

## The Multiple Publics of Science: Inclusion and Popularization

**Abstract:** The paper conceives the popularization of science as a structural effect of processes of inclusion; the universal inclusion of everyone into science being a consequence of the universality and openness of modern science. Popular communications are demonstrated to be a very elementary phenomenon in science, popularization even being present when research results are communicated to a colleague from whom one separates only the distance between two disciplinary knowledge systems. Different modes of popularization (interdisciplinary, pedagogical, political, general) are explained. It is then demonstrated that popularization is not a neutral translation of knowledge into a different linguistic repertoire. Instead numerous structural effects on science caused by popularization are presented. Finally, an outline of the historical development of popularization is given. There is a kind of curvilinear movement to be observed: popular communications and communication by amateurs sometimes dominating the premodern system of science in the eighteenth century; then a closure of the system of science in the differentiation of the classical scientific disciplines in the nineteenth century; and finally as a consequence of the ongoing differentiation and diversification of science since the early twentieth century a situation in which interdisciplinary contacts and interrelations with nonscientific publics become more important and therefrom results a finely graded system of communication types. Then the esoteric style of understandings germane to innerdisciplinary discourse is only one in such a plurality of communication forms.

**Zusammenfassung:** Der Aufsatz faßt die Popularisierung der Wissenschaft als einen strukturellen Effekt von Prozessen sozialer Inklusion auf; soziale Inklusion ihrerseits folgt aus der Universalität und Offenheit der Wissenschaft. Es wird gezeigt, daß Popularisierung ein basales Moment wissenschaftlicher Kommunikation schlechthin ist, weil sie immer dort gegeben ist, wo jemand einem Kollegen aus einem anderen disziplinären System etwas mitzuteilen versucht. Verschiedene Modi der Popularisierung werden vorgestellt: interdisziplinäre, pädagogische, politische, allgemeine. Der Aufsatz demonstriert dann, daß Popularisierung nicht einen „neutralen“ Vorgang der Übersetzung in ein anders verfaßtes sprachliches Repertoire meint, daß vielmehr zahlreiche strukturelle Effekte zu beobachten sind, die die Wissenschaft als Folge ihrer Popularisierung verändern. Der Aufsatz schließt mit einer Skizze der Geschichte der Popularisierung von Wissenschaft. Fast handelt es sich um eine kurvilineare Bewegung: im achtzehnten Jahrhundert gibt es zahlreiche Hinsichten, in denen populäre Kommunikationen und Amateure die Wissenschaft dominieren; im neunzehnten Jahrhundert erfolgt mit der Ausdifferenzierung der klassischen Disziplinen eine Schließung des Systems: schließlich bildet sich im zwanzigsten Jahrhundert eine Situation heraus, in der als Folge fortschreitender Differenzierung und Diversifizierung interdisziplinäre Kontakte und vielfältige Vernetzungen mit außerwissenschaftlichen Publika immer wichtiger werden und daraus ein fein abgestuftes System von Kommunikationstypen entsteht. Die esoterische Kommunikationsweise, die für innerdisziplinäre Kommunikationen typisch ist, ist jetzt nur noch eine in einer Pluralität von Kommunikationsformen.

### I Inclusion, Universality and Openness

I want to begin the reflections on the multiple publics of science with a concept central to sociological systems theory: the concept of inclusion. Inclusion means a premise which seems to be established in all the function systems of modern society: even if a person is not participating in a certain type of functionally defined activity in a professional or performance role there is always a complementary role defined for each individual person. One can participate in the respective type of activity as a lay, an amateur, a dilettante, or as the semantic tradition of ancient Greece called it as an *idiot* (cf. Gigon 1981). In all these complementary roles one acts as member of a public which is a public of the respective domain of activity. This creation of statuses for members of the public of a functional domain is what the concept of inclusion is about. The prominence of concepts of the *public sphere* in the self-description of modern society (cf. Stichweh 2003; Habermas 1962) points to the relevance of inclusion processes. The *popular noise* functioning as a core concept for this collection of papers obviously originates from contexts of inclusion.

This interrelationship of inclusion and popularization will be explored in this article in concentrating on the case of science. In the system of science two historical preconditions for processes of inclusion can be identified: *universality* and *openness*. Universality in the first instance means temporal and spatial invariability.<sup>1</sup> Scientific truths do not depend on the place where they have been found out first of all. After having been discovered and confirmed they are supposed to be true everywhere in the world. And there is no temporal instability built into them. As long as we are convinced of a certain truth claim we do not think that it is prone to processes of decay from internal reasons.<sup>2</sup> From the subjective dimension of these formulations it is to be seen that universality is not a simple and objective fact but that it is more a self-description, a normative stance towards itself which was historically produced by the European scientific tradition and by which this tradition tried to steer itself.

There are further aspects to universality. Two more will be mentioned. There is, first of all, *thematic universality* which means that there is no phenomenon in the world on which science could not try to or should not dare to formulate a statement. And there is *social universality* which implies that if something is true it is true for each individual in the world. As long as one communicates in the context of science one will never be able to say: “this hypothesis (statement etc.) may be true, but for me things are somehow different.” Of course, one can make such statements, but in doing this one is situating oneself in a different knowledge system, not in science. In scientific communication there is no place for private truths coexisting with the public truths of science. It should be emphasized once more that the different aspects of the universality of science are no ‘facts’ but that they are semantics, self-

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<sup>1</sup> For a more detailed argument on *universality* cf. Stichweh 2003a.

<sup>2</sup> This distinguishes modern science from early modern science which was very much characterized by the fear of decay of knowledge (Stichweh 1991, 127-132).

descriptions and norms by which science since medieval Europe steers its differentiation processes from other knowledge systems.

The second historical precondition for inclusion processes into science which was mentioned above is the *openness* of science. It is a remarkable aspect of the scientific tradition that since the sixteenth/seventeenth century there arose no new schools or traditions in science which institutionalized a preference for the secrecy of knowledge. In this early modern period one could observe the last offshoots of alchemy which by its nature had to be a tradition based on the secrecy of eventual positive results; then there was the temporary flourishing of Renaissance hermeticism, and finally one can mention Isaac Newton whom some authors named the last Renaissance *magus* as he in his person combined the otherwise separate mathematical and empirical traditions of emerging physical science (see Cohen 1956) and at the same time was intensively involved with private and unpublishable theological and alchemical speculations.

This dismissal of secrecy and implementation of practical and ideological openness clearly distinguishes scientific knowledge from the domain of technical knowledge in which a different preference and a clear-cut distinction of openness vs. secrecy is well established and both options are available. Either one wants to treat one's technical knowledge as part of the public domain and then one has to patent this knowledge to secure the property rights and the economic usage deriving from it,<sup>3</sup> or one opts for secrecy and this means one has to get along without the legal claims of a patent which can imply the risk that another successful researcher might bar you from using your own knowledge.

Social inclusion into science derives from universality and from openness. If science can claim universality, especially social universality in the sense of presupposing validity of its truth claims for any individual whosoever in the world, then it follows with a certain consequence that access to these universal truths should not be denied to any one of those individuals for whom these truths are supposed to be valid on the first hand. And if openness is the only standard acceptable in dealing with scientific knowledge then again this openness should be realized for a public of maximum social extension.

## II Modes of Popularization of Science

The medium of communication by which inclusion into scientific communication is realized should be called *popularization*. This is a significant term which we will have to look at with some care. The most important point is that popularization is not a somehow marginal phenomenon at the outer boundary of scientific communication. Instead *popularization progressively situates itself in the core of scientific discourse*. The first theorist who clearly made this point probably was the

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<sup>3</sup> See for a sociological overview of the patent system Mersch 2002.

Polish microbiologist Ludwik Fleck in his “Entstehung und Entwicklung einer wissenschaftlichen Tatsache” from 1935 (Fleck 1935). Fleck made it clear that even in addressing a colleague whom only a small distance separates from one’s own position in the problem space and communicative space of science, one has to secure understanding by producing a translation from a more technical presentation of one’s research to a well-balanced version which accommodates the knowledge and the capabilities of understanding one ascribes to the respective colleague.

That means popularization is elementary and it is inherent in scientific communication. It happens incessantly in numerous variants and with changing publics addressed. Furthermore, popularization is no longer a low-status activity. Today, high-status publication in the natural sciences means publication in journals such as “Nature”, “Science” and “Cell” in which one typically does not address closely affiliated disciplinary specialists, and for these occasions one has to choose a style of presentation adequate to such a rather broad scientific public.

A consideration which follows from this is that popularization is not at all a unitary phenomenon but involves a plurality of different publics and therefore different styles of popularization. In a first approximation four different modes of popularization in modern science will be distinguished: 1. Interdisciplinary popularization. It is illustrated by the case just mentioned: a certain disciplinary distance separates one from the colleagues one is addressing and this motivates trials of securing understanding. 2. Pedagogical popularization. This is probably the dominant mode of popularization in science. It includes speaking towards students but also the much more extensive phenomenon of teaching the sciences at school. 3. Political popularization. This is today a very prominent way of presenting science. A researcher addresses an institution or persons in public roles which can distribute financial resources or other resources relevant for the possibility of continuing scientific research. Among these other resources are jobs, laboratory space and permissions to do a certain piece of research if it is a matter of research which has to be legitimized in a legal or ethical way. Political popularization has its own mode of carefully drafted language which suggests the intellectual interest and social relevance of the piece of research one wants to complete. 4. General popularization. This fourth major kind of popularization is addressed at the abstract publics of modern society to which one can accede by self-selection and which are based on the potential inclusion of everyone. In the nineteenth century situation these general publics were mainly addressed via clubs and associations based on the principle of free association characteristic of modern society (Parsons 1971). This obviously limited access to those being motivated to enter such an associational context. In Germany, for example, this meant living in cities, and being either part of the *Bildungsbürgertum* or of the educational associations of the labor movement. Besides these clubs and associations there were the occasional public lectures of a prominent scientist. Alexander von Humboldt’s lectures on the *Kosmos* in the Berlin of the 1820s are a very famous example for this.

In the 20<sup>th</sup> century this nineteenth-century mode has nearly completely been dissolved. Instead general popularization is mainly done by the mass media. Two major channels can be distinguished. There is the popularization via newspapers, journals, radio and television which presupposes the social role of the professional journalist of science. It is based on a highly organized social structure which implies in the case of the major journals such as *Nature*, *Science* and *Cell* that the contents of the respective publications are distributed two weeks in advance to hundreds of specialized science journalists. These journalists then have to respect an embargo which forbids them to publish these informations until they have appeared in the scientific journals themselves. They normally will respect this embargo and, of course, they have to fear sanctions if they do not hold to their obligations. The interval of two weeks by the way gives them the time to transform the scientific novelty into a story they can tell the public they are looking to.

The other major mode of general popularization is done via books addressed towards a general public. This is a rather elite kind of popularization as regarding the side of the authors of these books one normally has to be a fairly successful scientist to be able to publish such a book. Today, there are major scientific figures such as Stephen Jay Gould, Richard Dawkins and Jared Diamond who to a considerable amount concentrate their intellectual work on this kind of general popularization. The essays and books they write include interdisciplinary, pedagogical and political intentions into the act of general popularization. A recent self-description arising from this kind of writing is the idea of a *third culture* as a public intellectual culture of its own which transcends the classical – and probably unjustified – distinction and divide between the natural sciences and the humanistic/social sciences.<sup>4</sup> Science popularization then is no longer a translation of information into another channel without intellectual claims of its own. It is much nearer to the status – of being a general self-reflection of thinking and society – which philosophy could once claim for itself. That is popularization invents new genres, shapes cognitive traditions of its own and has to be reckoned as one of the sources of innovation in contemporary science and intellectual discourse.

This already points to a question which is central for the collection of papers this text is published in. Which is the *noise* arising from the diversity of popular communications? Are there any retroactive effects of these popularization efforts on the core of the scientific tradition? As will already be supposed on the basis of the discussion up to this point I consider these effects to be substantial.

### III *Popularization Noise* in the Global System of Science

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<sup>4</sup> Cf. Snow 1965 as an influential text which postulates a nearly complete separation of two intellectual cultures; and as a collection which represents the intellectual claims of the *third culture* Brockman 1995; and see the website <http://www.edge.org>.

The first and probably most general class of effects on science may be called *selection effects*. It is a matter of course that any popular presentation of science has to be highly selective. Some scientific questions are too technical or too esoteric, they are specialized to a high degree, they seem to be antiquated or are perceived to be of no social relevance. There are numerous other reasons for the selective treatment of scientific knowledge. These selection effects will probably retroact on science. Lines of inquiry disprivileged by them may as a consequence suffer from lack of financial resources or lack of political support or scientists will believe that they are involved in a scientific endeavour which somehow lacks attractiveness.

A second dimension regards *innovation*. In modern science innovation, especially radical or revolutionary innovation is regularly coupled to interdisciplinarity as a mechanism of hybridization of scientific knowledge.<sup>5</sup> And popularization is often based on interdisciplinary combinations of knowledge which sometimes are audacious. Therefore there is a significant innovation potential in popularization so that especially for elite scientists this innovation potential becomes one of the motives for participating in popularization efforts. Doing popularization is not a tedious activity one engages in only for fame or for money. It is more an opportunity for experimenting with a level of intellectual risk which is not readily accepted in everyday scientific practice.<sup>6</sup>

The dimension of risk and innovation is somehow related to a third dimension which can be described via the distinction of *assertiveness* from *reflection*. Popularization sometimes speaks with a voice which is much more assertive than it normally would be accepted in scientific communication. The skeptical and probabilistic mode which is representative of science today can not completely be transferred into popular discourses. Such a transfer might even undermine societal trust in science. On the other hand it is possible that doing popularization inspires a reflective mood. There arises a certain distance towards what one normally does. Often this distance is enhanced by the authors of essays and books being somehow older and looking back on numerous scientific successes and failures in earlier stages of their scientific careers. Therefrom comes a kind of popularization of science which in explaining science to nonscientific publics tries at the same time to achieve a contribution to a critical self-understanding of science. It is to be supposed that these two sides of the distinction – assertiveness and self-reflection – are in most cases not realized in one and the same text but that they represent alternative textual possibilities of doing popularization.

A fourth effect of popularization on science can again be articulated as a distinction: *unification of science vs. amplification of dissensus*. On the one hand science seems to speak with only one voice in acts of popularization. Nuances and variants

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<sup>5</sup> Cf. Stichweh 1996 on variation mechanisms in science. Cf. for a recent argument for a potent role of hybridization in biological evolution Rieseberg et al. 2003.

<sup>6</sup> Cf. for a similar argument Perrow 1986 who compares publication in journals with publication in edited volumes from the perspective of choosing different levels of risk at different points in a scientific career.

are not articulated; consensus seems to prevail and to offer itself as an even philosophical description of the specificity of science. But there is again the alternative option of choosing an idiosyncratic point of view in trying to achieve popularity. One then often presents a somehow biased view of a scientific field which makes use of a radical dissensus one projects on this scientific field to let it appear more interesting than it otherwise would be to a nonscientific public. Science then appears as a confrontation of schools who have either good or bad intentions and whose fight is portrayed in a way that one might make a Hollywood film from it.

The *unification of science* has to be distinguished from *integration of science*. *Integration* is more a concept which refers to the *milieu interne* of science and its disciplines and to the effects due to intensive internal communication. In studies on physics as a scientific discipline it has repeatedly been said that physics is integrated by nearly every physicist being interested in high energy physics. But this interest obviously has to be exercised by reading articles on the progress of high energy physics (for example in the *Scientific American*) which somehow have to be understood as popular publications. Again structural imperatives or problem solutions internal to science have to be fulfilled by a popular medium of communication.

A still more central imperative for scientific disciplines may be the need for the *systematization* of scientific knowledge. Modern science can be described as a centrifugal system. To the existing stock of knowledge it adds ever more novelties, it even accepts minutiae and details as relevant scientific knowledge if only this knowledge appears to be *new*. To this centrifugality of knowledge processes in science a corrective seems to be necessary. This corrective arises in the form of pedagogical intentions which aim at a systematic teaching of science. Again these pedagogical communications, for example in the form of systematic textbooks on scientific problem areas, are instances of popular communication as they reflect on the different publics they want to get through to and as they adapt their style of treatment and writing to the expectations they have built regarding their publics. What follows from this is that the articulation of the fundamentals of science is strongly related to a perspective which as a pedagogical perspective is oriented to publics which do not belong to the core of the discipline the fundamentals of which are thematized.

The last structural effect which has to be mentioned here is that science is *historicized* by popularization. This is true in a double sense at least. Firstly, as has already been seen in some of our comments, in popular presentations disciplinary knowledge is typically transformed into the telling of a story. A narrative, event-based structure is given to the unfolding of knowledge one wants to present. This can even be observed in the journalistic sections of *Science* and *Nature* in which the articles are characterized by a story-line and by frequent verbal extracts from interviews with the protagonists of a certain sequence of scientific events.

In a second respect the link between historicization and popularization can be seen in the development of *history of science* as a scientific discipline. The broad institutionalization of *history of science* in American universities after World War II was motivated by the intention to create a kind of *studium generale*. Natural science was thought to be inaccessible to many students as long as one chose a systematical presentation of its knowledge structures, and therefore history was perceived as a medium of presentation which generated interest and allowed understanding to those students one would not have got through to otherwise.<sup>7</sup> What is interesting in this is how the divide between the natural sciences and the humanities has been bridged by a humanistic discipline born by the effects of popularizing natural science. As finally a normal scientific discipline arose from it which today exhibits all the social and intellectual characteristic of a scientific endeavor it can be seen once more how much the couple of inclusion and popularization is internal to the dynamics of the differentiated system of science itself.

#### IV History of Popularization of Science: Changing Communication Forms and Role Structures of Science

I want to finish my argument by going back to the historical development of popularization. In the history of popularization, too, one can observe the discontinuity which in many other respects is characteristic of modern science between the eighteenth and the early twentieth century (cf. Stichweh 1984; 2003a). Eighteenth-century science is still very much defined by professionals and amateurs or dilettantes being nearly indistinguishable. Of course, there was the highly professional world of the *académies*. But this was a small world with a limited inclusion of scientific fields into its purview. In other respects an enthusiastic amateur sometimes only needed weeks for changing from being an interested dilettante observer of science to being an active contributor to scientific advance. This is well illustrated by many figures from eighteenth century electrical science, among them Benjamin Franklin (cf. Heilbron 1979). There was no well-drawn boundary between professional science and amateur activities. Gaston Bachelard once resumed his picture of eighteenth-century science with the formula that there existed only islands of serious science in an ocean of *vulgarisation*.<sup>8</sup> This remark is, of course, slightly exaggerated but it adequately formulates the impression that *in eighteenth-century science quasi-popular writing dominated scientific publication and therefore could not yet be interpreted as a selective representation or translation of a differently structured scientific core*.

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<sup>7</sup> See Kuhn 1984 as a personal recollection of Harvard in the late forties and his own recruitment for history of science by James Conant; and the influential physics textbook Holton/Brush 1973 (1<sup>st</sup> ed. 1952) as a good example of an introductory textbook choosing the option of historical presentation. See the introduction to the first and second edition for the context of writing this textbook.

<sup>8</sup> Ambivalence towards popularisation is to be seen in the persistence of the word *vulgarisation* as the current French term for popularisation. For Bachelard's analysis of eighteenth century science see esp. Bachelard 1938, 1953.

In comparison to this, nineteenth-century science, and this first of all in Germany and France, was a paragon of professional science. If there ever was such a thing as an ivory tower it surely was built in the nineteenth century. The scientific discipline became the stable context of scientific communication which implied that professionalization of science came about on this level of professional and disciplinary scientific roles. Now one could be a “Physiker von Beruf” (cf. Olesko 1991) and this meant that one was separated by an enormous distance from amateur activities. From this arose for the first time in history the popularization of professional science as a clear-cut and separate activity of its own and as such it was occasionally done by many of the prominent nineteenth-century scientists. One typical context was a speech given by an influential scientist at a festive occasion for a public consisting from well-situated and somehow educated *bourgeois*.<sup>9</sup>

The twentieth century situation presupposed in the main part of the argument of this paper implies again a far reaching change in communication forms and role structures. On the one hand the esoteric style of the inner core of disciplinary communication is maintained, it is even intensified as one can easily demonstrate in measuring the incomprehensibility of language in the core academic journals and its continuous increase since the nineteenth century.<sup>10</sup> On the other side the ongoing disciplinary differentiation of science and the increasing frequency of interdisciplinary communications effect a certain blurring of boundaries. If every interdisciplinary communication involves in some respect a popularization of disciplinary knowledge there arises a new reality of finely graded distinctions which lead step by step from the esoteric language of the disciplinary core to communications which become ever more inclusive of extended scientific and finally extrascientific publics and which succeed in doing this by accepting to be somehow popular communications. What distinguishes the twentieth-century system of science from the nineteenth-century situation is the enormous differentiation and diversity of communication systems internal to science and the interrelations of these systems. And such a global system of science exhibiting an enormous degree of internal differentiation is at the same time characterized by a multiplicity and diversity of interrelations with external publics. These are the structural conditions accountable for the ubiquity of popular communications in contemporary science.

There is one last question in terms of systems theory. Does the openness of science towards multiple external publics and towards the inclusion of plural types of popular communications endanger the autonomy and autopoiesis of science? Does it imply de-differentiation in the sense of a contamination of scientific values by heterogeneous codes belonging to other function systems? Of course, science is used in these contexts by other function systems, for example for the production of sensational news and entertaining stories on which the system of mass media thrives. But on the other hand, even for popular communications in the last resort

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<sup>9</sup> See for collections of these *Reden* Du Bois-Reymond 1886/7; Helmholtz 1903; and see the overview of 19<sup>th</sup>-century popularization in Daum 2002.

<sup>10</sup> *Nature* regularly publishes such data.

one will always ask if the informations conveyed are really true. Informations have to be simplified to be accessible. But accessibility is not enough; truth/falsity will be the most important respect of observation. Therefore, no relativizations of the autonomy of science have to be conceded. It is rather the case that the openness of science towards multiple publics and multiple levels and types of communication is a clear indicator that the autonomy of science need no longer be practiced in a timid and defensive way.

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