Hard science, soft science: A political history of a disciplinary array

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Abstract

A distinction between the "hard" and "soft" scientific disciplines is a modern commonplace, widely invoked to contrast the natural and the social sciences and to distribute value accordingly, where it was generally agreed that it was good to be "hard," bad to be "soft." I trace the emergence of the distinction to institutional and political circumstances in the United States in the second part of the twentieth century; I describe varying academic efforts to give the contrast coherent meaning; I note the distinction's uses in disciplines' reflections on their own present and possible future status; and I document the consequential circulation of the antonym in settings where resources for science were distributed. To follow the history of the "hard–soft" distinction is to open a window on changing sensibilities about what science is, what values are attached to it, and what it is for. I conclude with speculations about more recent changes in the value-schemes implicated in the "hard" and the "soft" and about pertinent changes in the place of the "soft" human sciences in governance and production. I envisage a possible future in which the commonplace distinction might wither away.

Placing a commonplace

The familiar distinction between the *hard sciences* and the *soft sciences* has both a cultural geography and a history.[1] The sorting is, of course, particular to the English language, but it has become reasonably familiar in a modern global order where English

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1. I variously refer to the hard–soft commonplace as *vocabulary*, as a *distinction*, an *antonym*, a *classification*, a *contrast*, a *sorting*, and so on, but nothing much depends upon the particular term used. The notion of an *array* is somewhat different, and it is introduced below.

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serves as a lingua franca and where American cultural and institutional forms have effectively infiltrated indigenous arrangements. There have been skirmishes around its definitional margins, but most usages take the natural sciences to be hard (with physics and mathematics the most firm) and the social or human sciences (e.g., sociology, anthropology, psychology) as soft, while account is sometimes taken of disciplines and subdisciplines tending toward hardness and others supposed to have both aspects.[2] The hard–soft antonym does not map well onto non-English language classifications where distinctions between the natural and the human sciences are widely found, though these often tend to lack the evaluative sense conveyed by hard and soft.[3]

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2. For all sorts of reasons, one might distinguish between the categories of *social science*, *human science*, and *behavioral science*, but the historical invocations of hard and soft sciences rarely attended to such distinctions, and here I settle on "social science" as an umbrella term to cover a range of sensibilities.

3. German scholars asked about the antonym insist that what *must* be meant is the *Natur-/Geisteswissenschaften* (or *Verstehendewissenschaften*) classification. Italian academics note that the term *scienze dure* is in some use to reference the disciplines included in the Anglophone *hard sciences*, but that there is no equivalent to the category of *soft sciences*, for which you might talk about the *scienze umane* or *dell'uomo*. French researchers seem to find the English hard–soft science contrast problematic, saying that if the natural sciences were *hard* (= *dures*), then the social sciences would have to be *molles* (which makes no sense to them). *Les sciences dures* is well recognized, but, as in Italian, the contrast is with *les sciences humaines et sociales*. A possible translation of *soft science* as *sciences douces* is not entertained. Scandinavian usages are interesting and also problematic. Since about the 1960s, Scandinavians have distinguished between "dry" and "wet" disciplines (in Danish *tørre* and *våde fag*, in Norwegian *tørre* and *våte fag*, in Swedish *torra* and *våta ämnen*). Initially, the sorting figured in discussions about university buildings and as a way of indicating the need for different kinds of spaces for different disciplines – "wet" disciplines needing laboratories. It is still used this way, but the contrast was, and is, also recruited to distinguish academic faculties, with the humanities and social sciences counting as "dry" and the natural sciences, medicine, and engineering as "wet." The distinction is often used in connection with the distribution of funds among academic departments. Here, disciplines are "dry" if they are poorly funded – so to speak, less *well watered* by money – and if they have worse working conditions than the "wet" sciences. At present in Scandinavia, the expressions may also be combined with the Anglophone "soft" and "hard" – as "soft–dry" and "hard–wet." I thank Lisa Haushofer (Zürich), Paolo Savoia (Bologna), Henry Dicks (Lyon), Gloria Origgi (Paris), and Kasper Rijsberg Eskildsen (Copenhagen), none of whom are responsible for my representation of their views. In postwar America, not many people referring to the hard and soft sciences showed much interest in non-Anglophone sortings, for example, the *Naturwissenschaften* and the *Geisteswissenschaften*, so local sensibilities about the map of the sciences were largely taken as self-evident. There were exceptions, notably among émigrés from German-speaking lands; see, for example, the Austrian-American economist Fritz Machlup, "Are the Social Sciences Really Inferior?," *Southern Economic Journal* 27 (1961): 173–84, 173, and Fritz Machlup, *Knowledge and Knowledge Production* (Princeton, NJ: Princeton University Press, 1980), esp. pp.65–9, 75, 84–90.

I follow invocations of hard and soft science in contexts of use. Why was such a distinction made? What value was being assigned to the varieties of science when they were so tagged? What concrete consequences were meant to flow from assigning distinct textures to the disciplines? *Reflective* commentary on hardness and softness is pertinent here mainly with regard to academics and intellectuals engaged with questions about the nature and worthiness of different disciplines and about the actual or recommended intellectual trajectory they ought to take. These reflective definitions have varied, but invocations in other settings – notably in politics, bureaucracies, and journalism – have shown almost no coherence at all, and while coherence is an accepted mark of academic virtue, it is no reliable index of consequence. Common usage only intermittently picks out what it is about the hard and soft sciences that makes them so. The presence of "The Scientific Method" is sometimes invoked as a criterion of hardness; so too is the deployment of quantitative tools or the use of controlled experiment. Other criteria stipulated or presumed include the certainty or precision of findings; reliability and reproducibility; power of prediction; progressiveness or the speed of change; degrees of consensus or the extent of insulation from supposed distorting external influences; objectivity; the scope or level of generality; and the fundamental or derivative status of disciplinary knowledge. What has been relatively stable across usages is the sense that some or all of these criteria place the disciplines on an *array* – an ordered series – and that such an array is a basis for evaluating the disciplines' intellectual worthiness, reliability, and power. Yet even the notion of arraying hard and soft disciplines needs qualification. Some of those who invoked hard and soft presumed a *continuum* between, say, the hardness of physics and the softness of sociology; others saw *discontinuities*, which might be either large or small, permanent or reparable. On some presumed arrays, history and literary studies were judged even softer than sociology, while other commentary excluded such practices altogether from the array. Gestures at a disciplinary array quite often had a temporal dimension. It was common to assert that the soft sciences were becoming hard or that they would eventually become so, and that this counted as progress. It seems that no one saw a possibility that the hard sciences might lose their firmness, which would reverse progress. So, while the notion of a textural array is a historical commonplace, and while the natural and social sciences routinely form the poles of that array, there is little coherence in presumptions about what characteristics constitute the array or about the temporal stability of positions on the array.

My aim here is to follow the hard–soft distinction through the second part of the twentieth century and on into the present. I show the purposes the distinction served and the institutional, disciplinary, political, and cultural settings in which it was invoked. I describe the varying notions of science that were implicated in the distinction. Natural and social scientists intermittently used this vocabulary, sought to define its terms, and invoked it to distribute value among academic disciplines. But I show how the textural sorting also figured in cultural commentary and in settings where resources were distributed among the disciplines. I conclude by commenting on seeming changes in hard–soft attributions and evaluations occurring in more recent decades, and I speculate about what such changes may mean about shifts in the identity and institutional context of science. Here, tracking the hard–soft antonym contributes to a historical archaeology of ideas

about what science is, what it is good for, what its boundaries are, and how its disciplinary parts should be described and valued. These ideas have changed over the past century or so, and they may now be changing.

Hard and soft functioned as description and evaluation in many domains and long before they were applied to an array of academic disciplines. Rocks are texturally hard and sponges are soft – and there's no evident evaluation here – but the distinction is metaphorically extended in many linguistic scenes, as, for example, the hard as *difficult*, *durable*, *strong* and the soft as *easy*, *malleable*, *weak*. So we have, among many other instances, *hard* and *soft selling*, *currencies*, *drugs*, *drinks*, *pornography*, *targets*; being *hard* or *soft* on *crime* or *communism*. In the 1950s and 1960s, the American psychologist Charles Osgood developed what he called the *semantic differential scale* – a set of about fifty bipolar adjectives meant to measure the connotative meanings that people attach to practically anything – consumer goods, political parties, concepts, races. Subjects were asked to rate (on a scale of seven) the Democratic Party as: sweet–bitter, valuable–worthless, wet–dry, slow–fast – and soft–hard (the last taken as a measure of what Osgood called "potency"). The scale was adopted in a range of Cold War enterprises, including the formulation of CIA propaganda, and it continues in use, for example, in measuring consumer satisfaction.[4] So, in a pattern often to be repeated, the hard–soft antonym was operationalized in a supposedly "soft" social science as one of the fundamental techniques of a "hard-nosed" study of attitudes. The gendered aspect of the distinction is quite clear, as are the historically situated relative values placed on the hard and the soft that trade on attitudes to gender. Yet the references and values of attributed male and female qualities vary over historical time, of course, and there is a range of other pertinent social distinctions that do not seem to involve gender relations – for example, the ascribed attributes of the soldier and the scholar, the master and the servant, the powerful and the powerless. In very many modes of talk about human and social practices, it's considered *good* to be hard and *bad* to be soft, though there are notable exceptions. Both in economic recessions and in parachuting, soft landings are preferred, and marginal modern academic advocacy of "fuzzy studies" defends supposed "softness" as a wise rejection of intellectual hubris.[5] Hard and soft, as applied to a range of things and practices carry evaluations with them, and they have long done so.

In the past, textural terms were occasionally applied to a range of intellectual practices, though the senses conveyed were different from that of the modern hard–soft vocabulary. Sixteenth-century English humanists referred to "the high and

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4. Charles E. Osgood, George J. Suci, and Percy H. Tannenbaum, *The Measurement of Meaning* (Urbana: University of Illinois Press, 1957).

5. Jeffrey M. Perl, "Fuzzy Studies: A Symposium on the Consequence of Blur, Part I," *Common Knowledge* 17 (2011): 441–9, 441–2. The hard-nosed philosopher of science Clark Glymour had labeled Kuhnian, pragmatist, and Continental tendencies as "the new fuzziness," while Richard Rorty embraced the intended insult as a virtue.

hard sciences," but these included oratory, which was contrasted to such "easy and pleasant studies" as poetry.[6] The "soft science" gestured at by eighteenth- and nineteenth-century poets and playwrights designated either the arts of love or the civilizing arts in general – those that *softened* manners. Or, the notion of *soft science* then picked out the use of *manners* rather than the more blunt instruments of persuasion or coercion. In 1914, Bertrand Russell offered, as "a vague distinction," the contrast between what he called "hard data" and "soft data" – the latter vulnerable to critical reflection; the former – the facts delivered by sense and guaranteed by the general truths of logic – resistant to analysis.[7] In the United States, there has been a long-standing tradition among university students, when presented with a course-choice cafeteria, to contrast hard courses with "soft options" (easier to get a top grade and demanding less time, reading, and focused thought) – and, usually, to opt for the latter. And, sometimes, university courses in the human sciences – called "soft" for their supposed easiness – are allowed to satisfy curricular "science requirements." During the Cold War, American educators were alarmed that the country was producing fewer scientists and engineers than the Soviet Union, blaming "a 'soft' educational policy, which has turned students away from the 'hard' scientific subjects and into 'easy' courses in social studies," and a post-Sputnik lecture by former President Herbert Hoover worried about America's shortage of scientists, a cause of which was young people's tendency "to seek soft classes, not the hard work of science and mathematics."[8] Social scientists persistently addressed, and did not always dismiss, an apparently common notion that the measured intelligence of social science university students was inferior to that of "those specializing in the 'hard' sciences of physics, chemistry, and mathematics."[9]

The Google ngrams for both "hard science" and "soft science" (see Figures 1 and 2) track each other closely – crude and imperfect, but suggestive, indications that show little usage prior to about 1960, a sharp uptick thereafter, rising to a peak around the 1990s, and an apparent leveling-off or even drop-off toward the present. The distinction clearly emerged in the United States, and, whenever it was first used, it became a commonplace in the several decades following World War II. Invocations of the hard–soft distinction in

6. Roger Ascham, *The Scholemaster* (London: John Daye, 1570; comp. ca. 1536), p.4ᵛ.
7. Bertrand Russell, *Our Knowledge of the External World, As a Field for Scientific Method in Philosophy* (London: Open Court, 1914), pp.70–1.
8. "Study of Science Falling Sharply," *New York Times*, June 19, 1955, 69; "Text of Hoover's Speech Here on Need for Engineers," *New York Times*, November 22, 1957, 17. (Hoover had been a geologist and mining engineer.) See also E. B. Skaggs, "Dr. Schoen on 'The Elementary Courses in Psychology'," *American Journal of Psychology* 38 (1927): 153–4: "Unfortunately, there are many institutions of higher learning . . . where the student secures a 'soft science credit' by attending one lecture and two 'quiz' sections a week in psychology"; also Traver C. Sutton, "Science Training in War Time," *The Science Teacher* 10, no. 4 (1943): 28–43, 28–9, 39, 43, 29: "Fortunately for America the technical high schools have not offered 'soft' science courses," concentrating on chemistry, physics, biology, and mathematics.
9. Elbridge Sibley, "Education in Social Science and the Selection of Students for Professional Training," in G. Stanton Ford (ed.), *The Social Sciences at Mid-Century: Papers Delivered at the Dedication of Ford Hall, April 19-21, 1951* (Minneapolis: University of Minnesota Press, 1952), pp.50–61, 50, 61.
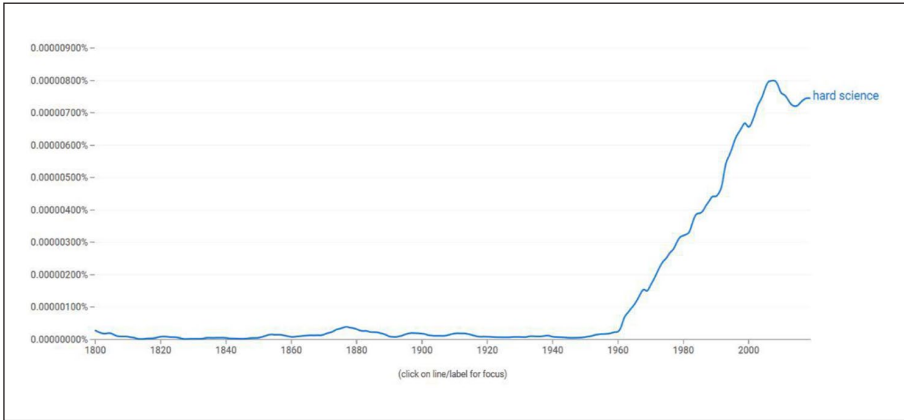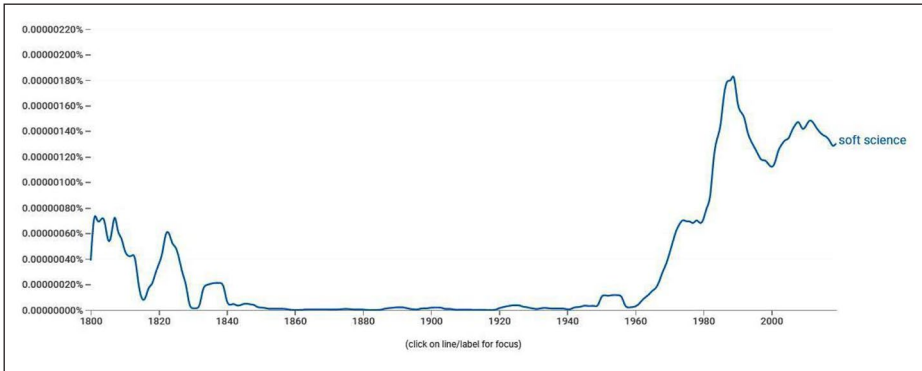
Figure 1. Google ngram for "hard science."[10]

Figure 2. Google ngram for "soft science."[11]

other English-speaking countries were far sparser in the 1960s and 1970s. In Britain, C. P. Snow glancingly referred to "'hard' subjects" in his 1963 "Second Look" at the *Two Cultures*,[12] and, in the late 1960s, a British pediatrician and a sociologist – both of whom

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10. Google ngram for "hard science": https://books.google.com/ngrams/graph?content=hard+science&year_start=1800&year_end=2019&corpus=26&smoothing=3&direct_url=t1%3B%2Chard%20science%3B%2Cc0#t1%3B%2Chard%20science%3B%2Cc0 (February 20, 2022).
11. Google ngram for "soft science: https://books.google.com/ngrams/graph?content=soft+science&year_start=1800&year_end=2019&corpus=26&smoothing=3&direct_url=t1%3B%2Csoft%20science%3B%2Cc0#t1%3B%2Csoft%20science%3B%2Cc0 (February 20, 2022).
12. C. P. Snow, *The Two Cultures* and *A Second Look*, Stefan Collini (ed.) (Cambridge: Cambridge University Press, 1998; orig. publ. 1959, 1963), p.70.

had United States connections – contrasted hard and soft sciences.[13] In 1972, the Czech émigré Stanislav Andreski, then teaching sociology at Reading, produced a swingeing attack on sociological mumbo-jumbo – including the use of "ultra-sophisticated quantitative methods." Gesturing at Anglophone usage, Andreski didn't allow that psychology, sociology, economics, or indeed any other kind of research into human conduct could be called sciences bearing any resemblance to physics or chemistry. But, when "science" was translated into Continental vocabulary, a label referring to "any kind of systematic study which aims at providing careful descriptions, substantiated explanations and factually supported generalizations," then why not say that they were a form of, for example, *Wissenschaft*? One might think that a book like Andreski's would be a natural place for the hard–soft antonym to crop up, but it did not.[14] It was an *American* reviewer who read Andreski's text as urging that the "limits of the 'soft' sciences" be recognized, and who took it as an attack on soft science.[15] Then, in 1976, the English popular science writer Peter Farago produced a book about the communication of science, and, although one chapter was called "Hard and Soft Science," that locution was nowhere to be found in the actual text.[16] It's likely that further research will turn up more British invocations of hard and soft sciences through the 1970s, but the indications are clear that they are less dense than in the United States and there is evidence that many of these were actually American imports.[17]

Dating the commonplace

I *may* have discovered the first, or at least one of the first, invocations of the hard science–soft science distinction in something like its modern form. In 1945, Gano Dunn, a politically active industrial engineer, was speaking to the professional association of American mechanical engineers, advocating a widened social scope for engineering expertise. The specific problem he addressed was the distribution of manufactured goods in a market economy. On the one hand, moving things from factory to consumer involved physical processes like transportation and warehousing; on the other, it encompassed the "psychology of distribution," concerning "'the desire to own,' and the great range of human appeals involved in that desire." Capitalist manufacturers needed to know not just

13. Douglas Hubble, "Personal View," *British Medical Journal* 4, no. 5632 (1968): 700; Albert Cherns, "The Use of the Social Sciences," *Human Relations* 21 (1968): 313–25, 313–14.

14. Stanislav Andreski, *Social Science as Sorcery* (London: Andre Deutsch, 1972), p.114 (for quantitative methods), pp.22–3 (for English and Continental senses of "science").

15. Edward A. Olsen, "Review of Andreski, *Social Science as Sorcery*," *Foreign Service Journal* 52, no. 3 (1975): 24.

16. Peter Farago, *Science and the Media* (London: Oxford University Press, 1976), pp.42–51.

17. In 1971, the American expatriate historian of science J. R. Ravetz (at Leeds University) surveyed a wide range of modern sciences. He bought into a quasi-Comtean scheme of more and less *developed* disciplines and made a near pass at the distinction: the "'soft' technologies will have certain characteristic differences from the 'hard' ones; their associated sciences will usually be less matured": Jerome R. Ravetz, *Scientific Knowledge and Its Social Problems* (New York: Oxford University Press, 1971), p.337 (and see pp.364–402 for treatment of the "maturity" stage of the disciplines).

how to produce but how to sell, and this, Dunn said, was the domain of social science expertise. One should think of the sciences as a hierarchical array:

> At the head of the list come the mathematical, physical, and biological sciences, *which I have been accustomed* to refer to as the "hard" sciences. That is because of the exactitude with which they are capable of predicting results. Prediction is the test of a "hard" science. Further down the list come those other sciences *which I call* the "soft" sciences, namely, anthropology, psychology, sociology, economics, history, and numerous disciplines associated with them. I call these soft sciences because of their relative inability to predict.

Dunn knew about the German idea of *Wissenschaft*, and this was, he thought, a better category for considering the social and natural sciences in the same frame. In the English-language sense, "the social sciences are not truly sciences," but America is not Germany, Dunn noted, and designating sociology, psychology, and economics as social sciences was now customary. The social sciences are inferior specimens of the natural sciences, but matters were improving: "our knowledge of the soft sciences is constantly increasing, rendering them increasingly ready to take their place with sister sciences that were once soft and have now become hard." And, in any case, it has become clear that engineers now have to know the sorts of things that social scientists reliably know, and it may come to pass that suitably informed engineers can do a better job of putting social knowledge to work.[18] (Engineers were prominent in the polemical use of hard–soft vocabulary. The "technocracy movement" launched in the United States in the post-World War I years, and reaching its peak in the early Depression, inspired leading engineers to claim that their techniques could either displace the human sciences or perfect them by reformulating their problems in engineering terms.[19])

In the 1950s and 1960s, the hard–soft science antonym increasingly circulated in both academic and nonacademic settings, the terms then often surrounded by inverted commas or otherwise flagged up as a fairly novel usage. Philosophers of science then occasionally invoked the distinction – either to say something about the status of different scientific disciplines or to comment on the status of their own discipline and the materials it was proper for philosophy to use.[20] The MIT economist Paul Samuelson joked that

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18. "Comment by Gano Dunn," *Mechanical Engineering: Journal of the American Society of Mechanical Engineers* 67 (1945): 246. This was probably not the first occasion on which Dunn used the hard–soft distinction – and the quoted passage (my italics) claims prior usage at the same time that it implied originality. See here Lewis E. Auerbach, "Scientists in the New Deal: A Pre-war Episode in the Relations between Science and Government in the United States," *Minerva* 3 (1965): 457–82, 480. Dunn evidently did not know about, or was not impressed by, the predictive power of earlier social science, e.g., Durkheim on suicide or Quetelet on crime and marriage rates. For Dunn, see Vannevar Bush, *Gano Sillick Dunn 1870-1953: Biographical Memoir* (Washington, DC: National Academy of Sciences, 1954).

19. On the technocracy movement: Henry Elsner, *The Technocrats: Prophets of Automation* (Syracuse, NY: Syracuse University Press, 1967); William E. Akin, *Technocracy and the American Dream: The Technocracy Movement, 1900-1941* (Berkeley: University of California Press, 1977).

20. See, notably, the Norwegian philosopher Arne Naess, who wanted colleagues to use some methods taken from the social sciences: Naess, "Philosophers and Research in the Soft

"the soft sciences spend time in talking about method because Satan finds tasks for idle hands to do,"[21] and the Harvard political scientist Don Price noted the conviction among "orthodox natural scientists" that "rigorous scientific method" was being "gradually extended from the hard sciences to the soft sciences," that there was a natural progression toward hardness, and that the soft sciences might eventually catch up.[22] (Here, it was widely, if not universally, agreed that hard and soft described the state of disciplines *as they currently were*: some commentators seemed to think that the human sciences would – owing to their subject-matter – *never* become hard, while, in America, many others expressed degrees of optimism that they were becoming so.) Cultural commentators and journalists were also acquiring fluency in hard–soft usages: in 1967, the great *Science* magazine news editor Daniel S. Greenberg covered the functions and make-up of the National Academy of Sciences, taking it to task for its "obsolete" attitude to the "so-called soft sciences." This attitude excluded "the producers of some of the most important, exciting, and pioneering research in recent years."[23] So, in the postwar years, the most common scenes in which hard–soft talk circulated were practical and political discussions in which the disciplines were valued and resources distributed. There were, however, academic settings, where social scientists reflectively addressed the nature of science, the differences among disciplines, their likely textural trajectories, and how the designations of hard and soft could be made reliable, robust, and administratively useful.

Sociology sorts the sciences

Sociology was the academic discipline that, in the postwar period, was most engaged with the hard-soft distinction. Some sociologists invoked it in reflections on the status of their own discipline; others addressed it as they took science as a *topic*. Robert Merton substantially launched the sociology of science in the United States, though his essays of 1938–42 on the "normative structure of science" were notably silent about *differences* between the disciplines, and he made no allusion to hard and soft. What did occupy Merton and those associated with him was the distinction between the *basic* and *applied*

Sciences,*" in *Actes du XIème Congrès International de Philosophie, Volume VI, Philosophie et Méthodologie des Sciences de la Nature* (Louvain: Éditions E. Nauwelaerts, 1953), pp.255–9; and see Kuhn's recollection of a conversation with Clark Glymour about the "'soft' philosophy of science," whose softness consisted in taking history seriously: Thomas S. Kuhn, "The Road Since *Structure*," in Kuhn, *The Road Since Structure: Philosophical Essays, 1970-1993, with an Autobiographical Interview*, James Conant and John Haugeland (eds.) (Chicago: University of Chicago Press, 2000), pp.90–104, 90.

21. G. C. Archibald, Herbert A. Simon, and Paul A. Samuelson, "Discussion," *American Economic Review* 53 (1963): 227–36, 231.

22. Don K. Price, "The Established Dissenters," *Daedalus* 94, no. 1 (1965): 84–116, 88. A splendid treatment of notions of "the scientific method" circulating in late nineteenth- and early twentieth-century culture is Henry M. Cowles, *The Scientific Method: An Evolution of Thinking from Darwin to Dewey* (Cambridge, MA: Harvard University Press, 2020), esp. ch. 1.

23. Daniel S. Greenberg, "The National Academy of Sciences: Profile of an Institution (III)," *Science* 156, no. 3774 (1967): 488–93, 489.

sciences. Given Merton's insistence on *disinterestedness* as a defining norm, those so-called sciences enlisted in profit-making enterprises could either be excluded from the authentic sciences or regarded as pathological forms.[24] Sociology in this mode was meant to provide a global account of *science*, and Merton's early writings assumed, for example, that what was said about the values of seventeenth-century English science counted as evidence for the values of twentieth-century French or American science, that disciplines like natural philosophy, chemistry, and natural history might all be subsumed into the same sociological framework, and, as a topic, the human sciences did not appear in these early papers. Merton's onetime student at Harvard, Bernard Barber, published *Science and the Social Order* in the early 1950s, arguably the first book-length exercise in the sociology of science. The last chapter of that book addressed "The Nature and Prospects of the Social Sciences," about which Barber had so far said little. But here Barber insisted that there was *no* "essential difference between the natural and social sciences"; they are "essentially the same in principle"; "Science is a unity." Social and natural sciences have the same "supporting values"; they use the same "rational methods"; they have the same "modes of social organization" and "social control."[25]

Hard–soft vocabulary began to infiltrate sociologists' writings in the early 1960s. The first anthology of the sociology of science – co-edited by Barber in 1962 – mentioned the hard and the soft just once, this in a political scientist's passing treatment of disciplinary identities. "There are," he said, "'hard scientists,' whose membership is taken for granted, and 'soft scientists,' whose credentials are dubious," and he wondered whether social scientists were regarded as "full members of the scientific community."[26] Entitlement to the resources and the authority attached to the idea of science was here matter-of-factly associated with the recognition of hardness – partly a legacy of textbook and popular celebrations of scientific method widely circulating from the late nineteenth century. A few years later, a different sociology of science anthology, edited by Norman Kaplan, still another Merton student, wandered off the reservation. The editor speculated whether the *differentiation* of science wasn't rapidly becoming a sociologically noticeable feature – whether science wasn't now "more like a federation than the old-fashioned community."[27] Even as the notion of *the scientific community*

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24.   See, e.g., Robert K. Merton, "Science and the Social Order," in Robert K. Merton, *The Sociology of Science: Theoretical and Empirical Investigations*, Norman W. Storer (ed.) (Chicago: University of Chicago Press, 1973; art. orig. publ. 1938), pp.254–66, 260; Bernard Barber, *Science and the Social Order* (New York: Collier Books, 1962; orig. publ. 1952), pp.135–41; Norman W. Storer, *The Social System of Science* (New York: Holt, Rinehart and Winston, 1966), pp.16, 92–4, 106–15, 142–3; also Norman W. Storer, "Relations among Scientific Disciplines," in Saad Z. Nagi and Ronald G. Corwin (eds.), *The Social Contexts of Research* (New York: Wiley-Interscience, 1972), pp.229–68, 239–40; Norman W. Storer, "Basic versus Applied Research: The Conflict Between Means and Ends in Science," *Indian Sociological Bulletin* 2, no. 1 (1964): 34–42.
25.   Barber, *Science and the Social Order*, pp.311–12, 321 (note 24).
26.   Wallace S. Sayre, "Scientists and American Science Policy," in Bernard Barber and Walter Hirsch (eds.), *The Sociology of Science* (New York: Free Press, 1962), pp.596–609, 597.
27.   Norman Kaplan, "Prologue to the Future," in idem (ed.), *Science and Society* (Chicago: Rand-McNally, 1965), pp.453–7, 457. Elsewhere in the anthology Kaplan canvassed

was coming to occupy sociologists' attention – and here the key text was Warren Hagstrom's 1965 book of that title[28] – they began to acknowledge disciplinary differentiation, a few even allowing that some science took place outside of academia and that it was orientated to commercial goals. There was a small number of social scientists in the 1960s who addressed the hard–soft antonym with the intention of denying its legitimacy and practical pertinence. Testifying in 1966 to a Senate committee considering a separate national foundation for the social sciences, the political scientist Kalman Silvert said that the then-common "distinction which is being made between the 'hard' or the physical sciences, and the 'soft' or social sciences may not persist much longer," and he offered an alternative classification based on the nature of the phenomena addressed: "A better differentiation might perhaps be between those sciences which study recurrent phenomena, and those sciences which study historical, and thus necessarily unique, phenomena."[29]

Hard and soft as sociological topic

So far as I now know, the first time that the hard–soft antonym became a matter of *focused* academic attention was in 1966. The sociologist Norman Storer – still another student in Merton's lineage – gave a paper to a group of medical librarians, which was titled "The Hard Sciences and the Soft." Storer began by noting that hard–soft talk was already common in the wider culture, presuming that his audience was familiar with these categories, but urging their sociological significance: "Through some faculty of folk-wisdom," Storer wrote, "we have hit upon a way to characterize different branches of science."[30] The basic disciplinary *references* were presumed clear enough. The natural sciences were hard, the social sciences were soft, and Storer's starting point was presented as a cultural commonplace. The professional sociologist's task was to find out what people meant, and what they might coherently mean, when they spoke this way. Sociology was, in the end, a soft science, but here it offered to *preside over* common usage, to refine it, and to make the distinction firm enough for further professional tasks. The hard–soft thing was a feature of the institutional and cultural environment in which

definitions of "basic research," considering that any such definitions must rely on fuzzy criteria "which most 'hard' scientists would reject out of hand": Norman Kaplan, "Science as a Changing Institution," in ibid., pp.107–11, 109.

28. Warren O. Hagstrom, *The Scientific Community* (New York: Basic Books, 1965).
29. Senate Committee on Government Operations, *Federal Support of International Social Science and Behavioral Research. Hearings before the Subcommittee on Government Research of the Committee on Government Operations . . . June 27, 28; July 19, and 20, 1966* (Washington, DC: Government Printing Office, 1967), p.228. See also Thomas Gieryn, *Cultural Boundaries of Science: Credibility on the Line* (Chicago: University of Chicago Press, 1999), pp.92–3; Mark Solovey, "Senator Fred Harris's National Social Science Foundation Proposal: Reconsidering Federal Science Policy, Natural Science-Social Science Relations, and American Liberalism During the 1960s," *Isis* 103 (2012): 54–82.
30. Norman W. Storer, "The Hard Sciences and the Soft: Some Sociological Observations," *Bulletin of the Medical Library Association* 55 (1967): 75–84, 79. This paper was presented to the Association's meeting in Boston in June 1966. Storer had been assistant professor in the Harvard Department of Social Relations and was, at the time of the paper's appearance, Staff Associate at the Social Science Research Council in New York.

social science lived; now it was made available as a *topic* to which social scientists could contribute, and which they might hope to clarify, make coherent, and then justify.

In Storer's account, hardness is partly constituted by bracketing, controlling, or ejecting *personal* considerations from making and presenting disciplinary knowledge. This *impersonality* helps make for consensus and for the recognition of objectivity, and scientific impersonality can be made into a sociological topic. Hard scientists are, so to speak, on the same page because they *quantify* and use mathematical tools – so sociologists can count and tabulate the genres and instances of quantification in published work. Mathematical methods make for the tight integration of bodies of knowledge, they keep disciplinary order, and they control dissent. The lack of mathematical tools in social sciences, and the resulting dissension, makes them soft: the social sciences suffer from weak intellectual integration and from a rigor deficit. It follows that "nonscientific criteria" may enter into their deliverances, for example, "relevance to common values or to practical problems, elegance of style, or even the unexpectedness of one's findings vis-à-vis common sense." And it is this softness that makes them weak, difficult to trust, and inadequate guides to practical action.[31]

Impersonality is evident in specific hard-scientific disciplinary behaviors and impersonality shapes the disciplinary environment. However, there are soft scientists --here sociologists --who possess the concepts and methods to make that impersonality visible and securely to establish it as part of legitimate textural definition. The role of mathematics makes judgment transparent and mathematized hard sciences have clear, agreed, and effective rules for assessing the value of contributions: "Error, irrelevance, [and] sloppy thinking is relatively easy to detect." Hard scientists live in a harsh risk environment; they know that mistakes and weaknesses will be easily found out and exposed by colleagues: "it is relatively easy for them to 'hurt' you"; it is hard to feel "close to" colleagues or to feel "warmth and trust." The sociologist can make this impersonality manifest, both as a technique of knowledge-making and as a mode of presentation. Storer "collected some data" on instances of quantification in hard science papers, counting tables, graphs, equations, and the like – so allowing the "soft" sociology of science to share some of the defining characteristics of the "hard" sciences it studied. He also looked at the ways in which authors' *names* were given, finding evidence of impersonality in the use of first-name initials in hard science papers compared to the general use of full first-names in the soft (see Figure 3).[32] Those indexes of texture were, in Storer's thinking, arrayed on a continuum, with no evidence of a dichotomy, whether based on method, on social circumstance or social relations, or on the tractability of subject-matter. So economics joined botany and zoology in Storer's category of "medium-hard" disciplines. And that continuum was itself partly a sign of a dynamic, historical relation between soft and hard. All soft sciences, Storer judged, naturally aspire to hardness and, when hardness is achieved, strive to maintain that condition: "As the years pass, we shall certainly see many false starts in this direction within the softer sciences, but I think the

31. Storer, "The Hard Sciences and the Soft," 79–80 (note 30). These views were substantially repeated in the later essay by Storer, "Relations among Scientific Disciplines," esp. pp.237–9 (note 24).

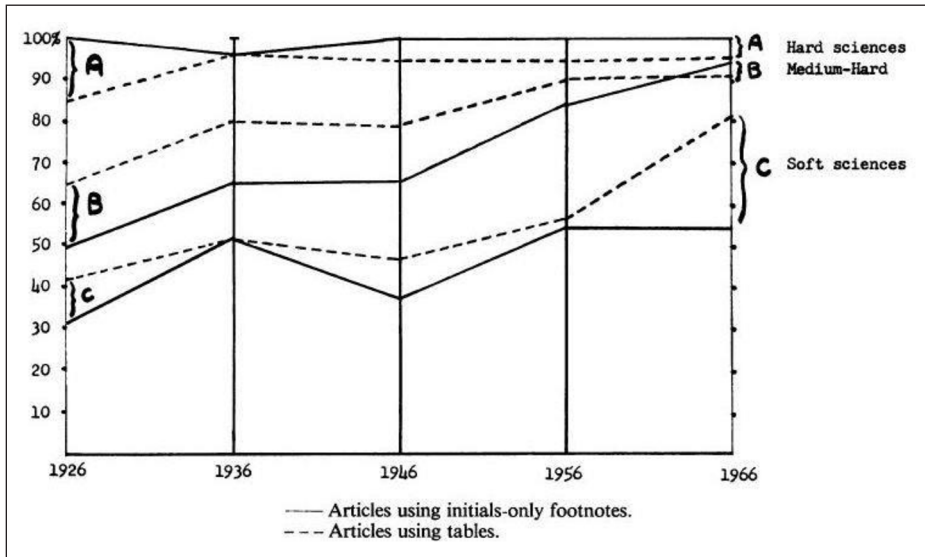32. Storer, "The Hard Sciences and the Soft," 79–80 (note 30).

Figure 3. (Storer, "The Hard Sciences and the Soft," 80).[35]

long-run trend is obviously toward more hardness throughout science generally."[33] Despite the obscurity of the journal in which Storer published, his paper was soon cited in a range of disciplines, and, even at the end of the century, it continued to be approved for the acuteness of its analytic insight.[34]

One of the first writers to carry forward Storer's focus on hard and soft was the founding figure of s*cientometrics*, the English physicist–historian Derek J. de Solla Price. Three years after Storer's paper appeared, Price addressed the hard and the soft in an interpretation of citation patterns. He credited Storer with drawing sociologists' attention to the hard–soft category – he "got us over the barrier that no one likes to be soft" – and he applauded Storer's account of the role of quantification and the conventions of authorial citation.[36] Price's 1963 *Little Science, Big Science* had aimed to "turn the tools of

33. Ibid., 82–3.
34. See, e.g., John M. Braxton and Lowell L. Hargens, "Variation among Academic Disciplines: Analytical Frameworks and Research," in John C. Smart (ed.), *Higher Education: Handbook of Theory and Research*, Vol. XI (New York: Agathon Press, 1996), pp.1–46.
35. "Hard" scientific periodicals surveyed included leading American and British journals in physics, chemistry, and biochemistry; "soft" journals included the major periodicals in American and British sociology, psychology, and political science. The category of "medium-hard" was populated by journals of botany, zoology, and economics.
36. Derek J. de Solla Price, "Citation Measures of Hard Science, Soft Science, Technology, and Nonscience," in Carnot E. Nelson and Donald Pollack (eds.), *Communication among Scientists and Engineers* (Lexington, MA: Lexington Books, 1970), pp.3–22. I cite here the version published (as chapter 8) of Derek J. de Solla Price, *Little Science, Big Science— And Beyond* (New York: Columbia University Press, 1986), pp.155–79, 156–7. This was a new edition of Price's 1963 original, with added material, including this chapter. Here Price also

science on science itself." Just as genuine science quantified, so the *study* of science could be scientific when it discovered quantitative patterns governing scientific dynamics. For Price, "the fundamental law of any analysis of science" was the law of exponential growth – the number of scientific papers, the number of journals, the resources devoted to science, and the number of scientists doubling about every ten or fifteen years, with the result that science was a uniquely progressive and cumulative enterprise: ninety percent of all scientists were then alive and the great majority of scientific papers had been published in very recent times.[37]

There was no attention to hard and soft in the first edition *Little Science, Big Science*, little to disciplinary differences, and almost none to the social sciences – but, when Price reconsidered the matter seven years later, he assimilated the textures to disciplinary differences in quantitatively assessable citation patterns. Hard and soft sciences, the humanities, and those inquiries that were judged not scientific at all could be distinguished not by the *quantity* of citations to existing writings – a lot of references or only a few – but by what Price called their *immediacy*. (Storer had made a passing remark about the rapid obsolescence of hard science findings – imagining an "index" of "the amount of material in the literature that has become entirely obsolete and is never referred to anymore, except by an occasional historian of science," but Price was prepared to take this idea beyond mere imagining.[38]) The hardness of scientific disciplines was reliably signaled by the *recentness* of cited works. In the hard sciences, a large proportion of the literature cited was published only a few years before – so having what he called a high *Price's Index*. This was treated both as a visible, quantifiable *sign* of hardness and as a knowledge-building practice that *made for* hardness. If a field grows, for example, at the rate of ten percent per year, it doubles in about seven years, and thirty-nine percent of its archive consists of literature published in its last five years – hence a Price's Index of thirty-nine. Papers in hard sciences like physics and biochemistry can have indexes around sixty to seventy; representative American sociology journals about forty to forty-five; journals of psychology twenty to thirty; history and archaeology seventeeen to twenty; and *Isis*, the journal of the History of Science Society, just eight – making Price's own discipline about as soft as it gets. Price proposed his eponymous Index as a secure measure of texture: "Perhaps the most important finding I have to offer is that the hierarchy of Price's Index seems to correspond very well with what we *intuit* as hard science, soft science an[d] nonscience as we *descend* the scale."[39]

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    credited the sociologist Warren Hagstrom with pertinent prior attention to hard and soft: Hagstrom, *The Scientific Community*, pp.133–4, 174 (note 28), but that attribution seems forced, as Hagstrom made only glancing reference to the categories – just as a way of glossing differences in "prestige."

37. Price, *Little Science, Big Science*, pp.1, 5, 11 (note 36). Price had fastened on this "law" long before *Little Science, Big Science* gave it wider publicity in the 1960s: see Price, "Quantitative Measures of the Development of Science," *Archives Internationales d'Histoire des Sciences* 4, no. 14 (1951): 86–93 – a paper that, as Price later admitted, "passed totally unnoticed" and that "went over like a lead balloon" with the historians of science at Cambridge University, where Price had enrolled for a second "soft" PhD – after his first "hard" doctorate in physics: Price, *Little Science, Big Science*, p.xix (note 36); see also Derek J. de Solla Price, "The Exponential Curve of Science," *Discovery* 17 (1956): 240–3.

38. Storer, "The Hard Sciences and the Soft," 82 (note 30).

39. Price, *Little Science, Big Science*, pp.164–79, 168 (note 36); italics added.

Intuition and folk-wisdom were here confirmed by quantifying rigor, but this hard rigor could also *replace* intuition – and scientometric techniques might even allow you to say that an inquiry we *intuit* as soft was *really* hard. Unlike Storer, Price considered that there were clear distinctions to be made between the different types of science. Although the indexes of the approximately 150 journals that Price ransacked might *seem* to form a smooth progression, he maintained that the disciplinary categories were distinct sociological species: "In short, hard science, soft science, technology, and non-science may be all different social systems," each with its own way of handling communication and publication.[40] Here was a way of establishing and displaying measures of the *objective* differences between the disciplines. It was available to be used by librarians and information scientists wanting to sort and arrange; to administrators wanting to know who was actually hard and good, who was soft and bad, and who was getting better or worse; and it might be a resource for scientists themselves wanting to play the game of Goodhart's Law, turning a measure into a target and then making strenuous efforts to achieve that target. And, far less consequentially, Price's Index could be a resource solving the philosophical problem of demarcation: we could really *know*, and not just intuit or assert, what was hard and progressive, what was soft and going nowhere, what was science and what was nonscience.[41]

Hard and soft let loose and in use

In the years following the Storer and Price interventions, hard–soft vocabulary was reflexively appropriated in other social sciences, practitioners wanting to know where their own disciplines were, where they ought to be, and where they might possibly come to be, in schemes of classification and evaluation. The language of hard and soft proved useful for such purposes, although the imperative to locate, sort, and evaluate the disciplines was nothing new. For the most part, there was little take-up of this vocabulary by *natural* scientists, more secure in their standing and less inclined to reflect upon what gave them the authority flowing from hardness. Chemists and physicists, for the most part, *did* chemistry and physics, reserving inquiries about "the nature of science" to special occasions and to those disciplines who took that nature as a special subdisciplinary topic. In the 1960s and 1970s, there was some interest among those natural scientists whose practice was considered to be soft-ish, and this was notable in the life sciences, then experiencing emerging tensions between organismic approaches and the surging modishness of molecular biology. Participants in a 1972 conference of American ecologists were anxious about the softness ascribed to their discipline. Post-*Silent Spring*, they found themselves wanting to offer expert advice to governments, for instance about pesticide use, a problem "on which we would like very much to state hard, realistic

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40. Ibid., p.179.
41. "The literature of the scientist differs essentially in its social role from that of the nonscientific scholar – it is not just a matter of a different substantive content . . . The problem has been to develop counts of such things that might be a diagnostic whether a piece of scholarship or a field of knowledge acted as 'science' or as 'nonscience'": ibid., pp.155–6.

predictions." But they knew that ecologists were widely considered "soft scientists," limited in their ability precisely to predict the future, and this diminished their authority.[42]

Yet a few natural scientists at the time were taking umbrage at what they saw as illegitimate claims by social scientists to equal standing with physics, chemistry, and the like. In 1964, John Platt, a Chicago biophysicist, lashed out at what he called the increasingly fashionable notion "that all science is equal," that "every scientist's field and methods of study are as good as every other scientist's."[43] But this was clearly not the case: some fields progressed, others did not, and this difference must not be glossed over in feel-good expressions of academic collegiality. Platt celebrated molecular biology as a model of progressiveness and, while he refrained from naming and shaming the left-behinds, it's clear enough that he had in mind the social sciences and the insufficiently experimental and mathematized branches of life science. The basis of difference was methodological, nothing to do with the supposed tractability of subject-matter, the quality of the brains drawn to the disciplines, or funding and available resources. There was a special, and specially effective, form of Baconian inductive inference that some disciplines had learned systematically to use – and that Platt called "strong inference." You dream up a range of alternative hypotheses; you devise a crucial experiment, the results of which will exclude one or more of these hypotheses; you then carry out experiments "to get a clean result," refining the hypotheses that remain and homing in on the best one. The methodological formula seems simple – so much so that Platt offered no plausible explanation why strong inference had not been universally recognized and applied, save that science as a whole had become so routinized that students were no longer taught "how to sharpen up their inductive inferences." Once strong inference is recognized as a touchstone of scientific authenticity, it can be used by "government agencies" in their funding decisions: "The man to watch, the man to put your money on, is not the man who wants to make 'a survey' or a 'more detailed study' but the man with the notebook, the man with alternative hypotheses and the crucial experiments."[44] Platt did not use the vocabulary of hard and soft, but his contribution was, and continues to be, celebrated by natural scientists and philosophers, who reckoned that this was precisely what he was talking about and who found his argument a powerful weapon against the pretensions of (so-called) social science.[45] By 1980, some natural scientists were emboldened to be even ruder about the social sciences: they weren't *even* soft; they weren't sciences at all. So, famously, said Richard Feynman: "*Because of the success of science, there is, I think,*

42. *Ecosystem Structure and Function, Proceedings of the 31st Annual Biology Colloquium*, John A. Wiens (ed.) (Corvallis: Oregon State University Press, 1972), pp.130 and 133, and p.163 (for quoted passage).

43. John R. Platt, "Strong Inference," *Science* 146, no. 3642 (1964): 347–53, 347. (This was later republished in John R. Platt, *The Step to Man* [New York: John Wiley, 1966], pp.19–36.)

44. Platt, "Strong Inference," 347–8, 352 (note 43).

45. See, among many examples, Douglas S. Fudge, "Fifty Years of J. R. Platt's Strong Inference," *Journal of Experimental Biology* 217 (2014): 1202–4; Massimo Pigliucci, "Hard Science, Soft Science," in his *Nonsense on Stilts: How to Tell Science from Bunk* (Chicago: University of Chicago Press, 2010), pp.6–23.

a kind of a pseudoscience. Social science is an example of a science which is not a science. They don't do scientific [research]. They follow the forms . . . but they don't get any laws. . . . They don't get anywhere."[46]

Of all the academic disciplines at mid-century, philosophy had the most long-standing investment in producing accounts of the nature of science and, especially, what might distinguish it from false claimants. Twentieth-century philosophers of science were greatly concerned with what became known as "the demarcation problem." The late nineteenth-century German *Methodenstreit* partly addressed the problem of whether there were essential differences in treating natural and social phenomena, but there was little interest in *arraying* the sciences on a scale of worthiness, and the major pertinent concern of Anglophone demarcationism was distinguishing science from nonsense, metaphysical speculations, pseudoscience, and such only-pretend sciences as Marxism and psychoanalysis. For philosophers, and for some other academics who reached to philosophy for such distinctions, Karl Popper's *falsificationism* did the trick, and, less influentially, Imre Lakatos offered criteria for sorting "progressive and degenerating research programmes."[47] Few philosophers had much time for what must have been seen as the crudeness and imprecision of hard–soft distinctions.[48] In 1972, Stephen Toulmin's ambitious text on "the variety of rational enterprises" focused almost entirely on the physical sciences, treating the social sciences only briefly, and under the category of "would-be disciplines," though not designating them as "soft."[49] In the late 1970s, Larry Laudan's influential philosophical survey of theories of scientific progress referred to "historical interaction between the 'soft' and the 'hard' sciences" in a throwaway remark, and the survey of *Reliable Knowledge* by the physicist–philosopher John Ziman only glancingly gestured at the fallibility of "even the 'hard' sciences," declining to characterize the social sciences as "soft" while recognizing that many natural scientists – like Feynman – didn't think of them as sciences at all.[50] Kuhn's 1962 *Structure* offered a metanarrative

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46. Jeremy D. Johnson, "Richard Feynman on Social Science," November 3, 2009, <http://opensocio.blogspot.com/2009/11/richard-feynman-on-social-science.html> (February 16, 2022). (This was in a 1981 BBC interview.)

47. For Popper: Karl Popper, *The Logic of Scientific Discovery* (London: Hutchinson, 1959; orig. publ. 1935); for Lakatos: Imre Lakatos, *The Methodology of Scientific Research Programmes*, *Philosophical Papers, Volume I* (Cambridge: Cambridge University Press, 1978); see also Larry Laudan, "The Demise of the Demarcation Problem," in R. S. Cohen and L. Laudan (eds.), *Physics, Philosophy and Psychoanalysis: Essays in Honor of Adolf Grünbaum*, *Boston Studies in the Philosophy of Science*, Vol. 76 (Dordrecht: D. Reidel, 1983), pp.111–27; Thomas S. Kuhn, "Logic of Discovery or Psychology of Research?" in Imre Lakatos and Alan Musgrave (eds.), *Criticism and the Growth of Knowledge* (Cambridge: Cambridge University Press, 1970), pp.1–24.

48. A recent American exception to current diminished interest among philosophers in the hard–soft antonym, and its use in demarcation, is Pigliucci, "Hard Science, Soft Science" (note 45).

49. Stephen Toulmin, *Human Understanding: The Collective Use and Evolution of Concepts* (Princeton, NJ: Princeton University Press, 1972), pp.382–9. Toulmin saw dissensus and the relative absence of accumulation in the social sciences as major marks of their immaturity.

50. Larry Laudan, *Progress and Its Problems: Toward a Theory of Scientific Growth* (Berkeley: University of California Press, 1977), p.174; John Ziman, *Reliable Knowledge: An*

of the patterns of scientific change – while the notion of science-under-a-paradigm tacitly pointed to its *disunity*. In the preface, Kuhn talked about the importance of a year he spent among behavioral scientists at the Stanford Center for Advanced Study from 1958 to 1959 for his developing sensitivity to social and cultural differences between the natural and social sciences. He said that he was struck by "unanticipated problems about the differences between such communities and those of the natural scientists among whom I had been trained." Kuhn noticed – surprisingly for the first time (as he said) – that social scientists overtly disagreed about both the nature of legitimate problems and the methods for resolving them, while the natural scientists he knew did not. Yet Kuhn doubted whether that distinction arose from natural scientific communities having "firmer or more permanent answers" to questions about problems and methods than their social scientific colleagues, and it was this observation that led him to the notion of *paradigms*, which the natural sciences possessed and which the social sciences lacked. Still, Kuhn did not use the language of hard and soft: *Structure*'s exemplars were drawn from the physical sciences, but he did not overtly characterize the social sciences as a lesser breed.[51]

In early academic usage, the subdisciplines that saw most potential in the hard–soft distinction were those from which it had substantially originated – the sociology of science and its relations.[52] Price's own emerging field of scientometrics, and allied modes of information and library science, had professional reasons to be concerned with the hard–soft sorting. Classifications of technical literatures based on citation patterns, and the use of those classifications to inform policy, were a large part of *what was done* in those fields. Within years of Price's suggestion about differences in the range and age of literature cited in the natural and social sciences, scientometricians were constructing elaborate tests of that idea using the "enormous data base" of citation patterns being compiled in the proprietary *Science Citation Index*® and the *Social Science Citation Index*®.[53] Early scientometricians hoped that the spread of scientific knowledge could now be securely documented using quantitative techniques originally developed to

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      Exploration of the Grounds for Belief in Science (Cambridge: Cambridge University Press, 1978), pp.92, 158. Ziman's earlier work explicitly rejected the idea that psychology and sociology should be given room "within the Scientific stable": John Ziman, *Public Knowledge: An Essay Concerning the Social Dimension of Science* (Cambridge: Cambridge University Press, 1968), p.3 (see also p.147).

51. Thomas S. Kuhn, *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press, 1962), pp.ix–x.

52. Psychologists also gestured in that direction as they addressed differences between scientific disciplines, though, compared to sociology, psychology was less invested in these materials; see Anthony Biglan, "The Characteristics of Subject Matter in Different Academic Areas," *Journal of Applied Psychology* 57 (1973): 195–203, 198, 201; Anthony Biglan, "Relationships between Subject Matter Characteristics and the Structure and Output of University Departments," *Journal of Applied Psychology* 57 (1973): 204–13, esp. 207–8.

53. E.g., H[enry] G. Small and D[iana] Crane, "Specialties and Disciplines in Science and Social Science: An Examination of Their Structure Using Citation Indexes," *Scientometrics* 1 (1979): 445–61, 446. (This paper was originally delivered to the first meeting of the Society for Social Studies of Science at Cornell in 1976.)

describe the spread of epidemic disease and now adapted to map citations, with the natural–social, hard–soft sort as a first cut.[54]

Librarians and library scientists wanting to understand the ways in which books and papers circulated, and wanting to frame organizational procedures accordingly, found pertinence in the contrast between hard and soft sciences, crediting Storer and Price with the insight.[55] Lloyd Houser, a Canadian library scientist writing in the mid-1980s, noted that "The organization of science literatures for use by scientists is one of the fundamental problems of library and information science," attributing significant practical value to the hard–soft distinction: "Any advance in the understanding of the nature, structure and behavior of science literatures provides to the librarian the means to organize those literatures more efficiently for use by their clients," though he provided no details about how this might actually work. He worried, however, that the distinction was not being properly understood and sternly criticized previous writers on the subject for "poor scholarship" and faulty understanding of Storer's and Price's claims.[56] The idea that the hard–soft antonym was of practical use in librarianship persists, as do attempts to operationalize and further mathematize the notion that empirically observable patterns of citation, communication, and presentation can put textural classification on firm footing, so promising an objective way of knowing which fields were making progress and how rapidly.[57]

Hard or soft? Academic disciplines arrayed

In the decades following the appearance of the Storer essay, several academic disciplines drew on hard–soft categories as they inquired into the nature of science and as they commented specifically about their own status. The two purposes often overlapped, since commenting on your own discipline commonly involved positioning it in relation to others. American economists were, in general, confident of their increasing hardness, though there were occasional cautions from skeptical disciplinary colleagues.[58] The psychologists were

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54. William Goffman, "Mathematical Approach to the Spread of Scientific Ideas—The History of Mast Cell Research," *Nature* 212, no. 5061 (1966): 449–52.

55. E.g., William E. McGrath, "Relationships between Hard/Soft, Pure/Applied, and Life/Nonlife Disciplines and Subject Book Use in a University Library," *Information Processing & Management* 14 (1978): 17–28.

56. Lloyd Houser, "The Classification of Science Literature by Their 'Hardness'," *Library & Information Science Research* 8 (1986): 357–72, 358–9. Houser was particularly rude (p. 360) about the construal of hard–soft categories in Janet M. Chase, "Normative Criteria for Scientific Publication," *The American Sociologist* 5 (1970): 262–5, 263, whose understanding of hard and soft referenced Storer's 1967 article.

57. E.g., Daniele Fanelli, "'Positive' Results Increase Down the Hierarchy of the Sciences," *PLoS ONE* 5, no. 4 (2010): e10068; Daniele Fanelli, "A Theory and Methodology to Quantify Knowledge," *Royal Society Open Science* 6 (2019): 181055; Daniele Fanelli and Wolfgang Glänzel, "Bibliometric Evidence for a Hierarchy of the Sciences," *PLoS ONE* 8, no. 6 (2013): e66938.

58. For measured dissent among the economists: Thomas Mayer, "Economics as a Hard Science: Realistic Goal or Wishful Thinking?" *Economic Inquiry* 18 (1980): 165–78; also Gunnar Myrdal, "How Scientific Are the Social Sciences?," *Journal of Social Issues* 28 (1972): 151–70.

increasingly split between experimentalists and behaviorists, convinced that they *were* doing hard science, and dissenters affiliated with humanistic, phenomenological, and philosophical tendencies who either accounted themselves reasonably hard or who, less commonly, defended their softness.[59] In the mid-1970s, the psychologist and information scientist Belver Griffith posed the question, "What Kind of Science Should Information Science Be?" He saw evident signs of hardness in information science in general and scientometrics in particular: the use of "hard technology" (computers); the deployment of analytic tools and quantification; the display of aspects of progress – one worker building on the results of a previous worker and doing better. The same counting and tabulating methods that scientometrics applied to chemistry and psychology also allowed some practitioners to consider that *they* had achieved a satisfactory degree of hardness. Yet Griffith cautiously warned against a surfeit of enthusiasm. Information science was, and likely would remain, soft: its subject-matter inevitably included the meaningful behavior of people, "with all their glorious inflexibility and petty fickleness." Protons and proteins don't talk back, but people do, so introducing a degree of dissensus and instability into disciplinary knowledge.[60] In the event, Griffith's caveat was widely ignored, and an unresolved hard–soft argument surrounding scientometrics proved no obstacle to ever more elaborate displays of quantitative virtuosity and to success in serving the administration of science.

The sociology of science was among the most heavily invested, with the hard–soft distinction framing questions about disciplinary differences, about whether sociology was a science, and, if it was, what kind of science it was. In the early 1980s, Merton's student Stephen Cole revisited the nineteenth-century question of a hierarchy of the

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59. For focused confrontations on the texture of psychology: Paul E. Meehl, "Theoretical Risks and Tabular Asterisks: Sir Karl, Sir Ronald, and the Slow Progress of Soft Psychology," *Journal of Consulting and Clinical* Psychology 46 (1978): 806–34; Larry V. Hedges, "How Hard is Hard Science, How Soft is Soft Science? The Empirical Cumulativeness of Research," *American Psychologist* 42 (1987): 443–55; George S. Howard, "When Psychology Looks Like a 'Soft' Science, It's for a Good Reason!," *Journal of Theoretical and Philosophical Psychology* 13 (1993): 42–7; Dean Keith Simonton, "Psychology's Status as a Scientific Discipline: Its Empirical Placement within an Implicit Hierarchy of the Sciences," *Review of General Psychology* 8 (2004): 59–67; Dean Keith Simonton, "Psychology as a Science within Comte's Hypothesized Hierarchy: Empirical Investigations and Conceptual Implications," *Review of General Psychology* 19 (2015): 334–44; Dean Keith Simonton, "Hard Science, Soft Science, and Pseudoscience: Implications of Research on the Hierarchy of the Sciences," in Allison B. Kaufman and James C. Kaufman (eds.), *Pseudoscience: The Conspiracy Against Science* (Cambridge, MA: MIT Press, 2018), pp.77–99. Also Laurence D. Smith, Lisa A. Best, D. Alan Stubbs, John Johnston, and Andrea Bastiani Archibald, "Scientific Graphs and the Hierarchy of the Sciences: A Latourian Survey of Inscription Practices," *Social Studies of Science* 30 (2000): 73–94.
60. The paper exists online only as typescript: https://sigir.org/files/museum/pub-13/40.pdf (paginated as pp.40–55, quoting p.42). A note (on p.40) indicates intended publication in the *Journal of the American Society for Information Science*, where Griffith regularly published, but it never appeared. Internal references indicate a date of composition around 1975. Self-referential attention to the textural status of scientometrics has continued: see the rather more optimistic conclusions in Paul Wouters and Loet Leydesdorff, "Has Price's Dream Come True: Is Scientometrics a Hard Science?," *Scientometrics* 31 (1994): 193–222.

sciences. Cole briefly invoked hard–soft categories – referencing Norman Storer's paper – and he was much concerned with the proper placement of the natural and social sciences on a modern disciplinary array.[61] He was familiar with Auguste Comte's nineteenth-century hierarchical scheme, though Comte saw sociology – "social physics" – as the Queen of the Sciences, while Cole accepted that sociology was thought to occupy the bottom rung of the scientific hierarchy.[62] Cole knew that *consensus* was widely thought to mark the hard sciences and *dissensus* the soft, and that the hard sciences rapidly assimilated new ideas while the soft sciences were slow to do so. But here Cole distinguished between what he called disciplinary "cores" – accepted and textbook-inscribed bodies of knowledge – and research "frontiers" – where new knowledge was being actively made. Cole now claimed that sociometric techniques revealed that traditional hierarchical classifications needed to be modified: "at the research frontier, there are *no systematic differences* between the sciences at the top and at the bottom of the hierarchy in either cognitive consensus or the rate at which new ideas are incorporated."[63] But already by the 1980s sociologists of science reviewing previous efforts to pin down social structural and functional differences among the disciplines were becoming unsure of existing ideas about disciplinary hierarchy: "attempts like these have now largely been abandoned." Perhaps – it was thought – an appropriate focus should not be on *disciplines* but on their smaller sub-units.[64]

   The sociology of science had the resources to rescue and repair the idea of scientific hierarchy and it could contribute to understanding where sociology itself stood on the modern array. Cole intermittently used hard–soft notions to disturb the presumption that sociology was, indeed, *soft*, or that, if it was, this softness should be recognized as a pervasive feature of *all* the disciplines. Years later, he revisited the status of social science, repeating his claim that at research frontiers there were no significant differences between natural and social sciences but asking why so little social science knowledge moved from frontier to core. After all, the social sciences didn't progress as the natural sciences did, and the reasons had to do with the *instability* of the phenomena studied

61. Stephen Cole, "The Hierarchy of the Sciences?," *American Journal of Sociology* 89 (1983): 111–39, 112.

62. Auguste Comte, *Introduction to Positive Philosophy*, Frederick Ferré (ed. and trans.) (Indianapolis, IN: Hackett, 1988; orig. publ. 1830–42).

63. Cole, "Hierarchy of the Sciences?," 111 (note 61) (italics added). On attempts to document degrees of consensus through citation analyses, see Stephen Cole, Jonathan R. Cole, and Lorraine Dietrich, "Measuring the Cognitive State of Scientific Disciplines," in Yehuda Elkana et al. (eds.), *Toward a Metric of Science: The Advent of Science Indicators* (New York: Wiley-Interscience, 1978), pp.209–52. In Britain, the sociologist Harry Collins had already explored the difference between assessing science as ready-made *ships in bottles* and the contingent and contestable work of putting ships *into bottles*: H. M. Collins, "The Seven Sexes: A Study in the Sociology of a Phenomenon, or the Replication of Experiments in Physics," *Sociology* 9 (1975): 205–24. But Merton's students had almost nothing to say about the already considerable body of British sociology of scientific knowledge, and they addressed British work mainly as supposed *criticism* of Merton's mode.

64. Susan E. Cozzens, "Comparing the Sciences: Citation Context Analysis of Papers from Neuropharmacology and Sociology of Science," *Social Studies of Science* 15 (1985): 127–53, 128.

– social phenomena may be historically specific and variable while only some natural sciences study historically changing things – and with the intrusion of what he called *non-cognitive* considerations – the judgments of social scientists more likely to be affected by ideology and interest. So, despite Cole's repair-work and the collective efforts of generations of quantitative sociologists, their discipline seemed fated to *remain* soft. And Cole positioned his intervention in long-standing conflicts between those practitioners who aggressively campaigned to realize a vision of sociology as another *natural* science and those who reckoned that such ambitions were delusional, the resisters including many sorts of cultural and historical sociologists, symbolic interactionists, and ethnomethodologists.[65] Despite Cole's enthusiasm for virtuosic displays of quantification, he considered that the instability of the phenomena that sociologists investigated meant that their discipline could never resemble physics.[66]

Mutual funds: Following the money

From the 1960s, American academics were increasingly familiar with the hard–soft disciplinary distinction; they put it to use, developed it, and modified its reference. But neither the origins nor the natural home of the distinction is in academic inquiries about the nature of science. The hard–soft antonym emerged strongly as a commonplace in settings where sortings followed the contours of political and institutional power and where the distribution of financial resources was negotiated. The pertinent contexts were post-World War II American arrangements for state funding of science and, particularly, the debates surrounding the founding and early career of the National Science Foundation. The NSF was charged with supporting what was recognized as *basic research* and, therefore, funding was predominantly given to members of discipline-based university departments. Different disciplines called for different levels of funding to do their work. Particle accelerators are expensive; the ethnographic study of city street gangs much less so. Although the scientific community as a whole supported ever-increasing state funding for *science*, the leaders and champions of a specific discipline might view money spent on another discipline as money denied to their own. Accordingly, this was an institutional setting that encouraged placing disciplines on an evaluative array. Science was worthy, but some scientific disciplines were more worthy than others. There are,

65. The classic site for tension between hermeneutic and naturalistic conceptions of social science is Peter Winch, *The Idea of Social Science and Its Relation to Philosophy* (London: Routledge & Kegan Paul, 1958); see also Mark Bevir and Jason Blakely, *Interpretive Social Science: An Anti-Naturalist Approach* (Oxford: Oxford University Press, 2018).

66. Stephen Cole, "Why Sociology Doesn't Make Progress Like the Natural Sciences," *Sociological Forum* 9 (1994): 133–54. Price's 1970 hard–soft paper was only cited here, but nothing was made of the distinction. Around the same time, the sociologist Randall Collins suggested that the failure of the social sciences to progress had to do with their lack of "hardware" – research technologies that create new phenomena of interest: Randall Collins, "Why the Social Sciences Won't Become High-Consensus, Rapid-Discovery Science," *Sociological Forum* 9 (1994): 155–77.

however, certain problems in equating money spent on scientific disciplines with the location of disciplines with respect to political power.

There were, indeed, substantial links between science and the American state long before the Second World War, but the scale was nothing like what followed. Nevertheless, if you had to say which sciences were most closely associated with political power in the first part of the twentieth century, the answer might well be the *social sciences*. In the 1920s, President Herbert Hoover – a former mining engineer – saw the social sciences as essential to government, and he engaged leading practitioners in a massive survey of social resources and social changes. With Franklin Roosevelt's election, social scientists were included among close presidential advisors, key movers in New Deal reform programs. Economists were, of course, important presences, but so too were a range of academic social scientists concerned with poverty, race, education, crime, vice, and rural development. The late nineteenth- and early twentieth-century career of American social science linked it strongly to programs of social reform – and so to governmental concerns – and this in a pre-Hiroshima period when the *systematic* ability of academic natural science to contribute to practical outcomes was far from completely accepted.[67] In 1938, the social sciences were receiving almost a quarter of all federal research funds – a much higher percentage than they got postwar.[68] The Social Science Research Council, founded in 1923, began receiving significant funding, not from the government but from major foundations. In the decade after World War II, the Rockefeller, Ford, and Carnegie foundations allocated almost $100 million to academic social science. The Ford Foundation's 1949 Gaither Report announced its support for social scientific research leading to a "more complete understanding of the mainsprings of human action" and its confidence that social scientific "theories now exist" that might effectively guide that research.[69] During World War II, the social sciences were firmly perched on all branches of the military – externally, in the formulation of propaganda, in psychological warfare, and in inquiries about "the enemy mind"; internally, in military personnel departments – counseling, for example, on recruitment, selection, promotion, motivation, the management of stress and trauma, race relations among the troops, and nutritional policy. And in nonmilitary government agencies, social scientists advised on civilian morale, war bond purchasing campaigns, domestic consumption, and much else.[70]

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67. E.g., Roberta Balstad Miller, "The Social Sciences and the Politics of Science: The 1940s," *The American Sociologist* 17 (1982): 205–09; Stephen P. Turner, *American Sociology: From Pre-Disciplinary to Post-Normal* (Basingstoke: Palgrave Macmillan, 2014); Daniel J. Kevles, *The Physicists: The History of a Scientific Community in Modern America* (New York: Alfred A. Knopf, 1978), pp.260–5; also Andrew Jewett, *Science, Democracy, and the American University: From the Civil War to the Cold War* (Cambridge: Cambridge University Press, 2012), esp. ch. 9; Andrew Jewett, "The Social Sciences, Philosophy, and the Cultural Turn in the 1930s USDA," *Journal of the History of the Behavioral Sciences* 49 (2013): 396–427.

68. United States National Resources Committee, *Research – A National Resource: Relation of the Federal Government to Research* (Washington, DC: Government Printing Office, 1938), pp.69–71.

69. *Report of the Study for the Ford Foundation on Policy and Program, November, 1949* (Detroit, MI: The Ford Foundation, 1950), pp.90–2.

Whether the proposed National Science Foundation should support the social as well as the natural sciences was debated from the end of the war until its creation five years later. In 1945, the postwar vision for institutionalizing federal support for *basic* scientific research contained in Vannevar Bush's *Science – The Endless Frontier* gave the briefest of lip-service to the social sciences, and it was clear that Bush thought that there should be *no* NSF funding for the basic social science research. That report was commissioned by Roosevelt and ultimately delivered to Truman, but it was the electrical engineer Bush who had himself drafted Roosevelt's direction and it was Bush's interpretation of this direction that excluded the social sciences.[71] The social scientists' noses were put out of joint by the Bush agenda, though some still questioned whether their disciplines were ready for significant state funding.[72] Truman himself backed the inclusion of the social sciences, and there were cautious sympathizers among the natural scientists – Robert Oppenheimer and James Bryant Conant among them – but, while there is evidence of considerable support for their case among rank-and-file natural scientists, thought-leaders among the physicists were strongly opposed to dedicated social science funding, and their opposition resonated strongly with conservative politicians.[73]

Right-wing senators resisted the idea of funding for social scientists' "wild-eyed so-called research"; others recalled conversations with natural scientists who told them that social science wasn't genuine science at all, that it was meddlesome moralizing only dressed up as science: "What is commonly called social science is one individual or group of individuals telling another group how they should live."[74] Southern senators

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70. E.g., Harry Alpert, "The Government's Growing Recognition of Social Science," *Annals of the American Academy of Political and Social Science* 327, no. 1 (1960): 59–67, 61; see also Joy Rohde, *Armed with Expertise: The Militarization of American Social Research During the Cold War* (Ithaca, NY: Cornell University Press, 2013); Samuel A. Stouffer et al., *Studies in Social Psychology in World War II: The American Soldier*, 4 vols. (Princeton, NJ: Princeton University Press, 1949–50); Tal Arbel, *The American Solider in Jerusalem: How Social Science and Social Scientists Travel*, PhD diss., Harvard University, 2016.

71. E.g., Daniel S. Greenberg, *The Politics of Pure Science*, 2nd ed. (Chicago: University of Chicago Press, 1999; orig. publ., 1967), pp.104–11; Miller, "Social Sciences and the Politics of Science," 207 (note 67).

72. E.g., Philip M. Hauser, "Are the Social Sciences Ready?," *American Sociological Review* 11 (1946): 379–84.

73. Greenberg, *Politics of Pure Science*, pp.109–10 (note 71); Miller, "Social Sciences and the Politics of Science," 207 (note 67); Milton D. Graham, *Federal Utilization of Social Science Research: Exploration of the Problems* (Washington, DC: The Brookings Institution, 1954), p.64; George A. Lundberg, "The Senate Ponders Social Science," *The Scientific Monthly* 64 (1947): 397–411, 400, 402–05; also Harry Alpert, "Congressmen, Social Scientists, and Attitudes toward Federal Support of Social Science Research," *American Sociological Review* 23 (1958): 682–6, 682.

74. Lundberg, "Senate Ponders Social Science," 397–8 (note 73); also Charles Dollard, "Strategy for Advancing the Social Sciences," in G. Stanton Ford (ed.), *The Social Sciences at Mid-Century*, pp.12–20, 14 (note 9) (indicating awareness of politicians' activist conception of social science in the early NSF hearings); Mark Solovey, "The Impossible Dream: Scientism as Strategy against Distrust of Social Science at the U.S. National Science Foundation, 1945-1980," *International Journal for History, Culture and Modernity* 7 (2019): 209–38, 209–10.

were disturbed by what they saw as social scientists' anti-segregationist agenda, and Vannevar Bush agreed: why should Congress commit public money "for studies designed to alleviate [the] conditions of the Negroes in the South"? One of Bush's colleagues in the wartime Office of Scientific Research and Development was of the same mind, writing to a Texan academic that support for the social sciences would be "dynamite," endangering the whole idea of a national institution for the support of basic research.[75] In the febrile political atmosphere of the McCarthy era, the idea gained currency that sociologists were, as a group, worryingly sympathetic to the poor and marginalized. While disciplinary leaders strove to ingratiate themselves with the federal government and the military, the notion got about that sociologists were politically left-wing, and a daring few acknowledged Marxist inspiration.[76] And, after all, senators concluded, no one really knew what social science *was*, whether it bore much resemblance to science proper, whether there was any value in its purported theories and models, whether there was any possibility that such knowledge could be kept free from bias, or whether academic social scientists' claims to expertise were any better than that possessed by experienced laypeople, such as politicians themselves.[77]

In the end, the enabling act that established the NSF in 1950 did not specifically mention the social sciences, but language about the support of "other sciences" held out the possibility of limited funding.[78] (In the 1950s, the bulk of government "social science" funding went to the collection and collation of social statistics, and there was discussion about whether these sorts of things belonged to social science proper.)[79] These matters, however, did not stay settled: the issue was intermittently taken up through the following decades; bills were introduced from the 1950s onward to formalize NSF social science support; and the argument goes on into the present. So, in the founding struggles over the NSF, in annual appropriation legislation, and in periodic efforts to modify the distribution of funds, the contest between the disciplines continually erupted. And it was this *administrative* setting that helped position the natural and social sciences on a descriptive and evaluative *array*, and that pressured participants – scientific and political – to

75.   Both from letters written in 1945–6 and quoted in Kevles, *The Physicists*, pp.345–6 (note 67).

76.   E.g., Alvin W. Gouldner, "Anti-Minotaur: The Myth of a Value-Free Sociology," *Social Problems* 9 (1961): 199–213. The most visible Leftists in Cold War American sociology included Gouldner, C. Wright Mills, and David Riesman. Although less explicitly political, Chicago School sociologists (for example, Erving Goffman and Howard Becker) were thought to display disturbing sympathy with the underclasses.

77.   Lundberg, "Senate Ponders Social Science," pp.397–8 (note 73); also Kevles, *The Physicists*, p.357 (note 67).

78.   See, for example, various publications cited here (notes 29, 74, 84) by the leading scholar in this area, Mark Solovey: also Mark Solovey, "Riding Natural Scientists' Coattails onto the Endless Frontier: The SSRC and the Quest for Scientific Legitimacy," *Journal of the History of the Behavioral Sciences* 40 (2004): 393–422; Mark Solovey, *Social Science for What? Battles Over Public Funding for the "Other Sciences" at the National Science Foundation* (Cambridge, MA: MIT Press, 2020). (This last, while partly synthesizing earlier publications, was not available to me at time of writing.)

79.   E.g., Harry Alpert, "The National Science Foundation and Social Science Research," *American Sociological Review* 19 (1954): 208–11, 208.

offer accounts of the differences among the scientific disciplines and to give reasons why these differences made one sort more worthy of support than the other. As a Vietnam War-era piece in the *New York Times* put it, "On the campuses, the people in the 'soft sciences' are arguing with the people in the 'hard sciences'." And much of that arguing was about who got government money: "The physical sciences and engineering bring in more research money."[80] Educational researchers in the 1960s were agitating for expanded support for their field – with regional R & D centers founded on the model of agricultural experiment stations – and they worried about "the question of proportional allocation of resources to 'hard' science vs. 'soft' science. . . . Most of the behavioral and social sciences suffer from their assignment to the 'soft' category," but educational research was feared to be considered the softest of the lot. Despite the acknowledged Cold War importance of getting education right, the attributed softness of educational research was a major funding handicap.[81]

Arraying and valuing

In the early days of the NSF, there were practical debates both over the unity or heterogeneity of the sciences and over the specific place of the social sciences. The chairman of the NSF's governing board in the early 1950s was Chester Barnard – businessman, management theorist, former president of the Rockefeller Foundation, and friend and admirer of the Harvard social theorist Talcott Parsons. Barnard said that the social sciences dealt with matters of great social and political consequence, that they had proven themselves eminently useful, but that, despite their services, they had received "slanderous treatment" from natural scientists, administrators, and politicians. Part of this disrespect flowed from a false conception of the unity of the sciences, a hierarchical notion in which the social sciences were flawed or undeveloped versions of the physical sciences:

> Although scientists like, I think, to proclaim, at least in principle, an as yet undemonstrated unity of science, the reading of scientific literature and discussions among scientists of all kinds would suggest variations so great in the actual research procedures in different fields that these fields would have to be considered as different species, if not classes, of science.[82]

Barnard did not think that the social sciences played by the same rules as physics and chemistry, and, for that reason, should not be seen as failed versions of the natural sciences. They had their own methods, objects, and standards of evaluation – different from, but not inferior to, the natural sciences. Yet this same sentiment was also expressed by the atomic scientists and their political allies who, for this reason, argued that support

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80. Evert Clark, "U.S. Aides Discount Effect of Protests on Campus War Studies," *New York Times*, June 2, 1968, p.61.
81. Norman J. Boyan, "The Political Realities of Educational R & D," *Journal of Research and Development in Education* 2, no. 4 (1969): 3–18, 14.
82. Chester I. Barnard, "Social Science: Illusion and Reality," *The American Scholar* 21, no. 3 (1952): 359–60, 359.

for the social sciences should *not* be part of the mission of a government bureaucracy mandated to fund *science*. The MIT engineer Karl Compton pointed out problems in attempting to combine the natural and social sciences "in one foundation": they were, he said, modes of inquiry whose "methods are so different." If you did include the social sciences, how might you distinguish the findings of expert inquiry from *common sense*, what experienced people, in the ordinary course of life, just came to know? "Theoretically, I think it would be fine to include the social sciences; practically, I don't know where you would stop, because everything is social science, really, everything that human beings are interested in."[83] Was it legitimate that any one institution should allocate resources to disciplines that were so fundamentally different? Was it right to conceive of them on a single array? If so, was that array a *hierarchy*, and, if it was, what bearing did a hierarchy of the sciences have on the distribution of public resources?

Arguments over disbursing NSF funds to the social sciences continued throughout the Cold War era, and they have never ended. In these settings, the vocabulary of hard and soft became a common way of supporting judgments about what disciplines, and what subdisciplines, were worthy of financial support. To the extent that the social sciences were to be funded at all, NSF discussions recurrently distinguished their varieties. In 1953, the NSF engaged the sociologist and Durkheim scholar Harry Alpert to advise them about what sorts of social science research the foundation should sustain. Alpert explained that the social sciences formed a "continuum." At one end, there were what should be known as "hard-core scientific studies" of human behavior, marked by the use of experiment and quantitative techniques; at the other end of the continuum were those "soft areas" which included "activities which are scarcely identifiable as science and are more concerned with considerations of ethics, welfare, and philosophical interpretations of man's destiny." Alpert's advice was unambiguous: an NSF social science program "can properly be limited to the hard-core scientific end of the continuum." That advice was accepted and the hard–soft antonym became a continuing part of the environment in which grant proposals were conceived, written, and assessed.[84]

In the mid-1960s, the House committee responsible for overseeing the NSF solicited academic opinion about the possible effects of federal funding on universities' mission. Textural sortings of the disciplines were inscribed in a set of questions sent to academic respondents. Has federal research funding, the questionnaire asked, "caused imbalances" among the disciplines, for instance, through "inordinate support of the hard science

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83. Quoted in Lundberg, "Senate Ponders Social Science," 402, 404 (note 73).
84. Alpert, "Congressmen, Social Scientists, and Attitudes," 685 (note 73). This language was contained in Alpert's report to the NSF in 1953, as quoted in Graham, *Federal Utilization of Social Science Research*, pp.87–8 (note 73). Alpert's role is recounted in Mark Solovey and Jefferson D. Pooley, "The Price of Success: Sociologist Harry Alpert, the NSF's First Social Science Policy Architect," *Annals of Science* 68 (2011): 229–60; Mark Solovey, *Shaky Foundations: The Politics-Patronage-Social Science Nexus in Cold War America* (New Brunswick, NJ: Rutgers University Press, 2013), pp.148–87; Solovey, "Senator Harris's National Social Science Foundation," 65, n.32 (note 29) (where Solovey notes that the economist directing the Rockefeller Foundation's social science division used the term "hard-core" social research in the early 1950s). Political debates about the nature and value of the natural and social sciences are also well treated in Gieryn, *Cultural Boundaries of Science*, ch. 2 (note 29).

departments to the neglect of the social sciences" and other disciplines? Unsurprisingly, the social scientists generally thought that it had.[85] It's now well known that Sputnik and the subsequent space race unleashed a torrent of funds – through the National Defense Education Act – for natural science and engineering training, but less well known is the effect on social science through support for strategically important language study, for science policy, for the purportedly scientific study of science, inspired in part by the rise of scientometrics, and, notably, for the history of science – viewed as a resource for enhancing public understanding of science.[86] Then-Vice-President Richard Nixon urged the formation of an NSF Division of Social Science, and Democratic Senator Wayne Morse of Oregon – long an enthusiast for the social sciences – linked social science research to Cold War imperatives: "We certainly need to keep ahead of Russia in the development of scientific research in the whole field of natural science, but let me warn the Senate," Morse said, "that we also need to keep ahead of Russia in the field of social science."[87]

Liberal social scientists bridled at the unfair treatment of their disciplines by federal funding agencies – in the mid-1960s, the social sciences were receiving about six percent of the NSF's funding – but, in absolute terms, matters were improving. Support for the social sciences benefited not just from Cold War tensions but from John F. Kennedy's liberal initiatives and Lyndon Johnson's Great Society programs. From 1960 to 1969, the NSF social science budget increased 700 percent, and legislation was brought forward to regularize the NSF's social science mandate.[88] While many social scientists continued to chafe at their second-class status, others were newly confident of their access to power and resources, the sociologist Irving Louis Horowitz saying that "social scientists are now in the process of flexing their muscles. They are growing very rapidly."[89] It was this political setting that sharpened political and public awareness of similarities and differences between the natural and social sciences, of their respective values, and of subdisciplinary tendencies within the social sciences.

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85. House of Representatives, Committee on Government Operations, *Conflicts between the Federal Research Programs and the Nation's Goals for Higher Education. Responses from the Academic and Other Interested Communities to an Inquiry by the Research and Technical Subcommittee of the Committee on Government Operations (Part 2). August 1965* (Washington, DC: Government Printing Office, 1965), p.116.

86. For the NSF and the history of science: Solovey, "Senator Harris's National Social Science Foundation," 69 and n.44 (note 29).

87. For Morse: House of Representatives, Committee on Government Operations, *The Use of Social Research in Federal Domestic Programs (Part I—Federally Financed Social Research—Expenditures, Status, and Objectives. A Staff Study for the Research and Technical Programs Subcommittee of the Committee on Government Operations* (Washington, DC: Government Printing Office, 1967), p.215 (reproduced from *Congressional Record*, May 28, 1958, p.8727); for Nixon: Alpert, "Government's Growing Recognition of Social Science," 65 (note 70); Solovey, *Shaky Foundations*, pp.95–6 (note 84).

88. Otto N. Larsen, *Milestones and Millstones: Social Science at the National Science Foundation, 1945-1991* (New Brunswick, NJ: Transaction, 1992), pp.63–5, 69; Solovey, "Senator Harris's National Social Science Foundation," esp. 59–60, 65, 68 (note 29).

89. Horowitz, quoted in Larsen, *Milestones and Millstones*, p.75 (note 88).

The good times for American social science did not continue. Claims for the power of the social sciences to solve public problems prompted pushback, and the attribution of "softness" figured in that opposition. A widely syndicated column by the right-wing commentator Joseph Alsop in May 1969 called out social scientists for their inability to solve any number of social problems, including those of inner-city schools. They had put their faith in desegregation, but no good had come of it: "This is only one of countless examples of the failure of the social sciences, which are in fact much less scientific than moralistic." The power of the natural sciences – "true science" – was visible in the recent splashdown of Apollo 10 and would be even more evident when Apollo 11 returned from the moon later that summer. This was offered as spectacular proof of "the difference between the 'hard' sciences and the 'soft' sciences in this country." Perhaps, Alsop suggested, "the time has come to put the 'hard' scientists to work" on these problems. After all, once the moon-landing had been achieved, there would be plenty of unemployed physicists and engineers looking for new sorts of work. We should "see whether the NASA scientists may not succeed where the social scientists have failed."[90] Writing a few years later, the Harvard political scientist Don Price also noted the use of sociological evidence by the Supreme Court in its 1954 *Brown vs. Board of Education* desegregation ruling, claiming that dissensus among social scientists about the intellectual equality of the races, and about the detrimental effects of school segregation on African-American children, showed that the experts had overreached the limits of their certainty: the matter was inherently ethical, not scientific.[91] The more aggressive social scientists, and their supporters, tended to focus on means, to the neglect of decisions about goals, but this was just where they failed in political scenes of action, and this is what made so much hard-nosed social science weak in political terms: "We have," Price wrote, "too many studies which try to determine the exact way to perform an operation which shouldn't be performed at all."[92]

Through the 1970s, NSF allocations for the social sciences increased broadly in line with the agency's overall budget, but, after the Kennedy and Johnson administrations, the political winds no longer blew so fair. The promised solutions to major social problems had not been delivered, and there were new charges of moralizing and meddling. Social scientists' advertisements of their objectivity and value-neutrality were exposed as a veneer ineffectively hiding social and political agendas.[93] There was also a revival of the persistent genre of criticism that held social scientific knowledge to be trivial, commonsensical, or frivolous. The social sciences were held up to public ridicule, with projects that were evidently a waste of public money recognized by Senator William

90. Joseph Alsop, "Decay of Schools Illustrates Bankruptcy of 'Soft' Science," *Washington Post*, May 28, 1969, p.A19.

91. Don K. Price, *The Scientific Estate* (Cambridge, MA: Harvard University Press, 1965), pp.110–11; see also Kenneth K. Wong and Anna C. Nicotera, "*Brown v. Board of Education* and the Coleman Report: Social Science Research and the Debate on Educational Equality," *Peabody Journal of Education* 79 (2004): 122–35.

92. Price, *The Scientific Estate*, pp.126–7 (note 91).

93. Andrew Jewett, *Science under Fire: Challenges to Scientific Authority in Modern America* (Cambridge, MA: Harvard University Press, 2020), esp. ch. 4.

Proxmire's celebrated "Golden Fleece Awards" – for example, an NSF-funded social psychological study of why people fall in love: "Not even the National Science Foundation can argue that falling in love is a science," Proxmire said.[94]

By the early 1980s, the language of hard and soft sciences was becoming even more familiar in the general culture, appearing not just in Congressional hearings and in academic publications but in newspaper headlines, sometimes associated with Proxmire-inspired ridicule of government support for social science research, more often with Reagan administration plans to cut "waste." This gave public airing to the arrayed distinctions between those sciences that were hard, good, and properly investable and those that were soft, worthless, and undeserving of public support. In 1981, The *New York Times* prominently announced that "Reagan's Plans on Research Cuts Are Said to Aim at 'Soft' Sciences." Budget proposals sought to preserve planned increases for "basic research in the so-called hard sciences, but would sharply curtail support for programs in the behavioral and other 'soft' sciences."[95] A few months later, an editorial in the same newspaper lamented Reagan's plans for "Slicing through 'Soft' Science": the social sciences "are scorned by natural scientists as 'soft' and full of hot air," though the *Times* had already ironically noted the dependency of the administration's budgetary thinking on the same "soft sciences."[96]

This thread runs through the public and political culture of the present. The natural sciences may be thought of as black-boxed in technological artifacts and processes, and this embodiment makes them both hard and visibly valuable; the social sciences are widely presumed not to figure in the world of hard technology. Instead, they can be considered as reformulations of, or comments on, ordinary ways of being, thinking, feeling, and interacting – and this makes them appear both soft and lacking entitlement to special expertise. The hard–soft antonym is available to be invoked on practically every occasion when consequential governmental and institutional decisions are taken about disciplinary worthiness. Soft sciences were, and they remain, a political soft target. In 2012, for instance, the House of Representatives voted to cut all political science funding from the NSF budget and reallocate resources to the natural sciences, prompting a flurry of headlines in a few sympathetic papers complaining about the "bullying" of the "soft sciences" and counters from adversaries that *all* social science support should be cut off.[97]

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94. Larsen, *Milestones and Millstones*, pp.103–4, 112–16 (note 88); "The Sexes: Ah, Sweet Mystery," *Time Magazine*, March 24, 1975, <http://content.time.com/time/subscriber/article/0,33009,946536,00.html> (for Proxmire's remark) (February 17, 2022).

95. Robert Reinhold, "Reagan's Plans on Research Cuts Are Said to Aim at 'Soft' Sciences," *New York Times*, February 9, 1981, p.A16; see also Larsen, *Milestones and Millstones*, pp.146–52 (note 88).

96. Editorial, "Slicing through 'Soft' Science," *New York Times*, April 4, 1981, p.22; Editorial, "Why Federal Spending Must Be Cut," *New York Times*, February 15, 1981, p.18.

97. Timothy D. Wilson, "Stop Bullying the 'Soft' Sciences," *Los Angeles Times*, July 12, 2012, <www.latimes.com/opinion/la-xpm-2012-jul-12-la-oe-wilson-social-sciences-20120712-story.html> (February 17, 2022); Kevin Drum, "Social Science is 'Hard,'" *Mother Jones*, July 24, 2012, <www.motherjones.com/kevin-drum/2012/07/social-science-hard/> (February 17, 2022); Charles Lane, "Congress Should Cut Funding for Political Science Research," *Washington Post*, June 4, 2012: "The 'larger' the social or political issue, the more difficult it is to illuminate definitively through the methods of 'hard science'."

The disciplinary references of hard–soft sortings have, of course, shifted somewhat since the 1960s. New and reconfigured disciplines have emerged: cognitive science scarcely existed in the 1960s; nor did informatics, systems and synthetic biology, or digital humanities – the latter tellingly funded by the National Endowment for the Humanities, not the NSF. The life sciences are now much less identified with botany, zoology, and physiology, and the recognized dominance of molecular biology and biotechnology in the public culture has given biology a more prominent place at the hard science table. The fracturing of some of the social sciences into their hard and soft, quantitative and qualitative, sects has become more institutionalized, but, in the academic world, the conventions of the sorting have remained basically stable: the natural sciences are hard; the social sciences are soft; the scientific disciplines can be arrayed from soft to hard; and that array figures on a scale of reliability and worthiness.

Thinking differently?

From its mid-century emergence, the hard–soft distinction was at once incoherent and consequential. There was widespread agreement about which disciplines were hard and which were soft, though there was little stability in thought about what made them so. The antonym persists in present-day sensibilities, but there is suggestive evidence – though not much more than that – of change in both the pertinence of the distinction and in the evaluations it traditionally carried. That apparent change can be seen as an index of alterations over the last several decades in the institutional place of scientific expertise, in how science is organized, in what science is for, and, ultimately, in what science *is*. What follows is partly evidenced, partly speculative, but it is mainly a prompt for historians and sociologists of science to see modern science, as it were, hiding in plain sight.

There is a remarkable bit of testimony given to the 1965 congressional committee looking into academic disciplinary "imbalances." Lawrence Cranberg was a nuclear physicist, then working at the University of Virginia, and he was replying to a questionnaire distributed by the committee. His response challenged the taken-for-granted characterization of the social sciences as *soft*:

> The questionnaire itself represents, of course, a standard tool of research in the so-called "soft" social sciences, to use the unfortunate terminology implied or used in the questionnaire. The fact that the tremendously important and difficult issues being considered by your committee clearly fall within the competence of those "soft" sciences suggest that the words "soft" and "hard" should be interchanged.

And this is just what Cranberg did in the remainder of his testimony – going on to refer to the physical sciences as soft and the social sciences as hard. While it's *possible* that Cranberg's remarks were ironically inflected, the turn of thought he was communicating seems like the outcome of serious reflection. Cranberg joined many commentators who had observed that the objects of social sciences were *complex*, and they were, in just this

<www.washingtonpost.com/opinions/congress-should-cut-funding-for-political-science-research/2012/06/04/gJQAuAJMEV_story.html> (February 17, 2022).

sense, *hard* –difficult to formulate, to control, and to solve. The objects of the physical sciences, in contrast, "yield easily to quantification," and you could, for that reason alone, say that physics was *easy* and, in the same sense, *soft*.[98] The complexity of social scientific phenomena was customarily packaged as criticism, but Cranberg did not do that. The physicist reckoned that you might regard the social sciences as *hard* because they might be *consequential* too – if in other ways than was customarily said about the powers of the natural sciences. The politicians were invited to look at the scene in front of them – a physicist responding to a bureaucratically crafted questionnaire – but *from a different perspective*. Hard scientists were being held to account not just by elected officials and administrators who, in most cases, *knew no natural science*. The circumstances of scientists' existence were made known by questionnaires, surveys, and statistics – formulated, tabulated, and interpreted using the resources of common sense, the calculations of political interest, and, often, the methods of social science. This was a scene re-enacted at every congressional hearing and administrative deliberation about which sciences merited financial support and how much, about what sorts of things should be the object of scientific inquiry. Here, the social sciences were acting as a kind of *master-discipline* – a resource for the actions of scientists' administrative masters – as it were, speaking Power to Truth.

If *hard* meant certainty or consensus or durability, then the natural sciences were indeed seen as hard; if, however, *hard* meant *consequence* or *cultural reach* or the extent of widespread *caring* about findings and interpretations, then the social sciences had strong claims. When politicians or physical scientists suggested that there was no legitimate expertise in social science because, as Karl Compton said, "everything is social science . . . everything that human beings are interested in," he meant to *criticize* its softness and to imply that there was no such thing as special social science expertise, but those same observations might have been offered as evidence of the social sciences' scope and power.[99] So this kind of critical evaluation contained a contradiction: on the one hand, the social sciences were soft and weak because they could not effectively police their knowledge, but the pervasive *caring about* and supposed *interference in* social scientific inquiry meant that these sciences might be insinuated into all sorts of political agendas and social practices. The contestability of social science knowledge that was taken as a mark of weakness might also be seen as a testament to power. Insecure claims about political rights and authority, gender roles, national and racial identities, intelligence, and the like mobilize strong sentiments and social energies. Claims about

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98. House of Representatives, Committee on Government Operations, *Conflicts between the Federal Research Programs and the Nation's Goals for Higher Education* (1965), pp.189–90 (note 85). An unironical interpretation is supported by Cranberg's expression (p.190) of great respect for nonscientific knowledge: "I hope that the Federal Government will continue and strengthen its support of 'science,' but let us go back to the meaning of 'science' as it was understood by Jefferson, when it meant all the best of human cultural achievement, and included what we now call 'humanities'." A similar sentiment has been more recently canvassed in a premier general scientific journal: Michael Shermer, "The Really Hard Science," *Scientific American* 297, no. 4 (2007): 44, 46.

99. Quoted in Lundberg, "Senate Ponders Social Science," 404 (note 73).

subatomic particles, the sex lives of mollusks, and the composition of comets – secure as that knowledge may be – rarely do. In *Leviathan*, Thomas Hobbes remarked that the doctrines of ethics were disputed while those of geometry were not, but he said that this difference was due to the contingent circumstance that people's passions and interests were engaged by the former and not by the latter.[100]

In the mid-1960s, Cranberg's testimony gestured only vaguely in those directions, yet changes in the place and recognized worth of the natural and social sciences were already underway; these changes have accelerated through the end of the twentieth century and into the present, and these changes have been affecting sensibilities about the value of knowledges accounted hard and soft and even about the propriety of such descriptions. There are still academic attempts to analyze, justify, and apply the hard–soft distinction, but it hasn't for many years had the matter-of-fact appeal that surrounded it in the 1960s and 1970s. The usage now increasingly circulates on the academic margins, and many recent engagements with hard and soft urge its abandonment or puzzle about why it continues to be invoked. As an unreflected-upon ordering and evaluating gesture, the antonym persists in sectors of political, journalistic, and organizational life, but it seems to be losing much of its cogency and legitimacy.

After the war, and increasingly into recent years, it was recurrently said that the social sciences potentially had a role as a useful *handmaid* to natural scientific and technological enterprises. The Manhattan Project had been a triumph of physical science and engineering, but now – it was asserted – advances in psychology and sociology were needed to equip politicians and the general population to live with the new nuclear realities. When the Manhattan Project physicist Leo Szilard said that the only defense against nuclear weapons would be the prevention of war, a contemporary observed that he had "by one stroke, chang[ed] the problem from one of physics to one of social psychology."[101] Medical science gave physicians all sorts of curative powers, but social scientists must be enlisted to assist doctors to communicate with patients and to help scientists effectively translate health initiatives from the laboratory to the public sphere.[102] Large technoscientific projects needed their "human resources" experts to motivate employees and they relied on their management science experts to advise on organizational forms. Hard-driving American corporations "forged partnerships between operations and human resources, bringing together the 'hard' science of profitability planning and the 'soft' science of nurturing talent."[103] Nutrition scientists determined the physiological goodness of foodstuffs, but social scientists offered to find out

100. Thomas Hobbes, *Leviathan*, C. B. Macpherson (ed.) (London: Penguin, 1968; orig. publ. 1651), p.166.

101. Szilard exchange in D. G. Marquis, "Social Psychology and the Atomic Bomb: A Round-Table Discussion," in James Grier Miller (ed.), *Experiments in Social Process: A Symposium on Social Psychology* (New York: McGraw-Hill, 1950), pp.169–94, 174; see also Philip Wylie, "Panic, Psychology, and the Bomb," *Bulletin of the Atomic Scientists* 10, no. 2 (1954): 37–40.

102. E.g., Mark VanLandingham, "On the Hard and Soft Sciences in Public Health," *Public Health Reports* 129 (2014): 124–6.

103. Barbara Presley Noble, "Retooling the 'People Skills' of Corporate America," *New York Times*, May 22, 1994, p.F8.

what might motivate people to eat as they ought to do. In the COVID pandemic, virologists and epidemiologists analyzed the structure of the coronavirus and tracked its dispersion, but sociologists and psychologists were mobilized to describe the modes of social interaction that transmit infection and to project the forms of constraint that people would or would not tolerate.[104]

This is, in the main, an *under-laborer* conception of social science. Even that conception encounters substantial obstacles, but it nevertheless accords "soft science" value in "hard" enterprises.[105] At the same time, the under-laborer or "assistant" sensibility was yet another basis for thinking of the social sciences as *undeveloped* or *immature* versions of the natural sciences. "Many of the difficulties that beset our world today," a RAND operations researcher wrote in the mid-1960s, "can be explained by the fact that progress in the social-science domain has lagged far behind that in the physical sciences." The physical sciences could often fail in their inquiries without consequence, while the objects of social science – how to keep the peace, how to alleviate poverty and inequality, how to adjust to the challenges of technological change – meant that failure would be "catastrophic."[106] Physics, chemistry, and biology had powerfully changed the world; now they were waiting for the social sciences to *catch up*. Through the end of the twentieth century, some thought that the social sciences *were* catching up and becoming hard; others despaired that they ever would – that they were fated to remain soft. But if there was any possibility that the social sciences could become hard, it was thought immensely important that they do so.

Future projects

In the Second World War, and even more in the decades following, large and complex *projects* developed – in government, military, industry, medicine, and nonprofit organizations – that embedded a range of scientific and technological expertise in complex and innovative organizational forms. It was these *projects*, rather than the institutions of academic *disciplines*, that increasingly came to constitute scientists' and technologists' work-environments. Technical experts continued, of course, to be trained in the disciplinary departments of higher learning, but they came more and more to exercise their skills in government and commercial concerns, and, in these settings, it was to the *project* rather than to the *discipline* that they were oriented.[107] There is a relationship between such nonacademic projects and the social sciences whose purported *softness* was often said to consist in the *complexity* of their subject-matters, the *uncertainty* of their

104. E.g., Jay J. Van Bavel et al., "Using Social and Behavioural Science to Support COVID-19 Pandemic Response," *Nature Human Behaviour* 4 (2020): 460–71.

105. See, among very many examples of such sentiments, Alvin M. Weinberg, "In Defense of Science," *Science* 167, no. 3915 (1970): 141–5, 144; Editorial, "In Praise of Soft Science," *Nature* 435, no. 7045 (2005): 1003: The United States has powerful pharmaceutical R & D, "but what good is that if patients don't take their drugs correctly? . . . Shouldn't psychology and sociology be better harnessed to address this problem?"

106. Olaf Helmer, *Social Technology* (New York: Basic Books, 1966), pp.3–4.

107. The practical policies of industrial research laboratories with respect to *projects* and *disciplines* are described in Steven Shapin, *The Scientific Life: A Moral History of a Late Modern Vocation* (Chicago: University of Chicago Press, 2008), ch. 5.

solutions, and their *openness* to various sorts of external perturbations. Consider, for example, the project of producing a market-successful hand-held digital assistant; the project of administering and encouraging take-up of COVID vaccines; the project of spinning government financial policies; or the project of launching a new fast-food chicken sandwich. Solutions here are all complex, uncertain of achievement, unable to generate binding and global *laws*, unsure of guaranteed survival when alternative solutions appear. That is, they could be called *soft* in the same way that sociological problems are said to be soft. And, indeed, the notion of *social technology* was advanced by RAND Corporation operations researchers in the 1960s precisely to gesture at that analogy, and, further, to express skepticism about the reality of the hardness and exactitude generally attributed to all forms of the physical sciences. The future is hard to predict, yet future-prediction was just the task increasingly required of *social technology*.[108] Within academic disciplines in the postwar world, funding arrangements made it natural for the disciplines to be *arrayed* and evaluated accordingly. But in large-scale governmental and commercial projects, there were few imperatives to do that.

Ideas about human nature, social interaction, and lay belief had, of course, always figured in statecraft, warfare, and business. But the growth of academic social science departments, the development of professional organizations, and the increasing supply of trained graduates encouraged reflection about what formal social science could contribute to a range of civil projects. This was happening on a global scale. The Japanese had ransacked largely American social and management science expertise, systematically applying it to manufacturing. In 1970, the Japanese government's Science and Technology Agency defined, and sought to encourage, a strand of what they called *soft science* – the term was then internationally recognized in business and development circles – based on "information science, behavioral science and systems engineering," "software for social systems" involved in manufacturing. Through the 1970s and 1980s, "soft science" was a discrete category in the R & D plan of Japan's Economic Planning Agency and the powerful Ministry of International Trade and Industry. Government initiatives prompted the large industrial group Mitsubishi Electric Corporation to establish a *Soft Science Group* that included a range of behavioral sciences, including management and organization science.[109] The management and motivation of industrial workers, notably with respect to quality control and productivity improvements, were leading concerns of Japanese automobile manufacturers, who acknowledged that the realization of "hard" productive technologies depended upon what they called the "soft technologies" that followed from understanding human behavior. Other East Asian economists and development thinkers were intrigued by Japanese attitudes to soft science. In China, from the 1980s, state initiatives recognized and promoted the category of "soft technology" as an essential

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108. Helmer, *Social Technology*, esp. pp.8, 16 (note 106); Olaf Helmer and Nicholas Rescher, *On the Epistemology of the Inexact Sciences* (Santa Monica, CA: RAND Corporation, 1958).

109. Kazuo Yanagishita, Taro Tanimitsu, and Tetsuo Kobayasji, "Activity of a 'Soft Science Group' in Mitsubishi Electric Corp," *R & D Management* 9, no. 3 (1979): 137–40; also Zhouying Jin, *Global Technological Change: From Hard Technology to Soft Technology*, 2nd ed., trans. Kelvin W. Willoughby and Ying Bai (Chicago: Intellect, 2011), p.47 (for recognition of "soft science" as an "international usage") and pp.148–58 (for a summary of Japanese governmental "soft science" initiatives).

resource in advancing hard technologies and the resulting productive industries; an academy of "soft technology" was founded in Beijing; and there were laments that physical scientists and engineers were ignorant of, or looked down on, the social sciences, considering the soft sciences as immature or defective versions of the hard sciences.[110] While much of the inspiration for East Asian soft-science thinking derived from Western social science, there was notable splashback: increasingly admired Japanese industrial practices stimulated changes in American attitudes. As early as 1980, testimony to U.S. congressional committees took note of the key role of the "soft sciences" in Japanese manufacture and applauded recent indications that American companies were trying to follow the examples of Mitsubishi, Toyota, Honda, and the like.[111] At present, business school revaluations of corporate "soft skills" – including the manipulation of "values," the management of interpersonal relations, and the appreciation of messy "real-world" conditions – approach the commonplace.

Many of the contemporary projects enlisting social science are so woven into the fabric of everyday life that their visibility as special forms of expertise recedes. Those who devise and manage such projects are increasingly aware of their social science components, while those subject to their workings typically have little notion of social-science-in-action. The flow of pedestrians in buildings and public spaces and of vehicular traffic on roads draws on social scientific knowledge about how people respond to the layout of pathways, obstacles, and signage and how they adapt to others' movements.[112] The canned music in stores is informed by studies of what tunes, in what rhythms, volumes, and timbres, make people buy which products, and restaurants now contract with psychologists who find that certain kinds of music or lighting make the food taste better.[113] The design, packaging, naming, pricing, marketing, and advertising of products – from fast-food burgers to smartphones to presidential candidates – has for some time routinely drawn on social scientific methods to elicit consumer attitudes and responses, these including the focus group methods pioneered in the 1940s by Robert Merton and his colleague Paul Lazarsfeld.[114]

Social-science-in-action is specially marked in high-tech, where *design* and concern with user wants and behaviors have long been central to corporate concerns.[115] How do

110. E.g., Jin, *Global Technological Change*, pp.120–8 (note 109).

111. Luther J. Carter, "Industrial Productivity and the 'Soft Sciences'," *Science* 209, no. 4455 (1980): 476–7.

112. E.g., Tom Vanderbilt, *Traffic: Why We Drive the Way We Do (and What It Says about Us)* (New York: Knopf Doubleday, 2008).

113. E.g., Joseph Lanza, *Elevator Music: A Surreal History of Muzak, Easy-Listening, and Other Moodsong* (New York: St. Martin's Press, 1994); David Owen, "The Soundtrack of Your Life: Muzak in the Realm of Retail Theatre," *New Yorker*, April 2, 2006, <www.newyorker.com/magazine/2006/04/10/the-soundtrack-of-your-life> (February 17, 2022); Charles Spence, *Gastrophysics: The New Science of Eating* (New York: Viking, 2017).

114. Robert K. Merton and Patricia L. Kendall, "The Focused Interview," *American Journal of Sociology* 51 (1946): 541–7; Raymond M. Lee, "The Secret Life of Focus Groups: Robert Merton and the Diffusion of a Research Method," *The American Sociologist* 41 (2010): 115–41.

115. E.g., a blog post by the creative designer Tobias van Schneider, "The Hard Truth about Soft Science," November 13, 2017, <https://vanschneider.com/blog/hard-truth-soft-science/> (February 17, 2022).

users interact with devices? What do they want, worry about, *like*? What may they be *encouraged* to want? Goods and services become more profitable as they become less commodified and more finely attuned to users' desires and needs, so increasing value is attached to knowledge of users. High-tech companies like Intel now employ hundreds of social scientists in a unit headed by a cultural anthropologist whose job it is to find out how people use digital technology and how the resulting knowledge can inform product development; at Google and other high-tech companies, social scientists and humanists work in *User Experience* (UX) units, composing the text that appears on websites and instruction manuals; Facebook recruits social scientists to expand the company's reach and to discover ever more effective ways to keep users on the site. Artificial intelligence develops in a recursive relationship with understandings of human intelligence; the practice of affective computing enlists psychologists, cognitive scientists, and computer scientists in projects aimed at building technological systems that recognize, respond to, and simulate human emotion; robots are now being produced to act as human companions, their design incorporating knowledge of human affective relationships and, in turn, producing new modes of affective relationship. Making, marketing, and operating self-driving cars are technological projects, but they also present psychological, and even moral, problems, and here too social scientific knowledge is an integral part of commercial projects.[116] The design of voice-operated digital assistants such as Alexa, Siri, and Cortana is informed by understandings of how people hear, understand, and emotionally react to voices, even as human beings learn to speak in a way that their digital assistants can cope with. And, everywhere, corporate human resources departments draw on embedded social scientific knowledge, and they employ graduates of university programs in human resource management, to recruit scarce skilled employees, to keep them happy and productive, and to manage smooth departures when employees are deemed inadequate or become surplus to requirements.[117] An English technology website announces that social scientists are much in demand in high-tech industry, specifying that the "softness" of social science is short-hand for its orientation to the human user and that it's this softness "that is its greatest asset."[118]

People now conduct much of their social life, and establish much of their identity, through technological mediation. Those same technologies – smartphones, activity

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116. Jean-François Bonnefon, Azim Shariff, and Iyad Rahwan, "The Social Dilemma of Autonomous Vehicles," *Science* 352, no. 6293 (2016): 1573–6; Caroline Lester, "A Study on Driverless-Car Ethics Offers a Troubling Look into Our Values," *New Yorker*, January 24, 2019, <www.newyorker.com/science/elements/a-study-on-driverless-car-ethics-offers-a-troubling-look-into-our-values> (February 17, 2022).

117. E.g., Natasha Singer, "Intel's Sharp-Eyed Social Scientist," *New York Times*, February 15, 2014, <www.nytimes.com/2014/02/16/technology/intels-sharp-eyed-social-scientist.html> (February 17, 2022); Oren Shapira, "UX Writers and Social Psychologists Should Talk Regularly," February 29, 2020, <https://uxdesign.cc/ux-writers-and-social-psychologists-should-talk-regularly-ac11f05b8b86> (February 17, 2022); Rosalind W. Picard, *Affective Computing* (Cambridge, MA: MIT Press, 1997); Roberto Pieraccini, *The Voice in the Machine: Building Computers That Understand Speech* (Cambridge, MA: MIT Press, 2012).

118. Jade Emmons, "Why Hiring Social Scientists is the Next Big Thing," November 13, 2018, <https://guild.co/blog/why-hiring-social-scientists-is-the-next-big-thing/> (February 17, 2022).

trackers, online ad trackers, social media apps – now produce terabytes of Big Data that Facebook, Google, Amazon, Twitter, and Netflix use to adapt their proprietary technologies to user wants, to generate new wants, to know users' patterns of activity, to design new technologies – software and hardware – and to turn knowledge of people into profit. The *surveillance capitalism* about which Shoshana Zuboff warns also constitutes a resource for academic social scientists, now capable of knowing vastly more than they ever did about human behaviors, interactions, and attitudes.[119] Sociologists deploy their knowledge of social affect and interaction to design online dating apps and, in turn, other sociologists mine the resulting data to discover more about sexual preferences and modes of affective communication. Knowledge about people's behaviors and desires is a resource for designing and marketing products, while, in the world of Big Data, that knowledge is *itself* the profitable product. University social science consortia work to build partnerships with industry, in part because so much data about human behaviors and attitudes that was once generated by academics and governments now belongs to commercial corporations.[120] This is not soft social science as *handmaid* or *under-laborer* to hard power and profit but social science knowledge and data *as* the substance of power and profit. It's suggestive that the appeal of the hard–soft antonym apparently diminished some time around the historical moment when the late modern economy began to be described as a *knowledge* economy or, more specifically, when, in high-tech business, computers became commodified and when *software* became recognized as more valuable than *hardware*.[121] It would be claiming more than I know to say that the evaluative arraying contained in the hard science–soft science distinction is absent from the present world of corporate high-tech, but I do not encounter nearly as much usage in recent decades. If, as Google ngrams suggest, there is a falling-off in recent years, it's possible that this has something to do with the changing place of the social scientific knowledge in both production and governance.

Long before there were academic departments of sociology and psychology, and even before there was a practice called *statistics*, governance enlisted knowledge about the nation's population – who and how many they were, what they did and what beliefs they professed, what they possessed and what they spent – and, into the twentieth century, data-collection and tabulation about such things once substantially defined governments'

119. Shoshana Zuboff, *The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power* (New York: PublicAffairs, 2019).

120. See, e.g., Heidi Ledford, "Computing Humanity: How Facebook, Twitter, and Other Data Troves Are Revolutionizing Social Science," *Nature* 582 (2020): 328–30. For joint projects between academic social science and IT companies, see, e.g., "Harvard's Institute for Quantitative Social Science and Microsoft announce a major collaboration to develop an open data differential privacy platform," September 26, 2019, <www.iq.harvard.edu/news/harvards-iqss-announces-major-collaboration-microsoft> (February 17, 2022); "Building Industry-Academic Partnerships," https://socialscience.one/ (February 17, 2022).

121. The idea of a *knowledge economy* (or *knowledge society*) was popularized by the management consultant and writer Peter Drucker in his *The Age of Discontinuity: Guidelines to Our Changing Society* (New York: Harper & Row, 1969).

views of what social science *was*.[122] Governments are now well aware of the diverse forms of social science, from the qualitative and theoretical modes of little interest to the state to data-driven practices that are so well integrated into practical governance that they are scarcely discernable as special forms of expertise. The result is a state of affairs in which the state exercises power through scientific modes that have been called *soft* but that approach invisibility as science at all.

Still, there are domains in which social science knowledge figures largely that are even *less* visible, and in which the idea of the social sciences as soft is even *less* sustainable. These include the role of social science in *making people* – providing resources people use to understand themselves, to account for their actions, to know their own attributes, and to position themselves with respect to the attributes of others. All of these commonly present themselves as *matters of course*, self-evident knowledge that one possesses simply by virtue of being a competent person, nothing to do with expertise. Yet some of this common knowledge *becomes* common through passage from social science expertise. Take, for example, our intelligence as indexed by IQ; our status as "a bit Aspie," "on the spectrum," or "neuro-diverse"; our exhibition of "type A behavior"; our accounting for our conduct by causal reference to the enduring effects of parenting in early childhood; our description of ourselves or others as having "multiple personalities" or suffering from "repressed memory"; our ascription of "charisma" to political leaders; our acceptance, or focused rejection, of races and genders having certain "essential identities."[123] Some of these bits of common knowledge were once not knowledge at all, some may not count as knowledge in the future, and they all passed through social science expertise on the way to becoming the knowledge through which many of us constitute our *selves*. Natural scientific knowledge reliably *represents* the real – and so it's accounted *objective* and *hard* – but social scientific knowledge can, under certain conditions, *realize itself*. That capacity might be accounted very hard indeed, though. Because the reality it can create is bound up with ourselves, it may lack distinctness: it's just what we see when we look in the mirror.[124]

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122. For governance and early modern practices of making the nation legible, see, for example, Ted McCormick, *William Petty and the Ambitions of Political Arithmetic* (Oxford: Oxford University Press, 2009) and James C. Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed* (New Haven, CT: Yale University Press, 1998); for the state and political economy into the nineteeenth century, see Mary Poovey, *The Culture of the Fact: Problems of Knowledge in the Sciences of Wealth and Society* (Chicago: University of Chicago Press, 1998); for social science and knowing the modern American public, see Sarah E. Igo, *The Averaged American: Surveys, Citizens, and the Making of a Mass Public* (Cambridge, MA: Harvard University Press, 2007). The Foucauldian notion of *governmentality* as the arts of knowing and controlling populations is set out in Michel Foucault, *Security, Territory, Population: Lectures at the Collège de France, 1977–1978*, trans. Graham Burchell (Basingstoke: Palgrave Macmillan, 2007).

123. Steven Shapin, "Invisible Science," *The Hedgehog Review* 18, no. 3 (2016): 34–46, 43–5.

124. The self-referential, and therefore reality-creating, character of social scientific knowledge was treated in one of Barry Barnes's most neglected, and most important, pieces of work: "Social Life as Bootstrapped Induction," *Sociology* 17 (1983): 524–45; also Ian Hacking, "Making Up People," *London Review of Books* 28, no. 16 (2006): <www.lrb.co.uk/the-paper/v28/n16/ian-hacking/making-up-people> (February 17, 2022); Ian Hacking, *Historical Ontology* (Cambridge, MA: Harvard University Press, 2002), pp.99–114.

The future: *hard* to predict?

In the 1970s, the label of *soft science fiction* was applied to a genre of imaginative future-prediction that focused not on changes in material technology but on changes in human nature, cognition, and ways of being – sometimes, but not always, flowing from academic understandings of what people are like and how they interact with others. There are, of course, few things softer than fiction, though the track-record of soft science fiction is not notably worse than supposedly nonfictional exercises in futurology. The fact, however, that the soft science fiction genre exists at all, and that it has some grip on the film-going and novel-reading public, is an indication that the power of the social sciences is increasingly recognized.[125] Historians can write *about* past futures, but they have no professional authority to speak about their own future. I have sketched some recent changes of sensibility about the natural and social sciences and I indicated how those changes might bear upon what *appears to be* a falling-off of hard–soft usage. Just as specific institutional and cultural circumstances encouraged the emergence and diffusion of this way of arraying the disciplines, so changes in circumstances may discourage its continuing use.

Those qualifications aside, a series of developments that were underway in the last decades of the twentieth century seem to be accelerating, and the future of the hard–soft antonym may come to be shaped by these changes. First, although discipline-based departments continue to be the academic norm, pressure toward *interdisciplinarity* has been building for some time, often as a way of talking about *projects* that universities now have in common with government and industry – among very many examples, genome sequencing; early stages of drug, vaccine, and biomedical device development; artificial intelligence and robotics research; data science; work on manufacturing technologies and agricultural genetics; and joint academic–industry research on food and sensory science. As the *project* is the customary way of deploying skilled knowledge-workers in industry, the commercialization of the late modern university works against the matter-of-fact acceptance of disciplinary categories. And, insofar as the social sciences participate in collaborative projects, the evaluative array of hard and soft may lose pertinence. The centralized distribution of government moneys to the academic disciplines will doubtless go on, and young people will probably long continue to acquire their knowledge and skills by passing through disciplinary departments. But those disciplines and departments may come less and less to define the sites in which technical skills and knowledge are deployed, and, if that happens, the political and economic forces that once so powerfully arrayed the hard sciences and the soft sciences could also fade away.

Projects – notably in business and in government – are, in their nature, *complex* in their objects and in their methods for delivering outcomes. A stable result is what's

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125. Examples of this genre include Walter M. Miller's *A Canticle for Leibowitz* (1960), Frank Herbert's *Dune* (1965), Philip K. Dick's *Man in the High Castle* (1962), and Kazuo Ishiguro's *Never Let Me Go* (2006). Ishiguro's recent *Klara and the Sun* (New York: Alfred A. Knopf, 2021) profoundly plays with the increasingly dense and indeterminate reciprocities between human capacities and identities, robotic hardware, and controlling software.

expected in a physics experiment, intended to arrive at how things *really are*, without respect to time, location, or setting; the result is meant to be both robust and certain, and the simplicity both of experimental design and of the underlying natural order addressed is part of what has been meant by hardness. But *projects* are rarely like that – whether the project is digging a tunnel under city streets, throwing a dam across a river, designing a new relational database, or fabricating and marketing a new chicken sandwich. Here, *complexity* comes with the territory, and that is one of the reasons why Aristotle reckoned that neither politics nor cooking could arrive at the certainty of philosophy. Fluid dynamics produces certain, simple, and global results about *how liquids and gases move*, but classical hydrodynamics is not expected to give an account of the disposition of water molecules as they flowed over Niagara Falls at 9 A.M. yesterday morning. Many academic social scientists routinely insist that theirs is not a science of the particular, that they deal with structure, the collective, ideal types, and the like, but laypeople are often deaf to such methodological niceties, and sociologists can be expected to deliver knowledge very like that describing the molecules in the waterfall.[126] The enlistment of the natural scientific disciplines in *projects* delivers them to the worlds of both complexity and uncertainty, even as it enfolds them in civil spheres of political and economic *value*. As Don Price put it in the 1960s, "the range from the more exact to the less exact sciences runs in inverse proportion to their suitability for solving problems that seem important to the average citizen or the administrator."[127] Complexity was once central to what was meant by the softness of the social sciences; now, very many natural scientists have been enlisted, and have enthusiastically enlisted themselves, in complex projects – disciplinarily impure, difficult of resolution, uncertain in their outcome, unclear as to appropriate methods, subject to all sorts of budgetary and substantive interference by technically unskilled administrators, and, in many cases, vulnerable to judgment by the public.

The expertise of the social sciences belongs more and more to those projects, and, while it is not clear how widely visible that role now is or may become, it's possible that the perceived equation between social science and the concerns of academic disciplines may weaken and that the place of social sciences in the projects of industry and government will be increasingly recognized. And one reason for that possible recognition is a growing perception that the most valued products and practices of late modernity are *hybrids* of the material and the human, folding together the expertise of the natural and the social sciences, making the distinction between hard sciences and soft sciences harder to see and more pointless to police.

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126. Invoking Durkheim on suicide and social facts, a New York sociologist insisted on *similarities* between the intellectual products of biological and social science: "The generalizations of the biological and the social sciences . . . are of the same order; they do not apply to the actions of unique individuals. The biological sciences are concerned with the typical, the average, the normal, the recurrent, as are such sciences as economics, sociology, and psychology," though he held out the possible future development of "individualizing" social sciences: Gerard De Gré, *Science as a Social Institution: An Introduction to the Sociology of Science* (Garden City, NY: Doubleday, 1955), pp.42n, 46.
127. Price, *The Scientific Estate*, p.129 (note 91).