The commoditization of science

Ecologist Richard Levins and geneticist Richard Lewontin argue that modern science has been fully incorporated into the process of capitalism, and is subject to the same conditions as any other commodity.

They discuss the implications this has for scientific research, and the influence of bourgeois ideology on the thinking of scientists. The essay is taken from their 1985 book, *The Dialectical Biologist*.

Modern science is a product of capitalism. The economic foundation of modern science is the need for capitalists not only to expand horizontally into new regions, but to transform production, create new products, make production methods more profitable, and to do all this ahead of others who are doing the same. Its ideological underpinnings are congruent with these needs and also with the political philosophy of the bourgeois revolution – individualism, belief in a marketplace of ideas, internationalism, nationalism, and rejection of authority as the basis of knowledge.

As capitalism developed, so did the ways in which science participated. From a luxury consumption for the aristocracy (along with court musicians and fools), science became in important ideological weapon in the struggle against feudal theology and a resource for solving practical problems of the economy. After the long depression in the last part of the 18th century, there was a definite upsurge of inventions and innovations in industry and agriculture. The number of patents registered in Great Britain rose from 92 during the 1750s to 477 in the 1780s. Agricultural societies were established around that time, and advances in animal breeding and management resulted in the formation of cattle breeds, such as Hereford. The weight of cattle marketed in London doubled in the course of the eighteenth century, and that of lambs tripled. In the early nineteenth century agricultural journals began to be published.

The leaders of the bourgeois revolutions recognized the potential of scientific research for military and commercial power. Among the earliest scientific societies were the Royal Society, in 1662; the American Academy of Arts and Sciences, founded in 1780 by leaders of the revolution in New England; Franklin's American Philosophical Society (1768); and the Naval Observatory in Greenwich (1675). In France the Directorate founded the Ecole Polytechnique in 1795, and Napoleon urged scientists to develop munitions, as well as a synthetic indigo dye to replace the imports from India that were cut off by war. The systematic surveying and cataloguing of the biological resources of tropical regions conquered by European countries led to a flowering of systematic biology under the leadership of Linnaeus. By 1862 the Morrill Act in the United States set up the land grant colleges of agriculture and mechanical arts in recognition of the importance of scientific knowledge for the improvement of farming and mining.

Throughout the first century of the industrial revolution, science enlarged its role as an externality of the capitalist expansion, like roads and lighthouses, and as a way to solve particular problems (as in Pasteur's identification of the *Phytophora* that threatened to wipe out the French wine industry). But science was not yet a commodity. Its application was still uncertain, its potential still mostly untapped, its product still often an after-the-fact explanation of empirical innovations.

The production of commodities, the expending of human labour to produce objects or services for sale certainly antedates capitalism. But under capitalism the commodity form of economic activity penetrated increasingly into all aspects of human life. In 1607, in the rarely performed *Timon of Athens*, Shakespeare lamented this commercialization:

*Gold? Yellow, glittering, precious gold?*
*Thus much of this will make*
*Black white, foul fair, wrong right,*
*Base noble, old young, coward valiant.*
*Ha, you gods! Why this? What this, you gods?*
Why, this  
Will lug your priests and servants from your sides, 
Pluck stout men's pillows from below their heads.  
This yellow slave  
Will knit and break religions; bless th' accurs'd;  
Make the hoar leprosy ador'd; place thieves  
And give them title, knee, and approbation  
With senators on the bench

Two centuries later Marx and Engels wrote in the *Communist Manifesto* (1848):  
The bourgeoisie, wherever it has got the upper hand, has put an end to all feudal, patriarchal, idyllic relations. It has pitilessly torn asunder the motley feudal ties that bound man to his "natural superiors" and has left no other bond between man and man than naked self-interest, than callous "cash payment." It has drowned the most heavenly ecstacies of religious fervor, of chivalrous enthusiasm, of philistine sentimentalism, in the icy water of egotistical calculation. It has resolved personal worth into exchange value and in place of the numberless indefeasible chartered freedoms has set up that single, unconscionable freedom – Free Trade ... The bourgeoisie has stripped of its halo every occupation hitherto honored and looked up to with reverant awe. It has converted the physician, the lawyer, the priest, the poet, the man of science, into paid wage labourers.

Activities that previously were the direct result of human interactions — entertainment, emotional support, learning, recreation, child care, even human blood and transplantable organs or the use of the womb — have now entered the marketplace, where human relations hide behind impersonal buying and selling. Each time a new aspect of life is commoditized, some resistance is expressed as outrage at the debasement of previous values. When the price of bread was freed to respond to the market, bread riots broke out among the English working class; the commercialization of the means of communication and the information monopoly led to the concerns raised by Third World delegates at UNESCO in the 1980s and the call for a new information order. The commercialization of health care forced people to raise the issues of national health service or insurance. The commoditization of science, then, is not a unique transformation but a natural part of capitalist development. And we discuss it not to express outrage but to examine the consequences of this change for scientific activity.

The commodity form establishes equivalences among very different objects. Although a camel is not equivalent to a blanket, the value of a camel is equivalent to the value of a certain number of blankets: \( C =/= B \), but \( V(C) = V(B) \). By way of the qualitatively equivalent exchange values of objects, it becomes possible to trade them and thus to transform them into each other. The market achieves what the alchemist could not: in 1980 lead could be transformed into gold in the ratio 500 pounds of lead for one fine ounce of gold. This ability to establish equivalences among dissimilar objects made trade the predominant form of exchange for the products of human labour outside of the individual household. There are of course other forms of exchange — customary gift giving, sharing, redistribution in periods of hardship, ritualized exchanges. But even within the family distribution may be dominated by commodity relations as when the best food is given to the wage earner or when women have to struggle to control their own earnings.

Commoditization also implies a giant step in abstract thought, in that the distinct objects are seen as both economically similar and physically different, the difference and the similarity both being prerequisites for trade. Before exchange can be completely commoditized and before exchange values can emerge as an objective economic property of goods, exchange must be frequent enough for the law of large numbers to operate. The idiosyncratic preferences of individual purchasers, their relative abilities to bargain, their individual urgencies are smoothed out when the same objects are regularly bought and sold, when a purchaser can reject an offer and look for the same product elsewhere, when a producer can expect other customers. The commoditization
becomes more profound when investors can put their capital into those enterprises that promise greatest profits, and the availability of labour allows investors to treat people, even highly skilled people, as generalized human labour power, an interchangeable cost of production.

By the end of the nineteenth century, scientific production was an essential part of the chemical and electrical industries. But not until the midtwentieth century did science become a commodity on a massive scale. As such, it has the following characteristics.

*Research has become a business investment.* Within corporations of the technical industries, some 3-7 percent of sales is reported as expenditure on research and development. Investing in research, which is one of several ways of investing capital, competes with other ways, such as increasing production of existing products, purchasing more advertising, hiring lawyers or lobbyists, buying up businesses in other fields, busting unions, bribing cabinet ministers of potential customer countries, and so on. All possibilities are measured against each other on the single scale of profit maximization (see Chapter 11).

It is widely known that research expenditures are the first to be cut back when a corporation suffers economic reverses, presumably because technical innovation has no immediate payoff, while increased advertising, labour costs, and material costs can be immediately reflected in profit. Studies of corporate decision making repeatedly show that the typical decision horizon of managers is at most three to five years. Since research often has no payoff within such a period, it is most dispensable. At the same time, the costs of long-range research are socialized by changing the locus of the work from individual enterprises to public institutions such as universities and national institutes. In this way, by tax subsidization, no individual firm need risk an investment, and the total costs are spread over the entire tax base. When such socialized research comes close to producing a marketable product, the final development stages are taken back into private hands in order to realize an exclusive property. This is the picture, for example, in the development of new varieties in agriculture. State experiment stations develop lines, which are then released to certified seed producers. The lines then become general property and are taken up by seed companies who “fine tune” them and sell the results to farmers.

The extreme form of research investment is the scientific consulting firm, whose only product is the scientific report. (In 1983 in the Boston area, between one hundred and two hundred firms were engaged in ecological consulting.) Here it is most obvious that the test of quality of the report is the client's satisfaction rather than peer review. If the report is an environmental impact evaluation, satisfying the client means convincing the appropriate regulatory authority that the company is complying with the law and that its activities are not harmful, and doing this for minimum cost. The relationship of the consulting firm to corporate client is complex. The consultant obviously prefers a big contract to a small one and therefore may push for a more thorough investigation than the client wants. On the other hand, because the field is so competitive, the consultant has an incentive to keep costs down. The result is that the consultant does just enough research to ensure that the environmental ruling will be favorable, to document those problems that are likely to arise, and not to look for trouble. Such ventures are highly risky for consulting firms. Their major asset is the good will of clients, since the capital consists mostly of computation facility and office furniture. There is a high rate of turnover of companies in environmental consulting.

Once the scientific report becomes a commodity, it is also subject to two other features of the business world: the stagecoach can be hijacked and the beer can be watered, that is, scientific commodities may be stolen or debased. Both kinds of entrepreneurship – the appropriation of the work of others and the falsification of results in order to publish accounts of success or to beat out competitors – are a growing problem. Although scientific frauds occurred in the past – everybody knows about the Piltdown hoax – and priority fights did occur among individuals vying for prestige, scientific frauds now have a rational economic base and so may be expected to increase.
Scientific discovery has become quantifiable. A corporation can estimate how long it takes on the average to develop a new drug or computer, with how much labour, and at what cost. Therefore a research and development company or corporate division can look at scientific activity as generalized human labour, rather than as a way to solve particular problems.

Scientists have become “scientific manpower:” As such, they are subject to costs of production, interchangeability, and managerial supervision. The division of labour within science, the creation of specialties and ranks now becomes increasingly rationalized. The creative parts of scientific work are more and more restricted to a small fraction of the working scientists, the rest are increasingly proletarianized, losing control not only over their choice of problem and approach, but even over their day-to-day, and sometimes, their hourly, activity.

Scientific management, first developed for the auto industry in the infamous Taylor system at Ford, has been extending into commerce, office work, and scientific research. The managerial approach self-consciously sees the labour force as objects to be used for the ends of the managers. The fragmentation of skills, and the resulting increase in specialization, is derived not from the intellectual needs of a field but from the managers' cost accounting: it is cheaper to train one laboratory hematologist and one urinalyst than to prepare two general medical technicians. Therefore their labour power is cheaper, wages are lower, obsolete parts can be fired and replaced. Furthermore, the fragmentation and deskilling consolidates control over the divided work force.

But deskilling in scientific work makes for greater alienation - the producers do not understand the whole process, have no say over where it is going or how, and have little opportunity to exercise creative intelligence. Once the labour is alienated in this sense, once science is just a job, increased supervision is necessary. The burdensomeness of that supervision makes for further alienation and encourages corruption or indifference. It also takes control out of the hands of scientists and gives it to managers. The researchers themselves, and even the administrators of science, are no longer responsible primarily to their peers but, rather, upward in the hierarchy, to the controllers of resources. One by-product of this phenomenon is that research proposals submitted to granting agencies become longer, more detailed and cautious and are a less honest reflection of the research intentions. The awarders of research money, concerned with justifying their decisions, opt for caution and demand increasing documentation.

Scientific labour must itself be produced. Universities and vocational schools aim at preparing the various grades of scientific labour at minimum cost, turning the education process itself into an external service for the personnel departments of private enterprise. This exerts a pressure on the educators for economic efficiency – don't have the students overqualified, concentrate on what they need to know (that is, what their employers require), shorten the duration of graduate study, get more Ph.D.s for the buck. At the elementary education level this pressure means "back to basics." The utilitarian approach is not universal and is not always so crude. Educators often have their own goals that clash with the prevailing social trends. But even the more innovative programs produce people for the less clearly defined assignments of ruling and keeping the system flexible. Scientists react to this commoditization in opposite ways. On the one hand, they deplore it. Many of them, recruited from the middle class, chose science as a way to escape the world of trade. They chose to engage in a kind of labour whose product was a use value, worthwhile for its own sake rather than for exchange. They resent the loss of the old esprit de corps and the selfless dedication to truth which was the organizing myth of precommodity science. They resent the proletarianization of scientific labour and their loss of autonomy, and they resist, in individualistic ways, the imposition of managerial controls and bureaucratic determination of worth. If they organize, they avoid calling their associations unions.

On the other hand, scientists rush to take advantage of new entrepreneurial opportunities. Some, especially during the brief period of American affluence following sputnik, chose a career in science as one of several alternatives that would provide financial and other rewards. Some two-thirds of all scientists working in the U.S. are employed by private industry and business, where the pursuit of profit is the frankly recognized goal.
The transitional condition of scientists as a stratum of professional intellectuals who are in the process of losing their professional status and being incorporated into the structure of capitalism exacerbates the contradictions in their ideological positions and their social action. These vary from defiant assertions of individual responsibility and dissent, through cautious criticism, and studied indifference, to servile sycophancy; from elitist resistance to being bureaucrataetized and proletarianized to realistic or enthusiastic participation in the new order, to alliance with other alienated sectors in the struggle against capitalism. As a result of these developments, the class divisions that plague our society as a whole also cut across the ranks of science. The majority of the one million or so working scientists in the United States form a scientific proletariat; they sell their labour power and have no control over their product or their labour. At the opposite end, a few thousand at most form a scientific bourgeoisie, investing in research and determining much of the direction of research and development. In between these extremes is the group of petty bourgeois professionals working alone or in small groups in universities and research institutes. Al- though they may be motivated by a great diversity of concerns, their activity depends increasingly on obtaining funding from government agencies, private foundations, or corporations. For them the research grant has become a necessity. And the relation between the grant and the research has gradually been transformed: whereas initially the grant was a means for research, for the entrepreneurs of science, the research has become the means to a grant.

The capital inputs for science have become major industries. These include chemicals, apparatus, culture media, standardized strains of laboratory animals, and scientific information. One consequence is that the development of scientific technology is often separate from the scientific research it is intended to serve. The technology is not directed at finding the cheapest or best way to study nature but at gaining profit from specific markets.

In Third World countries sales representatives urge the new scientific institutes to have the "best," the "most modern" equipment long before spare parts, repair service, or reliable electric power are available. The president of the country may pose at the dedication of a shiny new sixteen-channel electroencephalogram for the psychiatric institute, but he would not show up for the trial run of buckets filled with banana mash used for surveying fruit flies. It is more dramatic to found an institute than to keep it running. Therefore, there is now a rich tradition of telling about underutilized or broken or abandoned facilities throughout the tropics.

At present it costs about $100,000 a year to keep one scientist working in the United States, the equivalent of the wages of perhaps 5 industrial or service workers. In Third World countries, scientists' salaries are lower, but equipment and supplies cost more, and infrastructure is often not available. It may require the labour of fifty or more workers to provide the resources to support one scientist.

Originally, scientific journals were published by scientific societies to take the place of personal communications. Now, however, publishing companies have moved into publishing scientific books and journals. Company representatives often flatter and cajole scientists into writing another textbook in, say, population genetics, because "we already have good sellers in molecular genetics and developmental genetics, and this would complete the line." What is published now depends on the publisher's and editor's need to fill the journal and the author's need to be published in time for tenure review, a job hunt, or a raise. The question rarely arises, "Is this publication necessary?" Therefore, a significant part of the much-cited information explosion is really a noise explosion.

The commoditization of university science results from the financial needs of universities. They consider scientists to be an investment in four ways: for obtaining research grants from government agencies and corporations; for converting scientific reports into public relations and the prestige into endowments; for raising the "standing" of the university as the basis for raising tuition and attracting students; and, finally, for sharing in the patents of inventions made by university faculty. As a result, the allocation of resources within a university is influenced by the prestige and earning capacity of the various programs, and scientists in a number of
universities report pressure from their administrators to turn their research in more affluent directions, such as genetic engineering.

The conditions of existence of the scientific strata in the capitalist economy reinforce the beliefs and attitudes scientists receive as part of the general liberal-conservative heritage. Despite a broad range of variation in scientists’ beliefs, and despite the contradictory beliefs we all hold, there does exist a coherent implicit ideology that can legitimately be designated bourgeois. It includes the following characteristics:

**Individualism.** The bourgeois atomistic view of society, as applied to science, asserts that progress is made by a few individuals (who just happen to be “us”). Scientists see themselves as free agents independently pursuing their own inclinations. “Just as in astronomy the difficulty of admitting the motion of the earth lay in the immediate sensation of the earth’s stationariness and of the planets’ motion, so in history the difficulty of recognizing the subjection of the personality to the laws of space and time and causation lies in the difficulty of surmounting the direct sensation of the independence of one’s personality” (Tolstoy, War and Peace). Nowhere is the sensation of independence stronger and the deception more pitiful than among intellectuals. Individualism in science helps create the common belief that the properties of populations are simply derivable from those of the uncharged atoms (genes) of populations or societies. It also transforms the subjective experience of career ambition into the invention of selfishness as a law of evolution. A crucial element of individualistic ideology is the denial of that ideology.

**Elitism.** This assertion of the superiority of a small minority of intellectuals often leads to the belief that the survival of humanity depends on the ability of that minority to cajole and con the rest of the people into doing what is good for them. This bias is especially pronounced in science fiction accounts of resistance to political oppression, in which a few dedicated scientists conspire to outwit the rulers. This elitism is profoundly antidemocratic, encouraging a cult of expertise, an aesthetic appreciation of manipulation, and a disdain for those who do not make it by the rules of academia, which often reinforces racism and sexism. The dismissal of folk knowledge has contributed to disasters in agricultural development. The elitist view supports a managerial approach to the administration of intellectual life and sees the cooptive self-selection of the academic and corporate elite as a reasonable way to run human affairs.

In the internal theoretical issues of science, elitism perhaps contributes to the belief in the notion of hierarchical organization and to the search for the controlling factor that fits into the reductionist world view, which retards the study of the reciprocal interpenetration of parts in favor of a chain-of-command model of genetics, society, and even ecosystems. Whereas the individualistic view favors a model of the world in which the parts (say, species in an ecosystem) are essentially independent, the elitist paradigm imposes an organization that precludes autonomy.

**Pragmatism.** In Western ideology “pragmatic” is a term of praise, in contrast to “ideological,” which is pejorative. For scientists, pragmatism means accepting the boundary conditions imposed by commoditization and specialization. It means getting on with the job without asking why, a stance immortalized in Tom Lehrer’s song about the missile expert: “‘If the rockets go up, who cares where they come down? That’s not my department,’ said Werner von Braun.” Since the major pathway by which scientists affect policy is through their advice as consultants to “decision-makers,” being effective requires maintaining credibility. Therefore advice must be limited to the domain of the acceptable; the dread of the raised eyebrow that withdraws credibility acts to impose not only prudence in giving advice but also, eventually, to narrow the intellectual horizons of the advisers. In the pragmatist’s eyes, strong feelings about the injustice of social arrangements are necessarily suspect as ideological, reflecting immaturity as against scholarly cool.

**Separation of thinking from feeling.** Scientists may once have had to struggle to establish the principle that all claims about the world must be validated by evidence. Neither appeals to authority nor one’s own wishes are allowed to carry any weight in scientific controversy. Some separation of thinking from feeling was probably necessary to establish the legitimacy of science. But once it became absolute, that separation became an
obstacle to self-conscious scientific practice. It obscures the sources of our preferences about directions to take or methods to use; it imposes a formalized introduction to scientific papers, pretending to move the individual scientist out of the process of creative work through the pitiful device of removing first-person pronouns, adopting the grammatical form that Susan Griffith described as the passive impersonal. More important, after questions of fact are formally freed from questions of value, they are not easily rejoined. While philosophers devote lifetimes to discussing how to relate the "is" to the "should," scientists are free to build all kinds of weapons, buffered by the impersonal vocabulary of "cost effectiveness," "kill ratio," and such terms, from acknowledging the effects of the products of their labour.

Finally, the supposed superiority of thinking over feeling implies that those who withhold feelings are superior to those who express them. One result is that women, socialized in our society as the custodians of feeling, must either suppress themselves in order to be allowed to do science or must be systematically underestimated, as if "more emotional" meant less rational.

Reductionism. The specialization of scientific labour and of command functions from research creates a model of scientific organization that is easily seen as the model for the organization of the world. Nature is perceived as following the organization chart of our company or university, with similar phenomena united under a single chairman, distinct but related phenomena under a common dean, and unconnected events belonging to different schools or divisions. Thus specialization in practice joins with atomistic individualism to reinforce the reductionism that still predominates in the implicit philosophy of scientists.

As socialists, we do not criticize the commoditization of science in order to appeal for a return to the times before science became a commodity. That would be as futile as the antitrust laws, which seek to re-create precisely those past conditions that gave rise to the trusts. Our intent is different. The commoditization of science, its full incorporation into the process of capitalism, is the dominant fact of life for scientific activity and a pervasive influence on the thinking of scientists. To deny its relevance is to remain subject to its power, while the first step toward freedom is to acknowledge the dimensions of our unfreedom.

As working scientists, we see the commoditization of science as the prime cause of the alienation of most scientists from the products of their labour. It stands between the powerful insights of science and corresponding advances in human welfare, often producing results that contradict the stated purposes. The continuation of hunger in the modern world is not the result of an intractable problem thwarting our best efforts to feed people. Rather, agriculture in the capitalist world is directly concerned with profit and only indirectly with feeding people. Similarly, the organization of health care is directly an economic enterprise and is only secondarily influenced by people's health needs. The irrationalities of a scientifically sophisticated world come not from failures of intelligence but from the persistence of capitalism, which as a by-product also aborts human intelligence.

In a world in which some countries have broken with capitalism, it is important to emphasize that the way science is, is not how it has to be, that its present structure is not imposed by nature but by capitalism, and that it is not necessary to emulate this system of doing science.