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التاريخ الشاذ للعقل العلمي

بيير بوردو

ملخص

العلم هو مجال للقوى الاجتماعية، للصراعات، والعلاقات التي تتحدد في كل لحظة بواسطة علاقات القوة بين أصحاب النفوذ. الاختيارات العلمية تقاد من خلال فرضيات مسلم بها، تتفاعل مع التطبيقات العلمية، مثل ما الذي يمثل مشكلات حقيقية ومهمة، المناهج المقبولة، والمعرفة الأصيلة. مثل هذه الاختيارات تتشكل أيضا بواسطة رأس المال الاجتماعي المحكوم بواسطة المواقف والاتجاهات المختلفة داخل المجال. هذه الصورة الدينامية والمعقدة، إذن، ترفض، في نفس الوقت، الفكرة الإطلاقية-المثالية لبروز وتطور العلم، والنسبية التاريخية التي تطرح العلم كبناء اجتماعي وضعي بشكل كامل. الاستراتيجيات التي تستخدم في العلم هي في الحال اجتماعية وفكرية؛ على سبيل المثال، الاستراتيجيات التي نجدها في توافق ضمني مع النظام العلمي القائم تكون في نفس الوقت في تقارب كامل مع مراكز القوة خلال المجال نفسه. في المجالات العلمية الراسخة ذات الاستقلالية العالية، لم تعد "الثورات" ضرورية في نفس وقت التغيرات السياسية ولكنها، بدلا من ذلك، تتخلق من خلال المجال نفسه: المجال يتحول إلى موقع لثورة دائمة. تحت ظروف معينة، إذن، تضع الاستراتيجيات المستخدمة للتعبير عن القوة الرمزية نفسها في موقع متعالي حيث تكون خاضعة للرقابة المتعددة التي تمثل العقل الجمعي للمجال نفسه. الشرط اللازم والكافي لهذا التصحيح الحرج هو التنظيم الاجتماعي بحيث يمكن لكل مشارك أن يحقق اهتمام معين، فقط، بواسطة استخدام كل الإمكانيات العلمية المتاحة للتغلب على العوائق التي يشاركه فيها كل منافسيه. هكذا، نوع التحليل الذي نطرحه هنا لا يقود إلى انحياز ردي (reductive)، أو تحيز سوسيولوجي يؤدي إلى تقليل أساسها ذاته. ولكن هو يشير إلى موضوعية فكرية شاملة تفتح الباب أمام تحليل ذاتي جماعي تحريري.

Introduction

There are few areas of intellectual life in which the familiar choice between internal and external analysis has asserted itself more forcefully than in the realm of science. The one alternative, internal analysis, views scientific practice as a pure activity completely independent of any economic or social determination; in contrast, external analysis views science as a direct reflection of economic and social structures. The sharpness of the choice, no doubt, occurs because the stakes are very high: what is involved is in fact nothing less than the possibility of applying the genetic mode of thinking, which itself is science, to science itself, and thus of putting oneself in the position of discovering that reason, which thinks itself free from history, also has a history. Such a choice, in this case as elsewhere, imprisons thought: it brutally delimits the space of the thinkable and of the unthinkable by reducing the space of theoretical possibilities to pairs of elementary oppositions, outside of which there is no conceivable position.

The absolutist realism of those who hold that science, especially in the most advanced regions of physics, expresses the world as it really is, or at least provides the closest representation of what it is like in reality (some describe this position as representationism), stands in opposition to the historicist relativism of those who consider science as a social construct, that is, as conventional, reflecting the objective structures and the typical beliefs of a particular social universe. This epistemological couple imposes itself all the more forcefully because it echoes one of the most persistent and powerful of social antagonisms in the intellectual universe, that which sets into opposition, from the middle of the 19th century on, philosophy against the human sciences (biology, psychology, sociology). In a break analogous to the one effected by astronomy and physics when they excluded the metaphysical question of the why in favor of the positive (or positivist) inquiry into the how, the human sciences substitute for inquiries into the truth of beliefs (in the existence of God or of the external world, or in the validity of mathematical or logical principles) a historical examination of the genesis of these beliefs.

This instigates various attempts on the part of philosophers to give science a nonempirical foundation and to preserve the necessity of the laws of logic, as did Husserl, by constructing a pure logic, free of any empirical - notably psychological - presupposition and without any foundation other than its own internal coherence.

The "pincer effect" that this alternative exercises, politically overloaded as it is, is so powerful that - functioning as a principle of vision and division - it leads most historians of science to refuse to refer the history of scientific ideas to the history of the social conditions of their development (the most notable exception being represented by Thomas Kuhn [1962J, who, as it happens, sees himself as a sociologist). In their eyes, it is obvious this sort of linking can only take the form of the short circuit that is produced, most often in the name of Marxism, by all those who relate scientific activity directly to the economic and social structures of the time - as does, for example, Franz Borkenau (1934) when he links the emergence of mechanistic philosophy and of the mechanics that it establishes to the rise of manufacturing and of the new forms of division of labor that it imposes. And it is not unusual that, being victims of their categories of perception, these historians imagine that they stand in opposition to the sociology of science when - along with Koyré (1966), for example - they challenge it with tasks that are in reality part of its agenda, such as the analysis of the emergence of problems, that is, of the universe of possibles embodied notably in adversaries and in rival theories in relation to which each past scholar was situated and that determined the universe of the thinkable at that time.

The two antagonistic visions are both equally unaware of the universe in which science is engendered - namely, the field of cultural production that gradually wins its autonomy (and within which the scientific field itself tends to constitute itself as a separate subspace) by differentiating itself from the long-intermingled spheres of theology and of philosophy. Because of this lack of awareness, they cannot pose the question of the specificity of the scientific field. Even in the "pure" universe where the "purest" science is produced and reproduced, that science is in some respects a social field like all others - with its relations of force, its powers, its struggles and profits, its generic mechanisms such as those that regulate the selection of newcomers or the competition between the various producers. What, then, are the (exceptional) social conditions that must be met so that the field will assume the form that will make possible the emergence of these social products more or less completely independent from their social conditions of production that will constitute scientific truths?

Thus, far from setting itself up as a supreme science, sociology, through the sociology of science (and of sociology itself), is nothing more than scientific reason

turning upon itself by posing the question of the genesis of scientific reason in terms that will allow it to become the object of a scientific answer.

The Struggle for the Monopoly of Specific Competence

The scientific field is a separate world, apart, where a most specific social logic is at work, affirming itself more and more to the degree that symbolic relations of power impose themselves that are irreducible to those that are current in the political field as well as to those instituted in the legal or theological field. Analyses such as those of Ian Hacking (1975) of the emergence of concepts of probability or Steven Shapin and Simon Shaffer's (1985) of the invention of the experimental method enable one to form an idea of what a structural history of the genesis of the scientific field could be: as a universe in which a special form of accumulation takes place, a principle of methodical reinterpretation of all the external demands and pressures that come, as in the case of probability theory, from the legal field or from the economic field or even from ordinary experience. This "independent causal series" of problems engendering problems can be established (not without "intersecting" other fields) only from the moment when a scholarly city has been instituted that is simultaneously open and public (as opposed to hermetic and private), as well as closed and selective. This public and official space (as opposed to the secret, unchecked, and uncontrollable universe of alchemy) is at the same time increasingly more strictly reserved to those who have met the requirements for admittance - that is, those who know and recognize the cognitive and evaluative, implicit or explicit, presuppositions that constitute the fundamental law of the field at the given moment, and who possess the mastery of the specific resources necessary for reformulating the questions posed naively by the practical logic of the various social practices, be they scholarly or ordinary. The "open" laboratory, whose genesis is evoked by Steven Shapin and Simon Shaffer, is one of the most significant materializations of this uncommon social space where, under the collective supervision of reliable witnesses (reliable because they are experts), experiments are carried out that are capable of constituting the scientific fact as such - that is, as susceptible to being universally known and recognized.

The scientific field is a field of forces whose structure is defined by the continuous distribution of the specific capital possessed, at the given moment, by various agents or institutions operative in the field. It is also a field of struggles or a space of competition where agents or institutions who work at valorizing their own

capital - by means of strategies of accumulation imposed by the competition and appropriate for determining the preservation or transformation of the structure - confront one another. (No matter how powerful is the tendency for self-perpetuation inscribed in a position of monopoly, no holder of capital remains durably sheltered from intrusions into the space of competition.) These struggles, however, remain determined by the structure to the extent that scientific strategies - which are always socially overdetermined, at least in their effects - depend on the volume of capital possessed and therefore on the differential position within this structure and on the representation of the present and future of the field associated with this position. The strategies of agents are in fact determined, in their leaning more either toward (scientific and social) subversion, or toward conservation, by the specific interests associated with possession of a more or less important volume of various kinds of specific capital, which are both engaged in and engendered by the game. The specific capital, acquired in previous struggles, that guides the strategies of conservation aimed at perpetuating it always includes two components. First is the capital of strictly scientific authority, which rests upon the recognition granted by the peer competitors for the competency attested to by specific successes (notably success in finding solutions deemed legitimate to problems that are themselves held as legitimate within the state of the field in question). Second, there is the capital of social authority in matters of science, partly independent of the strictly scientific authority (more so as the field is less autonomous), which rests upon delegation from an institution, most often the educational system.

Strictly scientific authority tends to convert itself, over time, into a social authority capable of opposing the assertion of a new scientific authority. Further, social authority within the scientific field tends to become legitimized by presenting itself as pure technical reason, and also the recognized signs of statutory authority modify the social perception of strictly technical ability (so that judgments concerning scientific successes are always contaminated by the knowledge of the position occupied within the strictly social hierarchies, i.e., the hierarchy of institutions, the grandes Ecoles in France, or the universities in the United States). Because of these conditions and processes, it is only through a distinction of reason that one can separate in the specific capital that part which is pure social representation, legally guaranteed power, from pure technical ability. In fact, the contamination of the properly scientific authority by the statutory authority based on the institution is all the stronger as the autonomy of the scientific field is reduced. Similarly, as autonomy lessens, there is increased ability of the holders of a strictly temporal power over institutions (and in particular over mechanisms of institutional

reproduction) to exercise a nominally scientific authority (at least in its effects).

To say that the field of science is a field of struggles is not only a means of breaking with the irenic image of the "scientific community" as described by scientific hagiography - and often after it by the sociology of science - that is, with the idea of a kind of régne des fins (rule of end goals) that would know no law other than that of a pure and perfect competition of ideas, infallibly decided by the intrinsic force of the true idea. It is also the means of recalling that scientific practices appear "disinterested" only in reference to different interests, which are produced and required by other fields (notably the economic field), and that the very functioning of the scientific field produces and presupposes a specific form of interest, or better still, of illusio. Although the field does not necessarily know the boundaries that delimit the various spaces of play, admittance to the field, like entry into the game, presupposes a metamorphosis of the newcomer, or better yet, a sort of metanoia marked in particular by a bracketing of beliefs and of ordinary modes of thought and language, which is the correlate of a tacit adherence to the stakes and the rules of the game. This illusio implies, on the one hand, an investment in the game as such, the inclination to play the game (instead of leaving it, or of losing interest in it). On the other hand, it implies a "feel" for the game, a sense of the game mastered in the practical form of an embodied principle of relevance that guides investments (in time, labor, and also in affects) by allowing one to differentiate between interesting, important things (problems, debates, objects, lectures, masters, etc.), and insignificant things, devoid of interest. (The two dimensions of the illusio, inclination and ability, are inseparable: the ability to differentiate – "taste" - distinguishes those who, being capable of differentiating, are not indifferent, and for whom certain things matter more than others, from those to whom, as the saying goes, "it's all the same)."

Scientific thought has no foundation other than the collective belief in its foundations that the very functioning of the scientific field produces and presupposes. The doxic (implicit and unconscious) or dogmatic (explicit and codified) recognition of a certain definition of knowledge, that is to say, of the boundary between authentic knowledge and false science, between true and false problems, true and false objects of science, legitimate methods or solutions and those that are absurd, rests upon the objective orchestration of the practical schemes inculcated through explicit teaching and through familiarization. This orchestration itself finds its basis in the totality of the institutional mechanism ensuring the social and academic selection of legitimate scholars (depending, for example, on the established hierarchy of the disciplines), the training of the agents selected, and

control over access to the instruments of research and publication, etc. [2] The area of contested stakes, mapped out by the struggles between orthodoxy and heterodoxy, stands out against the backdrop of the universe of the doxa, that is, the set of presuppositions that antagonists take for granted and beyond dispute, because they constitute the implicit condition for discussion and contention. The censorship exercised by orthodoxy - and denounced by heterodoxy - conceals a more radical and also a more invisible form of censorship because it is constitutive of the very functioning of the field and because it bears upon the totality of what is accepted due to the mere fact of membership in it.

The choices that lead from one scientific vision of the world to another follow the logic of conversion rather than the logic of rational calculation, as is demonstrated, among other things, by the oft observed fact that these choices are made before all of the strictly scientific reasons that could, ex post, justify them are visible or accessible. These choices tend to disclose themselves as reasonable, that is to say, as objectively adjusted (or proportioned) to the structure of the chances for success that are objectively placed before them - without being for all that the product of a rational deliberation or of a cynical computation. Rather, as is most often the case, they have as their principle a sense of investment (positioning) that is the product of the embodiment of the objective regularities of the field in the form of dispositions. Thus the reconversions that are best adapted to the transformations of the chances for profit can be lived out as conversions.

Positions and Stances

The structure of the scientific field is defined, at every moment, by the state of the relations of power among the protagonists in the struggle, that is to say, by the structure of the distribution of the specific capital (in its various kinds) that they have been able to accumulate in the course of previous struggles. It is this structure that assigns to each scientist his or her strategies and scientific stances, and the objective chances for their success, depending on the position he/she occupies in it. There is no scientific choice - choice of area of research, choice of methods, choice of a publication outlet, or the choice, ably described by Hagstrom (1965), of quick publication of partially verified results (as over later publication of results that are

2. The hahitus produced by primary class upbringing and the secondary hahitus inculcated through schooling contribute (with differing weight in the case of the social sciences and of the natural sciences) to determine the prereflexive adherence to the presuppositions of the field. (On the role of socialization see Hagstrom, 1965:9; Kuhn, 1963).

thoroughly checked) - that does not constitute, in one or other of its aspects, a social strategy of investment aimed at maximizing the specific profit, inseparably political and scientific, provided by the field, and that could not be understood as a product of the relation between a position in the field and the dispositions (habitus) of its occupant.

One must contend against the idealist representation, which grants science the power to develop according to its own immanent logic (as Kuhn continues to do when he suggests that "scientific revolutions" come about as a result of the exhaustion of "paradigms"). One must assert that, if the direction of scientific movement (or elsewhere, the literary or artistic movement) is inscribed as a potential state within the field of actual or potential stances - in a space of possibles that the field, at every moment, presents to the researcher - the driving force of this movement resides in the space of objective positions, or more precisely, in the structural homology that obtains between the space of possible stances and the space of social positions. The space of possibles is this totality of objective potentialities, asking, in a sense, to be actualized, which are inscribed or registered in the very structure of the relations among the actually efficient scientific stances, as they are defended by the occupants of the various existing positions. This universe of legitimate problems and of objects, questions to be resolved, theories to refute or surpass, experiments to verify or invalidate, insistently captures the attention of all those who claim to assert their existence in the field, and who have the specific competency necessary for knowing and recognizing these insistent virtualities. The most pressing injunctions that the field can impose - and that may take the oblique and often impenetrable paths of admiration for and rivalry with great forerunners, of competition with intimate adversaries, or of indignation against the metaphysical religious or political presuppositions of the opposing scientific parties - obviously make themselves felt only to those who are disposed to perceive and to recognize them.

Thus the objective possibilities that are concretely offered to the various agents involved in the field are determined in the relation between, on the one hand, the universe of possibilities (determined, at the given moment, not only by the state of the problems, theories, and underlying beliefs, but also by the nature of the objects made accessible to analysis through the technical and mental equipment, notably the available language needed for observing and describing them; Jacob, 1970:20), and on the other, the resources that each scientist can mobilize, which define for him/her the universe of things "to be done." This is to say that agents are not pure creators, who invent in a vacuum, ex nihilo, but rather that they are, so to speak, actualizers who translate into action socially instituted potentialities; these potentialities in fact exist as such only for agents endowed with the socially

constituted dispositions that predispose them to perceive those potentialities as such and to realize them. But this also means that these potentialities, which may appear as the product of the development of the immanent tendencies of science, do not contain within themselves the principle of their own actualization. Rather, they become historical reality only through the intervention of agents capable of going beyond the science already constituted (by other agents) in order to perceive in it (thanks to it and beyond it) possibles to be realized and to "do what is necessary" (which is entirely different from mechanical submission to a physical necessity).

The analysis of the scientific field is thus opposed both to attempts to relate the scientific works of a period (broadly and crudely characterized) directly to the structures of the corresponding society, and to attempts - Michel Foucault's being the most consistent of these - to understand the field of stances in itself and for itself, that is, independently of the field of positions. Instead the present analysis in effect intends to apply the structural (or relational) mode of thinking not only to symbolic systems, as in the so-called structuralist tradition, but also to the social relationships of which the differential uses of these symbolic systems are an expression. In a manner quite typical of symbolic structuralism, Foucault, being aware that no work exists by itself, that is, outside of the relations linking it to other works, proposes to give the name of "field of strategic possibilities" to the "regulated system of differences and dispersions" within which each particular work is defined (1968). But very close in this to the semiologists and to the uses that - along with Trier, for example - they have made of a notion such as "semantic field," Foucault refuses to look anywhere except in the "discursive field" for the principle that will elucidate each of the discourses inserted in it: "If the analysis of the physiocrats belongs to the same discourses as that of the utilitarians, it is not at all because they lived in the same period, and not because they confronted each other within the same society, nor because their interests were interwoven in the same economy, but rather because their two options arose from one and the same allocation of choices, from one and the same strategic field" (Foucault, 1968:29). In short, Foucault transfers to the level of the symbolic field of possible stances strategies that arise out of and unfold in the social field of positions, thereby refusing to consider any relation between the works and the social conditions of their production. Foucault is more self-conscious and consistent than most historians of science who, by reason of a failure to grasp the very concept of the scientific world as a social world, remain confused on this point. Thus he explicitly rejects as "doxological illusion" the claim that one can find in the "field of polemics" and in the "divergences in interest or mental habits of individuals" (1968:37) the principle of what occurs in the field of strategic

possibilities , which appear to him as determined solely by the "strategic possibilities of conceptual games".

There is of course no denying the specific determinism that the possibles inscribed in one state of the space of stances exert on the direction of the choices. Indeed, it is one of the main functions of the notion of a relatively autonomous field, endowed with a history and, if you will, a memory of its own, precisely to take this into account. It is certain that the order of symbolic representations or, more precisely, the totality of objectified cultural resources, produced by history as it accumulates in the form of books, articles, documents, instruments, and institutions (so many traces of realizations of theories, of problematics, or of past conceptual systems), presents itself as an autonomous world. Although born of historical action, this world has its own laws that transcend the historical experiences of singular individuals and that tend to suggest, even to impose, the trajectory of its own development through the space of possibles (and of impossibles) that confronts any competent researcher.

But even in the case of the most advanced sciences it is not possible to grant the symbolic realm the power to transform itself by means of a mysterious form of Selbstbewegung, whose principle is found, as in Hegel, in its tensions or internal contradictions. Such potential resources exist and persist as materially and symbolically active cultural capital only in and through the struggles of which the field of cultural production - and most notably, in this case, the scientific field - are the site, and in which agents invest forces and obtain profits that are proportional to their master of this objectified patrimony, and therefore a function of their incorporated cultural capital (Bourdieu, forthcoming). If there is no doubt that the direction of the change depends on the repertory of present and potential possibilities at the given moment, it also depends on the relations of power between the agents and institutions that, having an absolutely vital interest in this or that of the possibilities put forth as instruments or stakes in the struggles for the "legitimate problematic," strive with all the means and powers at their disposal to see that those possibilities are actualized that best suit their dispositions and their position, and thus, their specific interests.

Capital and Power Over Capital

Struggle is established between agents who are unevenly endowed with specific capital and therefore unevenly able to appropriate the resources inherited from the past, and with that, the profits of the scientific work produced by all the competitors, through their objective collaboration in the implementation of the

totality of available means of scientific production. If all the participants must possess a strictly scientific capital - all the more important as accumulated scientific resources grow (at a given moment in a specific subfield) - it comes about that a small number of agents or institutions may hold a volume of capital sufficient to enable them to wield power over the capital held by the other agents. This occurs through the power they have to act upon the structure of the distribution of the chances for profit by imposing, as the universal norm for the value of scientific productions, the principles that they themselves utilize in their practice - in the choice of their objects, methods, etc. We thus observe that among other manifestations of their power, the dominants consecrate certain objects by devoting their investments to them, and that, through the very object of their investments, they tend to act upon the structure of the chances for profit and thereby upon the profits yielded by different investments.

In the competition that pits them against one another researchers (at least those who are richest in specific capital) strive not only to obtain the best rate of profit for their products within the limits of the current mode of price setting, but also to promote the mode of price setting most favorable to the means of scientific production that they hold either personally or institutionally - for example, as alumni of a particular school or as members of a particular research institution. Stated more concretely, they try to impose the definition of science that best conforms to their specific interest, that is, the one best suited to preserving or increasing their specific capital.

It is for this reason that controversies over the priority of discoveries have very often opposed someone who has discovered the hitherto unknown phenomenon as a simple anomaly, not covered by existing theory, against someone who has made it a genuine scientific fact by inserting it into a theoretical framework. In such political disputes over scientific property rights - which are at the same time scientific debates about the meaning of what is discovered and epistemological discussions on the nature of scientific discovery - there is in reality a confrontation, through particular protagonists, between two principles for the hierarchization of scientific practices. The one principle grants primacy to observation and experimentation, and therefore to the corresponding inclinations and abilities, and the other privileges theory and the scientific "interests" that go with it. This debate has never ceased to occupy the center of epistemological reflection. The epistemological struggles over the hierarchy of these moments of the scientific approach, both being nevertheless equally critical (theory or experiment, the construction of hypotheses or the elaboration of procedures of verification, explanation by means of formal laws or

systematic description), or over the relative importance of the problems and the relative value of the various methodologies used to resolve them, at times reach dramatic levels of violence that liken them to religious wars. This ferocity occurs because, having at stake the very definition of science - that is, the principles of the construction of the object of study as a scientific object and the rules of delimiting the relevant problems and methods that must be employed to resolve them and to measure accurately the solutions - these struggles bear upon the principle of the value of the various kinds of specifically scientific capital (often described as forms of "intellectual character"), and therefore touch upon questions of scientific life or death.

The definition of the stake in the scientific struggle (notably the delimiting of the problems, the methods, and the modes of expression that can be deemed scientific) is also a stake in the scientific battle. The dominant agents are those who have the power to impose that definition of science according to which the most accomplished science consists of having, being, and doing what they themselves have, are, and do. Contrary to the representation of science most commonly accepted by sociologists of science, which tends to reduce the specific relations of domination to relations between a "center" and a "periphery," following the emanatist metaphor, dear to Halbwachs, of the distance to the "focus" of central values (cf. Ben-David, 1971; Shils, 1961:117-130), official science is not the unanimously recognized system of norms and values that the "scientific community" as an undifferentiated group, would, for the sake of the greater good of science and of the scientific community itself, impose upon and inculcate in each of its members, revolutionary anomie being attributable only to the failings of scientific socialization.

It is indeed because the definition of the stake of the struggle is a stake in the struggle (even in sciences where the apparent consensus regarding the stakes is very strong) that one endlessly runs into the antinomy of legitimacy: in the scientific field, as elsewhere, there exists no judiciary for legitimizing claims to legitimacy, and claims to legitimacy carry a weight proportional to the symbolic power of the groups whose specific interests they express.

Scientific revolutions that overturn the tables of epistemological values overturn in the same blow the hierarchy of social values attached to the various forms of scientific practice, and thereby the social hierarchy of the various categories of scientists. The new scientific regime completely redistributes the meanings and values associated with the various scientific choices by imposing new norms of interpretation and new categories of perception and of appreciation of importance. As in those perceptual restructurings that ambiguous forms allow, what was central now becomes marginal, secondary, insignificant, while objects,

problems, and methods hitherto considered minor and therefore left to minor and secondary agents, find themselves brought to the forefront, in broad daylight, bringing a sudden visibility to those connected with them.

Variations According to the Degree of Autonomy

These principles of functioning assert themselves more completely the greater the autonomy of the field under consideration. The degree of autonomy varies - diachronically across the successive states of the scientific field, and sychronically across subfields or disciplines - according to the volume of scientific resources accumulated in the objectified state. These resources, through the mediation of the embodied capital required for their appropriation, institute a more or less clear-cut break between the professionals and the laymen, and a more or less intense cross censorship among scientists. Autonomy also varies with the intensity of the constraints and controls exercised, directly or indirectly, by external powers, which themselves appear to depend on the degree to which the scientific discoveries are liable to affect the legitimate representations of the social world. [3]

The greater the autonomy of the field, the more the struggles for power over capital, and especially the scientific revolutions that are their paroxysmal form, tend to confine themselves to strictly scientific grounds (even though, as we have seen, they can have consequential effects upon relations of symbolic power within the field). In the sectors of the scientific field that have attained the highest degree of autonomy, the requirements for entry tend to become so elevated that producers have their rivals as their only possible consumers, and the only effective power is that given by scientific competence as recognized by one's peers/competitors.

The ambiguity of the stakes, which inheres in the relation of relative autonomy and in all the form of dependence and independence, gives the agents' strategies a

3. If one admits that the degree of automony of a field from external determinations can be measured by the extent of the social arbitrariness that is comprised in the system of presuppositions constitutive of its specific illusio, one can situate any scientific field - the field of the social sciences or of mathematics today as well as those of alchemy and mathematical astronomy at the time of Copernicus - between the two poles represented, on the one side, by a scientific field from which every element of social arbitrariness (or unthought) would be excluded and whose social mechanisms would effect the necessary imposition of the universal norms of reason, and on the other side, by the judicial field or the religious field, which are specifically oriented to the legitimate (that is arbitrary and misrecognized as such) imposition of a cultural arbitrariness that expresses the specific interest of the dominant. (See Bourdieu, 1987h).

two-sided face, scientific and political, just like the motivations to which they respond. The distinction made by Merton (in speaking of the social sciences) between "social" conflicts (bearing on "the allocation of intellectual resources among various types of sociological work" or on "the role which befits the sociologist") and "intellectual" conflicts ("oppositions of strictly formulated sociological ideas") represents precisely one of these strategies, at once social and intellectual, through which orthodox sociology claims to secure for itself academic respectability. It does this by imposing a particular division between the scientific and the nonscientific that can treat as lacking in scientific propriety any questioning of a kind likely to call into question the foundations of its respectability (Merton, 1973:55).[4] An analysis that would in this case attempt to isolate a purely "political" dimension in scientific conflicts would be as radically false as the more common opposite bias that considers only the purely intellectual determinants of these conflicts. For example, the competition for funds and research tools that puts specialists in opposition is never reduced to a simple struggle for strictly "political" power: those who come to head the large scientific organizations are obliged to impose a definition of research implying that the correct way to do science necessitates the use of the services of a large scientific bureaucracy - endowed with funds, advanced technical equipment, abundant personnel - and to institute as the universal and eternal methodology the survey of large random samples, the statistical analysis of the data, and formalization of the results - in short, to set up the standard most favorable to their personal and institutional capacities as the yardstick of all scientific practice.

Such confusion of the powers is especially easy since there is room in any field for scientific strategies that, being founded upon implicit agreement with the established scientific order, are in affinity with occupation of positions of power within the field itself. Invention according to an already invented ars invenvendi that resolves all the problems likely to be raised within the limits of the established problematic through the application of proven methods obscures by the same token all the problems that are tacitly excluded from it. Thus the strategy is perfectly

4. In fact, as soon as a conflict of strictly scientific import engages economic and political stakes, as is always the case, by definition, in the social sciences, the opposition between those who hold official authority (for example, in the case of fluoridation analyzed by Sapolsky, 1968, "the health officials" who view themselves as the only party competent in matters of public health) and the opponents of this innovation (among whom one finds many scientists, but who are, in the eyes of the officials, overstepping "the limits of their own area of expertise") is manifest clearly. It is obvious, in this case, that the stake of the struggle is a power, "competency," that is exercised not only within the field but also outside of it, upon laypersons; therefore, it is a power that is both scientific and political, a political power exercised in the name of science.

suited to an establishment science and to all those whose docile dispositions (especially the oblates, fated and devoted to the system) incline them toward the safe investments of strategies of succession fit to guarantee them, at the end of a predictable career, the profits held out to those who fulfill the official ideal of scientific excellence at the cost of having their innovations circumscribed within authorized boundaries.

When the institutional powers that are in force in the scientific field are in line with external powers, political or economic, heretical invention that calls into question the very principles of the old scientific order is also a strategy of subversion aimed against the established scientific order of the field, and through it, against the social order with which this scientific order is bound up. To the degree that autonomy of the field increases, strategies of subversion do not have to be as radical and as encompassing as in earlier states of the most autonomous fields or in the least autonomous fields of the present - even if they still find their roots in heretical dispositions.

It follows that, by failing to perceive the structural and morphological properties that it owes to its place in this process, historians or sociologists of science are prone to universalizing the particular case they take directly as their object. Thus, it is no doubt that, because it tacitly identifies science with contemporary physics, positivist theory gives science the power to resolve all the questions it raises, provided that they be posited scientifically, and to impose a consensus on its solutions through the application of objective criteria. From this perspective, progress from one system to another - say, from Newton to Einstein - occurs simply by the accumulation of knowledge, by the refining of measurement, and by the correction of principles. The philosophy of the history of science offered by Thomas Kuhn, by adopting the obverse of the positivist vision, no doubt applies to the inaugural revolutions of a fledgling science, and especially for the "Copernican revolution" as he analyzed it and that he views as "typical of every other major scientific upheaval" (Kuhn, 1973:153, 162). In that case the relative autonomy of science in relation to power (notably here in relation to the Church) being still very limited, the scientific revolution requires a political revolution. Given that the field of mathematical astronomy in which it appears was still "embedded in social relationships" (to use Polanyi's expression about the market of archaic societies), the Copernican revolution of necessity had to claim the autonomy of a "self-regulating market" for a scientific field still "embedded" in the religious and philosophical field and, through it, in the political field. This demand for autonomy is expressed through the assertion of the right of scientists to settle scientific questions ("mathematics for mathematicians"), in the name of the specific legitimacy that is conferred upon them by their competence.

So long as the scientific method and the censorship or support it proposes or imposes are not objectified in specific institutions and dispositions, scientific revolutions will inevitably take the appearance of political ruptures. On the contrary, when, thanks to the gains made by these first revolutions, all recourse is excluded to weapons or to powers (even purely symbolic ones) other than those generated within the field itself, it is the very functioning of the field that defines more and more completely, not only the ordinary order of "normal science," but also the extraordinary breaks - these "orderly revolutions" in Bachelard's words - inscribed in the logic of the history of science, that is, of scientific polemics. A decisive change occurs when censorship of those social drives that are not scientifically sublimated has been progressively incorporated in the structure of the field and in the mechanisms that control entry in it, and also, most importantly, when it has been implanted in specific resources that are more and more completely objectified in formalized (notably mathematical) procedures. Under these circumstances, revolution against established science is carried out with the help of an institution that provides the instruments of rupture with that establishment: the field thus becomes the site of a permanent revolution, but one that is increasingly stripped of political effects.[5]

Because the intellectual equipment required for making a scientific revolution can henceforth be acquired only in and by the scientific city,[6] permanent revolution can, without contradiction, go hand in hand with "legitimate dogmatism" (Bachelard, 1953:41). As accumulated scientific resources increase, the requirements for entry continue to rise, and access to scientific problems and instruments, thus to scientific competition, requires an increasingly large amount of embodied capital. It follows that the opposition between strategies of succession and strategies of subversion tends more and more to lose its meaning, insofar as the accumulation of the capital necessary for revolutions to succeed and the acquisition of the capital gained by successful revolutions tend more and more to be carried out according to the regular procedures of a career. The fomenters of scientific revolutions are recruited, not among the least armed among the newcomers, but on the contrary, from among those who are scientifically best endowed. We thus know that inaugural revolutions - which have given birth to new fields by constituting new

5. This is what makes it possible for modern physics to serve as a paradigm for both the "continuist" representation of the positivist type (as discussed in the foregoing) and for the "discontinuist" vision defended by Toulmin (1968, 1972) and according to which science progresses by way of a series of microrevolutions.

6. This is also true in a highly autonomous artistic field, but the scientific field owes its specificity - notably its strong cumulativeness - to the fact that constructions born of the effort to surpass the works of predecessors must, here more than elsewhere, also preserve, in a restructured form, what they have surpassed.

realms of objectivity - have nearly always been the doing of holders of considerable amounts of specific capital who, owing to their membership in a class or an ethnic or religious group improbable in this universe, found themselves in an ambivalent position likely to foster nonconforming and noncomformist dispositions. Free from the statutory pretensions that inspire the fear of derogation in others, the likes of Fechner, Freud, and Durkheim have not hesitated to invest a large technical capital accumulated in a socially superior field in reputedly inferior regions of scientific space without at the same time renouncing the great ambitions associated with their initial position. This led them to regain their initial status by raising - through their scientific work - the value of the new discipline that they had to create in order to realize themselves (Ben-David, 1960; Ben-David and Collins, 1966).

The issue of autonomy and of the relations between scientific revolutions and political revolutions is obviously particularly salient in the case of the sciences of society. First, all powers - and especially symbolic powers - cannot but feel threatened by the existence of a discourse claiming truth about the social world and especially about powers: the temporally or spiritually powerful want discourses that are regulated and subordinated to the prerequisites of their own reproduction; they want applied techniques of rule or instruments of legitimation. The second reason for this salience is that this external demand, in both its negative and positive dimensions, always finds support within fields of cultural production among those who have an interest in heteronomy and who can summon a particular category of lay agents to given their cause a social force that it cannot acquire in the confrontation with peers/competitors. This explains why, in the scientific disciplines that are most vulnerable to the social demand for technical or symbolic services, we always see the emergence of an opposition, typical in the fields of literary or artistic production, between a field of restricted production that is to itself its own market, and a field of generalized production, where producers offer their ideological services to the dominant powers in the form of expert committees or "scientific ideologies" (in Canguilhem's sense, 1977:39,52; see also Bourdieu, 1985), or who, evading confrontation with their competitors, address themselves to nonprofessionals and extract from this direct link a form of symbolic power that they can attempt to bring into play in the realm of scientific debate itself.

This observation reminds us that the autonomy of which the "hardest" of sciences and the "purest" of arts avail themselves is perhaps but the counterpart of the indifferences that one accords purity the freedom that can be granted without risk to a universe closed unto itself, unto its formal games and its esoteric debates, in short, the price of self-exclusion. And formalisms of all stripes are often the gilded cage in which those who are free to say anything at all imprison themselves,

provided that they say nothing about anything essential or that they say it in such a form that nothing will escape from the closed circle of the initiated.

The Peculiar History of Reason

Thus an essential task is to reject the division between, first, the positive analysis of the social universe within which science exists (of its career patterns, its mechanisms of sanction and of reward, its norms, its motivations, and its values) and second, the epistemological discourse designed to ground and to justify science in and by a normative methodology tied to a logical reconstruction of the progress of reason. It is only by carrying this analysis into the heart of the domain unduly abandoned to philosophy by the sociology of science à la Merton, that is, by applying it even to the social processes of validation of knowledge and of legitimation of scholarship, that one can, paradoxically, construct a science of the historical genesis of truth that does not lead to a self-defeating relativism. Claims to scientific validity can no doubt hide claims to symbolic domination, and scientific debates can no doubt conceal, underneath the confrontation between statements and reality, the struggle for power of those who put them forward. It nevertheless remains true that, under certain conditions, that is, in certain states of this field of struggles for symbolic power that indeed is the scientific field, these strategies produce their own transcendence, because they are subjected to the crisscrossing censorship that represents the constitutive reason of the field.

One need not resort to the magic of a transcendental leap in order to establish a foundation for truth. It is possible to explain a theory genetically without undermining its claims to truth. There are states of the scientific field where the anarchic antagonism of particular interests is converted into a rational dialectic and where the war of all against all transcends itself through a critical correction of all by all. The necessary and sufficient condition for this is that a social organization of communication and exchange obtains in the field such that each can realize his or her specific interest only by mobilizing all the scientific resources available for overcoming the obstacles shared by all his or her competitors. We can quote here Canguilhem describing the process of the unification of the market that corresponds to the constitution of a field: “A guiding principle in the history of the sciences must be to admit that in a given period - and especially since the seventeenth century - discord and rivalry in the scientific community cannot totally impede communication. On the one hand, it is impossible not to be affected by what one rebuffs; on the other, even if exchange were impossible, the fact remains that

everyone gets supplies on the same market" (cf. Canguilhem, 1977:75-76). The generalized confrontation of comparable and competing products that criticize and correct one another can produce the official and public ratification that defines homologous discourse only inasmuch as a field of possibilities and above all impossibilities is instituted, such that, as in Darwinian theory, adjudication between competing variations is made possible and that the social coexistence of the advocates of logically mutually exclusive positions cannot go on indefinitely (as is the case in philosophy with the proponents and opponents of the existence of God or of freedom, for example). In point of fact, as the scientific field becomes more unified (at the level of the different disciplines or even at higher levels of integration) and as the capital necessary for efficiently entering the competition becomes larger with the increase of accumulated scientific resources, the market in which scientific products can be exchanged becomes the site of an increasingly intense competition among producers who continue to be better armed (and increasingly more numerous), thereby giving its full efficacy to the armed criticism implied in the production of competing solutions that are, in this case, also mutually exclusive, at least for a time.

Thus it is in history that we find the reason for the advances of a reason that is thoroughly historical and yet irreducible to history. Scientific reason realizes itself only when it is inscribed, not in the ethical norms of a practical reason or in the technical rules of a scientific methodology, but in the social mechanisms of an apparently anarchic competition between strategies armed with instruments of action and of thought capable of regulating the very conditions of their use as well as in the durable dispositions inculcated by the school and reinforced by the very functioning of the field. Far from being the product of obedience to ideal norms whose full realization would be aborted only by the interference of relations of domination (as Habermas would have it), the "ideal speech situation" becomes a reality when social mechanisms of communication and of exchange are established, mechanisms that impose the unrelenting censorships of well-armed criticism, often through the quest for domination, and outside of any reference to moral norms. We can understand the specific logic of the scientific field only by transcending the scholastic alternative between causes and reasons that tends to view any realistic consideration of the social determinations of cultural production as a historicist plot. Against all those who see no possibility of "grounding/founding" reason other than ascribing it to a transhistorical "human nature" independent of social conditionings, we must admit that reason realizes itself in history only to the degree that it inscribes itself in the objective mechanisms of a regulated competition capable of compelling interested claims to monopoly to convert themselves into mandatory contributions

to the universal, and to have it so that by submitting to causes, one in addition also obeys reasons. The ideal scientific city cannot be founded solely upon the virtue of scientists. Objectivity, in the natural sciences as in the social sciences, rests not upon the assumed impartiality of "free-floating intellectuals," but rather on the logic of the public competition that, through the free and generalized play of criticism, puts a real symbolic policing at the service of a code of verification. In short, the representation of the scientific city as the fulfillment of the ideal city can be accepted only if one has in mind a Machiavellian republic in which citizens are virtuous because they have a vested interest in virtue. The almost infinite diversity of the stakes that the logic of fields can constitute as worthy of interest proves the extreme plasticity of this alleged nature in which some want to inscribe only one form, and a very particular one, of egoistic interest: the constituting efficacy of the institution can obtain pretty much anything from social agents provided that it offers them games and stakes capable of providing self-interested reasons for accomplishing actions labeled as disinterested because they are indifferent to ordinary forms of profits. We must, indeed, resign ourselves to admitting that, short of demanding of everyone at every moment the extraordinary dispositions of the saint, the genius, or the hero, one can obtain ordinary reason or virtue only from a social order capable of making these into a specific form of well-understood self-interest.

The social history of the scientific field places the observer before a difficulty similar to that encountered by specialists in the natural sciences: just as one must admit both that vital phenomena stem only from physicochemical causes and that the organism exhibits an organization that makes it irreducible to its physicochemical basis (Canguilhem, 1977:135), so one must at the same time both (1) refuse to view the scientific field as an exception to the fundamental laws of all fields, and notably to the law of interest that, under the specific forms it assumes in this field, can give scientific struggles the character of a merciless violence, and (2) recognize the irreducibility of the peculiar organization of this social game where true ideas can be endowed with force because those who participate in the game have an interest in truth instead of having, as in other games, the truth of their interests.

To the extent that it formulates in a scientific manner the question of the historical conditions for the emergence of this form of universal discourse that scientific discourse is, the sociological analysis of the scientific field may appear as a scientific (others will say scientistic) redefinition of the Kantian project. That is, it replaces a reflexive analysis geared to discovering unknown universals (the universals of human speech capacity, for example) with an empirical investigation of the laws of functioning of social fields (which are so many linguistic markets),

conceived as institutional conditions inhering in a certain historical situation and operating as the social conditions of possibility of such or such a type of symbolic production. It does not suffice merely to record the fact that each field as a "form of life" has its corresponding "language game": one must seek out, through a sociological analysis of the laws of functioning specific to each of these arenas, the objective foundations of the table of constraints and rules of production of utterances (and therefore of knowledge) that define each of these language games in its own right (through a thoroughly historicist redefinition of the Kantian project to extract a definitive representation of the conditions of production of knowledge from the scientific results).

The specific case of the scientific field then takes on its full meaning: only a historical analysis of the paradoxical process through which the constraints and controls of rational dialectic have been gradually invented and instituted into structures and dispositions can allow us to escape the logical circle that this analysis itself brings forth without calling to the rescue that last remnant of the creationist miracle that every quest for an a priori foundation perpetuates: a historicized (rather than "naturalized," as Quine puts it) epistemology can only record and account for the emergence of a social world that, although not radically different from other worlds in terms of the motivations it inspires, is radically differentiated from them by the constraints and the orientations it imprints on them, because it is the realization of a history that has, little by little, installed the things of logic into the logic of things.

Logical forms emerge within a form of life, that is, in a contingent historicity within which logic is instituted as the mandatory form of social struggle. The rational subject exists only as the "union of the workers of proof," to use Bachelard's words, as a forced union that imposes itself through "scientific polemic," again in Bachelard's terms, as this war of all against all in which reason is the best weapon.

Thus, whether or not there are transhistorical universals of communication, there do exist forms of social organization of communication suitable to foster the production of the universal, forms that are established in the (historical) encounter between the product of two partially independent histories. On the one hand, there is a historical agent endowed with specific dispositions, acquired and developed under specific social conditions (ontogenesis); on the other, a historical field that is itself the product of a collective history and that imposes upon those dispositions institutional conditions of realization that are in themselves also thoroughly special (phytogenesis). Simultaneous inventions are understood perfectly according to this logic.

If, far from consisting of "categorical structures" of human existence, the "knowledge-forming interests" uncovered by transcendental hermeneutics are, in reality, the product of specific historical conditions, one understands that it will not suffice to abolish the "systematically distorted exchanges" that persist, here and there, even in the cultural order, to transform the subjects by reminding them to abide by the universals rediscovered by the philosopher but ignored and violated by the ordinary person. It is also and most importantly necessary to transform established structures of communication through a genuine politics of reason, which would arm itself with a rational science of the history of reason in order to advance reason in history, by working, for example, toward abolishing the social bases of the abuse of symbolic power and by advancing the economic and social conditions for the emergence of new forms of communicative or cognitive interest.[7]

It is not the sociologist who, blinded by a reductive and destructive bias, invents the laws that human practices obey, even when these practices are free from ordinary necessities. It is not the sociologist who becomes the cynical or disenchanted accessory to these laws that he or she merely discovers, but rather those who, by refusing to confront them, give them free range: the Pharisaic advocates of the rights of humanity and of the freedom of conscience in fact yield without a fight to the forces of an unconscious that is nothing other than consciousness ignorant of its own laws. When the sociologist relates scientific intention to the social conditions of which it is the product, when he or she labors to produce a science of the history of the categories of scientific thought and to objectify the objective structures of the scientific field as well as the cognitive and evaluative structures that are at once the condition and the product of its functioning, the sociologist does not destroy his or her own science, as those would have it who believe they can imprison the sociological analyst within the relativist circle and thereby magically wish away the threat of relativization that his or her science poses to any science. How could the sociologist possibly not know that the field of sociology itself functions according to the laws that govern the functioning of every scientific field? He or she is well aware that probable representations of the social world and of the science of the world correspond to the various positions in the field. And far from undermining his or her foundations, this knowledge gives the

7. See Bourdieu (1987). As is shown by the empirical investigation of relations of communication such as those that obtain, for example, between professors and students ("systematically distorted" exchanges in which the appearance of communication may be perpetuated in the quasi-total absence of real comprehension), relations of pseudo-communication are rooted in relations of power and, in the specific case, the instituted misunderstanding constitutes an abuse of power whose possibility is instituted in the very structure of the pedagogic relation, as the paradigm of all relations of authority (cf. Bourdieu et al, 1965).

sociologist the theoretical mastery of the social determinations of knowledge that can be the basis for the practical mastery of these determinations. The epistemological critique it implies is closer to the Einsteinian critique of "the absolute simultaneity of distant objects" than to the ex post speculation of an external observer and constitutes an integral part of scientific activity itself.

To construct the field of scientific production as such is to compel oneself to objectivize the entire system of strategies and of the positions in which these are rooted, and therefore, in the specific case of a sociology of sociology, to objectivize the very position of the sociologist as well as his or her own strategies. Practiced in this manner, the sociology of science constitutes one of the most powerful instruments of which sociology can avail itself in order to master the effects of the social determinisms, both internal and external, to which it is especially exposed. Far from leading to sociologism, it offers the sociologist (and to all others through him or her) the possibility of consciously grasping, so as to choose to accept or to reject them, the probable stances assigned to him or her by virtue of the definite position he or she occupies in the game that he or she claims to analyze. And in case the sociologist were to not understand the interest (this time strictly scientific) that he or she may have in applying to him- or herself such liberating treatment, the very dissemination of the symbolic weapon that the analysis of the sociological field constitutes would no doubt result in the generalization and systematization, by way of crisscrossing critiques, of a self-analysis that, having become really collective, would be less open to the kind of self-indulgence and self-complacency liable to blunt its effects.

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