member countries were experiencing grave shortfalls of qualified scientists, engineers and researchers in their domestic labor markets,[57] raising fears that the traditional European education systems might not be able to produce enough of these to meet the demands of the emerging technology-intensive world economy.[58]

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[57] OEEC studies documented these shortages and confirmed that they would get worse rather than better absent some change in policy. See, OEEC, The Problem of Scientific and Technical Manpower in Western Europe, Canada and the United States (Paris: OEEC, 1957) and OEEC, Scientific Manpower for Applied Research (Paris: OEEC, 1957.)

[58] In Wilgress' 1960 report to the OEEC on this problem, described below, he discusses the shortcoming of traditionalism in European education explicitly. "[European] educational systems are...better fitted for turning out people

OEEC science activities. In response to these fears, the OEEC Council created another Working Party (No.25 by this time) on Scientific and Technical Personnel to look into these issues. On the recommendation of this group, a semi-autonomous Office of Scientific and Technical Personnel (OSTP) was set up. To achieve its goal of increasing both the numbers and quality of scientific personnel in each country the OSTP adopted methods similar to those used by the OEEC in its more general reviews of economic policies of member states. A team of OSTP examiners would assemble data on the education structure and policies of each country and produce an evaluation. This in turn would lead to a "confrontation session" between the examiners, representatives of the country under examination, and senior educators and scientists from other participating countries, in which policy changes were discussed.[59]

The actions of the OEEC and the OSTP obviously were not the only moves toward educational reform in this period. They were part of a much larger movement in educational economics that refined the concept that educational expenditure was an

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trained in the liberal arts than in science and technology....In the social sphere there still prevails in Europe a prejudice against those who work with their hands...[T]he application of the results of science suffers throughout Europe from the lack of that fondness for working with one's hands which has become so characteristic of the present generation of North Americans." Dana Wilgress, Cooperation in Scientific and Technical Research (Paris: OEEC, 1960), 14-15.

[59] King, "Science in the OECD," 20-21.

item of national investment in economic growth. This attitude was widely accepted at the Educational Policy Conference held in Washington DC in 1961. At that meeting, senior officials concerned with education and finance from various countries discussed ways in which education policies and education planning could be linked with long-term economic and social goals. The following year, at a meeting in Rome, ministers of education from the European countries unanimously accepted this investment policy approach to education and established an OECD Educational Investment Program to meet the needs of member countries.[60]

These moves in the area of education were quickly followed by action in the area of science. In 1959 the Secretary-General of the OEEC commissioned Dana Wilgress, the former Canadian Ambassador to OEEC and NATO, to undertake a study of the scientific organization and of the major problems related to science in each of the member states. Specifically, Wilgress was directed:

> 1. To discuss with Government authorities as well as with senior representatives of national administrations, science and industry, measures already taken or planned to intensify the scientific and technical resources of each Member country.
> 2. To make those in high authority aware of the importance which scientific research and technological development is likely to have on the future economy.
> 3. To propose measures on the national or international level to increase technological

[60] King, "Science in the OECD," 22.

resources and to favour the establishment of common action for more rational use.[61]

The first and foremost recommendation of Wilgress' report was that each nation should draw up a national science policy.[62] It emphasized and elaborated the growing view of science as a form of national investment and identified a number of ways in which the OEEC could and should lead states toward productive science promotion and policy-making.

The ideas articulated and widely disseminated by Wilgress in his report were, for the most part, neither unique to him nor new. Throughout the 1950s a small group of Europeans had been working on ways to integrate science into government policy-making in more systematic ways. In different ways these men found their way into association with the OEEC, and later the OECD, during the late 1950s and early 1960s and together shaped the way the organization viewed science and science policy-making.

Perhaps the most important of these was Alexander King.[63] As the Chief Scientific Officer at the British Department of Scientific and Industrial Research from 1950 through 1956, King was an early promoter of international

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[61] Wilgress, Cooperation in Scientific Research, 10.

[62] Wilgress, Cooperation in Scientific Research, 24, 26.

[63] A physical chemist by training, King had served during the war, first as Deputy Scientific Advisory to the British Ministry of Production, then as Scientific Attache and head of the U.K. Scientific Office in Washington. When the war ended he moved back to London as the head of the Lord President's Scientific Secretariat (1947-50) before joining the DSIR.

collaboration, and specifically inter-European collaboration, in scientific research both for its own sake and as an aid to industry and economic growth.[64] He was involved with the British delegation proposal to the OEEC in 1949 that a working party be established on scientific and technical information. This working party later became the OEEC Committee of the Organization for Productivity, which later became the European Productivity Agency.

King maintained his connections with the European Productivity Agency, serving as Chairman of its Productivity and Applied Research Committee, and in 1956 became the Agency's deputy director. During this period he began emphasizing the importance of action by national governments, supporting and coordinating research in their own science establishments as an essential component of increasing productivity.[65]

The other two figures of importance to OEEC and OECD activities in this period were Pierre Auger and Pierre

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[64] For example see, Alexander King "International Scientific Co-operation: Its Possibilities and Limitations" Impact of Science on Society 4 (1953): 189-220.

[65] Alexander King, "Science and the Changing Face of Industry: The Social Phase." Impact of Science on Society 7 (March 1956): 3-33.

Note that international collaboration, which King has been espousing as the critical route to productivity only a few years earlier, had been eclipsed in King's thinking by 1955-56 by national level government action. As will be discussed later, this shift from international to national level science was occurring at very nearly the same time in UNESCO. See Chapter Four.

Piganiol. Auger, a member of the faculty of sciences at the University of Paris was commissioned by UNESCO to write a report summarizing the state of scientific research internationally at very nearly the same time Wilgress was compiling his report for the OEEC. Auger's report, entitled Current Trends in Scientific Research,[66] articulated many findings and suggestions similar to those of Wilgress. Most important Auger, like Wilgress, made establishing national science policies the first recommendation coming out of his report.[67] Piganiol, chief scientist in the French government, had been a promoter of centralized and coordinated science establishments, such as the French were creating in the 1950s and had argued that such a system should be widely applied to other states in Europe.[68]

These men came together in the early 1960s when the OEEC was reorganized into the OECD and a Directorate of Scientific Affairs was created. King was named head of the Directorate and was given, as his first major assignment, the task of

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[66] Paris, UNESCO, 1961.

[67] Pierre Auger, Current Trends in Scientific Research (Paris: UNESCO, 1961), 220. The Auger report is obviously important in UNESCO's activities in science policy and will be discussed in more detail in Chapter Four, below.

[68] See Pierre Piganiol and Louis Villecourt, Pour une politique scientifique (Paris: Flammarion, 1963) for the most comprehensive statement of Piganiol's views.

As Chief Scientist in the French government, Piganiol was almost certainly consulted by both Wilgress and Auger during the preparation of their reports, and so may well have shared his views with them. Auger explicitly notes France as one of the countries consulted in his research.

organizing the an ad hoc Advisory Group on Science Policy. He asked Piganiol to serve as the Group's chairman and hired Auger as a consultant. With these men in charge, a strong focus on national science policy-making was assured within the new OECD.

The OECD and science

During the 1950s what began as an organization for economic cooperation generally took on a more specific goal as popular pressures, political convenience and changes in economic thinking made rapid growth, rather than mere cooperation, the goal of European states. This new growth orientation was enshrined in the new name of the Organization when it was restructured in 1961: the Organization for European Economic Cooperation became the Organization for Economic Cooperation and Development.[69] The word was soon followed by the deed: one of the first actions taken by the reorganized OECD's Ministerial Council was to set a collective target of 50% growth in gross national product for all member countries by 1970.[70]

Seizing control of these newly-identified social and technological contributors to growth was one of the cornerstones of this massive growth effort. Following the

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[69] As part of this reorganization, membership in the organization was expanded to include non-European states such as the United States, Canada and Japan.

[70] OECD, Science, Economic Growth and Government Policy (Paris: OECD, 1963), 9.

recommendations of the Wilgress report, the OECD Secretary-General appointed an ad hoc Advisory Group on Science Policy.[71] Their report, Science and the Policies of Governments,[72] elaborated still further on the Wilgress report recommendations that countries needed to formulate an overall science policy in much the same way that they formulated economic policy. The Group's principal advice for OECD action to the Secretary-General was that he should call a meeting at the Ministerial level of all member countries to discuss how they could best formulate such science policies.[73]

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[71] In addition to Piganiol, the chairman, members of the Group were: Professor Karl Herz (Germany), Sir Wilis Jackson (UK), M. Robert Major (Norway), Professor Lucien Massart (Belgium), Professor Norman F. Ramsey (United States), M. Erik Ib Schmidt (Denmark), Professor Theodore William Schultz (United States), Dr. Edgar W.R. Steacie (Canada.)

[72] (Paris: OECD, 1963.)

[73] While the main thrust of the Scientific Affairs Directorate's activities was to ensure establishment of science policy bodies within the executive branches of the various member states (as it did through the Ad Hoc Group,) its activities were not limited to this. In 1961, the Scientific Affairs Directorate, together with the Council of Europe and the British Parliamentary and Scientific Committee co-sponsored a European Parliamentary and Scientific Conference in London whose aim was to establish permanent contacts between parliaments and the scientific community, modeled on the British example. A second conference was held in Vienna in 1964. For reports on the conferences see, British Parliamentary and Scientific Committee, et al. European Parliamentary and Scientific Conference (Strasbourg and Paris: OECD 1961;) Council of Europe et al. Science and Parliament: Second Parliamentary and Scientific Conference (Paris: OECD 1965.)

The result was the first OECD Ministerial Meeting on Science, held in Paris in October 1963.[74] The first agenda item for this meeting was the discussion of national science policy-making. There was early consensus at the meeting that a high-level government institution was needed in all countries to coordinate and direct science activities. The bulk of the discussion was over details and logistics--how these new institutions would be integrated into existing governmental structures, how much control they should have over various aspects of governmental funding for scientific research, the importance of these bodies as collectors of information and statistics about national science activity. In addition, the conference agreed on the value of an international forum for discussion of science policy issues and problems.[75]

At the same time that this ministerial meeting was being organized, the OECD's Committee on Scientific Research (CAR) was beginning a series of country-by-county reviews of the organization of scientific research, analogous to the reviews

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[74] This meeting is extensively documented in E. Mesthene (ed.), Ministers Talk about Science (Paris: OECD, 1963.) Mesthene was the Rapporteur General of the ad hoc Advisory Group.

[75] At this initial meeting "[t]he representatives of Germany, Italy, and Spain among others pointedly sought the advice of their colleagues from other countries in the resolution of their domestic science-policy problems, and thus testified to the potential value they saw in meetings such as the one at which they were assembled on this occasion." Mesthene, Ministers talk about Science, 127.

of national economic policy and national scientific manpower undertaken by other arms of the OECD. The procedure for these was that each country would designate a National Liaison Officer who would draft the report based on a standard set of questions drawn up by the CAR, in this case questions concerning "Mechanisms for the nation's science policy," "Government responsibility for research," "Central bodies for research" and the like. Following the now standard OECD procedure, these reports were reviewed by OECD science officials and then discussed with relevant members of the nation's science establishment in a "confrontation session" during which recommendations for policy changes would be drawn up for consideration by the home government.

By 1969 these science policy reviews of this kind had been carried out in Sweden, Greece, Belgium, France, Britain, Germany, Japan, the United States, the Soviet Union, Italy and Canada. Obviously, in many of these cases, science policy bodies had already been created at the time of the review. In these cases, the purpose of the review was to "improve" existing science policy establishments by bringing them more into line with the OECD's vision of what science policy should look like.

These general notions of a "proper" science policy establishment should look like were laid out in a number of early documents published by the OECD as handbooks and "do-it-yourself" manuals intended to guide members in making policy

about science. One example, and perhaps the earliest one, is Science and the Policies of Governments,[76] the report submitted by the Secretary-General's ad hoc committee on science (and referred to, above.) This was one of the first documents to be published by the OECD on the subject of science and lays out a number of fairly specific measures states should take. These recommendations center on the creation of a "Science and Policy Office." This office was not to be composed exclusively of scientists, but was also to include economists, industrialists, educators and public officials "to insure the breadth necessary to its effective operation is represented on its staff."[77] This requirement sprang directly from the OECD view of science as an economic investment, and of science policy as part of a much larger economic development plan or program.[78] Further, the report specified and OECD continued to promote the notion that the science policy body should have jurisdiction over military, space and atomic research programs and technology. Health and medical research was also to be included in under this new coordinating umbrella organization.[79] Finally, and in

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[76] (Paris: OECD, 1963.)

[77] As reprinted in Mesthene, Ministers Talk About Science, appendix 2, p.169.

[78] "Ministerial Meeting on Science," OECD Observer 7 (Dec. 1963), 41.

[79] OECD, Science and the Policies of Governments (OECD: Paris, 1963), 37-38.

keeping with the economic motivation behind OECD science activities, these science bureaucracies were to oversee applied, as well as basic or "pure," research.[80] These were contentious issues in several countries where separate bureaucratic entities existed to look after these areas, the United States among them.[81]

Both these ministerial meetings and the reviews of national science became regularized OECD activities. There was a second Ministerial meeting in 1966, a third in 1968 and a fourth in 1971. The reviews of national scientific research

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[80] Later documents expanded on many of these understandings as to the appropriate or best way of structuring science policy bureaucracies. See, for example, OECD, Fundamental Research and the Policies of Governments (OECD: Paris, 1966;) OECD, Government and Technological Innovation (OECD: Paris, 1966;) OECD, Government and Allocation of Resources to Science (OECD: Paris, 1966;) OECD, Problems of Science Policy: Seminar held at Jouy-en-Josas (France), 19-25 February, 1967 (OECD: Paris, 1967;) and OECD, Analytical Methods in Government Science Policy (OECD: Paris, 1972.)

It is worth noting that the Science and Policy Office outlined by the OECD in this early document differs in character from the national science policy-making bodies promoted by UNESCO on at least one important point. The OECD explicitly recommends that states set these bureaucracies up "without official line authority in the government structure. Only a high standing in the governmental hierarchy coupled with the calibre and prestige of its members can give such an advisory body...the degree of influence necessary to be effective." OECD, Science and the Policies of Governments, 36. UNESCO, by contrast, actively pushed its members to integrate these new science bodies directly into the government structure so that they would have access to the highest levels of government. See Chapter Four, below.

[81] The decentralization of the U.S. science policy apparatus was particularly disturbing to the OECD examiners, all Europeans. OECD, Reviews of National Science Policy: United States (Paris: OECD, 1968): 357-361, 451-456.

were soon retitled "Review of National Science Policy." They were updated frequently, if not regularly, by the OECD Directorate for Scientific Affairs and continue to be carried out and published today. With the exception of Turkey, all OECD member countries have now been reviewed, many more than once, as have at least two non-OECD countries--the USSR and Switzerland.[82]

The effect of these activities was both a proliferation of national science policy bodies in states not previously having them and an expansion and/or reorganization of science bureaucracies in the few states that did. When OECD held its initial 1963 Ministerial meeting, only four of the twenty-two participating countries had ministerial representatives

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[82] I am aware of the OECD science policy reviews for countries in the indicated years: Australia (1977, 1986): Austria (1971, 1988); Belgium (1965); Canada (1969); Denmark (1988); Finland (1987); France (1966); Finland (1987); Federal Republic of Germany (1967); Greece (1984); Iceland (1972, 1983); Ireland (1974); Italy (1969); Japan (1967); the Netherlands (1973, 1987); Norway (1971, 1985); Portugal (1986); Spain (1971); Sweden (1964, 1987); the United Kingdom (1967); and the United States (1968.) Yugoslavia has associate member status in the OECD and was reviewed by the science directorate in 1976 and 1989. The Soviet Union's science policy review took place in 1969; Switzerland was reviewed in 1971 and 1989.

specifically for science policy.[83] By 1968, when the third ministerial meeting took place, virtually all did.

In states already having science bureaucracies in this period, there was expansion and refinement. For example, the British began reorganizing the DSIR in 1964, creating separate organizations for basic and applied sciences (another frequent point of discussion as OECD meetings.)[84] Similarly, the U.S. expanded both the budget and mandate of its National Science Foundation during the 1960s to allow it to direct more resources to applied, rather than just basic, research.[85]

Conclusions

The reconstruction process following World War II had the effect of focusing the attention of all European countries simultaneous and collectively on problems of economic growth. One outcome of this collective reconstruction process was the identification of science as an essential ingredient in economic growth and the adoption of science policy promotion

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[83] These were Belgium, France, the United Kingdom, and the United States. It should be noted that a number of other countries had already begun to lay groundwork for establishment of a science policy apparatus, notably Germany and Sweden. Alexander King, Science and Policy: The International Stimulus (Oxford: Oxford University Press, 1974); Jarlath Royane, Science in Government (London: Edward Arnold, 1984.)

[84] Ros Herman, The European Scientific Community (Harlow, England: Longman Press, 1986) 69-71.

[85] England, A Patron for Pure Science. Smith, American Science Policy Since World War II, 73-90.

by the collective entity responsible for coordinating reconstruction, the OEEC (later OECD.)

In the early days of postwar recovery, the relationship between scientific research and rising GNP was viewed as distant. Converting scientific discoveries into industrially applicable technologies was viewed as a long and uncertain process, and being on the technological cutting edge was perceived as a luxury that war-torn economies would have to postpone. Further, finance ministers and economic planners lacked the tools to assess the contribution of technology to growth. Science and the technological changes it created were not incorporated into economic models of the day.

But by the mid 1950s both of these perceptions were being challenged. The rate of growth in scientific knowledge and attendant technological change during this period was immense, and the interval between scientific breakthrough and industrial application greatly reduced. At the same time, or perhaps as a consequence, economic theory began to incorporate these changes into models of growth. Technology came to be seen as a form of economic capital and science, which produced technology, a form of investment. Judicious investment in science was thus, in the new economic thinking, a means to growth.

This new understanding about science as economic investment was most strongly articulated, if not always invented, by the staff members of the OECD Directorate of

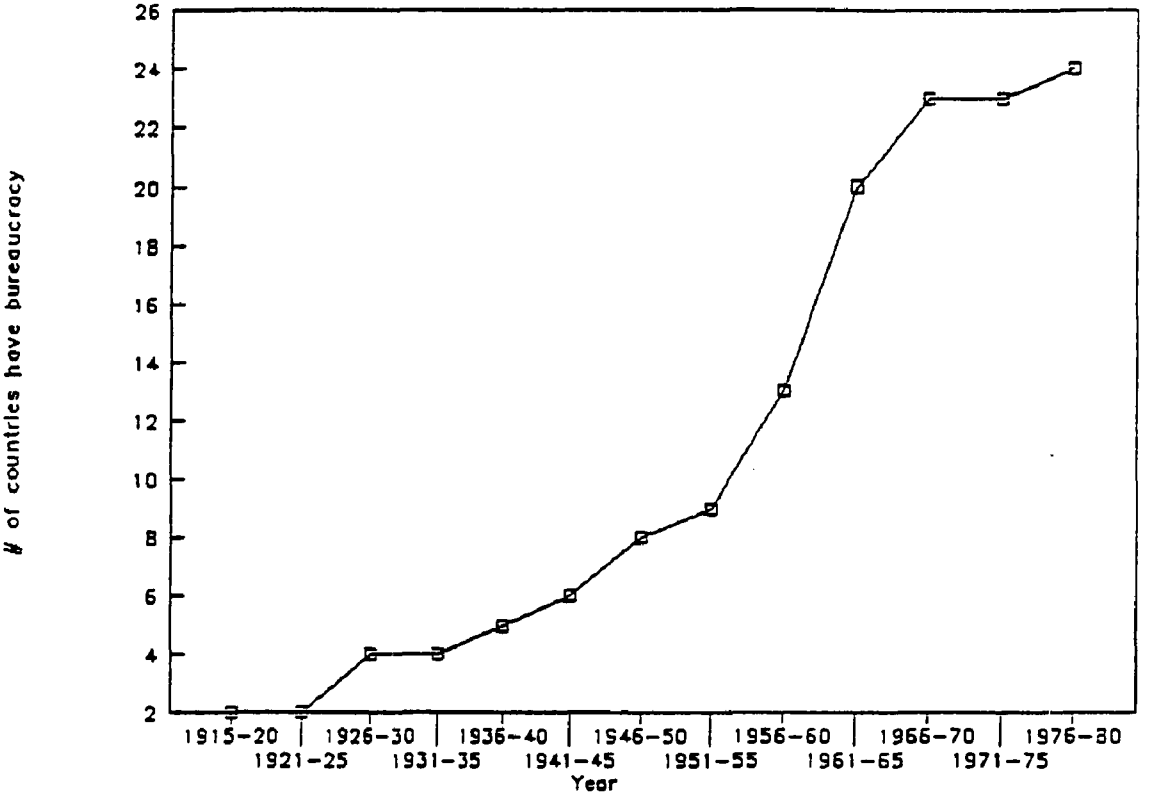
Scientific Affairs. Relegated by the failure of integration to a role as technical advisor to member states, promotion of science policy fit squarely within the now rather narrow mandate of the organization. Armed with this new set of understandings about science's relationship to development OECD staff members set out to bring the new science policy gospel to the attention of national policy-makers. In the wake of the meetings and national reviews organized by these international experts, national-level science policy activity increased markedly in the 1960s as the various OECD countries established or reorganized and expanded science policy bureaucracies. The results can be seen clearly in Figure 3-1 which shows that the proliferation of science bureaucracies in the OECD subsample follows the classic S-shaped diffusion pattern. The S-curve suggests that the observations are not simply independent. Rather, it indicates a contagion effect at work in the sample, a contagion spread, it is argued here, by the OECD.

OECD activities thus help provide some explain for concentration of adoptions of science bureaucracies in the 1960s in Europe, but they obviously do not explain the global pattern. Going back to our original analysis in Chapter Two, this change in the way science was treated in OECD countries does not appear so anomalous from a conventional, demand-centered perspective. The OECD countries are, after all, precisely the states one would expect to begin harnessing

Figure 3-1

Creation of Science Bureaucracies

OECD countries only



science first. They are the states in which most of the world's science activity takes place as well as being the states with the highest overall levels of economic development. Adherents to the more conventional explanations for state expansion might allow that OECD activities influenced the timing of adoptions in some instances, but they would expect these countries to be ripe for a science bureaucracy without OECD interference.

What is unexpected in the Chapter Two data from a conventional or demand-driven perspective is the way in which non-OECD countries, LDCs with very low levels of economic development and very little science activity, create these bureaucracies at very nearly the same time as the OECD countries. Chapter Four investigates an analogous process whereby this may be explained. While the OECD Scientific Affairs Directorate was "teaching" its members about science policy, the Natural Sciences Department of UNESCO was doing very much the same thing for <u>its</u> members. Because UNESCO's membership includes <u>both</u> industrialized states and LDCs, UNESCO was a place where notions about the role of science in economic growth originating among the first world states could be transferred and spread to the Third World. The next chapter describes how this came about.

Chapter Four

UNESCO'S PROMOTION OF SCIENCE POLICY

The data in Chapter Two suggested that, while science, economic and security concerns might have prompted the creation of science policy bureaucracies in some European and North American countries, indicators of these variables show no such correlation with the global pattern of science policy adoption. Chapter Three investigated this First World subsample in more detail and found that straightforward demand-making by industrialists and scientists was, indeed, critical in the creation of science policy bureaucracies in two of the earliest and most influential states--the United Kingdom and the United States. However, the chapter then described the evolution of an alternative impetus for creation of these bureaucracies among First World countries. It described the way in which an international organization, the OEEC (later the OECD) articulated and advocated a new understanding of the relationship between science and economic growth which led secretariat members of that organization actively to promote creation of this bureaucracy among members.

Since OECD countries tend to rank high on all of the internal demand variables identified in Chapter Two, it would be impossible to determine the relative importance of internal

demands versus OECD "teaching" in the establishment of these bureaucracies without detailed case studies of each country. However, the most striking feature of the Chapter Two data is that Third World countries, having very low levels of science capacity, economic development or military spending create these bureaucracies, on average, only a very short time after the OECD countries.[1] The question addressed in this chapter is, "why is this?"

Since demand-side explanations appear to be on weak ground for the global sample, this chapter will turn to supply-side explanations. Could it be that these bureaucratic innovations were not demanded from inside the state but were supplied from outside? The present chapter will focus on the global sample which includes the LDCs and will present an explanation for the overall lack of correlation between indicators of internal conditions and the pattern of adoption of science bureaucracies. The explanation presented follows up on a supply mechanism suggested by the First World subsample, that of the international organization as teacher.

Beginning in the 1950s the United Nations Educational Scientific and Cultural Organization (UNESCO) actively promoted this science policy innovation among its member

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[1] The median year for creation of science policy bureaucracies among the LDCs in the Chapter Two sample is 1967, less than ten years after the median adoption year for OECD countries (1958.) The closeness of these dates is particularly striking when one considers that many of the LDCs were not even states in 1958 and so do not even become candidates for bureaucracy creation until after that date.

states as a result of changes internal to that organization. From its inception UNESCO as an organization has had to address two constituencies--the states who are its members, on the one hand, and the professional experts in its substantive areas of concern, on the other. In the early to mid-1950s the relationship between these constituencies within UNESCO changed when states successfully asserted their control over the organization and became its primary constituents. In order to maintain its usefulness to states, UNESCO redefined the appropriate relationship between science and the state such as direction and control of science (or making science policy) became a necessary task of all states and teaching states how to do this became a mission of UNESCO.

Thus, the chapter argues that a global international organization, UNESCO, "taught" its members that the coordination and direction of science was a necessary role of the modern state. Prior to UNESCO's teaching activities, science had been viewed as a non-governmental, transnational enterprise best run by scientists. Organizational changes within UNESCO in 1954 caused it to redefine that norm about science-state relations such that science became a national resource to be harnessed for each state's economic well-being and security. Beginning in the late 1950s, UNESCO secretariat members began helping states organize, direct and expand their own domestic science establishments. Their preferred method of doing this was to create a national science policy

bureaucracy, and secretariat members actively intervened in domestic politics of states to bring these bureaucracies into existence.

The chapter begins with a discussion of the relationship between science and the state before science policy was so heavily promoted. The widespread understanding of science as transnational and non-governmental will be made clear, as will the ways in which that understanding shaped UNESCO's early organizational structure and science activities. The second section describes the 1954 shake-up within UNESCO and the organizational changes that came about as a result. The third section shows how these organizational changes prompted changes in UNESCO's science programs, specifically changes from programs designed to serve science and scientists to programs designed to serve states. The fourth section presents a detailed case study of the way in which UNESCO secretariat members intervened in one country, Lebanon, to set up the science policy bureaucracy there. The fifth section uses illustrations from UNESCO activities elsewhere to show how the process documented in the Lebanon case can vary. The chapter concludes with a discussion of some of the implications of this type of supply-side teaching activity.

Science and the State in the early days of UNESCO

Prior to World War II, science was generally treated by politicians as something akin to the arts. The words "arts and sciences" were spoken of in one breath to describe

academic and intellectual pursuits whose practitioners had more to say to each other than they did to governments. The transition from this to the current treatment of science as a national resource vital to states' wealth and security came about in two stages. First, science was uncoupled from the arts. As will be described below, the war provided much of the rationale for doing this and debates over UNESCO's founding underscored recognition of the new and special place science was to hold in the international community. However, recognizing science's power did not initially lead to the creation of national science policy establishments. Science after the war continued to be viewed as a transnational enterprise run by scientists. The shift to understanding science as a national enterprise came later, in the 1950s and 1960s.

Origins of UNESCO's interest in science. As originally conceived, UNESCO was to be the United Nations Educational and Cultural Organization. Science was understood to be part of culture. The notion that science was qualitatively different from other aspects of culture and therefore merited special recognition in the organization's mission and title had to be fought for by scientists and science promoters in government during the preliminary meetings and negotiations that took place in 1942-45.

During the Second World War, scientists gained unprecedented prominence. The Allies, in particular, set up

scientific liaison offices within their diplomatic missions to facilitate cooperation among scientists of allied nations. Scientists, in their turn, began to look for ways of insuring that these international networks developed in wartime would not evaporate in peacetime.

One veteran of these programs, a Cambridge University biochemist and future UNESCO staff member named Joseph Needham, proposed extending this idea much further in the post-war world. He proposed an International Scientific Cooperation Service under United Nations auspices which would allow scientists to "transcend national boundaries" in their collective and cooperative research enterprises. The Service would have permanent representatives in all countries and regions, with diplomatic status and guaranteed government facilities for communication and transport. "Field offices" of the Service would bring together international and local scientists for the purpose of exchanging information and promoting new applications and discoveries. With the help of an international center to be created as part of this new system, these offices would guarantee freer flow of research equipment, periodicals, manuscripts and scientists themselves across national boundaries. The Service would be financed by member states "on some income-tax basis to be agreed upon."[2]

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[2] James Sewell, UNESCO and World Politics (Princeton: Princeton University Press, 1975), 48-51; Joseph Needham, "An International Science Cooperation Service," Nature 154 (25 November 1944): 657-659; "Science in the Foreign Service" Nature 155 (17 February 1945): 187-88.

Needham's proposal was initially rebuffed by the Council of Allied Ministers of Education (CAME), whose meetings were laying out the format for the organization that was to become UNESCO. The scientists then began working to set up their own international organization, not under United Nations auspices. Two events conspired to bring science back into the UN fold. The first was Needham's success in late 1944 in convincing two of Britain's most prominent and influential scientists, Julian Huxley and Sir Henry Dale,[3] to persuade CAME officials to make science activities a top priority in the new UN organization. The second occurred in September 1945, after the dropping of the atomic bomb, when Dean Acheson instructed U.S. planners that "the role of scientists, scientific collaboration, and interchange of scientific knowledge should be emphasized and made explicit" in the new UN organization.[4]

During an October meeting with Dale and Huxley, the British Minister of Education, Ellen Wilkinson who was chairing the Preparatory Conference for the new UN

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[3] Dale and Huxley were particularly important and well-connected recruits for Needham. Sir Henry Dale wielded influence through his chairmanship of three different scientific groups--the British Council's Science Department, the Scientific Advisory Committee to the War Cabinet, and the CAME Science Commission. Biologist Huxley was a veteran of the League of Nations' Institut international de cooperation intellecutelle (ICCI), secretary of the London Zoological Society, and part of the British government's Political and Economic Planning (PEP) apparatus. He would later be chosen to head the UNESCO Preparatory Commission and would be the organization's Executive Director after the very short term of Sir Arthur Zimmern.

[4] As cited in Sewell, UNESCO in World Politics, 78.

organization finally agreed to support explicit recognition of science and the inclusion of an "S" in the organization's name. Her remarks in making the proposal summarize a perception of the scientific community echoed throughout the debate by others. "In these days, when we are all wondering, perhaps apprehensively, what the scientists will do to us next, it is important that they should be linked closely with the humanities and should feel that they have a responsibility to mankind for the result of their labours."[5] It was this combination of circumstance and politicking that allowed scientists to carve off a piece of the new UN organization for themselves.

UNESCO's early science programs and organizational structure. Giving science a titular role in the new inter-state organization was a way of recognizing the importance of science to states but did not, in these early years, entail state control of science. UNESCO's early science programs were designed to serve science and scientists rather than states. They aimed to increase the world sum of scientific knowledge and access to that knowledge without regard to national boundaries. The notion implicit in science policy, that science is a national resource to be developed, is very different from UNESCO's original notions of science as a

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[5] "Opening Address by the President of the Conference, the Rt. Honorable Ellen Wilkinson, MP," Conference for the Establishment of UNESCO, London, 1-16 November, 1945 (UNESCO: Paris, 1946), 24.

transnational enterprise. Indeed the principal rationale for internationalizing science and for bringing it under UN auspices in the first place was to free it from the meddling of self-interested (and presumably self-aggrandizing) states.

Apart from the dangers of states exploiting scientific discoveries for military gain, state interference in science had long been understood to stifle scientific progress. Science was believed to proceed most efficiently and productively when left to scientists. Certainly this was the attitude of the League of Nations' Institut International de Cooperation Intellectuelle during the inter-war period and it continued to be the attitude of most scientists' professional organizations and of individual scientists active in international affairs.[6]

Early statements of UNESCO's purpose with regard to science reflect this view. At the first session of the General Conference in November 1946, the Sub-Commission of the General Conference for Natural Sciences summed up the aims of UNESCO in the field of science as follows:

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[6] People like Julian Huxley, the first Executive Director of UNESCO and Joseph Needham, UNESCO's first Director of the Natural Sciences Department, who were instrumental in the founding of that organization, wrote extensively on their views of science as a transnational activity. See, for example, Julian Huxley, Unesco: Its Purpose and its Philosophy (Washington, D.C.: Public Affairs Press, 1947); and Joseph Needham, "An International Science Co-operation Service." Sir Henry Dale, who persuaded the establishing conference to accept science as a distinct part of the embryonic UNESCO and who had been part of the League's Institut International de Cooperation Intellectuelle, held similar views. Sewell, Unesco and World Politics.

1. to establish a world-wide network of field science cooperation offices;
2. to support the scientific unions,[7] add to their number and assist them in their work;
3. to organize and operate an international clearing house for scientific information;
4. to support the work of the United Nations and its specialized services;
5. to inform the general public in all countries of the international implications of scientific discoveries;
6. to create new forms of international scientific cooperation (international observatories and laboratories, etc.).[8]

Science policy and promoting national science capabilities of member states was not even mentioned.

Early UNESCO science programs conformed very much to these aims.[9] Science cooperation "field offices" were set up in Nanking, Cairo, Rio de Janeiro and New Delhi to facilitate the movement of scientists and information around the globe.[10] Financial support was extended to non-governmental

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[7] "Scientific unions" are scientists' professional organizations such as the International Astronomical Union and the International Geodesy and Geophysical Union. Their umbrella organization is the International Council of Scientific Unions (ICSU).

[8] Marcel Florkin, "Ten Years of Science at UNESCO" Impact of Science on Society 7 (1956): 123-4.

[9] See, for example, "Activities of Unesco in the Natural Sciences during 1948" UNESCO archives, doc. NS/67.

[10] The Rio office was moved to Montevideo in 1949 and in 1951 the Nanking office was relocated to Djakarta in the wake of the Chinese revolution. In creating these field offices Joseph Needham (head of Natural Sciences Department) was realizing the International Science Cooperation Service he had proposed during the war. See Needham, "An International Science Co-operation Service." For original plans for the field offices, see "UNESCO science cooperation offices," UNESCO archives, doc. Nat Sci/28/1947. For a brief history of early field office program see Florkin, "Ten Years of Science

organizations, particularly the International Council of Scientific Unions, as a means of promoting cooperation among scientists, and more of these unions were established.[11] Research institutes were established, such as the Institute of the Hylean Amazon, the Institute of the Arid Zone, and an International Computation Center, to bring scientists from different countries together to work on problems of mutual interest. All of these activities provided services directly to scientists rather than states.

The early organizational structure of UNESCO reflected this understanding of science and culture as transnational and often non-governmental activities. While the General Conference was composed of equal member states, UNESCO's Executive Board was to be composed of eighteen individuals, elected by General Conference delegates and distinguished by their prowess in the organization's substantive fields. Board members were to serve "on behalf of the Conferences as a whole and not as representatives of the respective Governments."[12]

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at UNESCO."

[11] Specifically, UNESCO help found the Union of International Engineering Associations and the Council of International Organizations of Medical Sciences. See Florkin, "Ten Years of Science at UNESCO."

[12] Note that this was a deliberate shift from the way in which CAME's executive bureau and the Preparatory Commission's executive committee were constituted. Both of these were composed of national representatives. Sewell, UNESCO and World Politics.

Shake-up and change

The principle of non-governmentalism enshrined in the composition of the Executive Board soon came under attack. While Board members were to be elected as individuals, the original UNESCO constitution provided that no state could supply more than one of its nationals to the Board. In practice this focused pressure on Board members when their governments wanted to pursue particular policies through the organization. One high American official described the U.S. government bringing its Board member back to Washington to "brief the hell out of [him] to try to get [him] to see things the State Department way."[13] Accounts of UNESCO Conference delegates from the period describe the decline of participation by scientists, scholars, educators and writers and the increased presence of "government technicians" who viewed themselves as government spokesmen.[14]

In 1954 UNESCO members voted to amend the constitution and reorganize the Executive Board into a body of twenty-two governmental representatives. The shift toward a governmentalized secretariat was justified on several grounds. The most often cited reasons were financial; since states were footing the bill for UNESCO's operations, the organization should serve states. In the words of one official who left the organization about this time, the shift was "the price for

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[13] As quoted in Sewell, UNESCO and World Politics, 169.

[14] Sewell, Unesco and World Politics, 168-169.

financial support." A cynical French delegate, Roger Seydoux, predicted that with this change "the Finance Ministries...would become masters of UNESCO and its programme."[15]

However, participants also understood the shift to be in keeping with a larger shift in the international climate from post-war Kantian transnationalism to Cold War Hobbesian nationalism. The original nongovernmental structure was a reflection of 1940s beliefs (or at least hopes) that ideas were a unifying force in the world. Education, science and culture could weave a web which would draw a divided world of nation-states together. If "wars begin in the minds of men," then the UNESCO solution follows logically: "it is in the minds of men that the defences of peace must be constructed".[16] Harry Truman voiced similar beliefs in his appeal to the 1945 UN founding conference in San Francisco to "set up an effective agency for consistent and thorough interchange of thought and ideas, for there lies the road to a better and more tolerant understanding among nations and

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[15] Both quotes from Sewell, UNESCO and World Politics, 169.

[16] Constitution of the United Nations Educational, Scientific and Cultural Organization as reprinted in William Preston, Hope and Folly (Minneapolis: University of Minnesota Press, 1989), 315. The original phrase, "war begins in the minds of men" was coined by Clement Atlee. Preston, Hope and Folly, 33.

a better and more tolerant understanding among nations and among peoples."[17]

By the mid-1950s this view had been eclipsed. At best, ideas were irrelevant to the intense power struggle raging in the world. At worst, ideas were viewed as divisive and dangerous in which case states could not afford to leave them to a collection of unaccountable individuals. As realpolitik replaced Kantian liberalism, states were reintegrated as major players in determining UNESCO policies if the organization's credibility was to be maintained.

Not surprisingly, the United States, then in the grips of anticommunist fervor, was the standard bearer for this new attitude. UNESCO came to be viewed as a political instrument in the cold war; its purpose was to be a "Marshall Plan for ideas" which would block the expansion of "intolerant" communism. Failure to convert UNESCO wholeheartedly to its own foreign policy agenda led U.S. officials to erect organizational barriers to contain and control its influence. Chief among these was the International Organizations Employment Loyalty Board, established in early 1953 to oversee the employment of Americans in all UN agencies. Such screening ensured that American Executive Board members would be sympathetic to government views and so clearly flew in the face of nongovernmental principles.

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[17] As quoted in Preston, Hope and Folly, 33.

While the Americans succeeded in replacing intellectuals of dubious leanings with patriots and loyalists, they failed in their ultimate goal of making the organization a tool of U.S. foreign policy. Just as their governmentalist reforms were enacted in 1954 the Soviet Union and several of her East bloc allies finally agreed to join UNESCO. Shortly thereafter came the influx of newly independent developing states with an agenda of their own. These two events effectively blocked efforts by the U.S. or any other great power to control UNESCO.

The shift from nongovernmentalism to governmentalism represented a shift in the balance of power among UNESCO's two constituencies. As the international climate changed and optimism about the utility of transnational activities declined, the champions of those activities--scientists, scholars, artists, educators--lost ground. Their rhetoric about building bridges to all mankind became less and less appealing to UNESCO's member states who increasingly viewed the world as hostile and the rest of mankind with suspicion. Thus, during the Cold War states reasserted themselves as UNESCO's chief constituents and UNESCO officials reshaped their programs to accommodate them.

Effects of organizational change on science programs

UNESCO's science activities soon reflected the shift in world view and the organization's rediscovered constituency of states. While international scientific projects begun

previously continued, UNESCO also became concerned with promoting science at the national level. UNESCO began to focus its attention on helping states to organize, direct and expand their own domestic science establishments, and its preferred method of doing this was to help states to create a new state agency to take care of these tasks.

UNESCO's concentration on what would later be called "science policy" did not, however, appear immediately. Instead, the state agencies UNESCO initially concentrated on promoting were research organizations--organizations whose primary mission was to do science rather than coordinate and direct science activities broadly. Thus, UNESCO's first response to the new influence of states was simply to transpose its activities from the international to the national level. Instead of assisting science and scientists internationally, UNESCO began assisting science and scientists in their work within national boundaries. Governments and government policies were still only a secondary consideration in the mid- to late 1950s.

As a first step in this direction, UNESCO had conducted a survey of the national research councils of member states when the winds of change in the organization began to blow in 1953.[18] The stated purpose of the survey was, first, to

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[18] Original survey analysis is contained in UNESCO archives, doc. NS/107. Survey results were also published as "Reports and Documents: Survey of national research councils for pure and applied science in the member states of UNESCO," Impact of Science on Society 4 (winter 1953): 231-255.

collect reference material for anyone asking advice on how to set up a research council, and second, to provide background material for the establishment within UNESCO of an International Advisory Committee on Scientific Research whose role would be to provide assistance to states seeking science policy advice.[19]

At this stage, UNESCO still viewed its role in science policy promotion as a relatively passive one; it waited for states to ask for advice and assistance. Following the 1954 reforms, the organization became more activist and science policy activities grew by leaps and bounds. In 1955, partly as an outgrowth of the 1953 survey, UNESCO convened a meeting of Directors of National Research Centers in Milan at which 30 countries were represented.[20] The first agenda item for this meeting was discussion of "the role of national plans for the development of scientific research."[21] Papers presented at the conference by UNESCO staff members outlined the virtues of nationally directed science activity, discussed different models for such direction, and emphasized the role UNESCO

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[19] "Reports and Documents: Survey of national research councils for pure and applied science in the member states of UNESCO" Impact 4 (winter 53): 231. See also Pierre Auger, "UNESCO and the Development of Research in the Field of Natural Sciences," UNESCO Chronicle 1 (1955): 5.

[20] Final report found in UNESCO archives, doc. UNESCO/NS/124. See also, Pierre Auger, "UNESCO and the Development of Research in the Field of Natural Sciences," 5.

[21] UNESCO Chronicle 1 (1955), 26.

would play in providing assistance in realizing these planning processes.[22]

At about the same time, in the mid-1950s, UNESCO began assisting countries directly who wanted to set up these kinds of research centers. UNESCO's activities in Egypt provide an example of this phase of UNESCO activities and how it differs from both previous and later activities.

In 1954, the Egyptian government asked UNESCO for help in reorganizing their National Research Council. The government's concern was that research being done by the Council lacked well-articulated aims and squandered resources. UNESCO's task was to provide the Council with a "legal, administrative and organizational structure that would permit it to function with maximum efficiency."[23]

In response, UNESCO sent Frederic White, Chief Executive Officer of Australia's Commonwealth Scientific and Industrial Research Organization to Egypt to review the situation. His recommendations focused on new ways to run the Council's laboratories that would yield more and more useful research results. These recommendations were largely adopted by the

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[22] Several of these papers were later published in Impact of Science on Society. Most relevant is Werner Moller's "National Research Councils and Science Policy," Impact of Science on Society 6 (1955): 155-168. Moller was a secretariat staff member of the Department of Natural Sciences at UNESCO.

[23] F.W.G. White. "Egypt: Reorganization du Conseil National Egyptien de la Recherche." Unpublished UNESCO report, May 1955. BMS Reports, "Reports from field expert Dr. F.W.G. White, Organisation and Development of NRC, Egypt."

Egyptians when they officially converted the Council into the National Research Center in June 1955.[24] Science policy making was not yet a concern of this UNESCO operation.[25]

During the late 1950s UNESCO begun to make the transition from promoting science research organizations to promoting science policy organizations and began actively assisting countries in setting up those new organizations. In 1957, when the Belgian government asked for help in setting up its National Science Policy Council, UNESCO sent the Chief of its Science Policy Division to direct these activities.[26] UNESCO also provided assistance to the Lebanese government in creating a National Council for Scientific Research

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[24] Additional information on White's mission and Egypt's reaction to in can be found in Frederick Bellinger, "Summary Report on Development of the Research Program of the National Research Center of Egypt, Sept. 1955-July 1956." UNESCO archives, BMS Reports. Bellinger's trip was a follow-on to White's and attempted to put some of White's proposals into action.

[25] Although it would become a concern. As UNESCO's ideas about what science establishments should look like developed during the 1960s, it continued to sent consultants to Egypt and the United Arab Republic in order to modify existing bureaucracies along UNESCO-approved lines. See, for example, R.V. Garcia, United Arab Republic: Government Structures for Science Policy, serial number 1342/BMS.RD/SCP, Paris, July 1969. By the time of Garcia's mission Egypt had a full-blown Ministry of Scientific Research but UNESCO continued to try to impose some of its own organizational forms upon existing institutions.

[26] The Belgian National Science Policy Council was established in 1959. UNESCO archives, doc. NS/ROU/100.

(established in 1962.)[27] This latter case will be discussed more fully below.

Critical to this shift in emphasis was the appearance and wide circulation of a 1960 report entitled "Current Trends in Scientific Research," written by UNESCO's Pierre Auger[28], then acting as a special consultant to the United Nations as a whole. The report's first recommendation was that national scientific policy should be one of the "foremost preoccupations of governments."

> States should make it their business to ensure [the] interaction between the encouragement of scientific research, on the one hand, and economic and social progress, on the other, operates smoothly to the advantage of both. It is, at the same time, the duty of organizations in the United Nations family to assist States in this matter.[29]

Auger's detailed report, requested and approved by the larger UN, provided a basis for expanding the science activities UNESCO had engaged in over the last five years and came to be routinely cited as the original basis for UNESCO's emerging science policy program.[30] Authorization for this

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[27] UNESCO archives, docs. NS/ROU/LEB. 1-23; UNESCO Secretariat Registry [ie. correspondence] files; also NS/ROU/100.

[28] Auger had been the second head of the UNESCO Natural Sciences Department after Joseph Needham and had recently retired from the Secretariat.

[29] Pierre Auger, Current Trends in Scientific Research (Paris: UNESCO, 1961), 220.

[30] See, for example, Y. de Hemptinne, "UNESCO's role in the organization of scientific research" UNESCO Chronicle 9 (July 1963), 245. Also, the opening speech by Alexei

program quickly expanded in scope. Beginning in 1960, UNESCO General Conference resolutions included instructions that the Director-General "collect, analyse and disseminate information concerning the organization of scientific research in Member States and the policies of Member States in this respect."[31] By 1963 the General Conference resolutions were more explicit. The Director-General was authorized to assist Member States "in the establishment or improvement of science policy planning and research organization, through sending advisory missions, conducting scientific and technological potential surveys, with particular regard to human resources and budgets, or organizing training seminars and, to this end, to participate in their activities in the field."[32] From this point on the goal of spreading and improving science policy organizations was firmly entrenched in UNESCO's official science program.

Matveyev, Assistant Director-General for Science of UNESCO to the Meeting of the Coordinators of Science Policy Studies in Karlovy-Vary, Czechoslovakia, June 1966, reprinted in Principles and Problems of National Science Policies, Science Policy Studies and Documents, no. 5 (Paris: UNESCO, 1966), 12. Also see, "Survey of UNESCO's activities and achievements with regard to science policy" UNESCO archives, doc. NS/ROU/100, p. 3.

[31] UNESCO, General Conference, 11th session, 1960. Resolutions 2.1131, (Paris, 1960).

[32] UNESCO, General Conference, 13th Session, 1964. Resolutions, 2.112(d), (Paris, 1964), 32.

The new norm about science and the state

One interesting feature of UNESCO's science policy program for the questions raised in this dissertation is that the language used is strongly normative: "States should make it their business..." to coordinate and direct science. Or, as later expressed, "The development of science policy should be the responsibility of an organization at the highest level of government in the country...."[33] and "[t]he Science Policy Programme of UNESCO is formulated on the basis of the principle that the planning of science policy is indispensable" for the coordination and promotion of scientific research.[34] These assertions are not coupled with any evidence that such bureaucratic entities actually enhance science capabilities. This is surprising given that, until only a few years earlier, conventional wisdom had held exactly the opposite--that government interference stifled scientific creativity.

In addition, the language is universal; it promotes these bureaucracies as good for all states, at all levels of scientific capability. This ignores an obvious potential strategy for many countries, particularly LDCs--free-riding. Science, with its imperatives to disseminate results widely and immediately, has many properties of a collective good.

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[33] UNESCO, Principles and Problems of Science Policy, 87.

[34] "The Proposed Science Policy Programme of Unesco for 1967-68" Unesco archives, doc. NS/ROU/117, p.1 [emphasis mine.]

The economic advantages of being a copycat follower rather than a leader in technological innovation have been widely discussed in other contexts. Why LDCs should focus their scarce resources on promoting domestic science rather than reaping the technological fruits of industrialized nations' research is not obvious.

Thus, from a functional standpoint, it is not obvious why all states suddenly "needed" a science policy bureaucracy at that particular point in time. In fact, it appears that these events were not related to functional need in any strict sense. Rather, they constitute a redefinition of the norms and expectations of state roles with regard to science. Initially scientists sought to harness state resources (protection, money, transport) to further their own scientific projects by claiming a piece of an interstate organization. To do so, they had to proclaim science an appropriate concern of governments. The debate over the "S" in UNESCO and Wilkinson's comments in proposing it reveal the scientists' success in this. However, when scientists and the other epistemic communities[35] lost control of UNESCO to the member states, the situation did not simply revert to the status quo ante. The norm that science was now an appropriate concern of

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[35] The term refers to "a community of experts sharing a belief in a common set of cause-and-effect relationships as well as common values to which policies governing these relationships will be applied." Peter Haas, "Do regimes matter? Epistemic communities and Mediterranean pollution control." International Organization 43 (summer 1989), 384, fn.20.

states remained firmly entrenched but the relationship between science and states, was redefined to reflect the new world climate and UNESCO's new dominant constituency. Rather than states collectively, within an international organization, promoting and directing science as a transnational enterprise, Natural Sciences Department officials in UNESCO now argued that states individually should take responsibility for promoting and directing science within their own borders. By proclaiming science policy-making to be an appropriate and necessary function of states qua states and by offering themselves as a source of knowledge about this new function, UNESCO science officials successfully redefined their role in a way that was neither "irrelevant" nor "dangerous" to their new clients.

Spreading science policy

Teaching states to fulfill their new role in science quickly became UNESCO's principal science mission, and by 1960 a special Research Organization Unit of the Natural Sciences Department had been established to deal with these tasks.[36] Efforts to establish and expand science policy organizations were undertaken on several fronts. First, following instructions from the Executive Board, the UNESCO field offices organized a series of meetings to promote the idea of

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[36] The Research Organization Unit was subsequently renamed the Science Policy Division. For more on the early activities of the Research Organization Unit see, Y. de Hemptinne, "UNESCO's role in the organization of scientific research" UNESCO Chronicle 9 (1963): 244-248.

science policy and disseminate information about establishing the necessary policy machinery.[37] The Southeast Asia Science Cooperation Office sponsored a December 1959 meeting in Bandung, Indonesia to discuss governmental science activities in those countries.[38] In 1960 the Latin American field office held a seminar on the organization of scientific research at Caracas at which the creation of science policy organs or research councils was recommended. Only three of the eleven countries attending had such councils at the time of the meeting.[39] The same year, science officials from the Middle Eastern countries met at the UNESCO Field Office in Cairo and resolved that a science policy organization should be set up in each country at the highest governmental level. At the time of the meeting only the United Arab Republic had such an entity.[40] In all three cases, these were only the first of what became a series of meetings on science policy, for once all states in the region had created the policy

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[37] "UNESCO Science Cooperation Offices" UNESCO Chronicle 7 (1961): 433-5.

[38] "The Development of Science in South-east Asia" Nature 186 (11 June 1960): 859-60.

[39] "Organization of Scientific Research in Latin America" Nature 188 (31 December 1960): 1157-8. The three were Argentina, Brazil and Mexico. Resolutions and Declarations from this seminar are found in Unesco archival document NS/ROU/36.

[40] UNESCO, Structural and Operation Schemes of National Science Policy. Science Policy Studies and Documents, no. 6. (Paris: Unesco, 1967); "Science Planning, Development and Co-operation in the Countries of the Middle East and North Africa" Nature 189 (4 February 1961): 362-3.

machinery talks continued on how this machinery could be refined and improved.[41]

In addition, UNESCO undertook a series of studies on science policy issues, published as the series Science Policy Studies and Documents. The first four and many subsequent of these are studies of the science policy establishments of individual states, designed to provide ideas and models to others seeking to establish and improve science policy-making in their own countries. Criteria for choosing states for study were originality of the science policy establishment and length of experience of that country with science policy-making. Other volumes in the series treat more general issues of science policy-making, such as the fifth volume, Principles and problems of national science policies[42] or the sixth, Structural and operational schemes of national science policy.[43] In both cases, these studies were coupled with meetings of government science officials from member states. Their participation in producing the recommendations of the studies insured that these recommendations were reaching the desired audience.

Perhaps most interesting, UNESCO officials would, if requested, come into a country and provide on-site consulting

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[41] Results of some the later meetings were later published as part of the Science Policy Studies and Documents series.

[42] (Paris, UNESCO, 1966).

[43] (Paris, UNESCO, 1967).

services about how a science policy program might be established there. By early 1966 UNESCO had science policy promotion programs of this kind either completed or underway in fifteen countries with programs to revised existing state science policy bureaucracies along preferred UNESCO lines in several others.[44]

In promoting science policy bodies, UNESCO officials came to have firm opinions about the appropriate form these bureaucracies should take. Two features, in particular, were considered essential. First, the entity making policy about science could not also do science; it could not also be a research organization. An organization could not objectively assess national research priorities when it also had a vested interest in certain lines of research being done in its own labs. The science policy body had to be liberated from such conflicts of interest. Second, the science policy body had to have access to the highest levels of government. It should be a ministerial level body or should be located close to the seat of power, for example in the President's office. It should not be subservient to some other ministry, for example education or planning. Such an arrangement would seriously limit the organization's independence and prevent the nation-

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[44] Science policy establishment missions were complete or underway in Algeria, Congo (Leopoldville), Ethiopia, Guinea, Iran, Iraq, Kenya, Lebanon, Madagascar, Morocco, Senegal, Sudan, Tanzania, Venezuela and Zambia. Science policy modification or reorganization programs were undertaken in Indonesia, the United Arab Republic, Nepal, the Philippines among others.

wide coordination across all aspects of science that was required.

One of the first places UNESCO officials undertook this kind of science policy consulting was in Lebanon. Because it was one of the first, the Lebanese case became a prototype for UNESCO consultants on later missions. A more detailed examination of the Lebanese case reveals the extent of UNESCO's influence on the construction of a science bureaucracy there. UNESCO officials did not just sit on the sidelines and make suggestions. The head of the UNESCO Natural Sciences Department actually drafted the enabling legislation for the new bureaucracy while other members of the secretariat staff lobbied relevant Lebanese politicians to get it passed. In doing so, they were squelched a conflicting Lebanese proposal for the new bureaucracy, which they considered inappropriate and inadequate.

UNESCO's promotion of science policy in Lebanon[45]

The starting point for UNESCO's involvement in Lebanon was the regional conference on science planning organized by the UNESCO Middle Eastern Field Office in Cairo in December of 1960, mentioned earlier. At that conference, Field Office staff members presented reports on the organization of science in various countries of the region. The report on science and

[45] All citations of letters and memoranda in this section are from UNESCO Secretariat Registry files, UNESCO archives, Paris. Where documents were assigned file numbers, these are noted in brackets.

technology in Lebanon, presented at the Cairo conference, revealed that Lebanese research lacked any practical orientation, that coordination of research was almost non-existent and that many necessary research materials were lacking.[46]

However, the report did not have precisely the intended effect. Rather than prompting the Lebanese government to begin organizing and coordinating scientific research, as the Cairo conference had recommended, it prompted the Lebanese Foreign Affairs Ministry to request UNESCO's help in setting up a scientific research center, to be part of the University of Lebanon, which could carry out scientific research in Lebanon in an efficient and effective way.[47]

This request was channelled to Yvan de Hemptinne, then Scientific Secretary to the Director of the Natural Sciences Department at UNESCO. After reviewing the request, de Hemptinne responded that a country like Lebanon did not need more laboratories or research centers; instead it needed coordination of its existing research efforts. He proposed that, rather than sending an expert to set up a research center, UNESCO should send an expert to set up a coordinative

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[46] As described in memorandum by Y. de Hemptinne, Scientific Secretary to the Director of the Department of Natural Sciences, to Malcolm S. Adiseshiah, Assistant Director-General, UNESCO, May 1961 [NS memo 50.085.]

[47] Described in letter, Fouad Sawaya, Director General of National Education, Lebanon to Malcolm S. Adiseshiah, Assistant Director-General, UNESCO, 23 May 1961.

science policy body in Lebanon. Further, de Hemptinne argued that UNESCO should not consider any further technical assistance measures to Lebanon until these coordination problems had been resolved.[48]

Negotiations over which project UNESCO would support, the center to carry out research or the science policy body to coordinate research, were eventually resolved by the Director General of UNESCO himself, Rene Maheu. "I believe that I have succeeded in convincing the President of the Republic [of Lebanon] (who is very interested in this project and who is by far the most important man in ensuring its success) of the duality and complementarity of plans for a science policy, on the one hand, and organizing research on the other."[49] The new body was to be a National Research Council that would

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[48] Memorandum, Y. de Hemptinne to M.S. Adiseshiah, May 1961 [NS memo 50.085.] De Hemptinne also proposes an elaborate 3-tiered structure for this coordinative bureaucracy. These proposals were greatly simplified under pressure from Karam at the Bureau of Member States (BMS) and from the Director-General of UNESCO, himself. See memorandum, F. Karam, BMS, to José Correa, Director of BMS, 5 May 1961 [BMS 80/memo 100]. Also memorandum, Director-General of UNESCO [René Maheu] to M.V. Kovda, Director of the Department of Natural Sciences, UNESCO, n.d. [June or July 1961].

[49] Memorandum, Director-General of UNESCO [René Maheu] to M.V. Kovda, Director of the Department of Natural Sciences, UNESCO, n.d. [June or July 1961], trans. mine.

The fact that the Director-General of UNESCO and the President of Lebanon were both involved in these negotiations indicates the importance attached to them by both parties. Maheu, in fact, goes on to say in the above-cited memo: "For many reasons, I attach the utmost importance to this project which, in my view, has great value as an example." Translation mine.

organize research and make policy about science rather than a research center that would do research.

On Maheu's instructions, de Hemptinne spent several weeks during the summer of 1961 in Lebanon drafting enabling legislation for this Council.[50] Key features of de Hemptinne's proposal were:

a) that coordination of research in all scientific disciplines were to be centralized under the Council;

b) that the Council was, under no circumstances, to operate any type of laboratory or research facility itself.

The next stage of UNESCO's work involved sending a second science policy expert to Lebanon for a longer period (four months) who would work with the Lebanese to refine and revise the proposed legislation drafted by de Hemptinne. Charles Boschloos, a Belgian, was hired for this purpose and began work in Beirut in the fall of 1961. The Lebanese, by this time, had formed a National Scientific Commission whose purpose was to work with UNESCO specialists in designing the new Council. In December, Boschloos and the Lebanese Commission circulated their revised draft of the enabling legislation. It differed in several ways from de Hemptinne's draft, notably by weakening both of what de Hemptinne had considered to be the key provisions of the legislation--that all scientific disciplines were to be brought under Council

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[50] This proposed legislation is document NS/ROU/7, 8 February 1962, in UNESCO archives.

jurisdiction and that absolutely no direct involvement in research activities was to be permitted.

De Hemptinne and other secretariat members were furious.[51] Boschloos' contract was terminated and elaborate negotiations were undertaken with the Lebanese Commission to push the legislation back onto what secretariat members considered to be the right track. UNESCO submitted formal comments to the Commission on the revised draft, arguing for changes back to the original proposals on these important issues.[52] After several weeks of negotiation, de Hemptinne was permitted to compile a synthesis of the two existing drafts for consideration by the Lebanese Parliament.[53] In it, de Hemptinne included strong statements about both of his chief concerns (that the Council be multi-disciplinary and purely coordinative,) while making concessions to the Commission's draft on issues of less consequence.

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[51] See, inter alia, memorandum from F. Karam, BMS, to A.K. Kinany, Chief, Unit of Arabic-speaking Countries, BMS, 15 December 1961. Also, letter from Y. de Hemptinne to T.O.P. Lilliefelt, Permanent Resident, Technical Assistance Bureau, Beirut [NS 801/226(40)], 20 December 1961.

[52] These comments are contained in UNESCO archives document NS/ROU/9, "Commentaires de l'UNESCO sûr l'avant-projet de loi portant création d'un 'Conseil National de la Recherche Scientifique' redige en novembre 1961 par la Commission Scientifique Nationale du Liban," 8 February 1962.

[53] UNESCO archives document NS/ROU/10, "Avant-projet de loi portant création au Liban: Synthèse des avant projects de loi établis par M.Y. de Hemptinne, Chef du Groupe d'organisation de la recherche scientifique de l'UNESCO et par la Commission Scientifique Nationale du Liban," 8 February 1962.

The synthesis proposal was submitted the Lebanese Parliament in February 1962. Now the Parliament had two alternatives to considered--the Lebanese Commission's proposal and de Hemptinne's new revised proposal. To promote his alternative, de Hemptinne traveled to Beirut that spring to answer questions and speak with Members of Parliament about the new Council proposals. He feared that the Commission would produce some new counter proposal and derail his efforts. To counter this possibility, he enlisted the help of the Commission's new President, Joseph Najjar, to keep him informed of any new developments.[54]

In fact, the new challenge to de Hemptinne's proposal came, not from the Lebanese, but from within UNESCO. In June, the Director of UNESCO's Department of Social Sciences, J. Hochfeld, fired off a letter to his counterpart in Natural Sciences complaining that they had been left out of the Lebanon project and arguing that the social sciences must be included among the responsibilities of any new National Research Council created in Lebanon. Failure to do so would "seriously prejudice social science research in Lebanon" for years to come.[55] This new internal squabbling was quickly

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[54] Letter, Y. de Hemptinne to J. Najjar, President, National Scientific Commission, Ecole Supérieure d'Ingenieurs, Université de St. Joseph, Lebanon, 20 February 1962. Note that de Hemptinne is now head of the new Research Organization Unit (ROU) at UNESCO's Natural Sciences Department.

[55] Letter, J. Hochfeld, Director of the Department of Social Sciences, UNESCO, to Director of the Department of Natural Sciences, UNESCO, 6 June 1962 [memo SS/62/390].

squelched from the top by Maheu, whose interest in keeping this project on track was noted earlier. He placating assured Hochfeld that once created, the Lebanese Research Council could undertake the question of expanding itself. Now was not the time to make significant changes in the proposed legislation.[56]

In the end, the lobbying efforts by Maheu, de Hemptinne, Karam, Adiseshiah and others at UNESCO paid off. On August 28, 1962 the Lebanese Parliament approved de Hemptinne's synthesis proposal for a National Scientific Research Council without discussion. An initial budget of 400,000 Lebanese pounds was approved for the Council with a budget supplement to be allotted once the Council was up and running.[57]

UNESCO's activities in Lebanon did not stop with the creation of the Council. Following passage of the enabling legislation, UNESCO immediately plunged into the task of helping the Lebanese set up the new bureaucracy and ensuring that the Lebanese science policy body headed in the desired direction. Before the end of 1962, UNESCO was recruiting two "experts in the organization of scientific research" to go to Lebanon and draft operating regulations, budgets and an

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[56] Memorandum, Director-General [René Maheu] to J. Hochfeld, 12 June 1962 [ODG/DG/memo 25.746].

[57] Letter, Chafic Moharram, Technical Counselor to the President of Lebanon to Y. de Hemptinne, 3 October 1962.
De Hemptinne's enabling legislation specified that the Council's budget was not to be less than 1% of the state's budget.

organization chart for the new Scientific Research Council.[58] UNESCO also conducted external reviews of Lebanese science policy-making at frequent intervals over the next decade, offering suggestions for improvements.[59]

Variations on the Lebanese experience

Obviously UNESCO's experiences in promoting science policy bodies among its members differed in different countries. Records from one of UNESCO's large subsequent science policy campaigns in East Africa during 1967 and 1968 provides some insight into the range of experience encountered by UNESCO consultants.

First, UNESCO consultants did not always spoon-feed the structure of the new science policy bureaucracy to countries as they did in Lebanon. Sometimes the original draft of enabling legislation for the new bureaucracy came from some group within the country, often a Ministry of Education or a Ministry of Planning,[60] and was then sent to UNESCO

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[58] See, for example, the report by B.K. Blount, Deputy Director of the British Department of Scientific and Industrial Research and temporary consultant to UNESCO, "Report to the National Research Council of Lebanon," compiled 10 March through 7 April 1964, Lebanon file, Secretariat Registry Files, UNESCO archives.

[59] See, for example, unpublished UNESCO reports by P. Piganiol, "Organisation de la politique scientifique au Liban," 1967-68, and M. Steyaert, "Liban: politique scientifique national et organisation des recherches oceanographiques," 1968, both in Lebanon file, Secretariat Registry Files, UNESCO archives.

[60] It should be noted that even in these cases, UNESCO activities still provided some of the impetus for creating the new bureaucracy. Virtually all of these locally-drafted

headquarters or to the UNESCO regional office for comments and suggestions. However, as discussed earlier, UNESCO officials had some firm notions about what these science policy bureaucracies should look like and did not let these opportunities to impose their views escape. Most often, the drafts were returned, not just with extensive comments but also with a visit by a UNESCO expert who would meet with relevant local officials about what UNESCO perceived as shortcomings of the country's plan and UNESCO's proposed remedies.

In 1966 the Ethiopian government, for example, sent a draft of their Order on the establishment of a National Research Council to UNESCO's regional office which forwarded it, along with suggested revisions, to the Science Policy Division staff at UNESCO headquarters in Paris. Headquarters then sent one of their science policy experts out to Addis Ababa to attend meetings of the Drafting Committee for the Research Council Order and to provide information regarding certain aspects of the proposed Council's potential

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enabling documents cite UNESCO regional science policy conferences (for example the 1964 Lagos Conference among African countries) as prompting local activity, and most follow conference recommendations to a large extent.

activities.[61] A similar course of events took place in Tanzania.[62]

Zambian officials, on the other hand, were making good progress toward creating a National Science Policy Board without UNESCO intervention when UNESCO staff officials discovered their activity. UNESCO consultants immediately inserted themselves into the process, offering advice and suggestions without any direct appeal from the Zambian government.[63]

The obstacles encountered by UNESCO officials in setting up these science bureaucracies also varied from country to country. In Ethiopia, UNESCO experts complained that creation of the Research Council was "not very popular" and that those working on the project "seem to be interested in safeguarding those rights and privileges of their institutions that might be delegated to the N.R.C. [National Research Council.] Hence they try to reduce the would-be powers of the N.R.C."[64] In Sudan, UNESCO officials had trouble finding enough qualified scientists even to draft a proposal for the new science policy

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[61] "Ethiopia," confidential annex I to science policy memo 541, I.C. Koupalov-Yaropolk, UNESCO science policy consultant, to A. Matveyev, Assistant Director-General, UNESCO, 13 April 1967, Secretariat Registry files, UNESCO archives, Paris.

[62] "Tanzania," annex V to science policy memo 541.

[63] "Zambia," annex VIII to science policy memo 541.

[64] "Ethiopia," confidential annex I to science policy memo 541.

body, let alone staff it once it was created.[65] In Tanzania, UNESCO officials complained that a general apathy about the entire project prevailed.[66] In Kenya, consultants complained of attempts to subordinate the science policy body to the Ministry of Economic Planning rather than making it part of the President's office and giving it direct access to the highest levels of government.[67]

One feature of all of UNESCO consultants' experience commonly remarked upon in many countries was the lack of familiarity with the notion of a science policy bureaucracy, even in the highest government and science circles, and the "necessity" for UNESCO officials to spread the word. For example, in Ethiopia UNESCO consultants were "astonished" to find that they were the first people to present the idea of a National Research Council to the Deans of the Medical, Engineering and Building Colleges at Haile Selassie I University, despite the fact that the Vice-Chairman of the

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[65] "Sudan," annex VII to science policy memo 541.

[66] UNESCO consultant Koupalov-Yaropolk described the situation as follows:
"The draft Constitution of the National Research Council has been lying for some 14 months in the Ministry of Agriculture. [This] indicates that there are few people really interested in the establishment of N.R.C. or that they do not have influence enough to push this matter forward."
"Tanzania," annex V to science policy memo 541.

[67] See discussion of two key features of UNESCO's preferred form of a science policy making body, above.

committee drafting the enabling legislation for the Council was the Dean of the Faculty of Sciences at the University.[68]

Despite these difficulties, all of these East African states had installed science policy bureaucracies of a type in keeping with UNESCO's guidelines by 1970, within three years of the UNESCO consultants' initial visits.[69]

Ongoing science policy advice to member states

By 1964, all of UNESCO's regional offices were holding regular conferences on the subject of science policy and member states were rapidly creating these new science bureaucracies along UNESCO guidelines. However, creating the new bureaucracy was by no means the end of the process. States still had to a) figure out what the bureaucracies were actually going to do, and b) make sure that those tasks were accomplished. Many of the difficulties described in East Africa plagued infant science bureaucracies elsewhere, particularly turf battles with other (usually larger) ministries and a lack of scientists to staff the organization adequately.

To address these issues, UNESCO began offering ongoing science policy advice to states in 1965. The purpose of the

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[68] "Ethiopia," confidential annex I to science policy memo 541.

[69] Kenya is the exception, since it did not create its own national science policy bureaucracy until 1977. The rationale for not creating such a bureaucracy earlier given by the Kenyans was that they could derive the necessary benefits from an existing East African Regional science policy bureaucracy.

program was "to provide leaders of governments and science policy makers of developing countries with top level advice for the formulation and implementation of a genuine national science policy."[70] This was to be a long-term effort. Consultants were assigned for a minimum of four years to a country. Developing countries had to request the assistance and bear a significant portion of the cost. As an inducement to LDCs to sign on, UNESCO recruited top-level talent from more developed states and advertised their credentials in promoting the program.[71] India and Indonesia were the first to states to request such science policy consultants. Requests from Iran and Pakistan followed shortly.

Conclusions

The foregoing account makes clear that in many states the impetus for creating a national science policy bureaucracy came, not from within states as a result of local conditions

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[70] "A proposed programme (1965-1966) for long-term science policy consultants to governments." UNESCO archives, doc. NS/ROU/67, 12 June 1964, p.3.

[71] UNESCO science policy consultants included people like S. Samarin, Vice-Chairman, State Committee of the Council of Ministers of the USSR on the coordination of scientific research; S.T. Todd, Chairman, Advisory Council on Scientific Policy, United Kingdom; L. Massart, President, National Council for Scientific Policy, Belgium; P. Piganiol, former Delegué général à la recherche scientifique de la France; Ignaci Malecki, Secretary of the Polish Academy of Sciences; S. Dedijer, University of Lund, Sweden, "a world specialist on science policy programmes;" Sir Frederic White, Chairman, Commonwealth Scientific and Industrial Research Organization, Australia. See, "A proposed programme (1965-1966) for long-term science policy consultants to governments." UNESCO archives, doc. NS/ROU/67, 12 June 1964, p.6.

and needs, but from outside states, from the international community. The impetus for action came from UNESCO and from the cadre of international experts working for UNESCO. They taught states the value of science policy-making and tutored states in the assumption of this new task. It was UNESCO staff members who convinced Lebanese officials that what they needed was a coordinative policy bureaucracy rather than a research center. It was UNESCO consultants who introduced many key figures in Ethiopia to the whole notion of science policy-making and who provided long-term science policy advisors to India and Indonesia.[72]

What UNESCO officials were teaching was a new norm of behavior concerning the state's role in science. Science was no longer to be viewed as a transnational enterprise best left to scientists. Rather it was to be viewed as a national resource that states could and should harness for the security and well-being of their citizens.

This new norm about science did not appear in a vacuum. Since norms of behavior are interrelated, changes in norms

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[72] UNESCO staff members were very much aware of the teaching role they played. Hilliard Roderick, then Deputy-Director of the UNESCO Natural Sciences Department, described the situation in 1962 as follows. "Since most Member States [at this time there are 106] have as yet no domestic policy towards science, it is unrealistic to expect them to have a foreign policy towards science and to know what they want done internationally. The result is that UNESCO gets few specific requests and instructions concerning science from Governments. (However, it does receive many demands from the scientific community.) In a sense, UNESCO was born before its time." Hilliard Roderick, "The Future Natural Sciences Programme of UNESCO," Nature 195 (21 July 1962): 215 [emphasis mine.]

must also be interrelated and appear in bundles. In this case, the new norm about science and the state was supported by other emerging norms about state autonomy and dependence that gained currency with decolonization.

The interest in and success of UNESCO's efforts is not unrelated to the fact that during this period large numbers of new states were being created, virtually all of which were LDCs. While it was developed countries such as the U.S. and the U.K. that initially pushed for the reorganization of UNESCO's Executive Board to favor states for Cold War reasons in the 1950s, UNESCO's reorientation toward states fit well with the climate of national self-determination in the 1960s. Among the large and growing membership of newly-independent LDCs, the notion that states should and could promote and direct science, with all its economic and military applications, was popular. At the 1963 "United Nations Conference on Science and Technology for the Benefit of Less Developed Areas" the agenda item "organization and planning of scientific and technological policies" "yielded one of the most fruitful discussions in the whole conference."[73] In addition to lauding science policy as an activity, conference delegates stressed the importance of building up in the

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[73] United Nations, Economic and Social Council, 36th session. "Report to the Secretary-General on the results of the United Nations Conference on Science and Technology for the Benefit of Less Developed Areas" (E/3772), annexes, agenda item 15.

developing countries indigenous programmes of research. They argued that "just as no country could develop economically on imported goods, so none could develop intellectually on imported ideas alone."[74] For these states, science as a transnational activity spelled continued dependence. Science had to be a national pursuit to be compatible with the newly created national state and provide the state with means of resisting encroachments from outside.[75]

Such a conception is diametrically opposed to the original understanding of science that prevailed in UNESCO's early years. States were now understood to be the primary purveyors of development and progress, thus it was states, not scientists, who could best bring the fruits of science and technology to their citizens. Scientific knowledge could be translated into increased wealth, security or improved standards of living only if it was harnessed by states and integrated into their larger economic and military establishments. Scientific capacity or "scientific potential" was viewed as a national resource, not as a branch of some larger collectively held international resource.

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[74] United Nations, Economic and Social Council, 36th session. "Report to the Secretary-General on the results of the United Nations Conference on Science and Technology for the Benefit of Less Developed Areas" (E/3772), annexes, agenda item 15, sec.181, p.24.

[75] This interpretation is compatible with the conclusions of Stephen D. Krasner in Structural Conflict: The Third World Against Global Liberalism (Berkeley: University of California Press, 1985.)

This kind of teaching suggests that states' perceptions of interest are malleable and may be shaped, at least in part, by social norms held by the international community. Before 1955, most states had no perception that a science policy bureaucracy was in their interest. Actions by UNESCO persuaded them that making science policy was an appropriate and necessary task of states qua states, regardless of objective science, developmental or security conditions.

Chapter Five

CONCLUSION

Summary of Aims and Findings

This study was undertaken with two principal aims. The first was to demonstrate that theoretical approaches which take the concept of international society seriously and elevate social features of international life to causal status can be tested empirically and systematically against more conventional approaches. The second was to specify more precisely the causal mechanisms whereby these social forces influence state action.

I have argued that rigorous testing of societal versus conventional approaches is possible because the two are based on different underlying logics which produce different expectations about state behavior. This difference in logics is best seen in terms of the structure/agent debate. Varied as they are, societal approaches emphasize the causal power of social structures; social structures shape actors, their preferences and capabilities. More conventional approaches, by contrast, locate causality at the unit level, in actors or agents; it is the interaction of actors that produces social structures, in these views.

These different underlying logics leads partisans of the two approaches to expect different patterns of behavior in the

international system. Specifically, the actor- or agent-driven logic would lead partisans of the more conventional approaches to expect that different actors with different characteristics and functional needs should act differently. Similar action in the face of different characteristics and needs would be anomalous. However, from a societal perspective, such similarities would have a similar cause. Societal forces--beliefs, norms, institutions--may provide similar preferences to dissimilar actors. In this way, actor preferences and, consequently, behavior may not be directly related to internal conditions or functional needs.

The evidence presented in Chapter Two revealed precisely the kind of dissociation between actor characteristics and behavior predicted by the societal approach. It also revealed another relationship that would not necessarily be predicted by a societal approach, and certainly not by a conventional approach. That is that, over time, states undertake this action and create a science policy bureaucracy at lower and lower levels of all relevant conditions.

To investigate in more detail societal influences generally and this negative relationship between internal conditions and action specifically, Chapters Three and Four examined the mechanisms by which this bureaucratic innovation was spread. They described how two international organizations, the OECD and UNESCO, picked up this innovation, which had been pioneered in a few powerful and influential

states, and popularized it. These organizations undertook an extensive set of activities designed to convince states that science bureaucracies were necessary and good, and to "teach" states how to set up such bureaucracies.

In both cases, the organizations' interest in this innovation was the result of the coincidence of two factors. The first of these was a new set of ideas or beliefs about the way science was related to economic growth. Some of these were developed outside the organizations, but the OECD secretariat staff actually played a significant role in articulating and spreading these ideas. The second was a sudden crisis of mission for the organizations. In both cases, political events within and around the organizations conspired so that they were forced to look for new tasks. The OEEC/OECD's role was redefined from one of engine-of-integration to technical-consultant-on-economic-growth; UNESCO's role was redefined to one of serving states rather than communities of international experts. In both cases, for rather different reasons, promoting national science policy bureaucracies provided these organizations with a new mission compatible with their new role.

The result of these organizations' activities was a sudden spurt in adoptions of this bureaucracy among member states that correlates to activities of international organizations and other states, not to internal conditions of states. The finding that states create these bureaucracies at

lower and lower levels of all internal conditions appears to have three contributing causes. First, the initial models for these bureaucracies that inspired both organizations in their efforts were powerful First World states that score high on all the various indicators of internal conditions and lift the front (or left) end of the curve (for example the United Kingdom and the United States.) Second, the OEEC (later OECD) became active in this area slightly earlier than UNESCO and, because OECD was dealing with a much smaller membership at a higher (eg. ministerial) level of government, it was able to establish the new bureaucracies in members a bit more quickly than was UNESCO. Since OECD states as a group are more likely to score high on the various indicators of internal conditions this also lifts the front (or left) end of the curve. Third, many of the least developed states did not actually become states until fairly late in the teaching process under analysis here. This truncation in the sample alone creates a sizable bias in favor of older, First World states as system or societal innovators.

The major finding of the dissertation is thus that state preferences are not necessarily an outgrowth of state characteristics or conditions. The evidence offered here suggests that states are more social entities than is recognized by traditional international relations theory. What states want, even what they <u>are</u>, is not inherent in the state itself. Rather, preferences and the shape of states

themselves are influenced by systemic factors, specifically by beliefs, organizations, institutions and norms within the international system or, perhaps more appropriate, international society. In this case, states were socialized to accept the promotion and direction of science as a necessary and appropriate role by international organizations.

Implications and further research

Because the societal approach investigated here has not yet been well elaborated, the evidence provided by this work that the approach has explanatory power raises as many questions as it answers. Four issues strike me as particularly worthy of discussion since answering them will be essential to any elaboration of the approach.

The first issue grows out of the first aim of the dissertation, described above, and concerns generalizability of these findings and the application of the test for sources of preferences to areas other than science policy. What would happen if one ran a test analogous to that in Chapter Two on a variety of other kinds of state bureaucracies or even, perhaps, state policy adoptions? In theory, one ought to be able to run a large array of such tests which would justify some firmer conclusions about the embeddedness of states in an international society. In practice, of course, there are some difficulties with running this array of tests. The principal problem is finding reasonable and workable independent variables for each dependent variable. For example, to

investigate whether the spread of ministries of culture was correlated to internal conditions it is not clear what quantitative indicators of internal conditions might be relevant. Even if there were some relevant indicator(s), data on that indicator would actually have to exist for a large number of countries over a large number of years to make the test workable. Still, in cases where these difficulties could be overcome, testing in other issue areas would indicate whether the findings in the area of science are unusual or modal.

There is some reason to think that the science findings are not unique. Institutionalists in sociology have done analyses of mass education, expansion of state authority, expansion of citizenship rights, expansion of rights to women, and the use of the census which support arguments about cross-national learning and societal embeddedness of states.[1] In

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[1] John W. Meyer, Francisco Ramirez, Richard Rubinson, and John Boli-Bennett, "The World Educational Revolutions, 1950-1970," Sociology of Education 50 (1977): 242-258; John Boli-Bennett, "Global Integration and the Universal Increase of State Dominance, 1910-1970," in Studies of the Modern World-System, ed. Albert Bergesen (New York: Academic Press, 1980), 77-108; John Boli-Bennett, "The Ideology of Expanding State Authority in National Constitutions, 1870-1970," in National Development and the World System, ed. John Meyer and Michael Hannan (Chicago: University of Chicago Press, 1979), 222-237; Yasemin Soysal, "Limits of Citizenship: Guestworkers in the Contemporary Nation-State System" (Ph.D. diss., Stanford University, 1991); also Yasemin Soysal, "Guestworkers and Citizenship: Towards a Post-National Model of Membership" (Paper presented at the meetings of the American Sociological Association, Washington, D.C., August, 1990); Francisco O. Ramirez and Jane Weiss, "The Political Incorporation of Women," in National Development and the World System, ed. John W. Meyer and Michael Hannan, 238-249. Chicago, University of

political science and elsewhere, studies of the expansion of the welfare state have also documented diffusion effects in that issue area.[2]

Finding similar patterns of systemic diffusion that are uncorrelated to internal conditions exist would lead to a second issue related to the second aim of the dissertation. Are there other mechanisms besides international organizations that transmit these changes through the international system? What are they?

One possibility suggested by the case studies in Chapters Three and Four is that epistemic communities play an important and largely unexplored role in socializing states. Existing work on epistemic communities has demonstrated their ability to insure regime compliance by capturing relevant bureaucracies within individual states.[3] The studies of the

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Chicago Press, 1979. Marc Ventresca, "Counting People when People Count: the Dynamics of Modern Census Formation" (Ph.D. diss., Stanford University, forthcoming.)

[2] Andrew Abbott and Stanley DeViney, "Sequences of Welfare State Development," [1990] Photocopy; David Collier and Richard Messick, "Prerequisites versus Diffusion: Testing Alternative Explanations of Social Security Adoption," American Political Science Review 69 (1975): 1299-1315.

Both of these studies document diffusion effects in the spread of social welfare policies, but neither offers much of a causal argument about why this diffusion process occurs. Thus, neither engages the basic theoretical arguments outlined here in more than a tangential way.

[3] Peter Haas, "Do regimes matter? Epistemic communities and Mediterranean pollution control." International Organization 43 (summer 1989): 377-404.

OECD and UNESCO presented here, however, suggest that these communities may also have significant persuasive powers to set international agendas and disseminate new beliefs. Their status as experts may allow them to establish international norms about appropriate responsibilities or necessary behaviors for international actors. Persuasion by experts, rather than coercion, as a means of ensuring compliance looks suspiciously like socialization. It, again, suggests a more social character for states than conventional approaches easily accommodate.

In doing further research on these transmission mechanisms, it will be important bear in mind the fact that international organizations, in particular, may do more than persuade and socialize. They may coerce states into compliance in ways well understood and well explained by conventional approaches. In instances where international organizations exercise real leverage over states they may induce states to adopt new bureaucratic forms and procedures, not through socialization but, by withholding important goods controlled by the organization. For example, organizations like the World Bank and the International Monetary Fund frequently force developing states to accept fiscal austerity policies and procedures as a price for future aid.

A third issue raised by this research revolves around the interconnectedness of these individual social structures found to be causal in different research enterprises, and whether or

how they should be woven back into a larger understanding of international society. What went on in science policy was almost certainly connected to state expansion of control into other areas of life in post World War II era. The case study of OECD activity makes it clear that expanded state control of science was directly related to expanded state intervention and planning in the economy during that period. One question worth considering as further research is done on these societal influences is whether these connections can be aggregated into any more sweeping understanding of international society.

In some ways this returns to problems raised in Chapter One when the three existing types of societal approaches were considered--the reflectivist, the English School, and the institutionalists in sociology. American political science has tended toward the reflective position which is the most fragmented of the three. The English school speaks of an international society and sociologists working in the institutionalist perspective speak of a global culture or world-system.[4] At present, one reason for adherence to the more fragmented view in American political science seems to be

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[4] Other scholars have argued that other world-systems have existed prior to the current Western rational one that Meyer and his colleagues focus on. These scholars do not, however, argue that multiple or competing world-systems exist concurrently. See, Janet Abu-Lughod, "Restructuring the Premodern World System." Photocopy, n.d.; Janet Abu-Lughod, Before European Hegemony: The World System, AD 1250-1350 (New York & London: Oxford University Press, 1989.)

simply the failure of the discipline to engage the other two positions directly. It may well be that weaving the various societal causal variables into a coherent whole is impossible or unproductive. However, if this is true, the research results and intellectual reasoning supporting this view need to be clearly articulated.

A fourth issue or set of issues raised by this research concerns the underlying nature of a societal approach and its practical implications. The finding that state preferences are malleable and change systematically with changes in the international social structure in which states are embedded points to an intersubjective character of preferences. Preferences are, to at least some degree, socially constructed. Understandings of what is good, legitimate, appropriate, effective or necessary are not something that can always, or perhaps ever, be objectively determined. Rather, the understandings are constructed by actors.

This intersubjective character of preferences poses serious questions for mainstream neorealists and others seeking to build a positivist "science" of politics. The explanatory power of these paradigms depends upon identifying preferences (as well as actors and capabilities) in such a way that these are objective facts that are universally apparent. To the extent that preferences are subjective, and exist as a shared social construction of actors, they cannot be known objectively. A positivist epistemology then becomes of

limited utility and cumulative "scientific" research is threatened.[5]

One of the many features of a societal approach which still needs to be specified is how this intersubjective ontology is to be dealt with epistemologically by researchers. Must positivism be abandoned? If so, what should replace it?

Comparativists and others doing detailed case studies often do abandon strictly postivistic methods, relying on "verstehen" to given them access to intersubjective societal and cultural understandings that then inform their case studies. Clifford Geertz uses something similar in his "thick description."[6]

Institutionalists in sociology, however, are not convinced that positivism is incompatible with a socially-constructed world. In the institutionalist view, most of what

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[5] Kratochwil and Ruggie provide a more extended discussion of this problem in their critique of the study of regimes within neorealism. They describe the fundamental problem as an inconsistency between an intersubjective ontology (one incorporating the "convergent expectations" of regimes) and a positivist epistemology (used by neorealism.) Since intersubjective understandings are not limited to regimes and since positivism underpins much more of social science than just neorealism, the problem identified by Kratochwil and Ruggie applies to a rather broad set of problems, including this one. Friedrich Kratochowil and John G. Ruggie, "International Organization: a state of the art on art of the state," International Organization 40 (1986): 753-775.

[6] Clifford Geertz, "Thick Description: Toward an Interpretive Theory of Culture," chap. in Interpretation of Cultures: Selected Essays by Clifford Geertz (New York: Basic Books, Inc., 1973), 3-30.

social theory has been treating as "real" and "universally apparent," ie. actors, their preferences and capabilities, is in fact socially constructed. Even the individual as an actor is a construct of western culture which has defined it as a relevant social unit and endowed with rights and worth.[7] Social science has been happily applying positivist methods to these social constructions for years. Applying these methods to other social constructions should be equally reasonable, institutionalists argue. Treating cultural phenomena such as norms, ideologies and beliefs as "real" and universally apparent is just as reasonable at treating actors, preferences and capabilities as such since both are socially constructed in one way or another.[8]

Both of these responses to the dilemma posed by an intersubjective ontology have the virtue of providing positive recommendations about research methods. Both also have drawbacks which should be considered carefully. It is not clear how verstehen and thick description can be applied to large-N research problems. Their utility seems limited to detailed case studies. Institutionalists, by contrast, have

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[7] John W. Meyer, "Self and Life Course: Institutionalization and its Effects," in Institutional Structure: Constituting State, Society, and the Individual, ed. George Thomas et al. (Newbury Park, Calif.: Sage, 1987), 242-260.

[8] John W. Meyer, John Boli, and George Thomas, "Ontology and Rationalization in the Western Cultural Account," in Institutional Structure ed. George Thomas et al. (Newbury Park, Calif.: Sage, 1987), 12-37.

concentrated precisely on global research questions and have developed sophisticated quantitative methods to investigate those questions. The drawback to their approach is a philosophical one. Their argument that since both ontologies (theirs of cultural phenomena and the more conventional ontology of actors and preferences) are socially constructed, positive methods can be applied in either case with equal validity could easily be stood on its head. Since both ontologies are socially constructed, perhaps neither can validly be coupled with positivism. Some other epistemological framework is needed, although what that framework would look like is unclear.

This study has combined the two responses, using one to compensate for the shortcomings of the other. It has used a large-N analysis to provide global breadth and then used detailed case studies to provide more intimate data on the intersubjective understandings shared by actors. Given current knowledge, this seemed the most reasonable way to proceed. However, this hybrid strategy does not solve all of the problems described above, particularly the epistemological problems. Developing a research methodology specifically suited to these intersubjective phenomena will require new laying new theoretical groundwork to underpin it. Addressing the four issues outlined here would provide a good start in that endeavor.

BIBLIOGRAPHY

Abbott, Andrew and Stanley DeViney, "Sequences of Welfare State Development," [1990.] Photocopy.

Abu-Lughod, Janet. Before European Hegemony: The World System, AD 1250-1350. New York & London: Oxford University Press, 1989.

_____. "Restructuring the Premodern World System," n.d. Photocopy.

Addison, Christopher. Four and a Half Years: A Personal Diary from June 1914 to January 1919, 2 vols. London: Hutchinson and Co., Ltd., [1934].

Adiseshiah, M.S. "The planned development of scientific research in Africa," Impact of Science on Society 14 (1964): 137-144.

Alker, Hayward Jr. and Thomas Biersteker. "The Dialectics of World Order: Notes for a Future Archeologist of International Savoir Faire," International Studies Quarterly 28 (1989): 121-142.

Alter, Peter. The Reluctant Patron: Science and the State in Britain, 1950-1920. Oxford, Berg, 1987.

Ashley, Richard. "The eye of power: the politics of world modeling," International Organization 37 (1983): 495-535.

_____. "The Poverty of Neorealism." In Neorealism and its Critics, ed. Robert O. Keohane, 255-300. New York: Columbia University Press, 1986.

Auerbach, Lewis. "Scientists in the New Deal: A pre-war episode in the relations between science and government in the United States," Minerva 3 (1965): 457-482.

"Auger of UNESCO," Newsweek, 1 March 1948, 48.

Auger, Pierre. Current Trends in Scientific Research. New York: United Nations, 1961.

_____. "Scientific Cooperation in Western Europe," Minerva 1 (1963): 428-438.

_____. "Unesco and the development of research in the field of the natural sciences," Unesco Chronicle 1 (1955): 3-8.

Axelrod, Robert. "The Emergence of Cooperation Among Egoists," American Political Science Review 75 (1981): 306-318.

_____. The Evolution of Cooperation. New York: Basic Books, Inc., 1983.

_____. "An Evolutionary Approach to Norms," American Political Science Review 80 (1986): 1095-1111.

Axelrod, Robert and Robert Keohane. "Achieving Cooperation Under Anarchy: Strategies and Institutions," World Politics 38 (1985): 226-254.

Ben-David, Joseph. "The Rise and Decline of France as a Scientific Centre," Minerva 8 (1970): 160-179.

_____. "Scientific Growth: A Sociological View," Minerva 2 (1964): 455-476.

_____. "The Scientific Role: The Conditions of its Establishment in Europe," Minerva 4 (1965): 15-54.

Behrman, Daniel. Web of Progress: UNESCO at work in Science and Technology. UNESCO: Paris, 1964.

Bergesen, Albert. "From Utilitarianism to Globology: The Shift from the Individual to the World as a Whole as the Primordial Unit of Analysis." In Studies of the Modern World-System, ed. Albert Bergesen, 1-12. New York: Academic Press, 1980.

Boli, John. "Issues of Sovereignty in the World Polity: An Institutionalist Research Agenda," n.d. Photocopy.

Boli-Bennett, John. "Global Integration and the Universal Increase of State Dominance, 1910-1970." In Studies of the Modern World-System, ed. Albert Bergesen, 77-108. New York: Academic Press, 1980.

_____. 1979. "The Ideology of Expanding State Authority in National Constitutions, 1870-1970." In National Development and the World System, ed. John Meyer and Michael Hannan, 222-237. Chicago: University of Chicago Press, 1979.

Bornschier, Volker, Christopher Chase-Dunn and Richard Rubinson. "Cross-National Evidence of the Effects of Foreign Investment and Aid on Economic Growth and Inequality: A Survey of Findings and a Reanalysis," American Journal of Sociology 84 (1978): 651-683.

British Parliamentary and Scientific Committee, Council of Europe and Organisation for Economic Cooperation and Development. European Parliamentary and Scientific Conference. Strasbourg and Paris: OECD, 1961.

Brown, Lawrence A. Innovation Diffusion: A New Perspective. London: Methuen and Co., Ltd., 1981.

Bull, Hedley. The Anarchical Society. New York: Columbia University Press, 1977.

_____. "The Grotian Concept of International Society." In Diplomatic Investigations: Essays in the Theory of International Relations, ed. Herbert Butterfield and Martin Wight, 51-73. Cambridge, Mass.: Harvard University Press, 1966.

_____. "International Theory: The Case for a Classical Approach." In Contending Approaches to International Politics, ed. Klaus Knorr and James Rosenau, 20-38. Princeton: Princeton University Press, 1969.

_____. "Society and Anarchy in Interntional Relations." In Diplomatic Investigations: Essays in the Theory of International Relations, ed. Herbert Butterfield and Martin Wight, 35-50. Cambridge, Mass.: Harvard University Press, 1966.

Bull, Hedley and Adam Watson. The Expansion of International Society. Oxford: Clarendon Press, 1984.

Bush, Vannevar. Science, The Endless Frontier: Report to the President on a Program for Postwar Scientific Research. Washington, D.C.: U.S. Government Printing Office, 1945.

Carr, Edward H. Twenty Years of Crisis: 1919-1939. London: Macmillan and Company, Ltd., 1939; reprint, New York: Harper & Row, 1964.

Chase-Dunn, Christopher. Global Formation: Structures of the World-Economy. Cambridge, Mass.: Basil Blackwell, 1989.

_____. "Theoretical Approaches to World-Systems Analysis." Paper presented at the annual meetings of the American Political Science Association, San Francisco, September 1990.

Chase-Dunn, Christopher and Richard Rubinson. "Cycles, Trends, and New Departures in World-System Development." In National Development and the World System, ed. John W. Meyer and Michael Hannan, 276-296. Chicago: University of Chicago Press, 1979.

Clark, Ronald. Tizard. London: Methuen & Co. Ltd., 1965.

Clesse, Armand and Archie C. Epps, eds. Present at the Creation: The Fortieth Anniversary of the Marshall Plan. New York: Ballinger, 1990.

Cohen, Michael, James March and Johan Olsen. "A Garbage Can Model of Organizational Choice," Administrative Science Quarterly 17 (1972): 1-25.

Cohen, Raymond. "Rules of the Game in International Politics." International Studies Quarterly 24 (1980): 129-150.

Collier, David and Richard Messick. "Prerequisites versus Diffusion: Testing Alternative Explanations of Social Security Adoption," American Political Science Review 69 (1975): 1299-1315.

Conference on Establishment of National Scientific Organizations held in Ankara, Turkey, June 1962 by the Central Treaty Organization. Beruit, Lebanon: Catholic Press, 1962.

Conseil National de la Politique Scientifique. Inventaire du Potentiel de la Belgique: Annee 1961. Brussels: C.N.P.S., 1964.

_____. Inventaire du Potentiel de la Belgique: Annee 1965. Brussels: C.N.P.S., n.d.

Council of Europe and Organisation for Economic Cooperation and Development. Science and Parliament: Second Parliamentary and Scientific Conference. Paris: OECD, 1965.

de Hemptinne, Y. "The Science Policy of States in Course of Independent Development," Impact of Science on Society 13 (1963): 233-247.

_____. "Unesco's role in the organization of scientific research," Unesco Chronicle 9 (1963): 244-248.

Delacroix, Jacques. The Distributive State in the World System," Studies in Comparative International Development 15 (1980): 3-21.

Dessler, David. "What's at stake in the agent-structure debate?" International Organization 43 (1989): 441-473.

"The Development of Science in Southeast Asia," Nature 186 (1960): 859-860.

"Development of scientific research in the Middle East," UNESCO Chronicle 7 (1961): 99.

Dickson, David. The New Politics of Science. New York: Pantheon Books, 1984.

DiMaggio, Paul. "Interest and Agency in Institutional Theory. In Institutional Patterns and Organizations: Culture and Environment ed. Lynne G. Zucker, 3-21. Cambridge, Mass.: Ballinger, 1988.

DiMaggio, Paul J. and Powell, W. "The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields," American Sociological Review, 48 (1983): 147-160.

Doyle, Michael. "Kant, Liberal Legacies, and Foreign Affairs," Philosophy and Public Affairs 12 (1983): 205-234.

Drysek, John S., Margaret Clark and Garry McKenzie. "Subject and System in International Interaction." International Organization 48 (1989): 475-503.

Dupre, A. Hunter. Science in the Federal Government: A History of Policies and Activities to 1940. Cambridge: Harvard University Press, Belknap Press, 1957.

Edelman, Murray. The Symbolic Uses of Politics. Urbana, Ill.: University of Illinois Press, 1964.

England, J. Merton. A Patron for Pure Science: The National ScienceFoundation's Formative Years: 1945-1957. Washington D.C.: The National Science Foundation, 1982.

European Productivity Agency. Activities for the Year 1958-1959. Paris: OEEC, 1960.

Ferejohn, John. "Rationality and Interpretation: Parliamentary Elections in Early Stuart England," 1990. Photocopy.

"First European Regional Seminar (for French-speaking countries,)" Minerva 1 (1962): 117-123.

Flora, Peter, and Arnold J. Heidenheimer, eds. The Development of Welfare States in Europe and America. New Brunswick and London: Transaction Books, 1981.

Florkin, Marcel. "Ten Years of Science at Unesco," Impact of Science on Society 7 (1956): 123-4.

Freeman, Christopher, Raymond Poignant, and Ingvar Svennilson. "Science, Economic Growth and Government Policy." In Ministers Talk About Science: A Summary and Review of the First Ministerial Meeting on Science, October 1963, ed. Emmanuel G. Mesthene, 95-119. Paris: OECD, 1965.

Gaddis, John Lewis. Stratigies of Containment. Oxford: Oxford University Press, 1982.

Geertz, Clifford. Negara: The Theater-State in Ninteenth Century Bali. Princeton: Princeton University Press, 1980.

_____. "Thick Description: Toward an Interpretive Theory of Culture." In Interpretation of Cultures: Selected Essays by Clifford Geertz, 3-30. New York: Basic Books, Inc., 1973.

Geimer, H. and R. Geimer. Research Organisation and Science Promotion in the Federal Republic of Germany. New York: K.G. Saur, 1981.

"General policy for UNESCO's scientific activities up to 1970," UNESCO Chronicle 7 (1961): 53-56.

Gilpin, Robert. U.S. Power and the Multinational Corporation: The Political Economy of Direct Foreign Investment. New York: Basic Books, Inc., 1975.

_____. France in the Age of the Scientific State. Princeton: Princeton University Press, 1968.

Goldstein, Judith. "The Impact of Ideas on Trade Policy," International Organization 43 (1989): 31-71.

"The Government and Chemical Research," Nature 95 (1915): 295.

Grader, Sheila. "The English School of International Relations: evidence and evaluation," Review of International Studies 14 (1988): 29-44.

Graham, Loren R. "The Development of Science Policy in the Soviet Union." In Science Policies of Industrial Nations, ed. T. Dixon Long and Christopher Wright, 12-58. New York: Praeger Publishers, 1975.

Groueff, Stephane. The Manhattan Project: The Untold Story of the Making of the Atomic Bomb. Boston: Little, Brown and Co., 1967.

Gummett, Philip. Scientists in Whitehall. Manchester, England: Manchester University Press, 1980.

Haas, Ernst. When Knowledge is Power: Three Models of Change in International Organizations. Berkeley, Calif.: University of California Press, 1990.

_____. "Words can hurt you; or, who said what to whom about regimes." In International Regimes, ed. Stephen D. Krasner, 23-59. Ithaca, N.Y.: Cornell University Press, 1983.

Haas, Peter M. "Do regimes matter? Epistemic communities and Mediterranean pollution control," International Organization 43 (1989): 377-404.

Haggard, Stephan and Beth Simmons. "Theories of International Regimes," International Organization 41 (1987): 491-517.

Hannan, Michael and John Freeman. "The Population Ecology of Organizations," American Journal of Sociology 82 (1977): 929-966.

Hartz, Louis. The Liberal Tradition in America. New York: Harcourt, Brace, 1955.

Heclo, Hugh. Modern Social Politics in Britain and Sweden. New Haven & London: Yale University Press, 1974.

Herman, Ros. The European Scientific Community. Harlow, England: Longman Press, 1986.

Herrera, Amilcar. "Social Determinants of Science Policy in Latin America: Explicit Science Policy and Implict Science Policy." In Science, Technology and Development, ed. Charles Cooper, 19-37. London: Frank Cass, 1973.

Hogan, Michael. The Marshall Plan: America, Britian, and the Reconstruction of Western Europe, 1947-1952. Cambridge: Cambridge University Press, 1987.

Hoggart, Richard. An Idea and its servants: Unesco from within. New York: Oxford University Press, 1978.

Hoffman, Stanley. The Political Ethics of International Relations. New York: Carnegie Council on Ethics and International Affairs, 1988.

Hutchinson, Eric. "Scientists as an Inferior Class: The Early Years of the DSIR," Minerva 8 (1970): 396-411.

Huxley, Julian. Unesco: Its Purpose and its philosophy. Washington, D.C.: Public Affairs Press, 1947.

Ikenberry G. John and Charles A. Kupchan. "Socialization and Hegemonic Power," International Organization 44 (1990): 283-315.

Jepperson, Ronald L. "Institutions, Institutional Effects, and Institutionalism." In The New Institutionalism in Organizational Analysis, ed. Walter W. Powell and Paul J. DiMaggio, 143-163. Chicago: University of Chicago Press, 1991.

Jervis, Robert. "Cooperation under the security dilemma," World Politics 30 (1978): 167-214.

Jones, Joseph. The Fifteen Weeks: An Inside Account of the Genesis of the Marshall Plan. New York: Viking Press, 1955.

Jones, Roy E. "The English School of International Relations: a case for closure," Review of International Studies 7 (1981): 1-13.

Kaempffert, Waldemar. Should the Government Support Science? New York: Public Affairs Committee, 1946.

Kamens, David H. and Tormod K. Lunde. "Institutionalizing Theory and the Expansion of Central State Organizations, 1960-1980." In Institutional Patterns and Organizations: Culture and Environment, ed. Lynne G. Zucker, 169-195. Cambridge, Mass.: Ballinger, 1988.

Kant, Immanuel. "Perpetual Peace." 1795. Reprinted in On History, ed. Lewis Beck White, 85-135. The Library of Liberal Arts. Indianapolis, Ind.: Bobbs-Merrill, 1963.

Kaplan, Morton. "The New Great Debate: Traditionalism vs. Science in International Relations." In Contending Approaches to International Politics, ed. Klaus Knorr and James Rosenau, 39-61. Princeton: Princeton University Press, 1969.

Kennedy, Paul. The Rise and Fall of Great Powers: Economic Change and Military Conflict, 1500-2000. New York: Vintage Books, 1989.

[Kennen, George.] The Sources of Soviet Conduct. Foreign Affairs 25 (1947): 566-582.

Kenney, Elinor M. The Origin of the Marshall Plan. Los Angeles: Bookman Press, n.d.

Keohane, Robert O. After Hegemony: Cooperation and Discord in the World Political Economy. Princeton: Princeton University Press, 1984.

_____. Neorealism and its Critics. New York: Columbia University Press, 1986.

_____. "International Institutions: Two Approaches," International Studies Quarterly 32 (1988): 379-396.

Keohane, Robert and Joseph Nye. Power and Interdependence: World Politics in Transition. Boston: Little, Brown & Co., 1977.

_____, eds. Transnational Relations and World Politics. Cambridge: Harvard University Press, 1972.

Kevles, Daniel J. The Physicists: The History of a Scientific Community in Modern America. New York: Alfred A. Knopf, 1978.

Kindleberger, Charles P. "European Economic Integration." In Money, Trade and Economic Growth: Essays in Honor of John Henry Williams, 58-75. New York: The Macmillan Company, 1951.

King, Alexander. "The Dilemma of Science Policy." The Round Table 247 (1972): 339-354.

_____. "International Scientific Cooperation." Impact of Science on Society 4 (1953): 189-220.

_____. "A Policy for Science." OECD Observer, January 1963, 19-23.

_____. Science and Policy: The International Stimulus. Oxford: Oxford University Press, 1974.

_____. "Science and the Changing Face of Industry." Impact of Science on Society 7 (1956): 3-33.

_____. "Science in the OECD." In Ministers Talk About Science: A Summaryand Review of the First Ministerial Meeting on Science, October 1963, ed. Emmanuel G. Mesthene, 17-24. Paris: OECD, 1965.

_____. "Towards a National Science Policy," Impact of Science on Society 12 (1962): 157-175.

Knorr, Klaus and James Rosenau, eds. Contending Approaches to International Politics. Princeton: Princeton University Press, 1969.

Kovda, Victor. "The Natural Sciences Programme," UNESCO Chroncle 6 (1960): 396-403.

Krasner, Stephen D. Defending the National Interest: Raw Materials Investments and U.S. Foreign Policy. Princeton: Princeton University Press, 1978.

_____, ed. International Regimes. Ithaca, N.Y.: Cornell University Press, 1983.

_____. Structural Conflict: The Third World Against Global Liberalism. Berkeley, Calif.: University of California Press, 1985.

Kratochwil, Friedrich. Rules, Norms and Decisions. Cambridge: Cambridge University Press, 1989.

Kratchowil, Friedrich and John G. Ruggie. "International Organization: a state of the art on art of the state," International Organization 40 (1986): 753-775.

Lakatos, Imre. "Falsification and the Methodology of Scientific Research Programmes." In Criticism and the Growth of Knowledge, ed. Imre Lakatos and Alan Musgrave, 91-180. Cambridge: Cambridge University Press, 1970.

Lakoff, Sanford. "Scientists, Technologists and Political Power." In Science, Technology and Society: A Cross-Disciplinary Perspective, ed. Ina Spiegel-Rosing and Derek de Solla Price, 355-392. London: Sage Publications, 1977.

Latin American Newsletters Limited. Science and Technology in Latin America. New York: Longman Press, 1983.

Langrod, Georges. The International Civil Service, trans. F. G. Berthoud. Leyden: A.W. Sythoff, 1963.

Larson, Deborah Welch. Origins of Containment: A Psychological Explanation. Princeton: Princeton University Press, 1985.

Laves, Walter and Charles Thomson. UNESCO: Purpose, Progress, Prospects. Bloomington, Ind.: University of Indiana Press, 1957.

LeFeber, Walter. America, Russia and the Cold War. New York: Wiley, 1980.

Lefevre, Theo. Memo from Belgium: Scientific Research Programming. Brussels: Ministry of Foreign Affairs and External Trade, 1963.

Levitt, Barbara and James March. "Organizational Learning," Annual Review of Sociology 14 (1988): 319-340.

Long, T. Dixon and Christopher Wright, eds. Science Policies of Industrial Nations. New York: Praeger, 1975.

Luck, James M. Science in Switzerland. New York: Columbia University Press, 1967.

Lunde, Tormod. "The State in a Cross-National Perspective: Growth, Inertia, and Internal Competition." Ph.D diss., Stanford University, Stanford, Calif., 1987.

Maier, Charles S. "The Politics of Productivity: Foundations of American International Economic Policy after World War II." In Between Power and Plenty: Foreign Economic Policies of Advanced Industrial States, ed. Peter J. Katzenstein, 23-49. Madison, Wisc.,: University of Wisconsin Press, 1978.

March, James and Johan P. Olsen. "Garbage Can Models of Decision Making in Organizations." In Ambiguity and Command: Organizatyinoal Perspectives on Military Decision Making, ed. James March and R. Weissinger-Baylon. Cambridge, Mass.: Ballinger, 1986.

_____. "The New Institutionalism: Organizational Factors in Political Life," American Political Science Review 78 (1984): 734-747.

_____. Rediscovering Institutions: The Organizational Basis of Politics. New York: Free Press, 1989.

_____. "What Administrative Reorganization Tells Us About Governing," American Political Science Review 77 (1983): 281-296.

Margalit-Ulman, Edna. The Emergence of Norms. Oxford: Clarendon Press, 1977.

Marshall, George C. "Address at Harvard Commencement, 5 June 1947." In Present at the Creation: The Fortieth Anniversary of the Marshall Plan, ed. Armand Clesse and Archie C. Epps, xv-xix. New York: Ballinger, 1990.

McElroy, Robert W. Morality and American Foreign Policy: The Role of Moral Norms in International Affairs. Princeton: Princeton University Press, forthcoming.

McLaughlin, G.H. "Research into the acceptance of technical change," Nature 198 (1963): 238-239.

McLeod, Roy and E. Kay Andrews. "The Origins of the D.S.I.R.: Reflections on Ideas and Men, 1915-1916," Public Administration 48 (1970): 23-48.

"Meeting of directors of national scientific research centres," UNESCO Chronicle 1 (1955): 26-27.

Mesthene, Emmanuel G., ed. Ministers Talk About Science: A Summary and Review of the First Ministerial Meeting on Science, October 1963. Paris: OECD, 1965.

Meyer, John W. "Self and Life Course: Institutionalization and its Effects." In Institutional Structure: Constituting State, Society, and the Individual, ed. George Thomas et al., 242-260. Newbury Park, Calif.: Sage, 1987.

_____. "The World Polity and the Authority of the Nation-State." In Studies of the Modern World-System, ed. Albert Bergesen, 109-137. New York: Academic Press, 1980.

Meyer, John W., John Boli, and George Thomas. "Ontology and Rationalization in the Western Cultural Account." In Institutional Structure ed. George Thomas et al., 12-37. Newbury Park, Calif.: Sage, 1987.

Meyer, John W. and Michael Hannan, eds. National Development and the World System. Chicago: University of Chicago Press, 1979.

_____. "National Development in a Changing World System: An Overview." In National Development and the World System, ed. John W. Meyer and Michael Hannan, 3-16. Chicago: University of Chicago Press, 1979.

Meyer, John W., Michael Hannan, Richard Rubinson and George Thomas. "National Economic Development, 1950-1970: Social and Political Factors." In National Development and the World System, ed. John W. Meyer and Michael Hannan, 85-116. Chicago: University of Chicago Press, 1979.

Meyer, John W., Francisco Ramirez, Richard Rubinson, and John Boli-Bennett. "The World Educational Revolutions, 1950-1970," Sociology of Education 50 (1977): 242-258.

Meyer, John W., and Brian Rowan. "Institutionalized Organizations: Formal Structure as Myth and Ceremony," American Journal of Sociology 84 (1977): 440-463.

Meyer, John W., W. Richard Scott, David Strang, and Andrew L. Creighton. "Bureaucratization without Centralization: Changes in the Organizational System of U.S. Public Education." In Institutional Patterns and Organizations: Culture and Environment, ed. Lynne G. Zucker, 139-167. Cambridge, Mass.: Ballinger, 1988.

Milward, Alan S. The Reconstruction of Western Europe, 1945-1951. London: Methuen and Co. Ltd., 1984.

"Ministerial Meeting on Science." OECD Observer, December 1963, 41-2.

"Ministers Talk about Science." OECD Observer, October 1963, 36-7.

Ministere de la Recherche et de la Technologie, "Ministere de la Recherche et de la Technologie" pamphlet, 1990.

Moller, Werner. "National Research Councils and Science Policy," Impact of Science on Society 6 (1955): 155-168.

National Science Foundation. The Science and Technology Resources of West Germany. NSF 86-310. Washington D.C.: U.S. Government Printing Office, 1986.

Needham, Joseph. "An International Science Co-operation Service," Nature 154 (25 November 1944): 657-659.

Nielsen, Francois and Michael Hannan. The Expansion of National Education Systems: Tests of a Population Ecology Model," American Sociological Review 42 (1977): 479-490.

Nora, S. Toward a Single Energy Policy: Individual National Policies vs. a Concerted European Policy. Lecture by S. Nora at the Centre Europeen Universitaire de Nancy, 24and 28 April, 1961. Doc. No. 4444/61e.

OECD. Analytical Methods in Government Science Policy. OECD: Paris, 1972.

_____. Country Reports on the Organization of Scientific Research. Paris: OECD, [1967].

_____. Fundamental Research and the Policies of Governments. Paris: OECD, 1966.

_____. Government and Technological Innovation. Paris: OECD, 1966.

_____. Government and Allocation of Resources to Science. Paris: OECD, 1966.

_____. Problems of Science Policy: Seminar held at Jouy-en-Josas (France), 19-25 February, 1967. Paris: OECD, 1967.

_____. Reviews of National Science Policy: Australia. Paris: OECD, 1977.

_____. Reviews of National Science Policy: Austria. Paris: OECD, [1971].

_____. Reviews of National Science Policy: Belgium. Paris: OECD, [1965].

_____. Reviews of National Science Policy: Canada. Paris: OECD, 1969.

_____. Reviews of National Science Policy: Finland. Paris: OECD, 1987.

_____. Reviews of National Science Policy: France. Paris: OECD, [1966].

_____. Reviews of National Science Policy: Greece. Paris: OECD, 1984.

_____. Reviews of National Science Policy: Iceland. Paris: OECD, 1972.

_____. Reviews of National Science Policy: Iceland. Paris: OECD, 1983.

_____. Reviews of National Science Policy: Ireland. Paris: OECD, 1974.

_____. Reviews of National Science Policy: Italy. Paris: OECD, 1969.

_____. Reviews of National Science Policy: Japan. Paris: OECD, 1967.

_____. Reviews of National Science Policy: Netherlands. Paris: OECD, 1973.

_____. Reviews of National Science Policy: Norway. Paris: OECD, 1971.

_____. Reviews of National Science Policy: Norway. Paris: OECD, 1985.

_____. Reviews of National Science Policy: Spain. Paris: OECD, 1971.

_____. Reviews of National Science Policy: Sweden. Paris: OECD, 1964.

_____. Reviews of National Science Policy: Switzerland. Paris: OECD, 1971.

_____. Reviews of National Science Policy: United Kingdom and Germany. Paris: OECD, 1967.

_____. Reviews of National Science Policy: United States. Paris: OECD, 1968.

_____. Reviews of National Science Policy: U.S.S.R. Paris: OECD, 1969.

_____. Reviews of National Science Policy: Yugoslavia. Paris: OECD, 1976.

_____. Reviews of National Science and Technology Policy: Australia. Paris: OECD, 1986.

_____. Reviews of National Science and Technology Policy: Austria. Paris: OECD, 1988.

_____. Reviews of National Science and Technology Policy: Denmark. Paris: OECD, 1988.

_____. Reviews of National Science and Technology Policy: Finland. Paris: OECD, 1987.

_____. Reviews of National Science and Technology Policy: Netherlands. Paris: OECD, 1987.

_____. Reviews of National Science and Technology Policy: Portugal. Paris: OECD, 1986.

_____. Reviews of National Science and Technology Policy: Sweden. Paris: OECD, 1987.

_____. Reviews of National Science and Technology Policy: Switzerland. Paris: OECD, 1989.

_____. Review of National Scientific and Technical Information Policy: Ireland. Paris: OECD, 1974.

_____. Science and Development: National Reports of the Pilot Teams: Greece. Paris: OECD, n.d.

_____. Science and Parliament: Second Parliamentary and Scientific Conference organized jointly by the Council for Europe and the Organisation of Economic Co-operation and Development. Paris: OECD, 1965.

_____. Science and the Policies of Governments. Paris: OECD, 1963.

_____. Science, Economic Growth and Government Policy. Paris: OECD, 1963.

_____. Science, Growth and Society. Paris: OECD, 1971.

_____. Science Policy Information. vols. 2-5. Paris: OECD, [1968.]

OEEC. Economic Progress and Problems of Western Europe. Paris: OEEC, 1951.

_____. European Economic Co-operation. Paris: OEEC, 1951.

_____. Organisation for European Economic Co-operation: History and Structure. Paris: OEEC, 1948.

_____. The Organisation of Applied Research in Europe: Proceedings of the Conference held at Nancy, 11th-13th October, 1954. Paris: OEEC, 1955.

_____. The Organisation of Applied Research in Europe, the United States and Canada,: Report of Technical Assistance Missions Nos. 81-82-83. Paris: OEEC, 1954.

_____. The Problem of Scientific and Technical Manpower in Western Europe, Canada and the United States. Paris: OEEC, 1957.

_____. Report to the Economic Co-operation Administration on the First Annual Programme. Paris: OEEC, 1949.

_____. Report to the Economic Co-operation Administration on the Second Annual Programme. Paris: OEEC, 1950.

_____. Scientific Manpower for Applied Research. Paris: OEEC, 1957.

Olson, Mancur. The Logic of Collective Action. Cambridge: Harvard University Press, 1965.

"Organization of Scientific Research in Latin America," Nature 188 (1960): 1157-1158.

Penick, James L., Carroll W. Pursell, Morgan B. Sherwood and Donald W. Swain, eds. The Politics of American Science: 1939 to the Present. Cambridge: MIT Press, 1965.

Perrow, Charles. Complex Organizations. 3rd ed. New York: Random House, 1986.

Pfetsch, Frank. "Scientific Organisation and Science Policy in Imperial Germany, 1871-1914: The Foundation of the Imperial Institute of Physics and Technology," Minerva 8 (1970): 557-580.

Piganiol, Pierre. "Scientific Policy and the European Community," Minerva 6 (1968): 354-365.

Piganiol, Pierre and Louis Villecourt. Pour une politique scientifique. Paris: Flammarion, 1963.

Postan, M.M. An Economic History of Western Europe, 1945-1964. London: Methuen & Co. Ltd., 1967.

Preston, William. Hope and Folly: The United States and Unesco, 1945-1985. Minneapolis: University of Minnesota Press, 1989.

Puchala, Donald J. and Raymond F. Hopkins. "International Regimes: lessons from inductive analysis." In International Regimes ed. Stephen D. Krasner, 61-92. Ithaca, N.Y.: Cornell University Press, 1983.

Ramirez, Francisco O. and Jane Weiss. "The Political Incorporation of Women." In National Development and the World System, ed. John W. Meyer and Michael Hannan, 238-249. Chicago, University of Chicago Press, 1979.

"The Relationship between Science and Economic Growth." OECD Observer, December 1963, 14-18.

"Reports and Documents: Survey of national research councils for pure and applied science in the member states of UNESCO," Impact of Science on Society 4 (1953): 231-255.

Rochester, J. Martin. "The rise and fall of international organization as a field of study," International Organization 40 (1986): 777-813.

Roderick, Hilliard. "The Future of Natural Sciences Programme of Unesco," Nature 195 (1962): 215-22.

Rosecrance, Richard. The Rise of the Trading State. New York: Basic Books, 1986.

Rosenau, James N. "Before cooperation: hegemons, regimes, and habit-driven actors in world politics," International Organization 40 (1986): 849-894.

Royane, Jarlath. Science in Government. London: Edward Arnold, 1984.

Ruggie, John G. "Continuity and Transformation in the World Polity: Toward a Neorealist Synthesis." In Neorealism and its Critics, ed. Robert Keohane, 131-157. New York: Columbia University Press, 1986.

_____. "International Regimes, Transactions, and Change: embedded liberalism in the post-war economic order." In International Regimes, ed. Stephen D. Krasner, 195-232. Ithaca, N.Y.: Cornell University Press, 1983.

Salomon, Jean-Jacques. "International Scientific Policy," Minerva 2 (1964): 411-434.

_____. Science et Politique. Paris: Aux Editions du Seuil, 1970.

_____. "Science Policy Studies and the Development of Science Policy." In Science, Technology and Society: A Cross-Disciplinary Perspective, ed. Ina Spiegel-Rosing and Derek de Solla Price, 43-70. London: Sage Publications, 1977.

Sapolsky, Harvey. "Science, Technology and Military Policy." In Science, Technology and Society: A Cross-Disciplinary Perspective ed. Ina Spiegel-Rosing and Derek de Solla Price, 443-472. London: Sage Publications, 1977.

Sathyamurthy, T.V. The Politics of International Cooperation: Contrasting Conceptions of UNESCO. Geneva: Libraire Droz, 1964.

Schlesinger, Arthur Jr. "Origins of the Cold War." Foreign Affairs 46 (1967): 22-52.

"Science in the Foreign Service," Nature 155 (17 February 1945): 187-8.

"Science Planning, Development and Cooperation in the Countries of the Middle East and North Africa," Nature 189 (1961): 362-64.

Scott, W. Richard. "The Adolescence of Institutional Theory," Administrative Science Quarterly 32 (1987): 493-511.

"Second European Regional Seminar (for German-speaking countries,)" Minerva 1 (1962): 123-131.

Sewell, James P. Unesco and World Politics. Princeton: Princeton University Press, 1975.

_____. "UNESCO: Pluralism Rampant." In The Anatomy of Influence, ed. Robert W. Cox and Harold K. Jacobson, 139-174. New Haven: Yale University Press, 1973.

Simon, Herbert. Administrative Behavior. 3rd ed. New York: Free Press, 1976.

_____. "A Behavioral Model of Rational Choice," Quarterly Journal of Economics 69 (1955): 99-118.

Skocpol, Theda. "States and Social Policies," Annual Review of Sociology 12 (1986): 131-157.

_____. "Wallerstein's World Capitalist System: A Theoretical and Historical Critique," American Journal of Sociology 82 (1977): 1075-1090.

Smith, Bruce L.R. American Science Policy Since World War II Washington D.C.: The Brookings Institution, 1990.

Soysal, Yasemin. "Guestworkers and Citizenship: Towards a Post-National Model of Membership." Paper presented at the meetins of the American Sociological Association, Washington, D.C., August, 1990.

Spiegel-Rosing, Ina and Derek de Solla Price, eds. Science, Technology and Society: A Cross-Disciplinary Perspective. London: Sage Publications, 1977.

Stoff, Michael B., Johathan F. Fanton and R. Hal Williams, eds. The Manhattan Project: A Documentary Introduction to the Atomic Age. Philadelphia: Temple University Press, 1991.

Strang, David. "Diffusion and Social Structure: Empire and Region in Decolonization," 1989. Photocopy.

_____. "The Grammar of Sovereignty." Ph.D. diss., Stanford University, Stanford, Calif., 1988.

Strange, Susan. "Cave! hic dragones: a critique of regime analysis." In International Regimes, ed. Stephen D. Krasner, 337-354. Ithaca, N.Y.: Cornell University Press, 1983.

"Survey of national research councils for pure and applied science in the member states of UNESCO," Impact of Science on Society 4 (1953): 231-255.

Teitel, Simon. "Science and Technology Indicators, Country Size and Economic Development: An International Comparison," World Development 15 (1987): 1225-1235.

Thomas, George M. and John W. Meyer. "The Expansion of the State," American Review of Sociology 10 (1984): 461-482.

_____. "Regime Changes and State Power in an Intensifying World-State-System." In Studies of the Modern World-System, ed. Albert Bergesen, 139-158. New York: Academic Press, 1980.

Thomas, George, John W. Meyer, Francisco O. Ramirez and John Boli, eds. Institutional Structure: Constituting State, Society, and the Individual. Newbury Park, Calif: Sage, 1987.

Thomson, Janice E. "The State, Sovereignty and International Violence: The Institutional and Normative Basis of State Control over External Violence." Ph.D. diss., Stanford University, Stanford, Calif, 1988.

Tilly, Charles, ed. The Formation of National States in Western Europe. Princeton: Princeton University Press, 1975.

Tolbert, Pamela S. and Lynne G. Zucker. "Institutional Sources of Change in the Formal Structure of Organizations: The Diffusion of Civil Service Reform, 1880-1935," Administrative Science Quarterly 28 (1983): 22-39.

Tuma, Nancy Brandon and Michael T. Hannan. Social Dynamics: Models and Methods. Orlando, Fla.: Academic Press, 1984.

United Nations. Economic and Social Council, 36th session. "Report to the Secretary-General on the results of the United Nations Conference on Science and Technology for the Benefit of Less Developed Areas" (E/3772), annexes, agenda item 15.

United Nations. Economic and Social Council, 37th session, supp. 14. "Report of the Advisory Committee on the Application of Science and Technology to Development on the first session" (E/3866), agenda item 8.

United Nations. Economic and Social Council, 39th session, supp. 14 May 1965. "Second Report of the Advisory Committee on the Application of Science and Technology to Development" (E/4026.)

"United Nations Research Laboratories," Nature 164 (1949): 1120-1121.

"UNESCO and the Geneva Conference on the Application of Science and Technology," UNESCO Chronicle 9 (1963): 85-98.

"UNESCO's contribution to the United Nations' Development Decade," UNESCO Chronicle 9 (1963): 45-53.

UNESCO. Comparative study on the national science and technology policy-making bodies in the countries of West Africa. Science Policy Studies and Documents, vol. 58. Paris: UNESCO, 1986.

_____. Conference for the Establishment of the United Nations Educational, Scientific and Cultural Organization. London: UNESCO, 1946.

_____. Final Report of the Lagos Conference. Paris: UNESCO, 1964.

_____. General Conference, 11th Session, 1960. Resolutions. Paris: UNESCO, 1960.

_____. General Conference, 13th Session, 1964. Resolutions. Paris: UNESCO, 1964.

_____. General Conference, 14th Session, 1966. Resolutions. Paris: UNESCO, 1966.

_____. General Conference, 15th Session, 1968. Resolutions. Paris: UNESCO, 1968.

_____. General Conference, 16th Session, 1970. Resolutions. Paris: UNESCO, 1970.

_____. In the Minds of Men: UNESCO, 1946-1971. Paris: UNESCO, 1972.

_____. Informes nacionales y subregionales de politica cientifica y tecnologica en America Latina y el Caribe. Science Policy Studies and Documents, vol. 54. Paris, UNESCO, 1983.

_____. La politique scientifique et l'organisation de la recherche scientifique en Belgique. Science Policy Studies and Documents, vol. 1. Paris: UNESCO, 1965.

_____. La politique scientifique et l'organisation de la recherche en France. Science Policy Studies and Documents, vol. 24. Paris: UNESCO, 1971.

_____. Looking at UNESCO. Paris: UNESCO, 1971.

_____. National Science and Technology Policies in Europe and North America. Science Policy Studies and Documents, vol. 43. Paris: UNESCO, 1979.

_____. Principles and Problems of National Science Policies. Science Policy Studies and Documents, vol. 5. Paris: UNESCO, 1966.

"UNESCO Science Cooperation Offices," UNESCO Chronicle 7 (1961): 433-435.

_____. Structural and Operation Schemes of National Science Policy. Science Policy Studies and Documents, vol. 6. Paris: UNESCO, 1967.

_____. UNESCO on the eve of its 40th anniversary. Paris: UNESCO, 1985.

_____. World directory of national science policy-making bodies: Asia and Ocieania. Paris: UNESCO, 1968.

_____. World directory of national science policy-making bodies: Europe and North America. Paris: UNESCO, 1966.

_____. World directory of national science policy-making bodies: Latin America Paris: UNESCO, 1968.

_____. World Directory of National Science Policy-making Bodies. Science Policy Studies and Documents, vol. 59. Paris: UNESCO, 1984.

_____. World Directory of National Science and Technology Policy Making Bodies, 2nd ed. Science Policy Studies and Documents, vol. 71. Paris: UNESCO, 1990.

U.S. Congress. House. Committee on Science and Technology. Task Force on Science Policy. A History of Science Policy in the United States, 1940-1985. Science Policy Study Background Report No. 1. 99th Cong., 2d sess., 1986. Serial R.

Van de Ven, Andrew H. and William F. Joyce, eds. Perspectives on Organization Design and Behavior. New York: John Wiley & Sons, 1981.

Varcoe, Ian. "Scientists, Government and Organized Research in Great Britain 1914-1916: The Early History of the DSIR," Minerva 8 (1970): 192-216.

Ventresca, Marc. "Counting People when People Count: the Dynamics of Modern Census Formation." Ph.D diss., Stanford University, Stanford, Calif., forthcoming.

Walker, Jack L. "The Diffusion of Innovations among the American States," American Political Science Review 61 (1967): 880-899.

Wallerstein, Immanuel. The Modern World-System, vol. I. New York: Academic Press, 1974.

_____. "The Rise and Future Demise of the World Capitalist System," Comparative Studies in Society and History 16 (1974): 387-415.

Waltz, Kenneth. Theory of International Politics. New York: Random House, 1979.

Warner, Sam Bass. Province of Reason. Cambridge: Harvard University Press, Belknap Press, 1984.

Wendt, Alexander. "The Agent-structure problem in international relations," International Organization 41 (1987): 335-370.

Wight, Martin. "Why is there no international relations theory?" In Diplomatic Investigations: Essays in the Theory of International Relations, ed. Herbert Butterfield and Martin Wight, 17-34. Cambridge: Harvard University Press, 1966.

Wightman, D. Economic Cooperation in Europe. London: Stevens, 1956.

Wilgress, Dana. Cooperation in Scientific and Technical Research. Paris: OEEC, 1960.

Williamson, Oliver E. The Economic Institutions of Capitalism. New York: The Free Press, 1985.

_____. Markets and Hierarchies. New York: Free Press, 1975.

Wilson, Peter. "The English School of International Relations: a reply to Sheila Grader," Review of International Studies 15 (1989): 49-58.

World Bank, World Tables, 1976. Baltimore: Johns Hopkins University Press, 1976.

Wuthnow, Robert. Meaning and Moral Order: Explorations in Cultural Analysis. Berkeley, Calif.,: University of California Press, 1987.

_____. "The World Economy and the Institutionalization of Science in Seventeenth-Century Europe." In Studies of the Modern World-System, ed. Albert Bergesen, 25-55. New York: Academic Press, 1980.

_____. "World Order and Religious Movements." In Studies of the Modern World-System, ed. Albert Bergesen, 57-76. New York: Academic Press, 1980.

Young, Oran. International Cooperation: Building Regimes for Natural Resources and the Environment. Ithaca, N.Y.: Cornell University Press, 1989.

Zald, Mayer N. "Review Essay: The New Institutional Economics," American Journal of Sociology 93 (1987): 701-8.

Zolberg, Aristide. "Origins of the Modern World System," World Politics 33 (1981): 253-281.

Zucker, Lynne G. ed. Institutional Patterns and Organizations: Culture and Environment. Cambridge, Mass.: Ballinger, 1988.

_____. "Institutional Theories of Organizations." American Review of Sociology 13 (1987): 443-464.

_____. "Introduction: Institutional Theories of Organization--Conceptual Development and Research Agenda." In Institutional Patterns and Organizations: Culture and Environment, ed. Lynne Zucker, xiii-xix. Cambridge, Mass.: Ballinger, 1988.

_____. "Where do Institutional Patterns Come From? Organizations as Actors in Social Systems." In Institutional Patterns and Organizations: Culture and Environment, ed. Lynne Zucker, 23-49. Cambridge, Mass.: Ballinger, 1988.

UNESCO archival material

"A proposed programme (1965-1966) for long-term science policy consultants to governments." UNESCO archives, doc. NS/ROU/67, June 12, 1964.

"Activities of UNESCO in the Natural Sciences during 1948." UNESCO archives, doc. NS/67, Feb. 14, 1949.

"Aid program to national Scientific Development." UNESCO archives, doc. NS.ROU/16 prov. Apr. 5, 1962.

"Assistance to member states in national science policy: Progress report on activities in 1966." UNESCO archives, doc. NS/ROU/138, Dec. 30, 1966.

"Avant-projet de loi portant creation d'un 'Conseil National de la Recherche Scientifique' au Liban." Redige en aout 1961 par M.Y. de Hemptinne, Chef du Groupe d'organisation de la recherche scientifique de l'UNESCO. NS/ROU/7. Feb. 8, 1962.

"Avant-projet de loi portant creation d'un 'Conseil National de la Recherche Scientifique.'" Redige en novembre 1961 par la Commission Scientifique Nationale du Liban avec la collaboration de F. Charles Boschloos, expert de l'UNESCO. NS/ROU/8, Feb. 8, 1962.

"Avant-projet de loi portant creation d'un Conseil National de la Recherche Scientifique au Liban." Synthese des avant projects de loi etablis par M.Y. de Hemptinne, Chef du Groupe d'organisation de la recherche scientifique de l'UNESCO et par la Commission Scientifique Nationale du Liban. NS/ROU/10. Feb. 8, 1962.

Bellinger, Frederick. "Summary Report on Development of the Research Program of the National Research Center of Egypt, Sept. 1955-July 1956." UNESCO archives, BMS Reports.

"Commentaires de l'UNESCO sur l'avant-projet de loi portant creation d'un 'Conseil National de la Recherche Scientifique' redige en novembre 1961 par la Commission Scientifique Nationale du Liban." NS/ROU/9, Feb. 8, 1962.

"Considerations on the concept of science policy." UNESCO archives, doc. NS/ROU/105/PR, Apr. 15, 1966.

"Field science cooperation offices." UNESCO archives, doc. Nat. Sci./28, June 12, 1947.

Garcia, R.V. United Arab Republic: Government Structures for Science Policy, serial number 1342/BMS.RD/SCP, Paris, July 1969.

Koupalov-Yaropolk, I.C. "Report on mission to Ethiopia, Kenya, Sudan, Tanzania and Zambia." SP memo 541, Apr. 13, 1967.

Koupalov-Yaropolk, I.C. "Comments on the draft order for the establishment of the National Scientific and Technical Research Council for Ethiopia." UNESCO archives, doc. NS/ROU/Ethiopia 2, May 1967.

"List of activities organized the the UNESCO science cooperation office for Latin America or carried out in close collaboration with it." UNESCO archives, doc. NS/ROU/83, annex I.

"Note on scientific planning missions under UNESCO scientific policy programme." UNESCO archives, doc. NS/ROU/44, Nov. 25 1963.

"Promotion of national science policies: UNESCO programme." UNESCO archives, doc. NS/ROU/107/PR, Apr. 20, 1966."Report of the seventh session of the international advisory committee on research in the natural sciences programme of UNESCO." UNESCO archives, doc. NS/166, 19 Aug. 1960.

"Provisional list oof ministries of science (or equivalent decision-making bodies for national science policy) existing in member states of UNESCO." UNESCO archives doc. NS/ROU/30 prov. Oct. 1 1963.

"Resolutions and declaration of the seminar on the organization of scientific research in Latin America, Central University, Caracas, 3-7 October 1960." UNESCO archives, doc. NS/ROU/37, Dec. 10, 1963.

"The scientific policy programme of UNESCO." UNESCO archives, doc. NS/ROU/3/Rev.1, May 1, 1963.

"The proposed science policy programme of UNESCO for 1967-1968." UNESCO archives, doc. NS/ROU/117, Apr. 25, 1966.

"Report of the eighth session of the international advisory committee on research in the natural sciences programme of UNESCO." UNESCO archives, doc. NS/174, Dec. 19 1961.
"Survey of national scientific research councils in the member states of UNESCO." UNESCO archives, doc. NS/122., May 2, 1957.

"Some remarks concerning the draft constitution of National Science Council of Tanzania." UNESCO archives, doc. NS/ROU/Tanz 1, Feb. 4 1966.

"Survey of the Main Trends of Research in the Natural Sciences: The dissemination of scientific knowledge and the application of such knowledge to peaceful ends." UNESCO archives, doc. NS/157, May 28, 1959.

"Survey of UNESCO's activities and achievements with regard to science policy." UNESCO archives, doc. NS/ROU/100, Jan. 20, 1966.

Sutherland, Gordon. "Ethiopia: Scientific Policy and Scientific Research." Serial No. 1250/BMS-RD/SCP. Paris, May 1969.

"UNESCO Southeast Asia science cooperation office 2nd regional meeting on scientific research, Hong Kong, November 28th to December 2nd, 1961." UNESCO archives, doc. NS/ROU/38.

"UNESCO's programme in the field of the natural sciences for the current ten-year period." UNESCO archives, doc. NS/170, Mar.22, 1961.

White, F.W.G. "Egypt: Reorganization du Conseil National Eyptien de la Recherche." Unpublished UNESCO report, May 1955. BMS Reports, "Reports from field experts Dr. FWG White, Organisation and Development of NRC, Egypt."