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Minimizing Wastes

Among the advanced countries, efforts are increasing to reduce wastes and associated pollution. The U.S. National Academy of Engineering (NAE) has sought to bring good judgment to this effort. It has sponsored workshops addressing what it calls "Industrial Ecosystems." It has issued three publications" derived from the workshops that present experiences of a number of engineers in activities aimed at achieving waste reduction. The overall NAE approach is summarized in the following statement: "...the reshaping of industrial systems for environmental and economic success is based on efficient use of materials and energy, substitution of more abundant and environmentally preferable materials for those that are rare or environmentally problematic, reuse and recycling of products and materials, and control of waste and emissions."

Progress is being made in the reduction of the content of waste streams, but the task is complex. Each of the thousands of industrial materials and consumer items presents a different set of problems. Some are tractable; for example, the recycling of paper products, aluminum, and scrap iron. In these instances the compositions are simple, the volumes to be recycled are large, a market exists, and the economics are favorable. But for other items a variety of impediments exists, such as the fact that the compositions of items are complex, or toxic substances are involved.

About 75% of the weight of automobiles is recycled. When a vehicle reaches a junkyard, useful subcomponents such as batteries, starters, tires, and generators are removed. Then the remainder is crushed to small lumps, and the iron separated for recycling. The remaining 25% (called "fluff") consists of plastics, liquids, and glass and has been sent to waste dumps. Recently, the German government has mandated that auto manufacturers take total responsibility for disposing of their products at the end of the vehicles' useful life. This edict will impact American companies that have sales there. It will ultimately lead to changes in designs that will facilitate disassembly and enhanced recycling of parts.

Components present in computers are numerous and complex. Processes involved in manufacture earlier gave rise to pollution, notably emission of chlorinated hydrocarbons. Teams of engineers have been devising means of minimizing pollution during production and in disposal of outmoded products. In one instance, they found that current technology was environmentally superior to alternatives. Replacement of lead solder by a solder containing either bismuth, indium, or silver was not justified when one considered total environmental impacts, beginning with the mining of the various elements.

In seeking to minimize hazardous wastes, it is sometimes necessary to consider tradeoffs. A new, highly efficient lamp has been created that if widely used would save an enormous amount of energy. The lamp contains mercury. Should use of the lamp be promoted?

To achieve minimization of wastes and environmental contamination in the United States, a combination of improved regulations and economic incentives will be required. At present, the regulatory machinery is not functioning optimally. For example, some of the regulations concerning the transportation and processing of waste discourage the reuse of waste. The result is unnecessary use of virgin material and unnecessary management and disposal of potentially useful material.

One of the workshops brought together engineers from Japan and the United States. In general, the technical problems encountered in the two countries are similar. Both sets of engineers are also affected by government regulations. In contrast to the situation in the United States, the Japanese government and industry work closely together.

As Japan and other countries gain experience and improve their waste management, they may well provide useful lessons for the United States. In turn, technology developed in the United States will be helpful to others. The rate of progress will be enhanced if means are found to improve the economics of recycling and waste minimization.

Philip H. Abelson

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LETTERS

Science in the Former Soviet Union

Having co-authored several papers in visual psychophysics as an undergraduate, I still feel some residual understanding of statistical and quantitative methods in science, in spite of my subsequent career change. So I was bemused by the statements in both the editorial and the lead article of the Science in Europe issue (27 May, pp. 1235 and 1259) regarding the leading role of Russia in post-Soviet science, as reflected by the bar graph (p. 1260) showing the number of International Science Foundation grant recipients by country. What the graph does show is that countries with larger populations—and hence more scientists—get more grants. If, however, one uses number of science grants awarded as a measure of strength or quality of scientific research, then surely one should take into account the size of the population. How else to draw conclusions about, let alone compare the quality of, science in Estonia and Russia when the latter has a population roughly 100 times the size of the former? This applies both to the graph’s rank-ordering by country the number of grants awarded, as well as to the rank-ordering in the table on page 1261 of scientific institutions by the number of grants received. Just as countries considered part of the former Soviet Union vary in population, so too the size of respective institutions and the number of different projects for which they can apply to receive funding is a function of the size of a country and of a country’s community of scientists.

A country such as Israel, for example, is considered a scientific powerhouse because of the quality of its science, measured, among other methods, by the number of grants received by Israeli scientists for a population of its size. No one would say that a much larger country is doing better science simply because it has many times the number of scientists applying for and receiving funding. The same holds for the countries listed in the Science in Europe ‘94: Russia article.

Similarly, a country’s GNP (gross national product) merely describes the size of its economy, not its strength or level of development. Per capita GNP is the measure that indicates whether a country is poor or rich.

A tabulation of grants received per million population (Fig. 1) yields somewhat different conclusions from those presented in the article regarding who “dominates” in science. One would hope that among the conclusions derived from such a statistical analysis, it is also concluded that, as in economic development, so also in scientific research, with a range of grants per population stretching over two orders of magnitude, the lumping together of very different countries under the rubric “the former Soviet Union” does rational analysis and science a grave disservice.

Toomas Hendrik Ilves
Ambassador of Estonia, Embassy of Estonia
Washington, DC 20005, USA

References


Having spent 3 months last summer in a Moscow scientific institute, where, for instance, researchers were working in semi-darkness to cut electricity bills, I have to say that Science’s extensive feature on the desperate state of Russian science was timely and important. One important point, however, was not stressed: science in Russia is being suffocated, not only by a chronic shortage of hard currency, but by an unignorably infrastructure and hostile bureaucrats in other government departments. Here are two examples. (i) Almost all the Russian scientists I knew lamented the fact that, while research funding had dried up completely, many institutes were still retaining large numbers of administrative and support staff who now have almost no work to do. Most workers felt that cuts were being made in the wrong areas. (ii) It is now very difficult to borrow material from Russia for study in the West, which severely impedes collaboration. For instance, new regula-
Institute of Human Origins: Separation Issues

The 25 May News article by Ann Gibbons about the Institute of Human Origins (IHO) (p. 1247) reports a number of statements by IHO’s critics that are inaccurate, out of context, or incomplete, providing readers with a distorted picture of the issues confronting our organization at present. It also reports unsubstantiated and erroneous assertions about IHO founder and president Donald Johanson’s job performance that cannot go unchallenged.

Gibbons writes, “When the motion [to force founder Donald Johanson out of IHO] was defeated, Getty withdrew his support of the IHO . . . .” Actually, Gordon Getty, a member of IHO’s Board of Directors since 1981, sent written notice to IHO on 29 April—5 days before the board meeting—rescinding the balance of his 5-year pledge effective immediately. It is crucial to an understanding of subsequent actions that the reader know that Getty’s unrestricted funding was withdrawn without warning or stated cause.

The board met on 3 May with the hope that Getty might reinstate his pledge, or at least provide transitional funding so that IHO could continue to operate normally through 1994. These hopes were dashed when Getty made the motion that two IHO staff members, Johanson and a respected geochronologist, be removed summarily, and that the board chairman step down.

The motion to cease operating the geochronology division (which had been part of IHO since 1985, not 1989, as reported by Gibbons) came only after repeated statements to Getty that the loss of such substantial funding without adequate time to seek alternative funding would make a reduction in staffing an economic necessity, and after he refused to continue his funding of IHO on an interim basis.

Getty’s attorney, William Coblentz, is quoted as saying, “Instead, we have more photo opportunities and NOVA interviews than pure research.” As founder and president of IHO, two of Johanson’s important functions are fund raising and public education. The NOVA film “In Search of Human Origins,” which was co-produced by IHO, was fully consistent with this role. The 1991 board meeting at which the NOVA project was first discussed featured discussion about the time commitment Johanson would need to make to the project; both Getty and Garniss Curtis were present, and no objections were raised by them then, or at any subsequent time. We are incredulous at the suggestion made by Coblentz that IHO, which is a recipient of American taxpayers’ dollars through NSF grants and operates for the public good with a tax-exempt status, should not be involved in educating the public about human evolution, especially through such important vehicles as public television. We wonder how many scientists and educators would agree with such sentiments in light of continuing attacks by creationists on the teaching of evolution in American public school science classes.

Furthermore, allegations of critics that Johanson was not involved enough in “pure research” are erroneous. He has co-led each of three IHO field expeditions to the Hadar fossil site in Ethiopia since 1990, co-authored a recent Nature paper on new hominid discoveries (1), and delivered a paper on these finds at a meeting of the American Association of Physical Anthropologists this past April. In fact, a research trip to Ethiopia scheduled for this month was postponed because of the withdrawal of Getty’s pledge and the need for Johanson to turn his immediate attention to fund raising. We leave it to the readers to judge whether it is Johanson’s record of research, or Getty’s interpretation of that record, that is wanting.

Gibbons’ article notes that “This should have been a banner year for the Institute of Human Origins . . . .” In fact, 1994 has been a banner year for IHO. We are confident that when we resolve these separation issues, IHO’s scientists and staff will be able to proceed with their work, and the achievements of the first half of 1994 will continue to provide the momentum that has brought so much good science to fruition.

Donald C. Johanson
Founder,
Institute of Human Origins,
2453 Ridge Road,
Berkeley, CA 94709, USA
Response: Characterizing my article as using "statements that are inaccurate" and "providing readers with a distorted picture" of the IHO schism is itself something of a distortion. My account of the IHO board meeting was confirmed before publication by several board members, and Johanson and Kimbel do not provide evidence of inaccuracy in my reporting of the dispute. Further, Johanson declined all requests for interviews while I was preparing the article for publication, and Kimbel also declined to discuss what occurred at the board meeting.

The fact that Getty sent the letter referred to by Johanson, Kimbel, and Shea on 29 April does not challenge the accuracy of my article. While Getty sent the letter, he also offered at the meeting to continue his funding—if the IHO board would meet his conditions. When the board refused, Getty withdrew his funding. And it was the IHO board that immediately voted to lay off the geochronology staff—even though Getty asked for that decision to be delayed 24 hours to try to find a way to ease the transition financially.

Johanson et al.'s second major point, objecting to the contention "that Johanson was not involved enough in 'pure research,'" refers to a statement by Getty's attorney, William Coblenz, indicating that Getty felt that Johanson was not spending enough time on basic research. The IHO's executive director, Susan Shea, responded to that charge in the article, mentioning, as do Johanson, Kimbel, and Shea in their letter, the recent Nature paper as evidence of Johanson's research activities.

---Ann Gibbons

The account of the rift between IHO director Donald Johanson and patron Gordon Getty suggests that there were a number of issues troubling the organization. It implies, however, that the major factor leading to Getty's withdrawal of support was the amount of time spent in recent years by Johanson in promoting paleoanthropology and human evolutionary studies to the public instead of focusing on pure research. Although the publication of two major papers, one establishing an entirely new time frame for Homo erectus and the other describing the long-sought skull of Australopithecus afarensis, suggests that research is
still a high-priority item at the institute, there can be little doubt that production of the recent NOVA series had to be an immensely time-consuming undertaking. But the result was a truly outstanding miniseries on human evolution and the processes of paleoanthropology. Many people watched it, and they will watch it again, where most will probably never read a book on the subject. We live in a society where knowledge of and acceptance of evolution is incredibly limited, and the assaults on it by the religious right and others are a constant and serious threat. Television is probably the most effective means of reaching a wide audience with an alternative message, and it would seem, therefore, that public education by any means ought to be an important part of the program of the IHO or of any institution dealing with this subject. We would all like an ivory tower where pure research is our only obligation. But this is clearly not feasible in a society where the anti-intellectual forces are so powerful. I simply do not see this as an issue open to criticism. As for the suggestion that Johanson should spend more time fund raising, I would ask where he could reach the greatest audience, in a number of lecture halls or in three programs on NOVA, one of the most popular series on public television.

If there are other ills that need to be set right at the IHO, then they should be addressed, but to run the entire organization onto the rocks over the issue of public education does not seem to me to be a reasonable way of setting things right.

Jack E. Smith
Park Archaeologist,
Mesa Verde National Park, CO 81330, USA

Corrections and Clarifications
In figure 3B (p. 1124) in the report "A molecular organic carbon isotope record of Miocene climate changes" by M. Schoell et al. (25 Feb., p. 1122), the extraneous upside-down "20" floating in white space under "8180" in the "Mixed" zone should not have appeared.

D. G. Rainnie et al., in their report "Adenosine inhibition of mesopontine cholinergic neurons: Implications for EEG arousal" (4 Feb., p. 689), suggested that adenosine may mediate sleep-debt related potentiation of EEG slow-wave activity in non-REM sleep. This is similar to a hypothesis proposed by J. H. Benington et al. ([Sleep Res. 22, 4 (1993)]. Rainnie et al. suggested that adenosine exerts this effect by means of inhibition of mesopontine cholinergic neurons rather than by direct inhibition of neurons in the cerebral cortex.
The logically harmonious thesis contained in this work will revolutionize our current way of thinking about human origins and behavior.

Ernst Mayr, Professor of Zoology, Emeritus, at Harvard University, considered by many to be the greatest evolutionist of the century, has written to the author: "...I am rather inclined to accept your thesis of the role of graincollecting in the history of mankind, persuaded by your arguments and those of others. Thank you very much for your interesting and closely argued book!"

How did bipedalism, the loss of body hair, and tool use originate? After more than 130 years of scientific research, the origin of these basic human characteristics is still unknown. Bipedalism, the loss of body hair, and tool use originated 14 million years ago, when our very distant ancestors, Ramapithecus, turned graincollectors. Errorneously, we still equate biological evolution with "progress", and therefore, believe humans descend from knuckle-walking, hairy, unskilled tool users who resembled the living great apes, when, in fact these apes descend from bipedal, naked, skilled tool users, who resemble modern man.

The large intestine, humans' largest internal organ, is presently used only to absorb water and electrolytes, although its sacculated nature indicates an evolutionary adaptation to digest cellulose. This intestine's movements are so slow that the first radiologist to observe it said it presented a picture of still life. Much of this inactivity can be attributed to mankind's omnivorous diet. Nonetheless, it follows that, when following an exclusively granivorous, cellulose-digesting diet, our large intestine proves to be much more useful and efficient, since our ancestors up to 50 thousand years ago always used it to digest cellulose fiber. We are presently neglecting a very useful capability that our ancestors adaptively acquired. Humans, as all other primates, were meant to be vegetarian cellulose-digesters and have slim bodies. The size of the human mouth is small for almost any type of omnivorous feeding, making this feature, as well as our powerful teeth, characteristic more of seed-eaters than of carnivorous or omnivorous mammals.

It is inconceivable to think that hominds and their protohominid ancestors lived in the savannas for millions of years and never developed the practice of feeding from gramineous seeds until the discovery of agriculture, or until fire was used to cook food. If we take into consideration that early hominds were already bipeds and tool users, and the seeds from grasses would lightly touch their hands as they walked in the long-grass grasslands, it would be illogical to assume that, in spite of the many vicissitudes they suffered during so many million years of living in the savannas, they never tried to feed from these seeds or that they never thought of removing the seeds with their hands. The author argues that when injuring themselves by removing the seeds, they used a natural small stone tool to protect their hands, which achieved an unanticipated advantage: they improved their efficiency in removing and threshing seeds.

We invite you to read this book and explore in it the scientific bases of these arguments, upholding the importance of the role of graincollecting in human evolution and behavior.

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Wide Spectrum Detection of Mycoplasmas: Eliminates detection failure in general by amplifying at least 12 species that include those frequently and mainly found in cell culture. They are 11 Mycoplasmas and 1 Ureaplasma: M. fermentans, M. hyorhinis, M. arginini, M. orale, M. salivarium, M. hominis, M. pulmonis, M. arthritidis, M. neurolyticum, M. hyopneumoniae, M. capricolum and U. urealyticum.

Synchro-Monitoring in PCR Amplification: Verifies and assures PCR performance. A positive control provided in the Set is a template that can be easily distinguished because it has a much longer spacer sequence than those of ordinary contaminants.

**Principle of Methodology**

![Diagram of PCR amplification process]

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Concurrent Sessions
M1 "New Methods of DNA-Based Diagnosis"
Dr. Stephen P.A. Fodor, Affymetrix, Inc.

M2 "Human Gene Identification"
Dr. Kay E. Davies, Institute of Molecular Medicine, University of Oxford

M3 "Social and Scientific Issues in Genetic Testing"
Dr. Nancy Wexler, Hereditary Disease Foundation

M4 "Gene Therapy"
Dr. Inder M. Verma, The Salk Institute

TUESDAY, OCTOBER 4

Plenary Session II: Development and Signal Transduction

Special Guest: Donna Shalala, U.S. Department of Health and Human Services

"MYOD & Myogenesis"
Dr. Harold Weintraub, Fred Hutchinson Cancer Research Center

"Genome Analysis in the Mouse"
Dr. Shirley M. Tilghman, Princeton University

"Fax: Genes for Mice and Men"
Dr. Peter Gruss, Max Planck Institute of Biophysical Chemistry, Germany

"From an Interferon Clone to the Regulation of Oncogenesis"
Dr. Tadatsugu Taniguchi, Institute for Molecular and Cellular Biology, Osaka University

"C. elegans Genome Project"
Dr. Richard Wilson, Washington University Medical School

"Small GTPases – Switching on Biological Responses"
Dr. Alan Hall, MRC Laboratory for Molecular Cell Biology, U.K.

Concurrent Sessions
T1 "Gene Targeting"
Dr. Elizabeth Robertson, Harvard University

T2 "Sequence to Function"
Dr. Temple F. Smith, Biomolecular Engineering Research Center, Boston University

WEDNESDAY, OCTOBER 5

Plenary Session III: Mapping

"Toward the Ultimate Generation of an Integrated Map of the Human Genome"
Dr. Daniel Cohen, C.E.P.H., France

"Application of High Resolution Genetic Maps to Studies of Common Disorders"
Dr. Jeffrey C. Murray, University of Iowa

"Yeast Genome Project"
Dr. André Golfeau, Université Catholique de Louvain, Unité de Biochimie Physiologique

"The Drosophila Genome Project – a Progress Report"
Dr. Gerald M. Rubin, University of California

"Status and Prospects for the Complete Human Genome Sequence"
Dr. Richard A. Gibbs, Baylor College of Medicine

"High Speed DNA Sequencing: Present and Future Technologies"
Dr. Lloyd M. Smith, University of Wisconsin

"Towards a Complete Set of Human Genes"
Dr. J. Craig Venter, The Institute for Genomic Research

Plenary Session IV: Mapping and Applications

"Vertically Integrated Mapping and Sequencing of Human DNA"
Dr. Maynard Olson, University of Washington School of Medicine

"Interpreting Genes and Genomes"
Dr. David J. Lipman, NIH, National Library of Medicine

"Some Applications of a Genome Library"
Dr. Melvin Simon, California Institute of Technology

"Huntington Disease"
Dr. James F. Gusella, Massachusetts General Hospital

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Dr. Svante Pääbo, Zoologisches Institut, Universität Munchen

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Clonetics announces the introduction of its new dermal microvascular endothelial cell system, EndoPack®-MVd. EndoPack®-MVd is a complete cell system containing cryopreserved cells, optimized low serum (5%) medium (EGM®-MV) and all the necessary reagents for subculture and propagation of the cells in vitro. This cell system is of great interest to researchers working in wound healing, inflammation and neo-vascularization in tumor growth. EndoPack®-MVd provides a state-of-the-art in vitro model directed at elucidating and controlling these processes.

Clonetics' EndoPack®-MVd is one of 15 complete normal human cell systems providing skin, vascular and airway cells. All systems are performance and virus tested. You may also purchase each component from any system separately. Clonetics also offers custom services including custom primary cell isolations and expansions and custom media formulations. For more information, in the US & Canada call

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