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Scientific Communication--A Vanity Fair?

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Is it cheap polemics to call scientific communication a vanity fair? Or does it help to understand how the scientific industry works? Does the vanity of scientists impede the advancement of knowledge, or is the chase after attention—from their peers and from the public—an indispensable part of scientific progress? Are scientists, when competing for attention, distracted from what they are committed to doing, or is it indeed their business to invest their own attention in order to get attentive returns? These questions are crucial for understanding science. They are crucial, moreover, for assessing the performance of the knowledge industry. Attention is a mode of payment, as well as the main input to scientific production. Suboptimal allocation of this scarce resource is as detrimental to the progress of science as are deficiencies in method.

Science is a collective endeavor: an industry in which the work of one set of specialists serves as input for other lines of specialized production. From a collective point of view, science can only function rationally by an efficient division of labor. If the available talents and efforts are allocated suboptimally, scientific production will not achieve collective excellence even if it is optimized from the viewpoint of the individual. But how are we to assess efficiency in science? Efficiency concerns the output into which resources that are used are transformed. But the output of scientific work consists of information, which is semantic and pragmatic in nature and thus defies immediate measurement. Scientific information even seems to escape economic valuation. Economic value is determined by the willingness of those interested in a particular item to pay for it. But the output of scientific production is not sold on markets: it is published. Publication puts intellectual property at the disposal of the general public under the sole condition that its processing into the intellectual property of the user is credited by citation. The performance of knowledge production can therefore not be assessed by comparing inputs and outputs in monetary terms.

Money is not the main motive for engaging in science. You do not become a scholar just to get rich. Nor is satisfaction of curiosity enough to make you a successful researcher. Success in science is rewarded with attention. You gain full membership in the scientific community only by receiving the attention of your fellow scientists. Earning this attention "income" is a prime

motive for becoming a scientist and for practicing science. In order to maximize this income, you have to employ your own attention in the most productive way. It does not pay to find things out anew that have been discovered already. Nor is reinvention rewarding in terms of the attention paid. It pays to pay attention to the work done by others.

When paying attention to the work done by others, those demanding scientific information are effectively collaborating with those supplying it. Conversely, suppliers of scientific information are collaborating with those demanding it, because in competing for attention they not only pursue their own interest, but are also concerned with what is useful for others. Such motivated concern about what is useful for others is the first condition for self-interested action to organize itself into an efficient division of labor. Might it thus be that an "invisible hand" is governing knowledge production even in the absence of monetary value?

The pursuit of attention leads to efficiency only if the attention earned measures the scientific value of the information supplied. However, the attention that a theory attracts is not necessarily a measure of its scientific value. A theory may attract attention because it looks suggestive, is an intriguing mixture of clarity and obscurity, matches the Zeitgeist, or rebels against convention. The attention attracted grows through being published in a renowned journal, by being presented to the right public in the proper surroundings, and by being reviewed by influential reviewers. But according to *The Logic of Scientific Discovery* of Karl Popper,* only criteria such as consistency, correspondence to facts, range, and productiveness are legitimate measures of scientific value. How can the scientific value of a theory then be connected with the attention it attracts?

The market forces that lead self-interested action to collective efficiency act through competition. Competitive markets measure the value of the traded commodity by making those interested in the commodity reveal their preparedness to pay. In the process of contracting and recontracting, the contracting parties' preparedness to pay for a commodity is polled and converted into the commodity's market price. Under conditions of perfect competition, market prices measure the value of commodities as precisely as polling.

What does this mean for scientific communication? Publication establishes intellectual property. Published information may thus not be used as a means of production without the user's acquiring a license to do so. The license for using somebody else's information productively is obtained through citation: in essence a fee paid through transfer of some of the attention earned by the citing author to the cited author. Citation thus reflects the preparedness to pay on the part of those using information productively, by crediting to somebody else the productive impact of the cited information on one's own work. A reliable accounting system for recording, validating, and adding up citations is therefore suitable for measuring the pragmatic value of scientific information.

The *Science Citation Index* (*SCI*) represents an accounting system that can measure scientific value effectively if the maximization of citations becomes the main goal of the rational scientist. For "attention-grabbing" researchers, it becomes rational to maximize the attention received via citations if their scientific career depends on the collection of citations they can call their own. Scientists are turned into citation-maximizers when they expect those deciding on scientific careers to consult the *SCI* above anything else.

In some scientific disciplines—generally those to which science owes its enormous prestige—a researcher's career depends heavily on her or his *SCI* "account." It does not follow, however, that everything is fine as soon as the citation account becomes a generally accepted measure of scientific value. Scientists with the largest citation accounts will not always be the best scientists. There are ways of accumulating citations that have little to do with scientific value. The simplest

way of circumventing the hurdle of productivity enhancement is the formation of citation cartels. One's account of citations can also be augmented without enhancing one's productivity by playing off one's power as an editor or referee. Why not suppress papers submitted for publication as long as the authors do not understand to whom they owe a citation?

For an accounting system such as the *SCI* to work reliably, cheating and politicking have to be prevented reliably in scientific communication. But wherever there is a market, there is a shadow market. It would be too costly to tighten control so as to eradicate illegal behavior completely. Nevertheless, there is built-in control: competition. The external rule of competition becomes indistinguishable from the internal rule of commitment (the sense of duty) when competition becomes "perfect." Two conditions for "perfect competition" are of immediate importance in the present context.

The first is that the market participants on both the supply and the demand side are so numerous that monopolistic practices are effectively prevented. The formation of citation cartels is a way of organizing monopoly power on the part of the producers. Suppressing papers worthy of publication is a case of exerting monopoly power on the part of the publishers. The existence of such practices indicates that competition in the scientific market is not perfect. But as long as competition is able to reduce cheating and politics, it remains rational for the average researcher to behave as if guided by a strong sense of duty.

The second condition is symmetrical information: those on the demand side should be fully informed about the goods in supply. In order to fulfill this condition, researchers looking for useful information would have to scrutinize supplied information in every detail. This condition has become unrealistic as scientists in all disciplines have to cope with a constant information oversupply. As soon as the information supplied can no longer be read in every detail by those on the demand side, it becomes tempting for suppliers to make their theories look especially suggestive at first sight. This is why, in the scientific communication market, the attention received by a new theory often differs from what it deserves after a second look. Advertising, public relations, and marketing enter the business of scientific research, filling the gap left by the scarcity of attention. But as long as the demand side is not seduced into grossly misallocating its attention, attention-grabbing selling practices are no serious threat. Scientists working for attention cannot afford to waste their attention on useless information, however conspicuously it may be offered. In pursuing their own interests, scientists are prepared to pay attention only to information likely to enhance their own productivity. As competition on the demand side grows tougher, the probability that selling practices will have deleterious effects diminishes.

Competition is effective in scientific communication. Monopolistic positions, if not prevented at the outset, are exposed to notoriously strong forces of dissolution. Being highly competitive, the exchange of information for attention is effective in self-organizing control, as well as in measuring the pragmatic value of scientific information. Both control and measurement depend on the fact that the economy of attention is a closed system. As soon as scientists, investing their own attention in order to get attentive returns, are mainly interested in the attention of fellow scientists, their work will be submitted to the valuation by those most competent to judge its value. As soon as attention by those capable of understanding one's work becomes the most highly valued income, the chase after attention turns into an endeavor to earn reputation. Reputation is the asset into which the attention received from colleagues crystallizes. As an asset, reputation measures the value of the work of a person in terms of how prepared her or his colleagues are to pay attention to it.

When maximizing their reputation, scientists are led to use their own attention most productively while enhancing the productivity of others. Given that scientists are themselves the best judges of

scientific value, there is thus a built-in tendency for optimization in the scientific economy of attention. This is not to say, of course, that all is well with scientific communication. It means, rather, that there are concrete and ascertainable circumstances that determine whether the attention science receives is used efficiently, that is, in a way that maximizes the collective advancement of knowledge.

Even though these conditions are not, and will never be, met with any precision, there is an incentive system operative in science, which links the collectively most rewarding allocation of attention with the maximum value of the attention its holder can earn. What distinguishes the use of scarce attention in scientific production most significantly from that in everyday life and from production that is not scientific is the collective management of efficiency. Efficiency in the use of attention means more than just economic excellence. Attention is the resource whose efficient use is called intelligence. In terms of the collective efficiency it attains, the intelligence of science as a whole surpasses that which individual scientists can attain in isolation. The scientific community, therefore, is that singular community to which collective intelligence can be attributed. A theory of science incapable of accounting for this intelligence is not only incomplete, but misses an essential point. The very success of scientific investigation remains poorly understood without an appropriate understanding of the mechanism bringing forth this unique intelligence.

- ↵*K. Popper, *The Logic of Scientific Discovery* (Routledge, New York, 1992).

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