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ESSAYS ON SCIENCE AND SOCIETY:

The Great Asymmetry

Stephen Jay Gould

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In March 1792, Charles-Henri Sanson, the public executioner of Paris, submitted a memorandum to the French National Assembly. He needed a new device to speed his job and reduce the large backlog of prisoners awaiting execution. He owned only two swords, and each required frequent sharpening, thus causing delays when his victims came by the cartload.

The Assembly therefore commissioned Joseph-Ignace Guillotin to build a "humane" device to "separate the head from the body in the twinkling of an eye" (to quote Guillotin's own instructions for use). The doctor's eponymous machine performed as specified--and France lost, among "many thousands gone" in the Reign of Terror, her greatest scientist, Antoine-Laurent Lavoisier, decapitated for his role as farmer-general (tax collector) on 8 May 1794, less than 3 months before the fall of Robespierre and the end of the Terror. Lavoisier had served with Guillotin and America's favorite son, Benjamin Franklin, on King Louis XVI's Royal Commission to investigate Franz Anton Mesmer's false claims for animal magnetism; their report of 1784* still stands as a model of scientific methodology, applied like a rapier.

As an example of the misuse of science and technology for destructive and immoral ends (usually quite contrary to the inventor's genuine intent as well), the guillotine hardly merits a glance compared with such efficient agents of wartime destruction as gunpowder, napalm, or atomic weaponry--not to mention the truly unintended and purely consequential impacts of technology on global environments, human social problems, and biodiversity.

This tale of technological "progress" gone ethically and socially awry illustrates the most troubling of all widely believed generalities about the relationship of science to human life and history, the unfortunate myth that underlies most of the fear and negative feeling that science often evokes. In this legend, abetted by innumerable cultural props (from misreading Mary Shelley's Frankenstein to the demonization of science by Hollywood), the practice of science, by recording either the intrinsic immorality of technological growth, or only the naïveté of well-intentioned people who confuse complexity with improvement, can only build dark Satanic mills upon our planet's green and pleasant land.

I cannot think of a more important task in our campaigns for improving "public understanding" of science than the dissipation of this myth. The idea that science is monolithic, incomprehensible, soulless, and basically bad for us forms the core of a central paradox of our times: Science has become least popular and most feared at the height of its influence and intrinsic interweaving with our daily lives and activities--least pursued and cherished when most essential to the core of education for all thinking people.

I believe that the two most common, if contrary, explanations for the origin and persistence of this myth must be debunked in favor of a third source, which I have dubbed "the great asymmetry." This third interpretation may be helpful to scientists in our struggle to convey the joys and promises, the hopes and accessibilities, of this great adventure to which we professionals have pledged our lives, our fortunes, and our honor. The logical structure of my argument follows the theme of Goldilocks in rejecting the two standard views as opposite extremes, while advocating a third position on middle ground.

1) *Science as intrinsically good, but too easily overwhelmed.* In a view more popular in the last century than in our own, science leads the combined forces of enlightenment on a slow upward course toward human betterment. The rhetoric varied greatly, from the militant Ernst Haeckel, who wrote in 1874:†

> On the one side spiritual freedom and truth, reason and culture, evolution and progress stand under the bright banner of science; on the other side, under the black flag of hierarchy, stand spiritual slavery and falsehood, irrationality and barbarism, superstition and retrogression [my translation]

to the ever genial Charles Darwin, who stated in 1880:‡

> Freedom of thought will best be promoted by that gradual enlightening of the human understanding which follows the progress of science. I have therefore always avoided writing about religion and have confined myself to science.

The essence of human tragedy, in this view, lies in the power of politics, reaction, and irrationality to overwhelm the still, small voice of science, and even to use its tools of intended benevolence for perverse ends. In 1848, the AAAS began in Philadelphia after many years of tentative gropings and failures to found an encompassing organization of American scientists. What influence could such an initially weak instrument of constructive progress wield in a world engulfed by the political revolutions of 1848--events that would place Louis Napoleon at the helm of France, send Pope Pius IX into exile in Gaeta, inspire Richard Wagner to man the barricades of Dresden and also, and not entirely coincidentally, mark the year of publication of Marx and Engels's *Communist Manifesto*?

Fifty years later, in his fin-de-siècle book of 1898, *The Wonderful Century,* Alfred Russel Wallace, Darwin's partner in discovery, veiled his optimism with fear that our society might crumble

because human moral progress could not keep pace with scientific advance:[§]

> The more we realize the vast possibilities of human welfare which science has given us, the more we must recognize our total failure to make any adequate use of them...Instead of devoting the highest powers of our greatest men to remedy these evils, we see the governments of the most advanced nations arming their people to the teeth, and expending much of their wealth and all the resources of their science, in preparation for the destruction of life, of property, and of happiness.

2) *Science as intrinsically evil*. In this view, all too common among the philistines of our own time, science breeds destruction by its own internal character and drive. Human nature can only use such power for conquest and rapine; moreover, the mechanical model underlying the acquisition of such power must mock and obliterate any countervailing force rooted in human spiritual decency.

We can easily identify the key fallacies in both these extreme positions. For the first, science cannot be separated from political change, if only because the primary motor of social reorganization throughout human history, from the advent of agriculture to the acme of modern industry, has been fueled by applied scientific knowledge. For the second, science cannot be conflated with the uses of discovery, for we have choices, and any discovery implies a plethora of potential realizations, spanning a full range of moral weights. Humanists have therefore held all possible attitudes toward science, for no necessary position emerges from the logic of complex interaction between knowledge and social utilization. Just consider the views of two successive poets laureate in Victorian Britain, from the suspicious and romantic Wordsworth, who held that "we murder to dissect," to the informed and celebratory Tennyson, who reveled in the march of science along "ringing grooves of change."

As silly and extreme as these two arguments may be, their force remains strong in popular culture because they express a focal empirical truth of human history, despite their false explanations. The worst destructions wrought by human hands have been potentiated by applied scientific knowledge, and could otherwise not have occurred at anything like their realized intensity. If the impotence of science's potential benevolence, or the inherently evil character of science's utility, do not underlie this troubling theme of human history, then why does such a triumph of human understanding so often become linked with tragedy and destruction?

3) *The great asymmetry.* Joseph Louis Lagrange lamented the death of his friend Lavoisier with a famously rueful and incisive remark: "It took them only an instant to cut off that head, but France may not produce another like it in a century." I suggest that an extension of Lagrange's observation from his colleague's ontogeny to human history and social organization, indeed, to the workings of nearly any complex system, may explain the disturbing correlation of applied scientific knowledge with the intensity of destructive events in human history.

In our universe of natural law, complex and adaptive systems can only be built sequentially. We can only reach our pinnacles by laborious steps, but destruction can occur in a minute fraction of the building time, and can often be truly catastrophic. A day of fire destroyed a millennium of knowledge in the library of Alexandria, and centuries of building in the city of London. The last blaauwbock of southern Africa, the last moa of New Zealand, perished in a momentary blow or shot from human hands, but took millions of years to evolve.

Homo sapiens is not an evil or destructive species. But the architecture of structural complexity--the great asymmetry of my title--permits moments to undo what only centuries can build. The essential human tragedy, and the true source of science's potential misuse for destruction, lies in the ineluctable nature of this great asymmetry, not in the character of knowledge itself. We

perform 10,000 acts of small and unrecorded kindness for each surpassingly rare, but sadly balancing, moment of cruelty. The shot of one assassin can launch a preventable war; one impulsive murder can topple years of trust carefully built by thousands of benevolent citizens in ethnically diverse communities. We must reject the old saw that science progresses through history, while morality stagnates (or retrogresses). I suspect that "mean morality" (if such a concept can be operationalized) has greatly improved in the last millennium of human history. In most of the world, we no longer keep slaves, virtually imprison women, mock the insane, burn witches, or slaughter our rivals with such gleeful abandon, or such unquestioned feelings of righteousness. Rather, our particular modern tragedy resides in the great asymmetry, and the consequential but unintended power of science to enhance its effect. I suspect that 20 Hitlers ruled over small groups of Europeans a thousand years ago. But what could such petty monsters accomplish with bows and arrows, battering rams, and a small cadre of executioners? Today, one evil man can engineer the murder of millions in months.

Who in their right mind would advocate a return to such times when greater evil wielded less potential might? Who would prefer to live in a culture with medical knowledge so rudimentary that many of one's offspring, in any social class, must die in childhood? In any case, we have no choice, for humans must wonder, ask, and seek--and science must therefore break through the strictures of custom--to become either our greatest glory, and our most potent engine of benevolent change, or an accelerator of destruction on the wrong side of the great asymmetry. Human choice, not the intrinsic content of science, determines the outcome--and scientists, as human beings, therefore have a special responsibility to provide council rooted in expertise. The content of science can only enhance or potentiate choices rooted in our social and ethical values. And so, as Franklin, the American partner of Guillotin and Lavoisier, told us in another context, what option remains for science (as an agent of such power for good or for evil), or for society (as the expression of our moral choices, and the locus of our potential and eminently attainable decency), but to hang together or to hang separately?

Nature, in her geological majesty, will little note nor long remember our transient passage, but wouldn't we achieve a crowning glory for our unique intellect if we joined the power of science with our unrealized potential for decency to rein in the great asymmetry, and to build a just world that finally tempted us to exclaim, with joy, Faust's paean to a lovely moment, attained after so much struggle and search (but without suppressing our need to strive further): *verweile doch, du bist so schön* [stay then, for you are so beautiful].

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[*] A. L. Lavoisier *et al.*, *Rapport des commissaires chargés par le roi de l'examen du magnetisme animal* (Imprimerie Royale, Paris, 1784).
[†] E. H. Haeckel, *Anthropogenie: Keimes-und Stammes-Geschichte des Menschen* (Engelmann, Leipzig, 1874), pp. xiii-xiv.
[‡] F. Darwin, Ed., *The Life and Letters of Charles Darwin* (Murray, London, 1888), vol.1, p. 304.
[§] A. R. Wallace, *The Wonderful Century: Its Successes and Failures* (Dodd, Mead, New York, 1898), p. 379.

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