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An International Journal of Bioethics

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CONTRIBUTORS

Nigel M. de S. Cameron, PhD, chairs the Ethics and Medicine Trust and founded this journal in 1983. In addition to his work in ethics and public policy, as principal of Strategic Futures Group, LLC, he consults with non-profit organizations and colleges in strategic planning. He is Executive Chairman of the Centre for Bioethics and Public Policy (London), and Dean of the Wilberforce Forum (founded by Charles W. Colson, Reston, Virginia).

William P. Cheshire, MD, is Assistant Professor in the Department of Neurology at the Mayo Clinic in Jacksonville, Florida, USA.

Joel Goodnough, MD, is a gynecologist practicing in Arlington Heights, Illinois, USA.

Henk Jochemsen, PhD, is director of the Lindeboom Instituut for Medical Ethics and holder of the Lindeboom chair for Medical Ethics at the Free University of Amsterdam, The Netherlands.

Bill Joy, cofounder and Chief Scientist of Sun Microsystems, was co-chair of the presidential commission on the future of IT research, and is coauthor of The Java Language Specification. His work on the Jini pervasive computing technology was featured in WIRED 6.08. This article originally appeared in WIRED 8.04 and is reprinted here with permission.

Emmanuel O. Okoro teaches in the Department of Medicine and **Arthur E. Davies** teaches in the Department of Political Science at the University of Ilorin, Ilorin, Nigeria.

EDITORIAL

C. BEN MITCHELL

The January decision of the British House of Lords to allow human embryonic cloning coincided nicely with the publication of WIRED magazine's lead article predicting that someone will clone a human in the next twelve months. The decision by the House of Lords is troublesome in many ways. First, the Peers had the opportunity to postpone their decision in favor of establishing a select committee to assist in doing the ethical analysis warranted by such a momentous step. After all, some of the most respected voices in England, including Lady Warnock's, called for such a commission. Instead, the Lords rushed in where angels fear to tread. Even worse, the policy proposed by the House of Lords requires that any cloned human embryo would have to be destroyed by 14 days after the procedure. Mandatory destruction hardly seems a fitting end for a human being who entered this world at the will of human somatic cell nuclear manipulators.

The temptation to manipulate another human life is almost irresistible for some. University of Kentucky reproductive physiologist, Panos Zavos, announced on 26 January that he and an Italian colleague, Severino Antinori, have joined a global consortium which plans to produce the world's first cloned baby with the next one to two years. Some of his colleagues have labeled Zavos a 'medical cowboy'. Yet he and his collaborator doubtless believe they are more like a Lewis and Clark than a Butch Cassidy and Sundance Kid.

It hardly takes prognosticatory gifts to know that it is either the case that someone has already successfully cloned a human being or that a human clone is just around the corner. The near inevitability of cloning does not, however, make its imminence more welcome. We are exquisitely ill equipped morally to deal with the reality of a human clone in our midst.

He or she would first have to suffer the infamous notoriety of being born through human somatic cell nuclear transfer. Next, his or her future would be shaped by someone else's past. That is to say, those who reared the clone would, no doubt, want to duplicate the environment of the donor as much as possible. Otherwise the experiment would be less likely to produce an identical replica of the original, since everyone knows environment is as important as inheritance. So much for that celebrated quality called human freedom. Furthermore, proprietary interests would be at stake. Who owns a clone? The cloned, the clone, or the cloner? In the commodified world of biotechnology, the one with the most investment money is likely to win. So, obviously, the cloner would own the clone.

Prospective parents might be able to purchase a clone, but the market would determine the selling price. Will the price be set in pounds, dollars, Euros, or yen?

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If there ever were an appropriate time to clone a human being (and there is not), this is not that time. The genesis of the 21st century is a period of unequaled technological prowess combined with unparalleled moral vacuity, especially when it comes to judging who counts in the moral equation. Do clones count as persons? On what moral basis could one make such a judgement? On what moral ground could one deny the personhood of a cloned human? When does protectable personhood obtain? How does one avoid being arbitrary in determining personhood? Until these questions are answered thoroughly and satisfactorily, cloning a human being either ought to be forthrightly banned or effectively postponed in order to engage in a now global debate about the morality of human cloning. Critics of such a proposal would say that the debate would prove intractable. Perhaps that fact alone is a necessary and sufficient reason to prohibit cloning a human being in the next twelve months, twenty four months, or forever. E&M

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GUEST EDITORIAL

NIGEL M DE S CAMERON, FOUNDING EDITOR

When this journal first saw the light of day in the early 1980s the very notion of 'bioethics' was still new, especially in Europe. An American invention, even today it faces deep-seated professionalism as the primary European context for its issues (so, for example, two sponsors of this journal, The Centre for Bioethics and Public Policy and The Lindeboom Instituut, are members of the deliberately named 'European Association of Centres of Medical Ethics'). The idea that the fundamental questions raised in medicine and the biosciences could be torn from their Judeo-Christian and Hippocratic cultural-professional contexts and incubated *in vitro,* as it were, on the lab bench of arid contemporary philosophy, sits uneasily with the strong public European traditions of professionalism and the Christian faith.

Ethics and Medicine originated in that milieu, and its peculiar contribution as a truly international journal (with its principal readership divided almost equally between the US, the UK, and continental Europe) lies precisely here: in calling contemporary bioethics/medical ethics back to its sources in the humane medical traditions of our civilisation. That is done partly because only here do we find coherence with that civilisation and its distinctive beliefs and moral vision. The idea that 'values' can be deciphered from the *tabula rasa* of human autonomy is a claim deserving of the myth of the emperor's new clothes. Moreover, this approach derives specifically from the deep Judeo-Christian roots of our culture, which blend with the best of the pagan culture of late antique Greece and Rome to form the amalgam of 'the west', with its unique (even if not uniquely good) role in the cultural leadership of our increasingly global community. Christians, Jews, and Muslims can rally around the Hippocratic flag, and be joined by Buddhists, Sikhs, and those of many other religious traditions, as well as humane secularists who hold dear the common morality of our culture. For many of us, Judeo-Christian moral leadership still offers the best hope of cultural renewal in the disenchanted and increasingly degraded societies that are the hapless legatees of Christendom.

This new-look *Ethics and Medicine* will therefore continue to offer vigorous contributions to this central debate, and to do so from the perspective of the best in our medical-cultural heritage. As the lead essay in this issue makes very clear, the stakes are being raised as every day passes. While the 'old' issues of abortion and euthanasia continue to press us with their life-or-death choices (underlined by the recent Dutch decision, noted elsewhere in this issue, finally to sanction medical killing after years of indecision and doublespeak, and the UK government's enthusiasm to extend the abuse of the human embryo), the 'new' issues

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that encompass nanotechnology and genetics and much else transcend these common- or garden-threats to human dignity with exotic new possibilities.

This journal has from its beginnings sought to set every question in the context of the biggest picture-the significance of medicine and its technological options for human being, the dignity of those who have been held within the western tradition to be made in the image of God himself. As we move with this issue into the third millennium *anno domini,* the task we face is huge: to harness these exponential capacities of human power to the good of the species. It is our confident belief that within the framework of Christian Hippocratism lies humanity's best hope for professional medicine and the development of the biosciences in the interests of *Homo sapiens.* E&M

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UPDATE: THE LEGALIZATION OF EUTHANASIA IN THE NETHERLANDS

HENK JOCHEMSEN, PHD

On 28 November 2000, the Second Chamber of the Dutch parliament accepted the proposal for law regarding legalization of voluntary euthanasia and assisted suicide.[1] The proposal will now go to the First Chamber which will probably discuss it early 2001. It will only become effective after the First Chamber has also accepted it. This law proposal implies a significant step further on the way of accepting euthanasia as part of medical practice.

A fundamental step in the beginning of this process was the decision of the Supreme Court (in 1984) that a physician who has committed euthanasia can, in cases of an objectively established 'conflict of duties', appeal to a defense of 'necessity' (Penal Code art. 40). This conflict concerns on the one hand the duty to obey the law that forbids euthanasia and assisted suicide (Penal Code art. 293, 294), and on the other hand to alleviate suffering. The government approved the Supreme Court's decision, thereby accepting euthanasia under certain circumstances.[2] The conditions establishing a 'conflict of duties' were essentially: a free, well-considered request, unacceptable suffering with no other reasonable possibilities to alleviate the suffering, and consultation of the physician by a colleague.[3]

In 1991 the government proposed a new legal regulation on the basis of the courts' decisions. The prohibition of euthanasia and assisted suicide was maintained in the Penal Code. At the same time the procedure by which physicians *report* death in cases of euthanasia, assisted suicide and life-terminating actions without an explicit request, was given a statutory basis by amending the law on the Disposal of the Dead.[4] According to this procedure, a physician who has terminated a patient's life informs the local medical examiner, who inspects the body externally and takes from the attending physician a statement which contains the relevant data (the patient's history, request, possible alternatives, consultation with a second physician, intervention). This report, together with an evaluation by the local medical examiner, is checked by the Public Prosecutor who considers if the termination of the patient's life was contrary to the Penal Code as interpreted by the courts. So, to the conditions mentioned above was added the requirement of reporting each case of euthanasia, assisted suicide and life terminating action without an explicit request.

Surveys

In 1990, and again in 1995, extensive surveys were carried out by P. J. van der Maas et al and G. van der Wal and P. J. van der Maas respectively, to get an

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insight into end-of-life decision-making by Dutch doctors. The results were published in 1991[5] and 1996[6]. The second survey sought particularly to ascertain the incidence of intentional life-shortening by doctors; the extent to which they complied with their duty to report such cases and the quality of their reporting. Some of the main results (of the 1995 survey) are:

1) Euthanasia or assisted suicide was performed in 3600 cases (of 9700 requests for euthanasia). The main reason why physicians did not comply with a request for euthanasia is that in their opinion the suffering was not yet unbearable. On the other hand, in 900 cases physicians terminated the life of a patient without an explicit request because in their opinion the condition of the patient was unbearable.

2) In 2000 cases the physician increases the pain medication with the explicit intention to shorten the life of the patient; in about 25% of these cases there was no explicit request of the patient to do so. In at least 14000 cases a treatment was withdrawn with the explicit intention to shorten the patient's life.

3) In 17% of the cases of euthanasia and of life termination without explicit request the physician still saw other medical possibilities to alleviate the suffering, but nevertheless intentionally ended the patient's life.

4) In a considerable part of the cases physicians do not adequately consult a colleague. Furthermore, physicians reported only 44% of the cases of euthanasia (18% in 1990) and virtually no cases of life termination without an explicit request. The legal authorities were not informed at all about the non-reported cases.

From these data I draw the following conclusions:

a) In practice it really is the physicians who decide whether in a certain situation the patient's life is ended and not so much the patient, although the physician is more inclined to do so when the patient persistently asks for it.

b) Life terminating actions are not merely used as last resort.

c) Adequate control of life terminating actions of physicians appears to be impossible, because contrary to the legal requirements the physicians do not report most of the cases of such actions. So, the legal regulation of 1994 has provided a kind of legitimation to physicians to end patients' lives, while the procedure to control this practice does not function well.

A New Procedure

In 1998, the Parliament accepted a new regulation of euthanasia reporting that became effective on November 1, 1998.[7,8] This did not imply a change of the

Penal Code prohibition of euthanasia, but a change of the procedure by which euthanasia should be reported. According to the new procedure, the report of every euthanasia case as well as the filled out form of the medical examiner, should no longer be sent directly to the public prosecutor, but should be sent to one of five regional euthanasia review committees. This committee, consisting of a physician, a lawyer, and an ethicist, should evaluate the case in the light of the courts' decisions on life-terminating actions thus far. The committee's opinion on the case is sent to the public prosecutor, together with the reports of the attending physician and of the medical examiner. The prosecutor has the freedom and duty to form his own opinion on the case, but the opinion of the committee will be of major importance in the decision of the prosecutor to prosecute or not.

Since in this procedure the legal authorities find themselves at larger distance from the euthanising physician, the government hopes that a higher percentage of cases will be reported. However, the first year report of these review committees indicate that so far this new procedure has not resulted in a substantial increase of the number of reported cases.[9] Furthermore, this report indicates that in the reported cases the information of the attending physician on the existence of alternatives and on the quality of the consultation was not always sufficient. In some cases additional information was requested from the physician. Ultimately in all cases the euthanasia or assisted suicide was approved by the committee concerned.

The New Proposal for Law

The proposal accepted by the Second Chamber essentially contains the following provisions:

1) In order to be deemed legal, acts of euthanasia must be performed according to 'careful medical practice.' Requests for euthanasia must be voluntary, well-considered, and persistent, and be made by patients who are experiencing unbearable suffering without hope of improvement. More than one physician must be involved in the decision, and both patient and physician must agree that euthanasia is the only reasonable option.

2) All cases of euthanasia must be reported to and evaluated by one of the regional committees, composed of a lawyer, physician, and ethicist /philosopher (for each one there is a deputy member).

3) Acts of euthanasia and assisted suicide will not be punishable if performed by a physician who has complied with the conditions in (1) and has reported the action to the coroner.

4) The coroner attending to a euthanasia case must send his or her report to the Public Prosecutor, as well as to the corresponding regional euthanasia committee. The report must demonstrate that all the requirements for legal euthanasia have been observed. In the event of severe infraction, the Prosecutor will not give consent for burial or cremation until further investigations have been conducted.

5) Also minors between the age of 12 and 16 can have euthanasia or assisted suicide provided their parents consent to it. (In response to critical questions by members of parliament the Cabinet dropped the provision that euthanasia requests of minors between 12 and 16 years in exceptional cases could be granted without the parents' consent.)

6) The proposal also establishes a legal basis for advance euthanasia declarations via a type of 'living will' in which an incompetent patient would request euthanasia in the event he or she became mentally incompetent. Though such a statement does not imply that a physician has a duty to perform euthanasia at any moment, it provides the legal opening to intentionally end the life of an incompetent patient who had signed such a document.

Improvement?

Would the Bill, if enacted, be likely to ensure effective control of voluntary euthanasia? The acceptance of this Bill would not imply a major change in the requirements and circumstances under which euthanasia will be approved. But it can be interpreted as a further acceptance and institutionalization of euthanasia in society. The relaxation of the reporting procedure by the introduction of interdisciplinary committees as a buffer between the doctor and prosecutor, as well as the enactment of the Bill, which would remove any remaining doubts about the legal permissibility of voluntary euthanasia, may lessen the fear of prosecution and encourage reporting. Yet it is doubtful whether this regulation would lead to a far higher reporting rate of euthanasia and assisted suicide. Also under the new legislation euthanasia will be allowed only under certain conditions and circumstances. When the physician has not fulfilled the requirements, the case has to be investigated and possibly brought before court. Hence, in the light of the data of the surveys it is to be expected that precisely those cases in which the requirements have not been fulfilled, will still not be reported.

Furthermore, the legal approach will be different. So far euthanasia is prohibited in the Penal Code and in individual cases the physician must be able to prove that he fulfilled the requirements in order to successfully appeal to the defense of necessity. But under the proposed regulation of euthanasia in the Penal Code the public prosecutor must be able to prove that the physician has *not* fulfilled requirements in order to start prosecution. So the burden of proof will be shifted from the physician to the prosecutor. This may be a reason for public prosecutors to forego prosecution in doubtful cases in which they foresee difficulty in proving noncompliance with the requirements. Therefore, effective control and prosecution of unacceptable euthanasia will probably become even more difficult.

Objections

A number of objections can be raised against this ominous proposal for legalizing euthanasia. First, summarizing the former section, the proposal does not adequately safeguard the public. The depenalization of intentional killing by

physicians constitutes, in itself, a serious violation of the legal protection of the life of all citizens. Moreover, whenever the committee rules favorably on a case by deeming an act of killing legal, the Public Prosecutor's ability to monitor physician conduct will be compromised because the Prosecutor will not even see the report of the physician involved in the case. Furthermore, it is likely that cases in which the legal requirements have not been fulfilled will go unreported, as is the case now. Data on reported cases are provided by the physician who performed the euthanasia; therefore, determinations of whether the legal requirements have been met, may very often be biased as well. Adequate control will continue to be impossible.

Second, once euthanasia becomes a legal option, a patient afflicted with terminal illness or unbearable suffering may have to justify not asking to be euthanized. The recent case of Mr Brongersma demonstrates the elasticity of the requirement of unbearable suffering, implying that a substantial group of people could become vulnerable to such pressure.[10] At the same time, legalization will tend to undermine the efforts and creativity of those committed to providing palliative care to a terminal patient. Such unintended outcomes seem inevitable in a health care system characterized by increasing costs and the need to make choices regarding resource allocation.

Third, this legalization of euthanasia will lead to a broader acceptance and increased practice of euthanasia, which will change the nature of the patient-physician relationship as well as the character of terminal palliative care. The acceptance of euthanasia as a treatment option is incompatible with the fundamental role of the physician as healer who is unconditionally devoted to respect for the life of his patients. Since the physician's role and the extent of his or her competence is regulated by law, such a fundamental change in the physician's competence concerns society as a whole and cannot be considered as a private matter for patients and physicians.

Fourth, accepting the euthanasia of minors 12 years of age and older seriously overestimates the capacity of such persons to evaluate the meaning and consequences of a request to be killed. It places an unacceptable burden on these young people and may well disturb society's confidence in the relationship between physicians, parents and children. Unless we are prepared to give minors the right to do everything else in life that an adult can do, giving them the right to end life itself seems out of place.

Fifth, legalizing the euthanasia declaration designed to permit a competent patient to request euthanasia in advance, should he or she later become incompetent, is likely to foster a broadening of the requirement of 'unbearable suffering' to 'loss of dignity'. Furthermore it is likely to increase the pressure on the physician to terminate a patient's life when a patient has become severely demented, especially when the patient's family insists on doing that. Such a practice may likely lead to a blurring of the distinction between voluntary and non-voluntary euthanasia. It is no wonder that the Dutch Association of Nursing Care Physicians has voiced their unhappiness with this part of the proposal.

Finally, although the responsible ministers have admitted during the debate in parliament that a physician who does not want to perform euthanasia to a patient insisting on having it, is not obliged to formally refer to a colleague who may be willing to do so, in practice physicians will feel pressured to either perform euthanasia themselves or refer to a colleague. If they refuse both they may run into trouble unless they have indicated in an early stage of the terminal phase of the disease that they object to performing euthanasia. Furthermore, health care professionals who reject euthanasia will likely find it difficult to obtain jobs in certain areas of the health care field. E&M

Endnotes

[1] In The Netherlands euthanasia is by definition voluntary euthanasia; non voluntary euthanasia is called 'termination of life without a request'; no fundamental legal and ethical difference is made between euthanasia and physician-assisted suicide.

[2] Standpunt van het Kabinet inzake medische beslissingen rond het levenseinde [Position of the Cabinet with respect to 'Euthanasia and other medical decisions concerning the end of life'] (Tweede Kamer 1991-1992, no. 14, d.d. 8 november 1991). In this position paper in which the Cabinet announces a proposal to change the law, it refers both to the Supreme Court's decision of 1984 and to the report of the Remmelink committee that is based on the results of the first survey of the practice of euthanasia (see further).

[3] WR Kastelein. *Standpunt hoofdbestuur KNMG inzake euthanasie,* [Position General Committee KNMG on Euthanasia]. Utrecht, august 1995.

[4] The new legal regulation (bill no. 22 572) amends the law on the Disposal of the Dead (article 10) which provides the legal basis for a form used by physicians to certify natural death. The law as amended provides that both the form to certify natural death and the form to notify all cases of euthanasia, assisted suicide and a life-terminating action without request will be set out in an enactment ['Algemene Maatregel van Bestuur', AMvB]. This AMvB has been published in the Staatsblad [official publication of the government] of 28 Dec 1993, as: *Besluit van 17 Dec 1993, Stb 688.* This law became formally effective on June 1, 1994.

[5] Van der Maas PJ, et al. *Medische beslissingen rond het levenseinde.* Den Haag: SDU Uitgeverij 1991. (Published in translation as Euthanasia and Other Medical Decisions Concerning the End of Life. Amsterdam: Elsevier 1992.

[6] Van der Wal G, Van der Maas PJ et al. *Euthanasie en andere medische beslissingen rond het levenseinde.* De praktijk en de meldingsprocedure. [Euthanasia and other medical decisions concerning the end of life. Practice and reporting procedure.] Den Haag: SDU uitgevers 1996. For summaries of the research in English see: Paul J van der Maas. Euthanasia, physician-assisted suicide, and other medical practices involving the end of life in the Netherlands 1990-1995. *New England Journal of Medicine* 335 (1996), p.1699; Gerrit van der Wal. Evaluation of the notification procedure for physician-assisted death in the Netherlands. *Ibid,* p.1706.

[7] These changes are announced and described in: Kabinetsstandpunt naar aanleiding van de evaluatie van de meldingsprocedure euthanasie. *Brief van Minister van Justitie en van de Minister van Volksgezondheid, Welzijn en Sport aan de Tweede Kamer, d.d. 21 januari 1997 (kenmerk 603400/97/6). [Position of Cabinet with respect to evaluation of reporting procedure of euthanasia. Letter of Ministers of Justice and of Health, Welfare and Sports, d.d. January 21, 1997].*

[8] *Staatscourant 1998,* 101 and 103.

[9] Regionale toetsingscommissies euthanasie. *Jaarverslag 1999.* [Regional euthanasia review commitees. *Year report 1999*]. Den Haag 1999, p. 8ff. This report indicates that in 1999, 2216 cases of euthanasia or assisted suicide were reported, whereas in 1998 2241 cases were reported. (Jaarverslag Openbaar Ministerie 1998 inzake euthanasie en hulp bij zelfdoding. *ProVita Humana* 7, no 1 (2000), p. 34.

[10] Brongersma was an 86 year old person who wanted and received help in committing suicide because he felt his life had become meaningless and too heavy a burden. The physician was quitted by the court; see BMJ 2000; 321: p. 1174.

Henk Jochemsen, PhD is director of the Lindeboom Instituut for Medical Ethics and holder of the Lindeboom chair for Medical Ethics at the Free University of Amsterdam, The Netherlands.

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WHY THE FUTURE DOESN'T NEED US

BILL JOY

From the moment I became involved in the creation of new technologies, their ethical dimensions have concerned me, but it was only in the autumn of 1998 that I became anxiously aware of how great are the dangers facing us in the 21st century. I can date the onset of my unease to the day I met Ray Kurzweil, the deservedly famous inventor of the first reading machine for the blind and many other amazing things.

Ray and I were both speakers at George Gilder's Telecosm conference, and I encountered him by chance in the bar of the hotel after both our sessions were over. I was sitting with John Searle, a Berkeley philosopher who studies consciousness. While we were talking, Ray approached and a conversation began, the subject of which haunts me to this day.

I had missed Ray's talk and the subsequent panel that Ray and John had been on, and they now picked right up where they'd left off, with Ray saying that the rate of improvement of technology was going to accelerate and that we were going to become robots or fuse with robots or something like that, and John countering that this couldn't happen, because the robots couldn't be conscious.

While I had heard such talk before, I had always felt sentient robots were in the realm of science fiction. But now, from someone I respected, I was hearing a strong argument that they were a near-term possibility. I was taken aback, especially given Ray's proven ability to imagine and create the future. I already knew that new technologies like genetic engineering and nanotechnology were giving us the power to remake the world, but a realistic and imminent scenario for intelligent robots surprised me.

It's easy to get jaded about such breakthroughs. We hear in the news almost every day of some kind of technological or scientific advance. Yet this was no ordinary prediction. In the hotel bar, Ray gave me a partial preprint of his then-forthcoming book *The Age of Spiritual Machines,* which outlined a utopia he foresaw – one in which humans gained near immortality by becoming one with robotic technology. On reading it, my sense of unease only intensified; I felt sure he had to be understating the dangers, understating the probability of a bad outcome along this path.

I found myself most troubled by a passage detailing adystopian scenario:

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The New Luddite Challenge

First let us postulate that the computer scientists succeed in developing intelligent machines that can do all things better than human beings can do them. In that case presumably all work will be done by vast, highly organized systems of machines and no human effort will be necessary. Either of two cases might occur. The machines might be permitted to make all of their own decisions without human oversight, or else human control over the machines might be retained.

If the machines are permitted to make all their own decisions, we can't make any conjectures as to the results, because it is impossible to guess how such machines might behave. We only point out that the fate of the human race would be at the mercy of the machines. It might be argued that the human race would never be foolish enough to hand over all the power to the machines. But we are suggesting neither that the human race would voluntarily turn power over to the machines nor that the machines would willfully seize power. What we do suggest is that the human race might easily permit itself to drift into a position of such dependence on the machines that it would have no practical choice but to accept all of the machines' decisions. As society and the problems that face it become more and more complex and machines become more and more intelligent, people will let machines make more of their decisions for them, simply because machine-made decisions will bring better results than man-made ones. Eventually a stage may be reached at which the decisions necessary to keep the system running will be so complex that human beings will be incapable of making them intelligently. At that stage the machines will be in effective control. People won't be able to just turn the machines off, because they will be so dependent on them that turning them off would amount to suicide.

On the other hand it is possible that human control over the machines may be retained. In that case the average man may have control over certain private machines of his own, such as his car or his personal computer, but control over large systems of machines will be in the hands of a tiny elite - just as it is today, but with two differences. Due to improved techniques the elite will have greater control over the masses; and because human work will no longer be necessary the masses will be superfluous, a useless burden on the system. If the elite is ruthless they may simply decide to exterminate the mass of humanity. If they are humane they may use propaganda or other psychological or biological techniques to reduce the birth rate until the mass of humanity becomes extinct, leaving the world to the elite. Or, if the elite consists of soft-hearted liberals, they may decide to play the role of good shepherds to the rest of the human race. They will see to it that everyone's physical needs are satisfied, that all children are raised under psychologically hygienic conditions, that everyone has a wholesome hobby to keep him busy, and that anyone who may become dissatisfied undergoes "treatment" to cure his "problem." Of course, life will be so purposeless that people will have to be biologically or psychologically engineered either to remove their need for the power process or make them "sublimate" their drive for power into some harmless hobby. These engineered human beings may be happy in such a society, but they will most certainly not be free. They will have been reduced to the status of domestic animals.[1]

In the book, you don't discover until you turn the page that the author of this passage is Theodore Kaczynski-the Unabomber. I am no apologist for Kaczynski. His bombs killed three people during a 17-year terror campaign and wounded many others. One of his bombs gravely injured my friend David Gelernter, one of the most brilliant and visionary computer scientists of our time. Like many of my colleagues, I felt that I could easily have been the Unabomber's next target. Kaczynski's actions were murderous and, in my view, criminally insane. He is clearly a Luddite, but simply saying this does not dismiss his argument; as difficult as it is for me to acknowledge, I saw some merit in the reasoning in this single passage. I felt compelled to confront it.

Kaczynski's dystopian vision describes unintended consequences, a well-known problem with the design and use of technology, and one that is clearly related to Murphy's law - "Anything that can go wrong, will." (Actually, this is Finagle's law, which in itself shows that Finagle was right.) Our overuse of antibiotics has led to what may be the biggest such problem so far: the emergence of antibiotic-resistant and much more dangerous bacteria. Similar things happened when attempts to eliminate malarial mosquitoes using DDT caused them to acquire DDT resistance; malarial parasites likewise acquired multi-drug-resistant genes.[2]

The cause of many such surprises seems clear: The systems involved are complex, involving interaction among and feedback between many parts. Any changes to such a system will cascade in ways that are difficult to predict; this is especially true when human actions are involved.

I started showing friends the Kaczynski quote from *The Age of Spiritual Machines;* I would hand them Kurzweil's book, let them read the quote, and then watch their reaction as they discovered who had written it. At around the same time, I found Hans Moravec's book Robot: Mere Machine to Transcendent Mind. Moravec is one of the leaders in robotics research, and was a founder of the world's largest robotics research program, at Carnegie Mellon University. Robot gave me more material to try out on my friends - material surprisingly supportive of Kaczynski's argument. For example:

> The Short Run (Early 2000s)
>
> Biological species almost never survive encounters with superior competitors. Ten million years ago, a sunken Panama isthmus separated South and North America. South America, like Australia today, was populated by marsupial mammals, including pouched equivalents of rats, deers, and tigers. When the isthmus connecting North and South America rose, it took only a few thousand years for the northern placental species, with slightly more effective metabolisms and reproductive and nervous systems, to displace and eliminate almost all the southern marsupials.
>
> In a completely free marketplace, superior robots would surely affect humans as North American placentals affected South American marsupials

> (and as humans have affected countless species). Robotic industries would compete vigorously among themselves for matter, energy, and space, incidentally driving their price beyond human reach. Unable to afford the necessities of life, biological humans would be squeezed out of existence.
>
> There is probably some breathing room, because we do not live in a completely free marketplace. Government coerces nonmarket behavior, especially by collecting taxes. Judiciously applied, governmental coercion could support human populations in high style on the fruits of robot labor, perhaps for a long while.

A textbook dystopia-and Moravec is just getting wound up. He goes on to discuss how our main job in the 21st century will be "ensuring continued cooperation from the robot industries" by passing laws decreeing that they be "nice,"[3] and to describe how seriously dangerous a human can be "once transformed into an unbounded superintelligent robot." Moravec's view is that the robots will eventually succeed us – that humans clearly face extinction.

I decided it was time to talk to my friend Danny Hillis. Danny became famous as the cofounder of Thinking Machines Corporation, which built a very powerful parallel supercomputer. Despite my current job title of Chief Scientist at Sun Microsystems, I am more a computer architect than a scientist, and I respect Danny's knowledge of the information and physical sciences more than that of any other single person I know. Danny is also a highly regarded futurist who thinks long-term – four years ago he started the Long Now Foundation, which is building a clock designed to last 10,000 years, in an attempt to draw attention to the pitifully short attention span of our society. (See "Test of Time," Wired 8.03, page 78.)

So I flew to Los Angeles for the express purpose of having dinner with Danny and his wife, Pati. I went through my now-familiar routine, trotting out the ideas and passages that I found so disturbing. Danny's answer – directed specifically at Kurzweil's scenario of humans merging with robots – came swiftly, and quite surprised me. He said, simply, that the changes would come gradually, and that we would get used to them.

But I guess I wasn't totally surprised. I had seen a quote from Danny in Kurzweil's book in which he said, "I'm as fond of my body as anyone, but if I can be 200 with a body of silicon, I'll take it." It seemed that he was at peace with this process and its attendant risks, while I was not.

While talking and thinking about Kurzweil, Kaczynski, and Moravec, I suddenly remembered a novel I had read almost 20 years ago – *The White Plague,* by Frank Herbert - in which a molecular biologist is driven insane by the senseless murder of his family. To seek revenge he constructs and disseminates a new and highly contagious plague that kills widely but selectively. (We're lucky Kaczynski was a mathematician, not a molecular biologist.) I was also reminded of the Borg of Star Trek, a hive of partly biological, partly robotic creatures with

a strong destructive streak. Borg-like disasters are a staple of science fiction, so why hadn't I been more concerned about such robotic dystopias earlier? Why weren't other people more concerned about these nightmarish scenarios?

Part of the answer certainly lies in our attitude toward the new – in our bias toward instant familiarity and unquestioning acceptance. Accustomed to living with almost routine scientific breakthroughs, we have yet to come to terms with the fact that the most compelling 21st-century technologies – robotics, genetic engineering, and nanotechnology – pose a different threat than the technologies that have come before. Specifically, robots, engineered organisms, and nanobots share a dangerous amplifying factor: They can self-replicate. A bomb is blown up only once – but one bot can become many, and quickly get out of control.

Much of my work over the past 25 years has been on computer networking, where the sending and receiving of messages creates the opportunity for out-of-control replication. But while replication in a computer or a computer network can be a nuisance, at worst it disables a machine or takes down a network or network service. Uncontrolled self-replication in these newer technologies runs a much greater risk: a risk of substantial damage in the physical world.

Each of these technologies also offers untold promise: The vision of near immortality that Kurzweil sees in his robot dreams drives us forward; genetic engineering may soon provide treatments, if not outright cures, for most diseases; and nanotechnology and nanomedicine can address yet more ills. Together they could significantly extend our average life span and improve the quality of our lives. Yet, with each of these technologies, a sequence of small, individually sensible advances leads to an accumulation of great power and, concomitantly, great danger.

What was different in the 20th century? Certainly, the technologies underlying the weapons of mass destruction (WMD) – nuclear, biological, and chemical (NBC) – were powerful, and the weapons an enormous threat. But building nuclear weapons required, at least for a time, access to both rare - indeed, effectively unavailable - raw materials and highly protected information; biological and chemical weapons programs also tended to require large-scale activities.

The 21st-century technologies – genetics, nanotechnology, and robotics (GNR) – are so powerful that they can spawn whole new classes of accidents and abuses. Most dangerously, for the first time, these accidents and abuses are widely within the reach of individuals or small groups. They will not require large facilities or rare raw materials. Knowledge alone will enable the use of them.

Thus we have the possibility not just of weapons of mass destruction but of knowledge-enabled mass destruction (KMD), this destructiveness hugely amplified by the power of self-replication.

I think it is no exaggeration to say we are on the cusp of the further perfection of extreme evil, an evil whose possibility spreads well beyond that which weapons of mass destruction bequeathed to the nation-states, on to a surprising and terrible empowerment of extreme individuals.

Nothing about the way I got involved with computers suggested to me that I was going to be facing these kinds of issues.

My life has been driven by a deep need to ask questions and find answers. When I was 3, I was already reading, so my father took me to the elementary school, where I sat on the principal's lap and read him a story. I started school early, later skipped a grade, and escaped into books - I was incredibly motivated to learn. I asked lots of questions, often driving adults to distraction.

As a teenager I was very interested in science and technology. I wanted to be a ham radio operator but didn't have the money to buy the equipment. Ham radio was the Internet of its time: very addictive, and quite solitary. Money issues aside, my mother put her foot down - I was not to be a ham; I was antisocial enough already.

I may not have had many close friends, but I was awash in ideas. By high school, I had discovered the great science fiction writers. I remember especially Heinlein's *Have Spacesuit Will Travel* and Asimov's *I, Robot,* with its Three Laws of Robotics. I was enchanted by the descriptions of space travel, and wanted to have a telescope to look at the stars; since I had no money to buy or make one, I checked books on telescope-making out of the library and read about making them instead. I soared in my imagination.

Thursday nights my parents went bowling, and we kids stayed home alone. It was the night of Gene Roddenberry's original *Star Trek,* and the program made a big impression on me. I came to accept its notion that humans had a future in space, Western-style, with big heroes and adventures. Roddenberry's vision of the centuries to come was one with strong moral values, embodied in codes like the Prime Directive: to not interfere in the development of less technologically advanced civilizations. This had an incredible appeal to me; ethical humans, not robots, dominated this future, and I took Roddenberry's dream as part of my own.

I excelled in mathematics in high school, and when I went to the University of Michigan as an undergraduate engineering student I took the advanced curriculum of the mathematics majors. Solving math problems was an exciting challenge, but when I discovered computers I found something much more interesting: a machine into which you could put a program that attempted to solve a problem, after which the machine quickly checked the solution. The computer had a clear notion of correct and incorrect, true and false. Were my ideas correct? The machine could tell me. This was very seductive.

I was lucky enough to get a job programming early supercomputers and discovered the amazing power of large machines to numerically simulate advanced designs. When I went to graduate school at UC Berkeley in the mid-1970s, I started staying up late, often all night, inventing new worlds inside the machines. Solving problems. Writing the code that argued so strongly to be written.

In *The Agony and the Ecstasy,* Irving Stone's biographical novel of Michelangelo, Stone described vividly how Michelangelo released the statues from the stone, "breaking the marble spell," carving from the images in his mind.[4] In my most ecstatic moments, the software in the computer emerged in the same way. Once I had imagined it in my mind I felt that it was already there in the machine, waiting to be released. Staying up all night seemed a small price to pay to free it – to give the ideas concrete form.

After a few years at Berkeley I started to send out some of the software I had written - an instructional Pascal system, Unix utilities, and a text editor called vi (which is still, to my surprise, widely used more than 20 years later) - to others who had similar small PDP-11 and VAX minicomputers. These adventures in software eventually turned into the Berkeley version of the Unix operating system, which became a personal "success disaster" – so many people wanted it that I never finished my PhD. Instead I got a job working for Darpa putting Berkeley Unix on the Internet and fixing it to be reliable and to run large research applications well. This was all great fun and very rewarding. And, frankly, I saw no robots here, or anywhere near.

Still, by the early 1980s, I was drowning. The Unix releases were very successful, and my little project of one soon had money and some staff, but the problem at Berkeley was always office space rather than money - there wasn't room for the help the project needed, so when the other founders of Sun Microsystems showed up I jumped at the chance to join them. At Sun, the long hours continued into the early days of workstations and personal computers, and I have enjoyed participating in the creation of advanced microprocessor technologies and Internet technologies such as Java and Jini.

From all this, I trust it is clear that I am not a Luddite. I have always, rather, had a strong belief in the value of the scientific search for truth and in the ability of great engineering to bring material progress. The Industrial Revolution has immeasurably improved everyone's life over the last couple hundred years, and I always expected my career to involve the building of worthwhile solutions to real problems, one problem at a time.

I have not been disappointed. My work has had more impact than I had ever hoped for and has been more widely used than I could have reasonably expected. I have spent the last 20 years still trying to figure out how to make computers as reliable as I want them to be (they are not nearly there yet) and how to make them simple to use (a goal that has met with even less relative success). Despite some progress, the problems that remain seem even more daunting.

But while I was aware of the moral dilemmas surrounding technology's consequences in fields like weapons research, I did not expect that I would confront such issues in my own field, or at least not so soon.

Perhaps it is always hard to see the bigger impact while you are in the vortex of a change. Failing to understand the consequences of our inventions while we are in the rapture of discovery and innovation seems to be a common fault of

scientists and technologists; we have long been driven by the overarching desire to know that is the nature of science's quest, not stopping to notice that the progress to newer and more powerful technologies can take on a life of its own.

I have long realized that the big advances in information technology come not from the work of computer scientists, computer architects, or electrical engineers, but from that of physical scientists. The physicists Stephen Wolfram and Brosl Hasslacher introduced me, in the early 1980s, to chaos theory and nonlinear systems. In the 1990s, I learned about complex systems from conversations with Danny Hillis, the biologist Stuart Kauffman, the Nobel-laureate physicist Murray Gell-Mann, and others. Most recently, Hasslacher and the electrical engineer and device physicist Mark Reed have been giving me insight into the incredible possibilities of molecular electronics.

In my own work, as codesigner of three microprocessor architectures - SPARC, picoJava, and MAJC - and as the designer of several implementations thereof, I've been afforded a deep and firsthand acquaintance with Moore's law. For decades, Moore's law has correctly predicted the exponential rate of improvement of semiconductor technology. Until last year I believed that the rate of advances predicted by Moore's law might continue only until roughly 2010, when some physical limits would begin to be reached. It was not obvious to me that a new technology would arrive in time to keep performance advancing smoothly.

But because of the recent rapid and radical progress in molecular electronics – where individual atoms and molecules replace lithographically drawn transistors – and related nanoscale technologies, we should be able to meet or exceed the Moore's law rate of progress for another 30 years. By 2030, we are likely to be able to build machines, in quantity, a million times as powerful as the personal computers of today – sufficient to implement the dreams of Kurzweil and Moravec.

As this enormous computing power is combined with the manipulative advances of the physical sciences and the new, deep understandings in genetics, enormous transformative power is being unleashed. These combinations open up the opportunity to completely redesign the world, for better or worse: The replicating and evolving processes that have been confined to the natural world are about to become realms of human endeavor.

In designing software and microprocessors, I have never had the feeling that I was designing an intelligent machine. The software and hardware is so fragile and the capabilities of the machine to "think" so clearly absent that, even as a possibility, this has always seemed very far in the future.

But now, with the prospect of human-level computing power in about 30 years, a new idea suggests itself: that I may be working to create tools which will enable the construction of the technology that may replace our species. How do I feel about this? Very uncomfortable. Having struggled my entire career to build

reliable software systems, it seems to me more than likely that this future will not work out as well as some people may imagine. My personal experience suggests we tend to overestimate our design abilities.

Given the incredible power of these new technologies, shouldn't we be asking how we can best coexist with them? And if our own extinction is a likely, or even possible, outcome of our technological development, shouldn't we proceed with great caution?

The dream of robotics is, first, that intelligent machines can do our work for us, allowing us lives of leisure, restoring us to Eden. Yet in his history of such ideas, *Darwin Among the Machines,* George Dyson warns: "In the game of life and evolution there are three players at the table: human beings, nature, and machines. I am firmly on the side of nature. But nature, I suspect, is on the side of the machines." As we have seen, Moravec agrees, believing we may well not survive the encounter with the superior robot species.

How soon could such an intelligent robot be built? The coming advances in computing power seem to make it possible by 2030. And once an intelligent robot exists, it is only a small step to a robot species - to an intelligent robot that can make evolved copies of itself.

A second dream of robotics is that we will gradually replace ourselves with our robotic technology, achieving near immortality by downloading our consciousnesses; it is this process that Danny Hillis thinks we will gradually get used to and that Ray Kurzweil elegantly details in The Age of Spiritual Machines. (We are beginning to see intimations of this in the implantation of computer devices into the human body, as illustrated on the cover of Wired 8.02.)

But if we are downloaded into our technology, what are the chances that we will thereafter be ourselves or even human? It seems to me far more likely that a robotic existence would not be like a human one in any sense that we understand, that the robots would in no sense be our children, that on this path our humanity may well be lost.

Genetic engineering promises to revolutionize agriculture by increasing crop yields while reducing the use of pesticides; to create tens of thousands of novel species of bacteria, plants, viruses, and animals; to replace reproduction, or supplement it, with cloning; to create cures for many diseases, increasing our life span and our quality of life; and much, much more. We now know with certainty that these profound changes in the biological sciences are imminent and will challenge all our notions of what life is.

Technologies such as human cloning have in particular raised our awareness of the profound ethical and moral issues we face. If, for example, we were to reengineer ourselves into several separate and unequal species using the power of genetic engineering, then we would threaten the notion of equality that is the very cornerstone of our democracy.

Given the incredible power of genetic engineering, it's no surprise that there are significant safety issues in its use. My friend Amory Lovins recently cowrote, along with Hunter Lovins, an editorial that provides an ecological view of some of these dangers. Among their concerns: that "the new botany aligns the development of plants with their economic, not evolutionary, success." (See "A Tale of Two Botanies," page 247.) Amory's long career has been focused on energy and resource efficiency by taking a whole-system view of human-made systems; such a whole-system view often finds simple, smart solutions to otherwise seemingly difficult problems, and is usefully applied here as well.

After reading the Lovins' editorial, I saw an op-ed by Gregg Easterbrook in *The New York Times* (November 19, 1999) about genetically engineered crops, under the headline: "Food for the Future: Someday, rice will have built-in vitamin A. Unless the Luddites win."

Are Amory and Hunter Lovins Luddites? Certainly not. I believe we all would agree that golden rice, with its built-in vitamin A, is probably a good thing, if developed with proper care and respect for the likely dangers in moving genes across species boundaries. Awareness of the dangers inherent in genetic engineering is beginning to grow, as reflected in the Lovins' editorial. The general public is aware of, and uneasy about, genetically modified foods, and seems to be rejecting the notion that such foods should be permitted to be unlabeled.

But genetic engineering technology is already very far along. As the Lovins note, the USDA has already approved about 50 genetically engineered crops for unlimited release; more than half of the world's soybeans and a third of its corn now contain genes spliced in from other forms of life.

While there are many important issues here, my own major concern with genetic engineering is narrower: that it gives the power - whether militarily, accidentally, or in a deliberate terrorist act - to create a White Plague.

The many wonders of nanotechnology were first imagined by the Nobel-laureate physicist Richard Feynman in a speech he gave in 1959, subsequently published under the title "There's Plenty of Room at the Bottom." The book that made a big impression on me, in the mid-'80s, was Eric Drexler's *Engines of Creation,* in which he described beautifully how manipulation of matter at the atomic level could create a utopian future of abundance, where just about everything could be made cheaply, and almost any imaginable disease or physical problem could be solved using nanotechnology and artificial intelligences.

A subsequent book, *Unbounding the Future: The Nanotechnology Revolution,* which Drexler co-wrote, imagines some of the changes that might take place in a world where we had molecular-level "assemblers." Assemblers could make possible incredibly low-cost solar power, cures for cancer and the common cold by augmentation of the human immune system, essentially complete cleanup of the environment, incredibly inexpensive pocket supercomputers – in fact, any product would be manufacturable by assemblers at a cost no greater than that of wood

– spaceflight more accessible than transoceanic travel today, and restoration of extinct species.

I remember feeling good about nanotechnology after reading *Engines of Creation.* As a technologist, it gave me a sense of calm - that is, nanotechnology showed us that incredible progress was possible, and indeed perhaps inevitable. If nanotechnology was our future, then I didn't feel pressed to solve so many problems in the present. I would get to Drexler's utopian future in due time; I might as well enjoy life more in the here and now. It didn't make sense, given his vision, to stay up all night, all the time.

Drexler's vision also led to a lot of good fun. I would occasionally get to describe the wonders of nanotechnology to others who had not heard of it. After teasing them with all the things Drexler described I would give a homework assignment of my own: "Use nanotechnology to create a vampire; for extra credit create an antidote."

With these wonders came clear dangers, of which I was acutely aware. As I said at a nanotechnology conference in 1989, "We can't simply do our science and not worry about these ethical issues."[5] But my subsequent conversations with physicists convinced me that nanotechnology might not even work - or, at least, it wouldn't work anytime soon. Shortly thereafter I moved to Colorado, to a skunk works I had set up, and the focus of my work shifted to software for the Internet, specifically on ideas that became Java and Jini.

Then, last summer, Brosl Hasslacher told me that nanoscale molecular electronics was now practical. This wasnew news, at least to me, and I think to many people – and it radically changed my opinion about nanotechnology. It sent me back to *Engines of Creation.* Rereading Drexler's work after more than 10 years, I was dismayed to realize how little I had remembered of its lengthy section called "Dangers and Hopes," including a discussion of how nanotechnologies can become "engines of destruction." Indeed, in my rereading of this cautionary material today, I am struck by how naive some of Drexler's safeguard proposals seem, and how much greater I judge the dangers to be now than even he seemed to then. (Having anticipated and described many technical and political problems with nanotechnology, Drexler started the Foresight Institute in the late 1980s "to help prepare society for anticipated advanced technologies" – most important, nanotechnology.)

The enabling breakthrough to assemblers seems quite likely within the next 20 years. Molecular electronics - the new subfield of nanotechnology where individual molecules are circuit elements - should mature quickly and become enormously lucrative within this decade, causing a large incremental investment in all nanotechnologies.

Unfortunately, as with nuclear technology, it is far easier to create destructive uses for nanotechnology than constructive ones. Nanotechnology has clear

military and terrorist uses, and you need not be suicidal to release a massively destructive nanotechnological device - such devices can be built to be selectively destructive, affecting, for example, only a certain geographical area or a group of people who are genetically distinct.

An immediate consequence of the Faustian bargain in obtaining the great power of nanotechnology is that we run a grave risk - the risk that we might destroy the biosphere on which all life depends.

As Drexler explained:

> "Plants" with "leaves" no more efficient than today's solar cells could out-compete real plants, crowding the biosphere with an inedible foliage. Tough omnivorous "bacteria" could out-compete real bacteria: They could spread like blowing pollen, replicate swiftly, and reduce the biosphere to dust in a matter of days. Dangerous replicators could easily be too tough, small, and rapidly spreading to stop – at least if we make no preparation. We have trouble enough controlling viruses and fruit flies.
>
> Among the cognoscenti of nanotechnology, this threat has become known as the "gray goo problem." Though masses of uncontrolled replicators need not be gray or gooey, the term "gray goo" emphasizes that replicators able to obliterate life might be less inspiring than a single species of crabgrass. They might be superior in an evolutionary sense, but this need not make them valuable.
>
> The gray goo threat makes one thing perfectly clear: We cannot afford certain kinds of accidents with replicating assemblers.

Gray goo would surely be a depressing ending to our human adventure on Earth, far worse than mere fire or ice, and one that could stem from a simple laboratory accident. [6] Oops.

It is most of all the power of destructive self-replication in genetics, nanotechnology, and robotics (GNR) that should give us pause. Self-replication is the modus operandi of genetic engineering, which uses the machinery of the cell to replicate its designs, and the prime danger underlying gray goo in nanotechnology. Stories of run-amok robots like the Borg, replicating or mutating to escape from the ethical constraints imposed on them by their creators, are well established in our science fiction books and movies. It is even possible that self-replication may be more fundamental than we thought, and hence harder – or even impossible – to control. A recent article by Stuart Kauffman in Nature titled "Self-Replication: Even Peptides Do It" discusses the discovery that a 32-amino-acid peptide can "autocatalyse its own synthesis." We don't know how widespread this ability is, but Kauffman notes that it may hint at "a route to self-reproducing molecular systems on a basis far wider than Watson-Crick base-pairing." [7]

In truth, we have had in hand for years clear warnings of the dangers inherent in widespread knowledge of GNR technologies – of the possibility of knowledge alone enabling mass destruction. But these warnings haven't been widely

publicized; the public discussions have been clearly inadequate. There is no profit in publicizing the dangers.

The nuclear, biological, and chemical (NBC) technologies used in 20th-century weapons of mass destruction were and are largely military, developed in government laboratories. In sharp contrast, the 21st-century GNR technologies have clear commercial uses and are being developed almost exclusively by corporate enterprises. In this age of triumphant commercialism, technology – with science as its handmaiden – is delivering a series of almost magical inventions that are the most phenomenally lucrative ever seen. We are aggressively pursuing the promises of these new technologies within the now-unchallenged system of global capitalism and its manifold financial incentives and competitive pressures.

> This is the first moment in the history of our planet when any species, by its own voluntary actions, has become a danger to itself – as well as to vast numbers of others.
>
> It might be a familiar progression, transpiring on many worlds – a planet, newly formed, placidly revolves around its star; life slowly forms; a kaleidoscopic procession of creatures evolves; intelligence emerges which, at least up to a point, confers enormous survival value; and then technology is invented. It dawns on them that there are such things as laws of Nature, that these laws can be revealed by experiment, and that knowledge of these laws can be made both to save and to take lives, both on unprecedented scales. Science, they recognize, grants immense powers. In a flash, they create world-altering contrivances. Some planetary civilizations see their way through, place limits on what may and what must not be done, and safely pass through the time of perils. Others, not so lucky or so prudent, perish.

That is Carl Sagan, writing in 1994, in *Pale Blue Dot,* a book describing his vision of the human future in space. I am only now realizing how deep his insight was, and how sorely I miss, and will miss, his voice. For all its eloquence, Sagan's contribution was not least that of simple common sense – an attribute that, along with humility, many of the leading advocates of the 21st-century technologies seem to lack.

I remember from my childhood that my grandmother was strongly against the overuse of antibiotics. She had worked since before the first World War as a nurse and had a commonsense attitude that taking antibiotics, unless they were absolutely necessary, was bad for you.

It is not that she was an enemy of progress. She saw much progress in an almost 70-year nursing career; my grandfather, a diabetic, benefited greatly from the improved treatments that became available in his lifetime. But she, like many levelheaded people, would probably think it greatly arrogant for us, now, to be designing a robotic "replacement species," when we obviously have so much trouble making relatively simple things work, and so much trouble managing – or even understanding – ourselves.

I realize now that she had an awareness of the nature of the order of life, and of the necessity of living with and respecting that order. With this respect comes a necessary humility that we, with our early-21st-century chutzpah, lack at our peril. The commonsense view, grounded in this respect, is often right, in advance of the scientific evidence. The clear fragility and inefficiencies of the human-made systems we have built should give us all pause; the fragility of the systems I have worked on certainly humbles me.

We should have learned a lesson from the making of the first atomic bomb and the resulting arms race. We didn't do well then, and the parallels to our current situation are troubling.

The effort to build the first atomic bomb was led by the brilliant physicist J. Robert Oppenheimer. Oppenheimer was not naturally interested in politics but became painfully aware of what he perceived as the grave threat to Western civilization from the Third Reich, a threat surely grave because of the possibility that Hitler might obtain nuclear weapons. Energized by this concern, he brought his strong intellect, passion for physics, and charismatic leadership skills to Los Alamos and led a rapid and successful effort by an incredible collection of great minds to quickly invent the bomb.

What is striking is how this effort continued so naturally after the initial impetus was removed. In a meeting shortly after V-E Day with some physicists who felt that perhaps the effort should stop, Oppenheimer argued to continue. His stated reason seems a bit strange: not because of the fear of large casualties from an invasion of Japan, but because the United Nations, which was soon to be formed, should have foreknowledge of atomic weapons. A more likely reason the project continued is the momentum that had built up – the first atomic test, Trinity, was nearly at hand.

We know that in preparing this first atomic test the physicists proceeded despite a large number of possible dangers. They were initially worried, based on a calculation by Edward Teller, that an atomic explosion might set fire to the atmosphere. A revised calculation reduced the danger of destroying the world to a three-in-a-million chance. (Teller says he was later able to dismiss the prospect of atmospheric ignition entirely.) Oppenheimer, though, was sufficiently concerned about the result of Trinity that he arranged for a possible evacuation of the southwest part of the state of New Mexico. And, of course, there was the clear danger of starting a nuclear arms race.

Within a month of that first, successful test, two atomic bombs destroyed Hiroshima and Nagasaki. Some scientists had suggested that the bomb simply be demonstrated, rather than dropped on Japanese cities - saying that this would greatly improve the chances for arms control after the war - but to no avail. With the tragedy of Pearl Harbor still fresh in Americans' minds, it would have been very difficult for President Truman to order a demonstration of the weapons rather than use them as he did - the desire to quickly end the war and save the

lives that would have been lost in any invasion of Japan was very strong. Yet the overriding truth was probably very simple: As the physicist Freeman Dyson later said, "The reason that it was dropped was just that nobody had the courage or the foresight to say no."

It's important to realize how shocked the physicists were in the aftermath of the bombing of Hiroshima, on August 6, 1945. They describe a series of waves of emotion: first, a sense of fulfillment that the bomb worked, then horror at all the people that had been killed, and then a convincing feeling that on no account should another bomb be dropped. Yet of course another bomb was dropped, on Nagasaki, only three days after the bombing of Hiroshima.

In November 1945, three months after the atomic bombings, Oppenheimer stood firmly behind the scientific attitude, saying, "It is not possible to be a scientist unless you believe that the knowledge of the world, and the power which this gives, is a thing which is of intrinsic value to humanity, and that you are using it to help in the spread of knowledge and are willing to take the consequences."

Oppenheimer went on to work, with others, on the Acheson-Lilienthal report, which, as Richard Rhodes says in his recent book Visions of Technology, "found a way to prevent a clandestine nuclear arms race without resorting to armed world government"; their suggestion was a form of relinquishment of nuclear weapons work by nation-states to an international agency.

This proposal led to the Baruch Plan, which was submitted to the United Nations in June 1946 but never adopted (perhaps because, as Rhodes suggests, Bernard Baruch had "insisted on burdening the plan with conventional sanctions," thereby inevitably dooming it, even though it would "almost certainly have been rejected by Stalinist Russia anyway"). Other efforts to promote sensible steps toward internationalizing nuclear power to prevent an arms race ran afoul either of US politics and internal distrust, or distrust by the Soviets. The opportunity to avoid the arms race was lost, and very quickly.

Two years later, in 1948, Oppenheimer seemed to have reached another stage in his thinking, saying, "In some sort of crude sense which no vulgarity, no humor, no overstatement can quite extinguish, the physicists have known sin; and this is a knowledge they cannot lose."

In 1949, the Soviets exploded an atom bomb. By 1955, both the US and the Soviet Union had tested hydrogen bombs suitable for delivery by aircraft. And so the nuclear arms race began.

Nearly 20 years ago, in the documentary *The Day After Trinity,* Freeman Dyson summarized the scientific attitudes that brought us to the nuclear precipice:

> I have felt it myself. The glitter of nuclear weapons. It is irresistible if you come to them as a scientist. To feel it's there in your hands, to release this energy that fuels the stars, to let it do your bidding. To perform these mira-

> cles, to lift a million tons of rock into the sky. It is something that gives people an illusion of illimitable power, and it is, in some ways, responsible for all our troubles - this, what you might call technical arrogance, that overcomes people when they see what they can do with their minds.[8]

Now, as then, we are creators of new technologies and stars of the imagined future, driven – this time by great financial rewards and global competition – despite the clear dangers, hardly evaluating what it may be like to try to live in a world that is the realistic outcome of what we are creating and imagining.

In 1947, *The Bulletin of the Atomic Scientists* began putting a Doomsday Clock on its cover. For more than 50 years, it has shown an estimate of the relative nuclear danger we have faced, reflecting the changing international conditions. The hands on the clock have moved 15 times and today, standing at nine minutes to midnight, reflect continuing and real danger from nuclear weapons. The recent addition of India and Pakistan to the list of nuclear powers has increased the threat of failure of the nonproliferation goal, and this danger was reflected by moving the hands closer to midnight in 1998.

In our time, how much danger do we face, not just from nuclear weapons, but from all of these technologies? How high are the extinction risks?

The philosopher John Leslie has studied this question and concluded that the risk of human extinction is at least 30 percent, [9] while Ray Kurzweil believes we have "a better than even chance of making it through," with the caveat that he has "always been accused of being an optimist." Not only are these estimates not encouraging, but they do not include the probability of many horrid outcomes that lie short of extinction.

Faced with such assessments, some serious people are already suggesting that we simply move beyond Earth as quickly as possible. We would colonize the galaxy using von Neumann probes, which hop from star system to star system, replicating as they go. This step will almost certainly be necessary 5 billion years from now (or sooner if our solar system is disastrously impacted by the impending collision of our galaxy with the Andromeda galaxy within the next 3 billion years), but if we take Kurzweil and Moravec at their word it might be necessary by the middle of this century.

What are the moral implications here? If we must move beyond Earth this quickly in order for the species to survive, who accepts the responsibility for the fate of those (most of us, after all) who are left behind? And even if we scatter to the stars, isn't it likely that we may take our problems with us or find, later, that they have followed us? The fate of our species on Earth and our fate in the galaxy seem inextricably linked.

Another idea is to erect a series of shields to defend against each of the dangerous technologies. The Strategic Defense Initiative, proposed by the Reagan administration, was an attempt to design such a shield against the threat of a nuclear attack from the Soviet Union. But as Arthur C. Clarke, who was privy to

discussions about the project, observed: "Though it might be possible, at vast expense, to construct local defense systems that would 'only' let through a few percent of ballistic missiles, the much touted idea of a national umbrella was nonsense. Luis Alvarez, perhaps the greatest experimental physicist of this century, remarked to me that the advocates of such schemes were 'very bright guys with no common sense.'"

Clarke continued: "Looking into my often cloudy crystal ball, I suspect that a total defense might indeed be possible in a century or so. But the technology involved would produce, as a by-product, weapons so terrible that no one would bother with anything as primitive as ballistic missiles." [10]

In *Engines of Creation*, Eric Drexler proposed that we build an active nanotechnological shield - a form of immune system for the biosphere - to defend against dangerous replicators of all kinds that might escape from laboratories or otherwise be maliciously created. But the shield he proposed would itself be extremely dangerous - nothing could prevent it from developing autoimmune problems and attacking the biosphere itself.[11]

Similar difficulties apply to the construction of shields against robotics and genetic engineering. These technologies are too powerful to be shielded against in the time frame of interest; even if it were possible to implement defensive shields, the side effects of their development would be at least as dangerous as the technologies we are trying to protect against.

These possibilities are all thus either undesirable or unachievable or both. The only realistic alternative I see is relinquishment: to limit development of the technologies that are too dangerous, by limiting our pursuit of certain kinds of knowledge.

Yes, I know, knowledge is good, as is the search for new truths. We have been seeking knowledge since ancient times. Aristotle opened his Metaphysics with the simple statement: "All men by nature desire to know." We have, as a bedrock value in our society, long agreed on the value of open access to information, and recognize the problems that arise with attempts to restrict access to and development of knowledge. In recent times, we have come to revere scientific knowledge.

But despite the strong historical precedents, if open access to and unlimited development of knowledge henceforth puts us all in clear danger of extinction, then common sense demands that we reexamine even these basic, long-held beliefs.

It was Nietzsche who warned us, at the end of the 19th century, not only that God is dead but that "faith in science, which after all exists undeniably, cannot owe its origin to a calculus of utility; it must have originated in spite of the fact that the disutility and dangerousness of the 'will to truth,' of 'truth at any price' is proved to it constantly." It is this further danger that we now fully face - the consequences of our truth-seeking. The truth that science seeks can certainly be considered a dangerous substitute for God if it is likely to lead to our extinction.

If we could agree, as a species, what we wanted, where we were headed, and why, then we would make our future much less dangerous – then we might understand what we can and should relinquish. Otherwise, we can easily imagine an arms race developing over GNR technologies, as it did with the NBC technologies in the 20th century. This is perhaps the greatest risk, for once such a race begins, it's very hard to end it. This time – unlike during the Manhattan Project – we aren't in a war, facing an implacable enemy that is threatening our civilization; we are driven, instead, by our habits, our desires, our economic system, and our competitive need to know.

I believe that we all wish our course could be determined by our collective values, ethics, and morals. If we had gained more collective wisdom over the past few thousand years, then a dialogue to this end would be more practical, and the incredible powers we are about to unleash would not be nearly so troubling.

One would think we might be driven to such a dialogue by our instinct for self-preservation. Individuals clearly have this desire, yet as a species our behavior seems to be not in our favor. In dealing with the nuclear threat, we often spoke dishonestly to ourselves and to each other, thereby greatly increasing the risks. Whether this was politically motivated, or because we chose not to think ahead, or because when faced with such grave threats we acted irrationally out of fear, I do not know, but it does not bode well.

The new Pandora's boxes of genetics, nanotechnology, and robotics are almost open, yet we seem hardly to have noticed. Ideas can't be put back in a box; unlike uranium or plutonium, they don't need to be mined and refined, and they can be freely copied. Once they are out, they are out. Churchill remarked, in a famous left-handed compliment, that the American people and their leaders "invariably do the right thing, after they have examined every other alternative." In this case, however, we must act more presciently, as to do the right thing only at last may be to lose the chance to do it at all.

As Thoreau said, "We do not ride on the railroad; it rides upon us"; and this is what we must fight, in our time. The question is, indeed, which is to be master? Will we survive our technologies?

We are being propelled into this new century with no plan, no control, no brakes. Have we already gone too far down the path to alter course? I don't believe so, but we aren't trying yet, and the last chance to assert control – the fail-safe point – is rapidly approaching. We have our first pet robots, as well as commercially available genetic engineering techniques, and our nanoscale techniques are advancing rapidly. While the development of these technologies proceeds through a number of steps, it isn't necessarily the case – as happened in the Manhattan Project and the Trinity test – that the last step in proving a technology is large and hard. The breakthrough to wild self-replication in robotics, genetic engineering, or nanotechnology could come suddenly, reprising the surprise we felt when we learned of the cloning of a mammal.

And yet I believe we do have a strong and solid basis for hope. Our attempts to deal with weapons of mass destruction in the last century provide a shining example of relinquishment for us to consider: the unilateral US abandonment, without preconditions, of the development of biological weapons. This relinquishment stemmed from the realization that while it would take an enormous effort to create these terrible weapons, they could from then on easily be duplicated and fall into the hands of rogue nations or terrorist groups.

The clear conclusion was that we would create additional threats to ourselves by pursuing these weapons, and that we would be more secure if we did not pursue them. We have embodied our relinquishment of biological and chemical weapons in the 1972 Biological Weapons Convention (BWC) and the 1993 Chemical Weapons Convention (CWC).[12]

As for the continuing sizable threat from nuclear weapons, which we have lived with now for more than 50 years, the US Senate's recent rejection of the Comprehensive Test Ban Treaty makes it clear relinquishing nuclear weapons will not be politically easy. But we have a unique opportunity, with the end of the Cold War, to avert a multipolararms race. Building on the BWC and CWC relinquishments, successful abolition of nuclear weapons could help us build toward a habit of relinquishing dangerous technologies. (Actually, by getting rid of all but 100 nuclear weapons worldwide – roughly the total destructive power of World War II and a considerably easier task – we could eliminate this extinction threat.[13])

Verifying relinquishment will be a difficult problem, but not an unsolvable one. We are fortunate to have already done a lot of relevant work in the context of the BWC and other treaties. Our major task will be to apply this to technologies that are naturally much more commercial than military. The substantial need here is for transparency, as difficulty of verification is directly proportional to the difficulty of distinguishing relinquished from legitimate activities.

I frankly believe that the situation in 1945 was simpler than the one we now face: The nuclear technologies were reasonably separable into commercial and military uses, and monitoring was aided by the nature of atomic tests and the ease with which radioactivity could be measured. Research on military applications could be performed at national laboratories such as Los Alamos, with the results kept secret as long as possible.

The GNR technologies do not divide clearly into commercial and military uses; given their potential in the market, it's hard to imagine pursuing them only in national laboratories. With their widespread commercial pursuit, enforcing relinquishment will require a verification regime similar to that for biological weapons, but on an unprecedented scale. This, inevitably, will raise tensions between our individual privacy and desire for proprietary information, and the need for verification to protect us all. We will undoubtedly encounter strong resistance to this loss of privacy and freedom of action.

Verifying the relinquishment of certain GNR technologies will have to occur in cyberspace as well as at physical facilities. The critical issue will be to make the necessary transparency acceptable in a world of proprietary information, presumably by providing new forms of protection for intellectual property.

Verifying compliance will also require that scientists and engineers adopt a strong code of ethical conduct, resembling the Hippocratic oath, and that they have the courage to whistleblow as necessary, even at high personal cost. This would answer the call – 50 years after Hiroshima – by the Nobel laureate Hans Bethe, one of the most senior of the surviving members of the Manhattan Project, that all scientists "cease and desist from work creating, developing, improving, and manufacturing nuclear weapons and other weapons of potential mass destruction."[14] In the 21st century, this requires vigilance and personal responsibility by those who would work on both NBC and GNR technologies to avoid implementing weapons of mass destruction and knowledge-enabled mass destruction.

Thoreau also said that we will be "rich in proportion to the number of things which we can afford to let alone." We each seek to be happy, but it would seem worthwhile to question whether we need to take such a high risk of total destruction to gain yet more knowledge and yet more things; common sense says that there is a limit to our material needs - and that certain knowledge is too dangerous and is best forgone.

Neither should we pursue near immortality without considering the costs, without considering the commensurate increase in the risk of extinction. Immortality, while perhaps the original, is certainly not the only possible utopian dream.

I recently had the good fortune to meet the distinguished author and scholar Jacques Attali, whose book *Lignes d'horizons* (Millennium, in the English translation) helped inspire the Java and Jini approach to the coming age of pervasive computing, as previously described in this magazine. In his new book *Fraternités*, Attali describes how our dreams of utopia have changed over time:

> "At the dawn of societies, men saw their passage on Earth as nothing more than a labyrinth of pain, at the end of which stood a door leading, via their death, to the company of gods and to Eternity. With the Hebrews and then the Greeks, some men dared free themselves from theological demands and dream of an ideal City where Liberty would flourish. Others, noting the evolution of the market society, understood that the liberty of some would entail the alienation of others, and they sought Equality."

Jacques helped me understand how these three different utopian goals exist in tension in our society today. He goes on to describe a fourth utopia, Fraternity, whose foundation is altruism. Fraternity alone associates individual happiness with the happiness of others, affording the promise of self-sustainment.

This crystallized for me my problem with Kurzweil's dream. A technological approach to Eternity - near immortality through robotics - may not be the most desirable utopia, and its pursuit brings clear dangers. Maybe we should rethink our utopian choices.

Where can we look for a new ethical basis to set our course? I have found the ideas in the book *Ethics for the New Millennium,* by the Dalai Lama, to be very helpful. As is perhaps well known but little heeded, the Dalai Lama argues that the most important thing is for us to conduct our lives with love and compassion for others, and that our societies need to develop a stronger notion of universal responsibility and of our interdependency; he proposes a standard of positive ethical conduct for individuals and societies that seems consonant with Attali's Fraternity utopia.

The Dalai Lama further argues that we must understand what it is that makes people happy, and acknowledge the strong evidence that neither material progress nor the pursuit of the power of knowledge is the key – that there are limits to what science and the scientific pursuit alone can do.

Our Western notion of happiness seems to come from the Greeks, who defined it as "the exercise of vital powers along lines of excellence in a life affording them scope."[15] Clearly, we need to find meaningful challenges and sufficient scope in our lives if we are to be happy in whatever is to come. But I believe we must find alternative outlets for our creative forces, beyond the culture of perpetual economic growth; this growth has largely been a blessing for several hundred years, but it has not brought us unalloyed happiness, and we must now choose between the pursuit of unrestricted and undirected growth through science and technology and the clear accompanying dangers.

It is now more than a year since my first encounter with Ray Kurzweil and John Searle. I see around me cause for hope in the voices for caution and relinquishment and in those people I have discovered who are as concerned as I am about our current predicament. I feel, too, a deepened sense of personal responsibility – not for the work I have already done, but for the work that I might yet do, at the confluence of the sciences.

But many other people who know about the dangers still seem strangely silent. When pressed, they trot out the "this is nothing new" riposte – as if awareness of what could happen is response enough. They tell me, 'there are universities filled with bioethicists who study this stuff all day long.' They say, a'll this has been written about before, and by experts.' They complain, y'our worries and your arguments are already old hat.'

I don't know where these people hide their fear. As an architect of complex systems I enter this arena as a generalist. But should this diminish my concerns? I am aware of how much has been written about, talked about, and lectured about so authoritatively. But does this mean it has reached people? Does this mean we can discount the dangers before us?

Knowing is not a rationale for not acting. Can we doubt that knowledge has become a weapon we wield against ourselves? The experiences of the atomic scientists clearly show the need to take personal responsibility, the danger that things will move too fast, and the way in which a process can take on a life of its own. We can, as they did, create insurmountable problems in almost no time flat. We must do more thinking up front if we are not to be similarly surprised and shocked by the consequences of our inventions.

My continuing professional work is on improving the reliability of software. Software is a tool, and as a toolbuilder I must struggle with the uses to which the tools I make are put. I have always believed that making software more reliable, given its many uses, will make the world a safer and better place; if I were to come to believe the opposite, then I would be morally obligated to stop this work. I can now imagine such a day may come.

This all leaves me not angry but at least a bit melancholic. Henceforth, for me, progress will be somewhat bittersweet.

Do you remember the beautiful penultimate scene in Manhattan where Woody Allen is lying on his couch and talking into a tape recorder? He is writing a short story about people who are creating unnecessary, neurotic problems for themselves, because it keeps them from dealing with more unsolvable, terrifying problems about the universe.

He leads himself to the question, "Why is life worth living?" and to consider what makes it worthwhile for him: Groucho Marx, Willie Mays, the second movement of the *Jupiter* Symphony, Louis Armstrong's recording of "Potato Head Blues," Swedish movies, Flaubert's *Sentimental Education,* Marlon Brando, Frank Sinatra, the apples and pears by Cézanne, the crabs at Sam Wo's, and, finally, the showstopper: his love Tracy's face.

Each of us has our precious things, and as we care for them we locate the essence of our humanity. In the end, it is because of our great capacity for caring that I remain optimistic we will confront the dangerous issues now before us.

My immediate hope is to participate in a much larger discussion of the issues raised here, with people from many different backgrounds, in settings not predisposed to fear or favor technology for its own sake.

As a start, I have twice raised many of these issues at events sponsored by the Aspen Institute and have separately proposed that the American Academy of Arts and Sciences take them up as an extension of its work with the Pugwash Conferences. (These have been held since 1957 to discuss arms control, especially of nuclear weapons, and to formulate workable policies.)

It's unfortunate that the Pugwash meetings started only well after the nuclear genie was out of the bottle – roughly 15 years too late. We are also getting a belated start on seriously addressing the issues around 21st-century technologies – the prevention of knowledge-enabled mass destruction – and further delay seems unacceptable.

So I'm still searching; there are many more things to learn. Whether we are to succeed or fail, to survive or fall victim to these technologies, is not yet decided. I'm up late again – it's almost 6 am. I'm trying to imagine some better answers, to break the spell and free them from the stone. E&M

References

[1] The passage Kurzweil quotes is from Kaczynski's *Unabomber Manifesto,* which was published jointly, under duress, by The New York Times and The Washington Post to attempt to bring his campaign of terror to an end. I agree with David Gelernter, who said about their decision:

"It was a tough call for the newspapers. To say yes would be giving in to terrorism, and for all they knew he was lying anyway. On the other hand, to say yes might stop the killing. There was also a chance that someone would read the tract and get a hunch about the author; and that is exactly what happened. The suspect's brother read it, and it rang a bell.
"I would have told them not to publish. I'm glad they didn't ask me. I guess."

Drawing Life: Surviving the Unabomber. Free Press, 1997: 120.)

[2] Garrett, Laurie. *The Coming Plague: Newly Emerging Diseases in a World Out of Balance.* Penguin, 1994: 47-52, 414, 419, 452.

[3] Isaac Asimov described what became the most famous view of ethical rules for robot behavior in his book I, Robot in 1950, in his *Three Laws of Robotics:* 1. A robot may not injure a human being, or, through inaction, allow a human being to come to harm. 2. A robot must obey the orders given it by human beings, except where such orders would conflict with the First Law. 3. A robot must protect its own existence, as long as such protection does not conflict with the First or Second Law.

[4] Michelangelo wrote a sonnet that begins:

Non ha l' ottimo artista alcun concetto
Ch' un marmo solo in sè non circonscriva
Col suo soverchio; e solo a quello arriva
La man che ubbidisce all' intelleto.

Stone translates this as:

The best of artists hath no thought to show
which the rough stone in its superfluous shell
doth not include; to break the marble spell
is all the hand that serves the brain can do.

Stone describes the process: "He was not working from his drawings or clay models; they had all been put away. He was carving from the images in his mind. His eyes and hands knew where every line, curve, mass must emerge, and at what depth in the heart of the stone to create the low relief."

(*The Agony and the Ecstasy.* Doubleday, 1961: 6, 144.)

[5] First Foresight Conference on Nanotechnology in October 1989, a talk titled "The Future of Computation." Published in Crandall, B. C. and James Lewis, editors. Nanotechnology: Research and Perspectives. MIT Press, 1992: 269.

See also www.foresight.org/Conferences/MNT01/Nano1.html.

[6] In his 1963 novel *Cat's Cradle,* Kurt Vonnegut imagined a gray-goo-like accident where a form of ice called ice-nine, which becomes solid at a much higher temperature, freezes the oceans.

[7] Kauffman, Stuart. "Self-replication: Even Peptides Do It." Nature, 382, August 8, 1996: 496. See www.santafe.edu/sfi/People/kauffman/sak-peptides.html.

[8] Else, Jon. *The Day After Trinity: J. Robert Oppenheimer and The Atomic Bomb* (available at www.pyramiddirect.com).

[9] This estimate is in Leslie's book *The End of the World: The Science and Ethics of Human Extinction,* where he notes that the probability of extinction is substantially higher if we accept Brandon Carter's Doomsday Argument, which is, briefly, that "we ought to have some reluctance to believe that we are very exceptionally early, for instance in the earliest 0.001 percent, among all humans who will ever have lived. This would be some reason for thinking that humankind will not survive for many more centuries, let alone colonize the galaxy. Carter's doomsday argument doesn't generate any risk estimates just by itself. It is an argument for revising the estimates which we generate when we consider various possible dangers." (Routledge, 1996: 1, 3, 145.)

[10] Clarke, Arthur C. "Presidents, Experts, and Asteroids." Science, June 5, 1998. Reprinted as "Science and Society" in Greetings, Carbon-Based Bipeds! Collected Essays, 1934-1998. St. Martin's Press, 1999: 526.

[11] And, as David Forrest suggests in his paper "Regulating Nanotechnology Development," available at www.foresight.org/NanoRev/Forrest1989.html, "If we used strict liability as an alternative to regulation it would be impossible for any developer to internalize the cost of the risk (destruction of the biosphere), so theoretically the activity of developing nanotechnology should never be undertaken." Forrest's analysis leaves us with only government regulation to protect us – not a comforting thought.

[12] Meselson, Matthew. "The Problem of Biological Weapons." Presentation to the 1,818th Stated Meeting of the American Academy of Arts and Sciences, January 13, 1999. (minerva.amacad.org/archive/bulletin4.htm)

[13] Doty, Paul. "The Forgotten Menace: Nuclear Weapons Stockpiles Still Represent the Biggest Threat to Civilization." Nature, 402, December 9, 1999: 583.

[14] See also Hans Bethe's 1997 letter to President Clinton, at www.fas.org/bethecr.htm.

[15] Hamilton, Edith. *The Greek Way.* W. W. Norton & Co., 1942: 35.

Bill Joy, cofounder and Chief Scientist of Sun Microsystems, was co-chair of the presidential commission on the future of IT research, and is coauthor of The Java Language Specification. His work on the Jini pervasive computing technology was featured in WIRED 6.08. This article originally appeared in WIRED 8.04 and is reprinted here with permission.

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REDUX: IS THE ORAL CONTRACEPTIVE PILL AN ABORTIFACIENT?

JOEL E. GOODNOUGH, MD

Randy Alcorn has written a very thought provoking book[1] which examines the evidence and concludes that the combined estrogen and progesterone oral contraceptive pill (OCP), or birth control pill as he prefers to call it, sometimes causes abortion[2] of the early embryo. He believes that the OCP prevents a clinically recognizable pregnancy not only through prevention of conception, or fertilization, but also through prevention of successful implantation of the embryo into the wall of the uterus when conception does occur.

The central question that Alcorn asks is whether the OCP exclusively acts as a contraceptive or whether it sometimes prevents implantation and therefore causes abortion (pg 12 of his book). He cites a number of mechanisms of action for the OCP in preventing pregnancy:[3] Inhibition of ovulation; thickened cervical mucous and decreased sperm transport; prevention of implantation of the embryo; and long-term effects that have an abortive effect even after discontinuation of OCP use. He then goes on to say that if the OCP sometimes prevents implantation and therefore causes abortions, it is more Christ-like to not use it (pg 54 of his book). In other words, the OCP should not be used because it is an abortifacient. But are his conclusions appropriate? Does the OCP cause early loss of the embryo at all, infrequently, or frequently? And if it does cause abortion, does that make it an abortifacient? If we cannot decide if the OCP causes abortions, what should we do? To answer these questions, we must assess the pill's ability to prevent fertilization and then try to determine the consequences to the embryo when the pill fails to do so. Finally, we have to decide how to live in an imperfect world with risks.

Ovulation Rates on the OCP

Alcorn believes that the OCP may fail to prevent ovulation in 10-30% of cycles (page 22 of his book). The significance of ovulation, of course, is that it may lead to conception and open up the question of the possible abortive effect of the OCP. He bases his conclusion on studies that show a high level of ovarian activity in women taking the OCP. Ovarian activity is not synonymous with ovulation, however. Spona, et al showed ovarian activity, as evidenced by the presence of follicles and unruptured corpus luteum cysts, in up to 35% of patients correctly taking the OCP.[4] Some of these patients also had a rise in their serum progesterone levels, indicating corpus luteum function.[5] Ultrasound studies, however, failed to show ovulation in any of these patients, a phenomenon called the luteinized unruptured follicle syndrome. In a similar study, Crosignani, et al

Ethics & Medicine, 17(2001):37-51.

showed ovarian activity in patients who correctly took low dose and very low dose OCP, but again there was no evidence of ovulation.[6]

Alcorn also cites a statement by Stephen Killick to support the argument for ovulation on the OCP. In his paper, Killick opens his introduction with the statement: "It is well established that newer, lower-dose regimes of combined oral contraceptive (OC) therapy do not completely suppress pituitary and ovarian function."[7] The question of whether this ovarian function could result in ovulation, however, is the very basis for Killick's study. Killick then goes on to show that he can *artificially induce* ovulation in cycles where ovarian function occurred as a result of intentionally missed pills. This result, however, is in contrast to his clinical trials, which show no ovulation in over 150 cycles when the OCP was taken correctly.

Rossmanith et al.,[8] in a German study, showed ovarian activity based on progesterone levels in 2.9% and 4.1% of cycles of women who were on very low dose OCP. Combined analysis with ultrasound and hormone levels, however, showed no ovulations in any of the cycles. He concludes that "although the capability of these [follicles] to grow and ovulate has been demonstrated in previous studies [he cites Killick's study], the likelihood that this occurs is very limited. This view is substantiated by the findings of the current and previous investigations, which clearly showed that there was no evidence for ovulation occurring." Finally, there are at least three studies which show that missing up to four pills in a row does not result in ovulation.[9]

It is particularly distressing that Alcorn refers to studies in order to make a point, even though one would be hard pressed to find actual support for the point within the context of the study. Wilks[10] cites a study by Letterie in which women began taking a combined OCP six to eight days late in the cycle. In addition, they took the combined OCP for only five days followed by a progesterone-only pill (POP) for another nine days. The purpose of the study was to determine if other formulations of pills would be effective at preventing ovulation. The study showed a 30% ovulatory rate, primarily in the second cycle studied. Now, why would Wilks even mention this study in his discussion on the effect of missed pills on ovulation? Is he suggesting that women who start their pills a week late, take them for only five days, and then switch to a progesterone-only (POP) pill for nine days are at a similar risk of ovulating as women who take the combined OCP and, that therefore, the OCP should not be used because conception and embryo loss is possible? That would be like saying that safe, routine driving has the same potential of causing a fatal accident as driving the wrong way on a one-way street, therefore we should not drive at all. If his point is that studies, to be truly valid, have to look at the second cycle in the study, then Spona addresses that in his previously referenced study when he looked at three cycles. In either case, Letterie's study would only be representative of a woman totally misusing the OCP. It should be noted that Letterie showed in 1992 that missing four OCP's in a row in various times in the cycle resulted in no ovulations.[11]

The point is not that ovulation never occurs, for we know that pregnancy occurs on the OCP. In carefully monitored studies with highly motivated women, the rate of pregnancy on the OCP is .1% per year whereas the observed rate in the general population is 3% per year.[12] This difference is due to breakthrough ovulation when errors are made in taking the OCP or to decreased absorption of the OCP secondary to medications or illness. The point is that it is wrong to assume, based on evidence of ovarian activity, that there is a high frequency of ovulation, especially when the OCP is taken responsibly and correctly.

Prevention of Implantation

Alcorn believes that if ovulation and conception occurs on the OCP, the embryo is at risk of being aborted due to changes in the endometrium (the lining of the uterine wall) that are hostile to implantation of the embryo. He does a wonderful job of reviewing the literature that shows that the OCP produces changes in the endometrium (pages 14-18 of his book). It is speculative, however, to say that these changes result in inhibition of implantation of the embryo and therefore result in abortion. Alcorn refers to this as the third mechanism of action of the OCP. The literature that he quotes describes the endometrium in women on the OCP as being hostile to the embryo, but no literature actually shows that death of the embryo results. *The Physician's Desk Reference,* for instance, states, "Although the primary mechanism of this action [contraception] is inhibition of ovulation, other alterations include changes in the cervical mucous (which increase the difficulty of sperm entry into the uterus) and the endometrium (which reduce the likelihood of implantation)." No references are cited to support the speculation that implantation is actually inhibited, however. Alcorn states that because women sometimes get pregnant on the OCP, this means that the third mechanism sometimes fails. The embryo sometimes implants and survives despite the changes in the endometrium. But in light of the fact that there is no definitive information on whether the embryo implants or not, he could just as easily assume that the embryo always implants and survives despite seemingly hostile changes in the endometrium. Or, more accurately stated, he could say that the embryo implants and survives as frequently in those on the OCP as happens in those not on the OCP, since embryo loss occurs in an estimated 70% of fertilizations in women not taking the OCP. Fifteen percent of these embryos die immediately after fertilization, 15% fail to implant, and 41% are lost after implantation.

Animal studies in rodents have shown the failure of embryos to implant in an endometrium created to be similar to that which is found on the OCP.[13] The author of the study, however, cautions that "mechanisms of implantation vary markedly between species, making extrapolation [to humans] difficult." He goes on to point out that the human embryo, unlike other species, has a unique invasiveness and ability to implant in extrauterine locations such as the fallopian tube.

Alcorn's assertion that the OCP causes abortion is based on the observation that the OCP causes this seemingly hostile endometrium. The thinner endometri-

um that is seen on ultrasound may be a direct result of the progestin in the OCP, but it could also be a result of suppressed ovarian hormones.[14] Although it is true that the endometrium has a hostile appearance when the OCP succeeds in preventing ovulation, it does not follow that the endometrium is hostile when the OCP fails and ovulation occurs. Ovulation and endometrial condition are not independent factors. Ovulation occurs as a result of rising follicle stimulating hormone (FSH), luteinizng hormone (LH), and estrogen levels. After ovulation, progesterone levels rise. These rising hormone levels are responsible for making the endometrium receptive to the embryo. One would therefore expect the endometrium in an ovulatory cycle on the OCP to be more receptive than the endometrium in an anovulatory cycle on the OCP where there is no rise in hormone levels. Stephen Killick, for example, was able to demonstrate normal ovulatory endometrium in cycles where pills were intentionally missed and ovulation artificially produced.[15] Finally, it has been shown that the embryo is capable of sending signals prior to implantation that create a more favorable endometrium.[16] This effect would not be seen in an anovulatory cycle where no embryo exists.

In the absence of large numbers of studies addressing the status of the endometrium in an ovulatory cycle on the OCP, the expectation that the endometrium is more receptive in such cycles is somewhat speculative, although in my opinion reasonable. It is incorrect, however, to assume that the embryo sometimes implants and survives despite the third mechanism of creating a hostile endometrium since that mechanism may not even be a factor in ovulatory cycles. Alcorn states: "When you say the effect of preventing implantation is absent in some cases, you are implying it is present in some cases" (pg 37 of his book). That is simply not true, for it may be that the third mechanism is absent in all cases of fertilization. The effect of a hostile endometrium may be absent in cases of ovulation when it matters and present in cases of anovulation, when it does not matter.

Alcorn compares the situation of the hostile endometrium and the embryo with that of the dry, thin soil and the seed. "Surely no one believes its chances of survival are as great on a thin rocky path as in cultivated fertilized soil" (pg 44 of his book). My thought, having read that statement, was "surely no one believes that the human embryo is in any way analogous to a seed or that the human endometrial lining is in any way analogous to dirt." If one insisted on using the example of the seed and the hostile soil, it may be more analogous to say that in times of drought, the soil is dry and barren. Because of the drought, there is also no seed production. When conditions are more favorable and there is seed production, the soil also responds and becomes more favorable. In addition, the seed sends signals to the soil to make it even more fertile. It is interesting to note that, at one time, the pioneers who came through Illinois thought that the treeless prairie must have infertile soil. After all, they speculated, the lack of trees must mean that the soil is hostile to seed germination. Things are not always as they seem.

Integrins are molecules believed to be markers of endometrial receptivity. Alcorn cites a study that shows changes in integrin expression in the endometri-

um of OCP users that are unfavorable to implantation.[17] No attempt was made, however, to ascertain whether these patients were anovulatory or ovulatory. The critical question, again, is whether these unfavorable changes in integrin expression occur in ovulatory cycles on the OCP. That same study cites another study in which integrin levels were measured in cycles where the postcoital contraceptive (the morning-after pill) approach was used. That is, high dose OCP was used for a short time after coitus. In these cycles where ovulation was documented, the integrin expression was no different than that seen in non-OCP users. The author cautions that this could be due to sampling the endometrium too late in the cycle. It is tempting to argue that the cycle in which postcoital OCP is used after ovulation is an approximate representation of what happens when a woman misses pills and ovulates. Would it then be reasonable to speculate that integrin expression in the endometrium of ovulatory women on the OCP may be normal? Probably not, since the "morning-after pill" is so different from the OCP in timing and dose.

Alcorn, however, does attempt to equate the so-called morning-after pill with the OCP (pg 35 of his book). "It is significant that this 'morning-after pill' is in fact nothing but a combination of several standard birth control pills taken in high dosages. When the announcement was made, the uninformed public probably assumed that the high dosage makes birth control pills do something they were otherwise incapable of doing. But the truth is, it simply increases the chances of doing what it already does – *cause an abortion*" (emphasis his). But how can he reach that conclusion? The "morning-after pill" is four pills in one day, nothing at all like the OCP where one pill is taken every day to prevent ovulation. In addition, those four pills are taken at any time in the cycle that they might be needed. The mechanism of action of the "morning after pill" is not at all clear. It may prevent ovulation in some cases and prevent implantation in others, depending on when in the menstrual cycle it is taken. This is far different from the OCP in both mechanism of action and intent. Any medication, if taken in a way other than for which it was designed, can have a different adverse effect. That certainly does not mean that the adverse effect is present when the medication is taken correctly.

Alcorn proposes yet another means of preventing implantation (pg 33 of his book) when he quotes from *My Body, My Health:* "Estrogen and progestin may also alter the pattern of muscle contractions in the tubes and uterus. This may interfere with implantation by speeding up the fertilized egg's travel time so that it reaches the uterus before it is mature enough to implant." He then goes on to say that "this is the same contraceptive effect Dr. Speroff referred to as 'peristalsis within the fallopian tube.'" Speroff, however, was referring to animal studies rather than human studies. In fact, Speroff states: "Moreover, when fertilized donor eggs are transferred to women who are on hormone supplementation, there are a number of days during the treatment cycle when the blastocysts will implant. This crucial difference between animal and human physiology is of more than academic importance. There has been speculation concerning the use of drugs that could accelerate tubal transport as a means of providing contracep-

tion by ensuring that the egg would reach the uterus when it was in an unreceptive state. Although this may work in animals, it is of doubtful value in the human because perfect synchrony is not required."[19]

The Incidence of Ectopic Pregnancy

Alcorn, quoting Dr. Walter Larimore, suggests that the use of OCP does not lower the incidence of ectopic pregnancy to the same degree that it prevents intrauterine pregnancy (pg 31 of his book). This would imply that the endometrium on the OCP is more hostile than the tubal lining in an ovulatory cycle on the OCP. Larimore believes, in other words, that the OCP is better at preventing implantation in the right place than it is at preventing implantation in the wrong place. He refers to a study by Mol et al to back up his belief.[20] In a meta-analysis, Mol showed that the OCP protects against both ectopic and intrauterine pregnancies. But when pregnancy does occur, there is a slightly increased risk of ectopic pregnancy on the OCP. Mol, however, offers an explanation for this observed increased risk that is different from the explanation offered by Larimore. He points out that the meta-analysis includes the progesterone-only pill, which is known to have higher rates of ovulation and which is also known to slow tubal transport, thereby increasing the risk of implantation in the tube. This is an effect of progesterone, as opposed to estrogen, which speeds up tubal transport.

In addition, Weiss et al. suggest that the apparent increased risk of ectopic pregnancy may be explained by the definition of the control group.[21] The control group consisted of pregnant women seeking abortion. Those women who had a tubal pregnancy diagnosed prior to seeking abortion would not be included in the control group since they did not present to the abortion clinic to have an abortion. The pregnant control group in the study would therefore have an under-representation of tubal pregnancies.

Larimore refers to another study to support his belief that the OCP prevents the embryo from implanting in the right place, leading to a relative increased risk of ectopic pregnancy. The author of the study, however, does not come to the same conclusion: "Use of combined oral contraceptives at time of conception was not associated with a significant increase in the risk of ectopic pregnancy. However, four cases and two pregnant controls used the minipill (POP), and this excess among cases is consistent with previous reports suggesting a higher proportion of extrauterine pregnancies in minipill failures."[22] Larimore again lumps the progesterone-only minipill in with the combined estrogen and progesterone OCP. This is in contrast to the author's observation of no increased risk of ectopic pregnancy with the combined estrogen and progesterone OCP. In fact, the author goes on to say: "Our interpretation of the present results is that methods such as the combined pill provide the maximum protective effect against ectopic pregnancy by preventing ovulation . . .."

Another source for the Alcorn/Larimore proposal is a letter to the editor in *The Journal of the American Medical Association* (JAMA)[23] in which a study was described showing an increased rate of ectopic pregnancy relative to the rate of

intrauterine pregnancy on the OCP. Although studies had shown increased risk on the progesterone-only minipill (POP), this study showed an increased risk on the estrogen and progesterone combined OCP. The author of the study concluded that the new lower dose OCP may allow ovulation and prevent implantation in the uterus, but not in the tube. The author who replied to the letter agreed, but also said that the observed increase risk of ectopic pregnancy could be due to some other OCP associated risk of ectopic pregnancy, such as pelvic infection.

Long Term Effects

Alcorn quotes from *Linacre Quarterly* when he suggests that the OCP may have a prolonged effect on the endometrium or cause chromosomal abnormalities in the embryo after a woman has stopped taking the OCP, both of which would cause increased risk of miscarriage. He then suggests that this is the reason that it is recommended that pregnancy be avoided for three months after stopping the OCP. Numerous studies, however, have shown no increase in the risk of miscarriage in women who conceive immediately after stopping the OCP. In those miscarriages that do occur, studies have shown no increase in the incidence of chromosomal abnormalities in the aborted tissue. Women are advised to avoid pregnancy for at least one spontaneous cycle for one simple reason: The OCP can delay resumption of spontaneous ovulation after stopping the OCP, making it difficult to determine the due date for the pregnancy. It is more accurate to determine the due date based on a spontaneous last menstrual period rather than relying on a pill-induced period.[24]

The OCP: Contraceptive or Abortifacient?

Based on the ovulation studies it is clear that the OCP is capable of living up to its name of being an effective contraceptive. When used correctly, it effectively prevents ovulation and therefore conception. It is also clear, however, that it sometimes fails to do so. Although there is no direct evidence that this results in loss of the embryo, one cannot prove that it never happens. Does this mean that the OCP is an abortifacient, as Alcorn contends?

An abortifacient, according to *Taber's Cyclopedic Medical Dictionary,* is anything used to cause or induce an abortion. Is the OCP an abortifacient? Or is it a contraceptive that has the potential for failure, a failure that may result in the death of the embryo? A gun becomes a murder weapon when used intentionally to kill someone. A car becomes an instrument of homicide when driven by a drunk. When used correctly and for the purpose for which they were designed, the gun and the car are simply agents of sport and transportation respectively. It would be absurd to say that because the gun and the car sometimes kill people, they are in essence agents of homicide. In the same way, the OCP is not an abortifacient simply because it may have the potential to abort.

In saying that the OCP is an abortifacient, Alcorn confuses function and essence. By design, by intent, and by primary function, the OCP, when properly

used, is in essence a contraceptive. The fact that it may fail to act as it was designed does not change its essence. We see this same confusion of function and essence in pro-abortion arguments when it is argued that the unborn is not fully human because she does not function as a human being. The pro-life response is that we are not human because we function as humans. Rather, we function as humans because we are human. The unborn is a human person who is not yet fully functional. Similarly, the OCP is a contraceptive even though it may not always be a fully functional contraceptive.

Alcorn states that "to be an abortifacient does not require that something always causes an abortion, only that it sometimes does" (pg 23 of his book). The first part of his statement is true, for the success of an agent does not define its essence. That is to say, a hunter who uses his sport to kill people is a murderer if even just one of ten attempts at murder succeeds. On the other hand, if a hunter accidentally kills a fellow hunter, he is not a murderer. In the same way, a medication that is used to prevent conception is not an abortifacient even if it sometimes causes abortion. A medication that is designed and intended to cause abortion, however, is an abortifacient.

What to do?

What are we to do with the information at hand? Since the OCP may pose an unknown degree of risk to the embryo, should we use it as a form of birth control? Randy Alcorn believes that it is more Christ-like to not use the OCP.

There are other analogous situations to which we can turn for guidance. With every medication, with every treatment, with every surgery there is an inherent risk of causing harm. Physicians decide to treat or not to treat based on risks versus benefits. If the treatment causes some deaths but the number of deaths is acceptable compared to the benefits of being free of the disease or condition, then we say that the benefits outweigh the risks. We know that many treatments can result in the death of the patient, but we prescribe them nevertheless because statistically patients benefit from the treatment and the risk is justified. The harmful effect of the treatment is tolerated because the benefits of the treatment are proportionately great. We may not know if a particular patient will be harmed or helped from a treatment, but we know that if we prescribe that treatment to enough patients, more patients will be helped than hurt.

When I was an intern I found myself one day in an elevator alone with the chairman of my department. I was troubled by my timidity in treating patients and expressed my fear of hurting someone. My chairman, Dr. Fred Zuspan, told me something that I lean on to this day. Looking at me he said: "Joel, that's fine, but now you have to start worrying about not helping someone." That is what medicine is about. If we were to let fear of hurting an individual patient paralyze us into inaction, no one would be helped.

In prescribing the oral contraceptive, some women (viz., one in 100,000) and perhaps some embryos will die. It is a matter of degree of risk. If the risk of death

is low, the benefits of the OCP justify use. Since the risk of death on the OCP is less than the risk of death in pregnancy, the risk is tolerable. Alcorn does not object to the use of the OCP based on the risk of death to the woman taking the pill. Yet, her risk of death is known and acceptable whereas the risk of death to the embryo is unknown and to Mr. Alcorn unacceptable. The death of the woman, however, is just as much my responsibility as the death of an embryo. The fact that she consents and the embryo does not in no way lessens my responsibility.

Be aware, however, that responsibility, as I am using the word, does not imply desire or intent. Although I know that deaths do occur as a result of my prescription, I do not want that particular patient to die. When I prescribe the OCP, I do not want an embryo to die. The death of the embryo, should it occur, is the undesired result of intending to prevent fertilization. If the risk of death is acceptably low and the benefit of contraception is felt to be high, then prescribing the pill is an acceptable practice of medicine.[25]

Some would argue that the concept of risk and benefit does not apply since the OCP does not directly benefit the embryo while at the same time posing some risk. This is one of the interesting aspects of reproductive medicine, however. Everything that a pregnant woman ingests and every activity that she undertakes poses a potential risk to her baby. Yet, most of her daily activity and some of what she ingests does not directly benefit her unborn baby. She drinks a cup of coffee, takes a Tylenol, and drives to work, all for her benefit. She does this believing that the benefits to her outweigh the risks to her baby. Similarly, physicians prescribe medications for the pregnant woman for her benefit, believing that the benefits outweigh the risks to the baby.

The issue of hormonal therapy and breast cancer is a good illustration of the decision-making process that physicians must go through in deciding how to best treat a patient. We know that breast cancer is linked in some way to estrogen. Breast cancer is much more common in women than in men, for instance, and breast cancer is many times estrogen receptor positive, meaning it will be stimulated by estrogen. Yet, the preponderance of evidence suggests that prescribing estrogen to menopausal woman does not substantially increase the risk of breast cancer. The studies on the subject are somewhat mixed in results, but for the most part are reassuring. On the other hand, the benefits of taking estrogen after menopause are well documented and consistent. What should we do? After all, we cannot prove that estrogen therapy never causes breast cancer, and future studies could show that estrogen clearly causes breast cancer. If we wanted to be completely safe, I suppose we should not prescribe estrogens at all. That approach, however, would deny to many women the benefits provided by taking estrogen.

The answer is that we try to practice evidence-based medicine. Evidence-based medicine is best described by the following quote from *Danforth's Obstetrics and Gynecology:*

> Excellent medical practice should be inspired by love and guided by science. Both are essential. If a clinician practices scientific medicine without compassion, he or she becomes an automaton. On the other hand, if a clinician is compassionate but unscientific, he or she may be as dangerous as a well-intended parent feeding chicken soup to a child with meningitis. Evidence-based medicine is not only well-intended, it is well directed.
>
> – David A. Grimes

So we look at the studies and act on what we know to be true given the present state of knowledge. We do not act on speculation or unfounded fears. We inform the patient and then give our best recommendation, letting her make the final decision. We prescribe estrogen, not yielding to unproven fears of cancer, while at the same time keeping our eyes on future studies.

Perhaps a more commonly encountered dilemma is one faced by all of us – driving a car. We know that a certain number of children are struck and killed by cars each day. On any particular day, we could be driving the car that kills a child. Yet, we still get in our car each day to go to work or play. We do this knowing that the risk is acceptable and the benefits of being able to drive outweigh the risks to children. Alcorn feels that, unlike using the OCP, driving a car is an acceptable risk because he feels that there are no alternatives. He states that "there is no such thing as a car or a house that poses no risk to your children. But there is such a thing as a contraceptive method which dose not put a child's life at risk. There are safe alternatives to the Pill that do not and cannot cause abortions" (pg 60 in his book). Alcorn asks: "Is it a Christ-like attitude to say 'Because taking the Pill may or may not kill a child, I will therefore take the Pill'?" (pg 55 in his book).

But just as we choose our mode of transportation based on the risks versus convenience, can we not choose our contraception based on risks versus convenience? Just as we could choose not to use the OCP because of a perceived unacceptable but unknown risk to children, could we choose not to drive a car based on a known risk to children? If our driving sometimes causes the death of innocent human beings, the Christ-like thing to do, perhaps, would be to not drive at all. Yet Mr. Alcorn does not say this. Apparently walking, which is much less convenient and efficient, is not for Mr. Alcorn an acceptable alternative to driving just as condoms, which are much less convenient and efficient, are to some not an acceptable alternative to the OCP. Yet, are we not responsible for the death of a child we have killed with our car in the same way that we are responsible for the death of the embryo we have killed with the OCP? We did not want the death but we chose a course of action with the foreknowledge that it could happen and knowing that we had a safer alternative course of action.

Another well known risk is hunting. We know that a certain number of hunting accidents occur each year resulting in a number of deaths. Alcorn asks the rhetorical question: "If a hunter is uncertain whether a movement in the brush is caused by a deer or a person, should this uncertainty lead him to shoot

or not to shoot?" (pg 55 in his book). The answer, I assume, that Alcorn would give is to not shoot. But to be consistent with his conclusion that we should not take the OCP, he would have to conclude that, to be totally safe, we should not hunt at all. There are safer alternatives to hunting, such as photography, and if hunting sometimes causes the death of innocent human beings, the Christ-like thing to do, perhaps, is not to hunt at all.

The Principle of Double Effect

Walt Larimore[26] feels that the OCP does not satisfy the conditions necessary for successful application of the Principle of the Double Effect. This principle allows the performance of an act that has good and bad effects under certain conditions:

1. The act itself must be morally good or at least neutral.
2. The person performing the act must intend the act to be morally good.
3. The good effect must not follow a bad effect.
4. The good effect that is intended must have sufficient moral value to justify tolerating the bad effect.
5. There must be no other way of producing the good effect.

Larimore concedes that the first and second conditions are met. He feels that the third and fourth conditions are debatable and the fifth is not met. That is to say, sometimes the birth control effect is accomplished through the pill's abortifacient effect (3), convenience of birth control is not of sufficient value to justify the deaths of embryos (4), and there are effective, safer alternatives to the pill (5).

The problem is in his definition of the good effect. He refers to the pill as the birth control pill (BCP) because he feels that it controls birth, not conception. He naturally concludes, therefore, that the desired effect is birth control. The effect of birth control may in part be from abortion and there are other forms of birth control that do not cause abortion.

If, however, one feels that the pill is a contraceptive through its prevention of ovulation, the pill is referred to as the oral contraceptive pill (OCP). The desired effect is not simply birth control but rather prevention of conception by prevention of ovulation. As a matter of fact, physicians frequently prescribe the OCP to prevent ovulation for medical reasons that have nothing to do with birth control. If the desired effect is prevention of conception by prevention of ovulation, it is not accomplished by a bad effect and there are no alternatives that are safer. The conditions necessary for successful application of the Rule of Double Effect are met.

Summary

I have examined Randy Alcorn's work on the mechanism of action of the OCP. Although I found some of his statements to be in error or misleading, he does raise a very important question about the OCP. Does it cause abortion? The only thing clear to me is that the answer to this question is unclear.

Alcorn's contention that it does cause abortions is speculative, being based primarily on the observation that the OCP creates an endometrium that appears to be hostile to implantation when it functions as it was designed to do – prevent ovulation. What is not clear is what happens to the endometrium when the OCP fails to do what it was designed to do and ovulation occurs. I have cited some studies that suggest that the endometrium is more normal when ovulation does occur on the OCP, but this does not prove that implantation is as successful as in those not on the OCP. And just how good is the embryo at implanting into a hostile environment if it does exist anyway?

I have also found some real problems with Mr. Alcorn's interpretation of the studies on ovulation rates and tubal pregnancy rates with the combination estrogen and progesterone OCP. At times, he seems to come to a conclusion that is different from that of the authors of the studies. It is not possible, based on these studies, to conclude that the OCP causes abortions. In fact, based on more recent studies, it appears that the OCP, when taken correctly, approaches 100% effectiveness in preventing ovulation.

I certainly do not want to represent myself as being an expert in the area of contraceptive technology. The paucity of good studies that specifically address the question of the OCP's potential to cause abortions makes it impossible to be an expert. It is clear to me, however, that it is not possible to say that the OCP causes abortions. I am comforted to some degree by the fact that, as pointed out by Alcorn (pg 67 in his book), the majority of the Focus on the Family's Physician's Resource Council also concluded in 1997 that there is no direct evidence that the pill causes abortions.

As a physician, I have seen countless women who have benefited from the OCP. The benefits go beyond adequate birth control to a better quality of life. They have more manageable periods, less cramps, improved acne, less premenstrual symptoms, less chance of tubal infection, less chance of ectopic pregnancy, less benign breast disease, less rheumatoid arthritis, better bone density, and a decreased risk of ovarian and uterine cancer. The studies on cervical and breast cancer are mixed, but overall the results are reassuring. The safety of the OCP, one of the most studied drugs ever, is well established.[27] Just as I am not willing to deny estrogen to menopausal women based on unfounded fears of breast cancer, I am also not willing to withhold the benefits of the OCP based on unfounded fears of causing abortion.

Alcorn would say that this is not good enough. "Show me the evidence, direct or indirect, that the Pill never causes abortions" (pg 73 in his book). This, of course, would be impossible. If he were to apply this same standard to other risks, he would never drive his car or give his children a headache medication. He would not use a cellular phone either, since there is no evidence that says cellular phones never cause brain tumors.

If we cannot decide if the OCP causes abortions, perhaps we can determine what we are dealing with. What is the OCP? Is the OCP an abortifacient, as Alcorn

asserts? Or is it a contraceptive that has the potential for failure, a failure that may result in the death of the embryo? I think it is clear that, when used for the purpose for which it is designed, the OCP is a contraceptive both in design and intent.

One solution to our dilemma would be to simply not use the OCP, as Alcorn suggests. I would not criticize someone for taking that approach. In the face of a lack of credible evidence that the OCP does cause abortions, however, I would wonder about someone's consistency if they advocated not using the OCP while at the same time driving to work, hunting, taking estrogen after menopause, or engaging in any other activity with potential risks, whether real or perceived.

Another approach would be to use the OCP but use it responsibly. In carefully monitored studies with highly motivated women, the rate of pregnancy on the OCP is .1% per year whereas the observed rate in the general population is 3% per year[28]. This difference is due to breakthrough ovulation when errors are made in taking the OCP or to decreased absorption of the OCP secondary to medications or illness. If the OCP has the capacity to cause abortions when it fails to prevent ovulation, it makes sense to increase its capacity to do what it is designed to do – prevent ovulation. This means acting responsibly when using the OCP. This means remembering to take the pill as it was designed and using back-up contraception when an error is made or when taking a medication that might interfere with the OCP. This means using back up contraception when one has an illness with nausea and vomiting. This is no different than handling a car or gun responsibly.

Do the benefits of taking the OCP outweigh the risks? The answer is yes if one considers only the woman taking the pill. But what about the embryo? We simply cannot quantify the actual risk to the embryo with our present state of knowledge, but we know that we can lessen that risk by taking the OCP responsibly. In my judgment, responsible use of the OCP results in a risk to the embryo that is tolerable.

Finally, Alcorn made a good point about informed consent. Perhaps we should tell our patients about this controversy. But what exactly do we tell them? Is there a high risk or low risk of causing abortion? I tell them that there is an unknown risk but that the risk can be reduced to a tolerable level through responsible pill taking. I have advised some of my patients to take the OCP continuously rather than cyclically. By avoiding the pill – free week, one would theoretically lower the risk of accidental ovulation due to missing those pills most commonly forgotten, the first few pills of the pack. There are no health risks associated with taking the OCP in this manner. Spona advocates a similar approach in suggesting a shorter pill-free interval to minimize side effects and increase effectiveness of the OCP.[29] E&M

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[1] Alcorn R. *Does the Birth Control Pill Cause Abortions?* (Eternal Perspective Ministries, 1998, 2nd ed.).

[2] Abortion is the termination of pregnancy by any means prior to viability of the fetus.

[3] I follow the position of the American College of Ob-Gyn (ACOG) in defining the beginning of pregnancy as the time of implantation. Pregnancy is a maternal condition unrelated to the condition of the embryo. One can have a pregnancy that is abnormal with no embryo (molar pregnancy), for instance. On the other hand, one can have an embryo in the laboratory in which case no one is pregnant. This in no way means that the embryo prior to implantation is less significant in any morally relevant way. Contrary to ACOG, however, I define conception as meaning fertilization rather than implantation. In other words, I consider conception to refer to the beginning of the embryo's existence, usually by fertilization, not the beginning of a pregnancy. Defining the terms pregnancy, conception, and abortion is not just an academic exercise. Since ACOG defines conception and pregnancy as beginning at implantation of the embryo, the embryo cannot be aborted prior to implantation since the pregnancy has not yet begun. Therefore, destruction of the embryo prior to implantation is not an abortion. Similarly, a contraceptive is anything that prevents fertilization and implantation since conception is at implantation. This confusion of terms can be used to mask moral issues. For this paper, to avoid confusion over moral issues, I will continue to use the term abortion to describe the loss of the embryo both prior to and after implantation.

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Joel Goodnough, MD is a gynecologist who practices in Arlington Heights, Illinois, USA.

SPONSORSHIP OF EDUCATIONAL PROGRAMMES IN NIGERIAN MEDICAL & PHARMACY SCHOOLS BY PHARMACEUTICAL COMPANIES: POSSIBLE RISK IMPLICATION FOR PUBLIC HEALTH

EMMANUEL O. OKORO AND ARTHUR E. DAVIES

In Nigeria, cost of drugs can account for up to sixty percent (60%) of health expenditure (Salako, 1992), in contrast to only about 10-20% in developed nations. The reason is that until recently, health was heavily subsidized and even free in some parts of the country where the party in power claimed to pursue a welfarist agenda. However, a careful scrutiny of the health budget will show that not all the drugs need to be purchased and many of those that are purchased do not necessarily give the users any substantive value for their money. Part of the problem is the intense promotional activities of marketers of pharmaceuticals, which are often more concerned with boosting sales of their drugs than promoting genuine scientific knowledge (Lexchin, 1987).

Consequently, health care professionals unwittingly rely on the information on drugs provided in the advertisement by marketing companies rather than on the scientific literature (Avorn *et al,* 1989; Lexchin, 1992). Advertisement-induced knowledge has been implicated in incorrect use of medicinal drugs in many developing countries (Dikshit and Dikshit, 1996) as a result of inadequate prescription guides. There is some evidence (Assad and Mirza, 1999, Okoro and Davies, 2000) that providing accurate and comprehensive drug information is not a priority for many marketing companies doing business in third world countries. Indeed, the United States Office of Technology Assessment estimated that up to two-thirds of medicines sold in developing countries by Multinational Drug Companies have probably been packaged with incomplete or misleading prescription guides (Frankel, 1993), thus precipitating irrational use of drugs as well as increasing the cost of health care.

In order to minimise this problem, the Nigerian Government organised in 1994 a workshop for senior medical educators and teachers of pharmacology in the country. At the workshop, the participants were asked to draw up a programme that would incorporate into the curriculum, the teaching of essential drug concepts with a view to inculcating the principle and practice of rational drug use as well as economic prescription model in future doctors and pharmacists.

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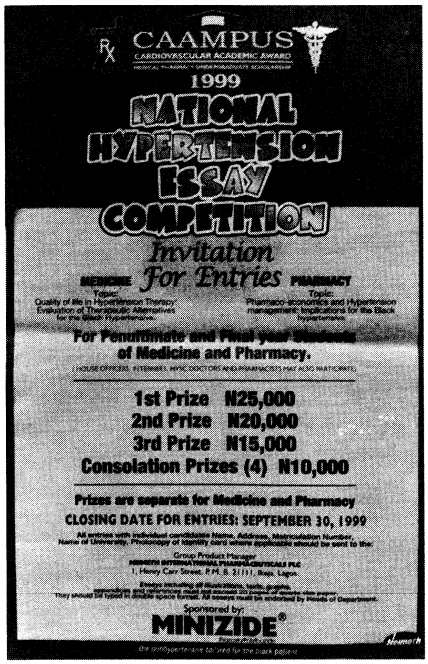
In 1998, a pharmaceutical company also launched an educational programme, ostensibly as part of its contribution to the rational drug use programme. The educational programme was in the form of an essay competition and was designed specifically for penultimate and final year medical and pharmacy students as well as intern doctors and pharmacists. The objective of the programme, as stated by the company, was to draw attention to the peculiarities of hypertension in blacks that should be taken into consideration in the choice of anti-hypertensive drugs for Nigerians. For this reason, the company listed two essay topics for the 1999 competition for two categories of competitors, namely (1) medical interns and students and (2) intern pharmacists and pharmacy students. The essay topics were: (a) *Quality of life in hypertension: Evaluation of therapeutic alternatives,* for medical interns and students. (b) *Pharmaco-economics and hypertension: Implications for the black hypertensives,* for intern pharmacists and pharmacy students.

In the advertisement announcing the 1999 essay competition (fig. 1) the sponsors of this educational programme who were also the makers and distributors of a fixed drug combination of prazosin 0.5mg and 0.25mg polythiazide per tablet indicated conspicuously and for effect, that this medication is the "*anti-hypertensive tailored for the black patient*" (fig. 1).



(figure 1)

In this article we examine the basis of this outlandish claim by the promoters of this medicine vis-à-vis the stated objective of the educational programme which is to promote the wise and economic use of anti-hypertensive drugs through new and potential Nigerian prescribers.

Background Pharmacology of Prazosin

Prazosin is an anti-hypertensive drug available as a single formulation and prazosin as a fixed combination which contains prazosin and polythiazide in doses as earlier indicated (fig. 1). Generally, prazosin is a highly selective a1-adrenergic antagonist that lowers blood pressure on the basis of its blockade of this receptor type at arterial smooth muscle. Its neutral effect on blood lipids and glucose metabolism reported in many studies (Alderman and Madhaven, 1981; Murphy *et al,* 1982) initially enhanced its popularity and preference over thiazides because of safety concerns. At that time, it was believed that the adverse effects of thiazides on electrolytes, particularly hypokalaemia, were in some way linked to the lack of reduction in cardiac mortality in hypertensive patients treated with thiazides. However, this problem has now been laid to rest because subsequent studies (Ajayi *et al, 1*989; Salako *et al,* 1998; Matterson *et al,* 1993; Flack and Cushman, 1996; Kapuku *et al,* 1998) in many parts of the world, including Nigeria, have shown that when correctly used, thiazides effectively lower blood pressure without any clinically relevant electrolyte and metabolic consequences.

Furthermore, while prazosin (single formulation) is made available in many countries by the Marketers referred to - in fig. 1, prazosin is only available and marketed as a fixed drug combination in Nigeria (Mims, 1983 - 1989; 1999; BNF, 1991). The maximum recommended daily dose for the treatment of hypertension is 16 tablets, i.e. 8 mg prazosin combined with 4 mg polythiazide (Ibid). On the other hand, polythiazide on its own is not marketed in Nigeria but is available to prescribers in the UK (BNF, 1991). The recommended daily dose for polythiazide in the treatment of hypertension is 1-4 mg, although prescribers are advised to start with as low as 0.5 mg which is often sufficient to control blood pressure in most cases (Ibid).

How Effective is Prazosin?

Many studies (Pikajarvi *et al,* 1977; Alderman *et al,* 1986, Stamter *et al,* 1986; Stokes, 1998) on hypertensive Caucasians reported that in treating hypertension 3 mg to 9.5 mg prazosin (single formulation) given in two or three divided daily doses will be effective. In contrast, early observations (Mroczek *et al,* 1974) in Americans of African descent indicated that a daily dose of about 16.5 mg prazosin could be required to lower blood pressure effectively, thus, raising the possibility of racial differences in the anti-hypertensive efficacy of prazosin.

Specifically, two studies carried out on Nigerians using prazosin showed striking results. In 1976, a team of two cardiologists and a clinical pharmacologist in Ibadan, south western Nigeria, reported (Falase *et al,* 1976) their experience with prazosin in which they found that even doses as high as 15 mg/daily significantly reduced blood pressure only when 3 mg daily of polythiazide was added. Later, Oviasu and Idahosa (1976) in another part of southern Nigeria reported that between 4-6 mg doses of prazosin administered daily caused significant reduction in blood pressure, defined as a fall of 10 mmHg in systolic and or diastolic BP in supine or erect positions.

However, examination of the responses in all the patients studied showed that 50 mg of hydrochlorothiazide daily was added to prazosin (single formulation) before their blood pressure could be normalised. Both clinical trials were sponsored by the then sole marketers of prazosin in Nigeria. The study designs were similar and the two studies drew similar conclusions regarding the doubtful efficacy of prazosin (single formulation) in controlling blood pressure. Besides, the two Nigerian studies were reported as preliminary with both groups of investigators clearly indicating that further studies were needed to clarify the question of comparative anti-hypertensive efficacy and safety of prazosin vs polythiazides or hydrochlorothiazide.

To date there is no evidence that such studies so recommended by the investigators have been carried out. Meanwhile, prazosin as a fixed combination drug is being produced for and marketed in the Nigerian market (Mims, 1983; 1989; 1999; BNF, 1991). It is probable that the two Nigerian studies cited above, particularly that of Falase *et al* (1976), greatly influenced the product formulation, It is also plausible that the two studies were in fact undertaken as part of the process of fulfilling the regulatory requirement for product licensing in Nigeria.

However, the absence of any study on the comparative anti-hypertensive efficacy and safety of prazosin as a fixed combination vis-a-vis its individual components has made it impossible for prescribers to have information on whether its low dose is more effective than the single conventional doses of (4-6 or 15 mg/daily) or polythiazide (3 mg daily) or hydrochlorothiazide (50 mg/daily) in patients with hypertension as reported in the available Nigerian studies (Falase *et al,* 1976; Oviasu and Idahosa, 1976). Such information would have enabled us to determine whether the routine use of this fixed combination as advocated (fig. 1) as a first line treatment of high blood pressure in Nigeria confers any real benefit more than the use of the individual components and if it does at what cost to the patients.

Prazosin vs Thiazides: Comparative Anti-hypertensive Efficacy

A number of studies conducted elsewhere exist on the comparative anti-hypertensive efficacy and tolerability of prazosin and thiazides. First, in a double-blind placebo controlled randomised comparative study involving 62 patients followed for a year, prazosin (single formulation, 2 mg, 6 mg, 10 mg, 20 mg) and hydrochlorothiazide (25 mg, 50 mg) at this dose range showed similar anti-hypertensive efficacy and patient tolerability, although prazosin had a more favourable influence on biochemical indices of blood lipid profile (Stamler *et al,* 1986). Similarly, in a bi-racial population of Americans (black and white) with hypertension of all grades, 11.4 mg of prazosin and 49.5 mg hydrochlorothiazide were reported (Alderman *et al,* 1986) to be equi-effective in blood pressure reduction.

Of note, nearly 66% of patients who responded (over 75% in either drug group) to prazosin with satisfactory blood pressure required either 10 mg or 20

mg of prazosin daily, while all those who responded satisfactorily to hydrochlorothiazide required either 25 mg or 50 mg daily of hydrochlorothiazide. Interestingly, in those not responding to the maximum dose, combination with the other drug at sub maximal dose did not often lead to a further fall in blood pressure beyond that observed with maximum dose of either drug after a year. This may suggest that in those groups of hypertensive patients responsive to thiazide, the addition of prazosin may confer no additional benefit in terms of blood pressure reduction beyond that observed with the thiazide alone. Also hydrochlorothiazide was better tolerated than prazosin contrary to expectation at that time.

In addition, an earlier study (Pitkajarvi *et al,* 1977) on Finnish patients demonstrated that polythiazide at a dose of l mg daily normalised the blood pressure in all patients with mild hypertension within 3 weeks, but addition of daily dose of prazosin ranging from 6-15 mg to this dose of polythiazide was often required to normalise blood pressure in those with more severe form of hypertension. It is important to note that in this study, 31 of the 41 patients exposed to this dose of polythiazide had hypokalaemia, necessitating the reduction in the dose of polythiazide to 1mg, 4-5 times weekly. This suggests that low doses (less than 1 mg daily) of polythiazide are equally effective in reducing blood pressure without any adverse metabolic effect.

More recently (Matterson *et al,* 1993), in a study comparing the efficacy of six anti-hypertensive drugs on young and old adult white and African Americans, prazosin (4 mg/daily) was no more effective in blood pressure reduction than hydrochlorothiazide (12.5 mg/daily) in the entire study population. Among blacks, particularly the elderly, hydrochlorothiazide (12.5 mg, 25mg, 50mg) daily was found to be superior to prazosin (4mg, 10mg, 20mg) in terms of anti-hypertensive efficacy and side-effect profile. This reinforces earlier conclusion that people of African descent are less responsive to the anti-hypertensive action of prazosin when compared with their response to thiazide.

Comments

The foregoing raises a number of issues. First, the evidence to suggest that prazosin is superior to the thiazides in terms of anti-hypertensive efficacy and side effect profile is lacking. Rather, the available data (Matterson *et al,* 1993; Kapuku *et al,* 1998) suggest that individuals of African descent are probably more responsive to the anti-hypertensive effects of thiazides when compared to their response to prazosin, thus, indicating that thiazides are probably better (Alderman *et al,* 1986; Stamler *et al,* 1986; Olowoyeye *et al* 1986). This is consistent with available data which also show that black people including Nigerians are more responsive to the anti-hypertensive effects of thiazides when compared with their responses to even the newer and far more expensive angiotensin, converting enzymes inhibitors (Ajayi *et al,* 1989; Kalow, 1989; Matterson *et al,* 1993) and b-blockers probably with the exception of atenolol (Salako *et al,* 1990).

Second, the evidence demonstrating that low dose combination of prazosin and polythiazide as formulated in the product sold only in Nigeria is far more effective and better tolerated than the individual components in Nigerians is yet to emerge. That being the case, the claim made by the distributors of prazosin (fixed combination) in Nigeria, that it is "*the anti-hypertensive tailored for the black patient*" is at variance with the existing data from scientific literature. Furthermore, the results of the available clinical trials on prazosin do not justify the misleading advertisement and extensive marketing of prazosin as a fixed combination drug in Nigeria, when the individual components are not available to Nigerian prescribers unlike the case in the UK.

There are many implications arising from the formulation and marketing of this fixed combination drug in Nigeria. In the first place, hypertensive Nigerians who have been placed on a treatment regime of prazosin as a fixed combination drug may be paying more for the cost of the components of the drug when in reality only the therapeutic benefit of the thiazide component is all that accrues to them; thus, paying an extra cost for nothing beyond placebo effect. It would appear therefore that the marketers of prazosin as a fixed combination drug have been using its polythiazide component to sell its less effective prazosin component in Nigeria without any benefit accruing to the patient for using both components. Even where marginal benefits may, exist as in special cases (e. g., diabetic hypertensive and hypertensives with benign prostastic enlargement), there are still unanswered questions on long term superiority to justify the increased cost of this specially formulated prazosin as against the cheaper and more widely available thiazides (Salako *et al,* 1998; Kapuku *et al,* 1998). The Nigerian health scene is replete with very many disastrous consequences of untreated or poorly treated hypertension, despite the increased awareness of the danger inherent in this. However, one of the problems responsible for this situation is that many hypertensive patients do not have effective blood pressure control because they cannot afford the cost of prescribed drugs (Onwuchekwa, 1996- Salako *et al,* 1998). The implication is that the degree of drug compliance is very low among many hypertensives with access to health care who are predominantly illiterate and of low economic status. The results of this are premature death or disabilities which the treatment of hypertension was supposed to prevent in the first instance.

The problem is further compounded by the action of many prescribers. Although there are enough research data which show that consideration for affordable drug cost and in the case of hypertension, the prescription of appropriate and cost-effective anti-hypertensive drugs by health care professionals for optimising BP control, some prescribers do not seem sufficiently concerned with the cost implication of the regime they institute for their patients. It is true that there are many classes of anti-hypertensive drugs widely available in Nigeria, many of which are even listed in the country's Essential Drug List/National Formulary. But it is also true that many of these drugs are of doubtful comparative efficacy and of low value in terms of cost-benefit to Nigerian hypertensives

(Olowoyeye *et al,* 1986; Ajayi *et al,* 1989; Onwuchekwa, 1996; Salako *et al,* 1998) as it is the case with prazosin. Yet these classes of anti-hypertensive drugs carry prohibitive price tags and are still the favourites of prescribers who probably have been influenced by the promotional gimmick of drug advertisers (Avorn *et al,* 1987; Lexchin, 1992). Thus, lack of consideration for affordability of the cost of drugs to patients by prescribers invariably increases the cost of medication to patients, thereby making drug cost the single largest component of the health budget not only for the individual but also for the state. The objective of the sponsors of the educational programme to promote *wise and economic use of anti-hypertensive drugs* is not altruistic and indeed has been masked by the company's desire to boost the sale of the anti-hypertensive medication indicated in Fig. I of which the company is also the sole distributor in Nigeria (Mims, 1983; 1989; 1999). The company is likely to realise the masked objective, given the promotional strategy adopted for prazosin (fig. 1). A stamp of recognition will easily be conferred on the product because of the following reasons: (i) The target audience, i.e., the participants in the educational programme, are medical and pharmacy interns as well as students, all of whom are new and potential prescribers. They are probably less likely to be capable of evaluating the scientific data, if any, on which the company's claims are based because of their limited exposure to copious literature. (ii) What many doctors and pharmacists in most developing countries including Nigeria know about prescription drugs are often those provided in product advertisements which are more principally aimed at capturing the market than providing comprehensive and accurate information on drugs (Lexchin, 1992; Assad and Mirza, 1999). The negative effect of this is that prescription of anti-hypertensive drugs like prazosin and other expensive drugs, which has been influenced mainly by the promotional activities of drug distributors, is capable of contributing to the erection of unnecessary financial barriers to effective blood pressure control in Nigerians (Ajayi *et al,* 1989; Onwuchekwa, 1996, Salako *et al,* 1998).

Conclusion

Sponsorship of educational programme by pharmaceutical companies which are also distributors of a particular brand of anti-hypertensive drug as it is with the case of prazosin (fixed combination) may do more harm to the National Health Policy of minimising the financial barriers of Nigerians to quality Health Care. This is because the usual pre-marketing clinical trials for the drugs, sponsored by drug manufacturers as part of regulatory requirement are less likely to generate the kind of information on efficacy, tolerability, etc., on account of inadequate sample size, unresolved conflict of interest and inappropriate study design (Emmanuel and Steiner, 1995, Angell and Kassier, 1996, Smith, 1998).

The best way to prevent this type of situation is for the Nigerian government, through its Food and Drugs regulatory body to tighten its procedures for registering new drugs and insist on independent pre-marketing clinical trials. The government should also pay more attention to a grand swell of informed opinion

(Henry and Hill, 1995; Freemantle *et al,* 1995) which advocates that government should sponsor randomised trials, even after a drug has been registered, to find answers to unresolved questions regarding clinical and economic performance of licensed drugs. Above all, the government should go beyond organising workshops by sponsoring good clinical trials that could provide valuable information to guide Health Care Professionals in their choice of anti-hypertensive drugs and on which the government itself will base its drug procurement policy. All of these will have remarkably beneficial effect on good prescription habit of the professionals and help to minimise the cost of treating hypertension in Nigeria. E&M

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Emmanuel O Okoro teaches in the Department of Medicine and **Arthur E Davies** teaches in the Department of Political Science at the University of Ilorin, Ilorin, Nigeria.

Book Reviews

False Hopes: Overcoming The Obstacles to a Sustainable, Affordable Medicine
Daniel Callahan
New Brunswick, N.J. and London: Rutgers University Press, 1999
ISBN 0-8135-2674-4, 330 pp., paper $17.00

Daniel Callahan, co-founder and until recently the Director of the Hastings Center, continues here his quest, embarked on in his earlier *Setting Limits, What Kind of Life* and *The Troubled Dream of Life,* to redirect public understanding and expectations of medicine and healthcare. We are near crisis point, Callahan believes. The US system of healthcare is both the most expensive and the least fairly distributed of the western world. (41 million people without health insurance is morally unacceptable.) We cannot continue our current rates of spending on healthcare; the costs and the expansive delivery of healthcare in the western world are neither sustainable nor equitable. Tinkering with the system, however, will not sufficiently alter the strain upon the system from expensive new technologies, ever-increasing consumer demand and an ageing population; nor does tinkering address the problems of distribution. Instead, we need to rethink what medicine is, what its purposes are, what kind of value and of how much value health is. *False Hopes* endeavours to aid us in that rethinking of medicine.

Callahan's inspiration for his new model of medicine is the environmental movement's talk of 'sustainable environments.' Callahan proposes a 'sustainable medicine,' 'a medicine that in both research and health care delivery aims for a steady-state plateau, at a level that is economically affordable and equitably available, and also at a level that is no less psychologically sustainable, satisfying most—but, of necessity, not all—reasonable health needs and expectations' (p. 26). In short, what is required is a change in the demands we make for our healthcare, a change that is premised upon a more fundamental change in our attitudes, a change in our ideals with respect to medicine. Innovations in technology coupled with a growing affluence (in the western world) has led us to expect medicine and healthcare to continually 'progress' towards higher tech interventions at continuously lower costs. But this is a false hope, Callahan argues. We ought to expect medical progress, to be sure, but the future benefits of medicine are not likely to accrue to the general populace, but rather to a wealthy few, future benefits are likely to be more expensive than past medical achievements, and the future benefits of medicine are not likely to be unambiguously good. For example, who are the mostly likely to benefit from advanced techniques of genetic intervention? How expensive is genetic therapy likely to be? Would it be an obviously good thing to tweak the ageing gene so that we are able to live to be 120-140 years old?

Callahan, thus, maintains that we must give up the ideal of unlimited, ever advancing, rapid medical progress and replace that ideal with a 'sustainable' medicine. The consequences of failing to turn from 'progressive' to 'sustainable' medicine are significant: the economic stress upon the national economies of developed nations created by providing health care, the psychological costs of a growing medical perfectionism which tolerates no risk and no imperfections, the expansion of medicine to address all human needs, the skewing of medical priorities with the marginalization of the caring function of medicine, and the ever widening gap between the rich and the poor.

True hope lies in sustainable medicine. Sustainable medicine requires, first of all, that we 'live within the boundaries of nature.' The natural life cycle, thus, acts as a norm for healthcare. Rather than continuing our attempts to extend life expectancies, we should respect nature's tutelage that a decent life can be lived and end at the age of 75. Why spend money on research aimed at extending the life-span? Why invest significant healthcare dollars in treatment of the aged, already at or beyond their natural life-span? There are natural barriers to be heeded at the beginning of life as well. Attempts to improve the prospects for low-birthweight (below 500 grams) are likely to be most expensive while offering little real hope. Finally, a sustainable medicine

will recognise our natures as the complex, multifaceted creatures that we are, will, thus, recognise that perfect health is not the only human good and not the greatest of human goods.

Callahan recognises that the shift to a sustainable medicine is more easily accomplished in nations with more communitarian approaches to public health. American individualism and the dominance of the market model of medicine make it more likely that European nations with their longer traditions of 'solidarity' will harness the creeping imperialism of market medicine. The American emphasis upon personal responsibility, on the other hand, may better lend itself to corralling expansionist expectations of medicine.

False Hopes is a wise and provocative challenge to the practice of medicine in the developed world. Christians appropriately worry about the corruptive effects of the market upon the practice of medicine and about the ever widening gap between the medical have and have-nots. Callahan presents us with good reasons to settle for less when more might be achievable.

Thomas D. Kennedy, PhD
Philosophy Department
Valparaiso University, Indiana, USA

The Foundations of Bioethics, 2nd edition
H. Tristram Engelhardt, Jr.
Oxford and New York: Oxford University Press, 1996
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For those who have been following the career of modern bioethics for the past few decades, it is obvious that things are changing fast. Methodological certainties of just a few years ago seem strangely quaint and outdated. Bioethics was built upon a faith that the quandaries arising out of the new medicine could be resolved by the conscientious use of philosophical method. H. Tristram Engelhardt, Jr., physician and philosopher, has been a prominent figure in the movement to find a philosophical foundation for the bioethical enterprise. In 1986 he published his important work, *The Foundations of Bioethics,* and now in 1996 he has published a second, significantly revised edition. In the first edition Engelhardt acclaimed the development of secular bioethics, which is 'the attempt to find those understandings that can be justified across particular moral communities, traditions, and ideologies,' an approach that appeals to us 'as rational individuals without the special illumination of some divine grace.' This method provides 'the peaceable neutral framework through which [people] can reach out to others beyond their own particular religious tradition.' The job of the religious bioethicist, according to Engelhardt, is to 'establish through reason alone the great body of Judeo-Christian precepts.' The approach recommended to Christian ethicists was to engage in dialog using the methodology of general, public, and secular bioethics, while providing a theological interpretation and backing of the method for private consumption.

Dr. Engelhardt, who teaches in the Baylor College of Medicine and in the Philosophy Department of Rice University, has ranked among the most prominent of secular bioethicists. Thus it was surprising when, in this recent edition, he announced that he is now a 'born again Texan Orthodox Catholic, a convert by choice and conviction, through grace and in repentance for sins innumerable (including a first edition upon which much improvement was needed.)' Engelhardt, now a member of the morally conservative Antiochian Orthodox Church, revisits the topics he addressed in the past through Christian eyes. In this work, he clearly and forcefully articulates his ethically conservative views about the moral evil of such acts as abortion, while considering carefully the extent to which his convictions should be enforced in the broader society.

The faith on which bioethics was built, the faith that moral problems could be addressed through rational philosophical methodology in a way that could be compelling to people from across religious and philosophical traditions, has been strenuously challenged in the profound upheaval in philosophical ethics that has characterised the past decade or two. *Antitheory*, the

view that ethical theory is an impossible or undesirable intellectual enterprise, has put ethical theory on the defensive as perhaps never before. According to antitheorists, no compelling conclusions can be gained by the use of ethical theory. In addition, morality itself has come under attack by antimorality theorists, relativists and nihilists in the tradition of Nietzsche and others. Together, these movements challenge the idea that there is a 'common morality' that can bind together the diverse elements of society and provide a means for the resolution of moral controversies.

These theoretical developments have found their way down to the realm of applied ethics. The impact of these developments on bioethics can be seen in startling relief by comparing the 1994 fourth edition of Beauchamp and Childress's *Principles of Biomedical Ethics,* with their 1989 version. In those five years, the confidence in their method of principles based on ethical theory that had characterised the first three versions has given way in the face of a plethora of challenges and of such alternative perspectives as casuistry, care, virtue theory, and communitarianism.

Engelhardt also tries to do bioethics in the light of a complete acceptance of post-modern critiques of its foundations. He agrees with such contemporary thinkers as Alasdair MacIntyre that the Enlightenment project of philosophically justifying 'a particular concrete moral viewpoint' has been a complete failure. Although Engelhardt denies philosophy's prospects for justifying particular moral conclusions, this scepticism does not extend to morality itself. He believes that a rich, content-full morality, in fact, the true morality, is available within those communities which accept divine revelation. Outside the community of the faithful, the best we have to go on is 'the agreement of those who decide to collaborate.' A socially contracted morality is grounded, not on natural law, universal reason, or revelation, but on the interest of society's members to resolve their disputes by means other than coercion. Engelhardt is an antitheorist, but not an antimorality thinker.

What is left is a greatly pared-down version of the Enlightenment goal of finding a means to provide rational resolutions to moral questions. He believes that as 'moral friends,' those who share in a tradition, there is much that we share in terms of concrete moral outlook, but as 'moral strangers,' only basic procedural agreements can be found. Bioethics remains as a means for moral strangers to adjudicate ethical controversies in medicine. Engelhardt believes that we can avoid nihilism and relativism even after the collapse of philosophical ethics by articulating this very limited secular morality. We are forced to live in 'two dimensions of morality,' he states, one within our communities of shared values, and the other in a secular pluralist world, in which we cannot impose our values on those who have different moralities. We need to be tolerant of those whom we consider 'profoundly wrong,' as long as their acts do not affect nonconsenting others.

Many of Engelhardt's conclusions will be disappointing to Christians working in bioethics. He can find no way in secular terms to justify the claim that the foetus or new-born is a person with rights, and concludes that for secular purposes the value of a foetus is its value to those to whom they 'belong.' So, despite his strong personal objections to abortion and infanticide, he sees no way to defend those convictions in public debate.

Philosophical questions that are stimulated by this book are profound and many. Are the prospects for a philosophical defense of the rights of the unborn or newly born as bleak as he depicts? Is 'common' ethics as impotent as he believes? Why, after all, is tolerance such an important virtue? Certainly it is not equally important to all communities in a pluralistic society. How are those who believe an action to be intolerably wrong really supposed to live 'peaceably' with those who endorse and practice such behaviour?

David B. Fletcher, PhD
Philosophy Department, Wheaton College
Wheaton, Illinois, USA

Do We Still Need Doctors?
John Lantos, MD
London: Routledge, 1997
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For anyone who wishes a relatively brief, easy-to-read, thoughtful, and deeply penetrating examination of the issues facing medicine today, this is the book to read.

John Lantos, a paediatrician, teacher, and bioethicist, opens and closes the book with unanswered questions. In doing so his purpose is 'to think about the roles and responsibilities within the ever-metastazing enterprise that we call the health system'. Particularly, he wants to 'think about what doctors do within that system, what doctors once did, and what doctors ought to do'.

What makes the book so lively and relevant is the way the author draws upon his own personal and professional experience as well as a wide range of literature, including novels, which graphically illustrate some of the shortcomings and ethical challenges of modern medical practice. This brings into focus a wide range of issues affecting the doctor-patient relationship, including trends towards specialisation, managed care, group practice, etc. As a paediatrician he considers many issues concerning children, their care, medical treatment, custody, and involvement in research, showing that their rights and best interests sometimes conflict with those of parents, siblings, and society. He engages in critical consideration of the ethical framework for evaluation of innovative therapy and the underlying assumptions of modern reliance on evidence-based medicine and, in particular, the techniques of randomised controlled trials. He discusses the education of medical students and the pressures of scientific medicine, career requirements, university finance, and method of undergraduate and postgraduate teaching. He also deals with specific ethical questions such as whether patients should always be told nothing but the truth about their condition, their prognosis, the side-effects of treatment, and when mistakes have been made.

Quoting from novels to highlight a narrow vision of biomedical science, John Lantos argues that the doctor-patient relationship has changed. To his mind, medicine as a healing profession in the traditional mould is 'primarily and intrinsically moral enterprise with its own internal values and norms', rather than a 'technical and scientific exercise that is morally neutral'. Thus he quotes Leon Kass, who likewise 'argues strongly that medicine is essentially a moral enterprise and who elucidates strongly the continuing relevance of the Hippocratic Oath and other Greek ideas about the nature of health and disease and about the virtues and ends of the medical profession'. Like Kass, Lantos holds that today's problems derive from inattention to the traditional values recognised by the profession and that 'today's solutions can only come from a return to them'.

In short, the author, whose religious background is Judaism, provides much food for thought for the Christian and for the medical profession.

W. Malcolm U. Moffat, MD, FRCP
Paediatrician
Edinburgh, Scotland