Laying Down The Law To Robots

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This article discusses the nature of law and the challenges to the law posed by the rapidly developing field of computer technology. If the law is to retain vitality as the framework within which society operates, it must respond to technological forces which threaten the law with obsolescence. The Article focuses on robots as symbols of machines performing functions usually reserved to human beings. Several specific legal areas in which the use of computers raises novel, and as yet unanswered, legal and ethical issues are surveyed, including criminal procedure, copyright of computer-generated works, and liability for computer-produced catastrophes.

The Random House Dictionary defines a robot as "a machine that resembles a human and does mechanical, routine tasks on command."[1] It is questionable how far into the future this definition will be acceptable; moreover, man must consider the legal and ethical implications of the technological developments that will render the definition unacceptable. Robots, like the computers that often serve as their "brains," are with us to stay. However, as with computers, the use of robots raises questions that must be addressed in order to retain control over the framework of society.

If a robot is a machine that resembles a human, then the closer the resemblance, the more uncomfortable man may feel. Man will begin to question what it means to be a machine or to be human. Moreover, the more closely the robot resembles a human or its actions parallel those of humans, the less likely it is that its actions will be merely "mechanical, routine tasks," or that such tasks will be

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    1. THE RANDOM HOUSE DICTIONARY 777 (1978).

done only "on command." In the future, robots may have the capacity to choose what they will do, and they may receive commands not from human beings, but from computers and other robots.

The law is the principal mechanism by which a society defines and enforces the constraints which govern individual and corporate behavior within the society to promote order, preserve values[2] and maintain an environment which is at least moderately predictable. If some new technology or set of conditions markedly alters the sociological and physical framework within which the law has been established, the law must be adapted to the new situation. If it cannot be adapted, then, to the extent that the new situation is incompatible with the law, the law becomes irrelevant. Not only the temptation, but often the need, arises to disregard the law; the law is brought into disrepute, and the stage is set for turmoil. Beyond merely being an integral part of the scheme within which society operates, the law must be consonant with its society's concept of itself if it is to achieve its purpose.[3]

As times have changed, our laws have been adjusted. The increasing dependency on mass-produced products has led to the development of the law of products liability. The vast changes in communications technology have led to a complete revision of the Copyright Law. However, lawmakers have found it increasingly difficult to keep pace with the ever more rapid advances in technology. The 1976 Copyright Act, drafted to bring copyright into the age of the photocopier and video recorder, already finds itself outpaced by, among other things, satellite transmissions and computer technology.

The law generally reacts to issues only after they have become the center of a real controversy. Courts generally, and some courts exclusively, address a question of law only after an actual dispute involving that question has been brought before them. Legislation is also more often reactive than proactive. Yet in a society that seems to lurch from crisis to crisis, it is unclear whether such a strategy can avert eventual disaster.

The danger of this reactive approach to technological advance becomes clear when dealing with robots and computers. Society, in promoting the common good, presumably will proscribe certain acts, such as murder and theft, which interfere with both the individual and collective well-being. However, there are certain types of acts against which society must guard more carefully. First are those acts which can cause large-scale destruction of lives and property. For

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2. There is no doubt that prevailing values heavily influence what legislation is passed and how courts decide cases.

3. If a society may be considered a building, then the law may be considered the girders which support it. One cannot imagine a stable structure where the girders bear no relationship to the shape of the whole structure.

example, the society must provide, through its laws, that nuclear power plants are built to specifications stringent enough to insure safety.[4] Second are those acts which can destroy the philosophical and ethical foundations upon which society is built. If those underpinnings are shorn away, society itself will crumble.[5]

Unfortunately, robots can or soon will be able to perform acts which can cause large scale destruction of lives and property and destroy society's ethical and philosophical foundation. Robots, and the computers that drive them, force us to look deeply into ourselves concerning the limits to which we can permit technology to go and still run acceptable risks.

Consider the following example. The results obtained from lie detectors are still sufficiently suspect to be inadmissible as evidence in most jurisdictions. However, the current lie detector is a rather primitive device. The brain, like a computer, emits electromagnetic radiation as it functions.[6] Devices already exist which can pick up the emissions from active computers and terminals and reproduce precisely whatever the computer is doing or whatever the terminal is transmitting or receiving.[7] If "brainwaves" could be deciphered in this same fashion, the ultimate lie detector would be possible. The guilt or innocence of a suspect could be determined simply by reading his mind.

Society would then be in a position to bypass the criminal courts. The delay between indictment and trial, the cost to the state of pre-

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4. A society will try to prevent the use of nuclear weapons as well, but it also knows that that if another society has such weapons exclusively, it will be subject to nuclear blackmail; so it builds them too. Presumably, a society would use such weapons only if (1) it felt its survival was at stake and had nothing to lose; (2) it believed that it had developed a strategy to avoid heavy losses due to a retaliatory strike; or (3) the persons controlling the use of such weapons were, for whatever reason, no longer acting in the interests of the society they were supposed to guard.

5. An obvious example of such a value-centered law is the proposed constitutional amendment prohibiting abortion. One argument its proponents raise in its favor is that if abortion is permitted, human life will become "cheap," opening the door to active euthanasia, destruction of mentally defective infants, etc. The philosophical axiom involved is that human life represented in a fetus is something so valuable that it must be preserved at virtually any cost. Anti-abortionists fear that the failure to prevent an act which is highly localized in its consequences will have globally catastrophic results for society as they envision it.

6. This is the basis of an electroencephalograph which measures these emissions and produces distinctive patterns from them.

7. For this reason terminals in high security areas must be "tempest-certified," which means their emissions must be low enough so that they do not constitute a security hazard. A non-certified terminal, if placed within six feet of a telephone, even one still on the hook, will allow the telephone line to be tapped for information going between the terminal and the computer.

paring its case, the expense of the accused's attorney, the delay between verdict and sentencing, and even the sentencing itself would be relics of the past. The suspect simply would be questioned within the proximity of the mind-reading machine and the machine would determine the suspect's guilt or innocence. In the case of capital crime the machine could be programmed to administer a quick, painless death. What reason would there be for delay if there were no possibility of error? To make this already strange scene even more bizarre, the external sensors of the machine could be encased in the form of a human being and the form could be dressed in the robes of justice. The entire spectacle could be played out in a space resembling a court room, but human beings would be needed only to supply the suspects.

No doubt, this scenario is repugnant to most people. But, is it possible to analyze what is repugnant about a machine, however infallible, judging human beings and imposing penalties on them? If so, perhaps it will bring us closer to an understanding of what limits should be set on the use of machines, particularly those which mimic peculiarly human activity.[8]

The most troubling aspect of the electronic judge and jury may be that a machine was elevated to the status of judge over a human being. Our species is still viewed as resting at the apex of creation. If we are to be judged, then it ought to be by someone of equal or greater dignity even if there resides in such judgment the possibility of error.

Some will find a robot judge offensive because the judgment of humans incorporates a large measure of discretion based on a consideration of the circumstances under which an act was committed, the mental competence and mental state of the actor, and the values reflected in the act.[9] This assumes that humans are less deterministic than machines and that computers cannot be programmed to take into account mitigating circumstances. Consistency in sentencing and swiftly reached judgments might form more powerful deterrents to crime than the current system with its delays in prosecution and uncertainty as to penalties.

Yet another reason for unease in the face of a computer judge is the belief that machines are unreliable. They suffer malfunctions and design defects which may lead to abhorrent results. However,

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8. Lest the reader believe that this futuristic possibility has been made up out of whole cloth, he or she might read such articles as Hoard, *Entrepreneur Working on 'Electronic' Jury*, COMPUTERWORLD, Mar. 14, 1983, at 17. The article begins, "The 'electronic jury' sits dispassionately, weighing the evidence it has ingested. When the computer reaches a verdict, it delivers it orally to the courtroom. Case closed." *Id.*

9. A starving person who shoplifts a loaf of bread is generally treated with more compassion than someone who robs an item of similar value from an invalid at gunpoint.

computers are no less reliable than the humans they serve. Computers can run for days doing the most routine or complex of tasks without faltering. The mechanical judge could digest vastly larger quantities of data concerning a defendant than could a human judge and it could instantly draw more logical conclusions from such data than a human judge could draw after months of intense study. If machines are unreliable, then humans can hardly be found to be more reliable. Moreover, computers can be programmed to "learn" from "experience" and their programs can be refined to produce exactly the result desired.

Others may object that a human being can be punished for improper conduct, but a machine cannot experience guilt or shame or be subjected to sanctions which have any meaning to it. A machine can be unplugged but this causes the machine no pain. The machine has no conscience or consciousness. Incompetent or wicked judges can be removed from office either by the voters or by impeachment. However, the record shows that few judges have ever been impeached,[10] and most attorneys will admit that judges are subject to the same failings one finds in human beings in every walk of life.

Society has not been afraid to create statues or other works of art embodying the human form so long as it is understood they are just artistic renderings. Likewise, we have not hesitated to build robots which have some likeness to human beings so long as it was clear that they were just a machine or a fiction of the imagination. But there has been a strong tendency to shrink from creating machines in the likenesses of human beings when the machines' capabilities rival those of their human designers. One commentator points out that workers in the field of artificial intelligence, however high the ambitions they have for their science, have resisted the temptation to cloak their creations in human images.[11]

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10. The origin of impeachment lies in fourteenth century England, but there have been no impeachment proceedings in England since 1806. "In the United States the impeachment process has rarely been employed." 5 ENCYCLOPEDIA BRITTANICA 314 (5th ed. 1974). In 1804, there was an attempt to impeach Chief Justice Salmon Chase on political grounds, but his acquittal effectively ended impeachment as a political weapon against the judiciary. 11 ACADEMIC AMERICAN ENCYCLOPEDIA 61 (1981).

11. "Several Hollywood productions of the 70's have shown automata used as personal companions, and it has been suggested that commercial development of such alternative beings is unavoidable. Yet the same experts who rave about the powerful capabilities of their software creations are scared to have their machines look human. They cringe at the suggestions that the computer's ability to speak, compose poems, compute, and even play music could be embodied in anything more elegant than a steel cabinet with plastic buttons, set on four casters and firmly held in place by thick black cables.

This reluctance is understandable. It is the reaction of the monkey looking at himself

Should there be a law that no machine which carries out a peculiarly human function, such as determining guilt or innocence, be permitted to take a human form?[12] Is it so serious a threat to our self-image and to the social order we have created in that image, that no robot, no matter how seemingly fair and just, be allowed to judge human beings? To what extent can robots be allowed to judge in other areas such as foreign policy and economics and still preserve for humans whatever measure of individual freedom and autonomy that is required to support the framework of our social order?

These are no longer merely hypothetical questions. The robot judge is not yet on the bench, but its precursor, the decision-making computer, is among us. The technology which will make the robot judge both credible and possible is going forward at a rapid pace.

Can computers really make decisions? Those involved with decision support systems (DSS), management information systems (MIS), or the like, will say that the computer merely serves as a tool to provide humans the data they need to make intelligent decisions.[13] The human being decides, even if the decision is based in part on information the computer provides.[14] Nevertheless, so-called "expert systems"[15] already exist and the research to produce even more ad-

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in a mirror. It is the shudder that seizes any being when he recognizes his own self, or part of it, in the world of the *others.*" Vallee, *An Infatuation with Androids,* COMPUTERWORLD, Nov. 8, 1982, at 15, 26.

12. The Moslem religion forbids any images which portray the human figure. 9 ENCYCLOPEDIA BRITTANICA 952 (5th ed. 1974). Perhaps inherent in this prohibition is a subconscious fear that by mimicking the human likeness, we cheapen it and detract from the unique position of human beings in the universal order.

13. Decision support systems and management information systems are tools which are intended to provide management with the information it needs to make decisions. Thus, if an executive is called upon to solve a problem, he or she can frame the questions which must first be answered to come to a reasoned judgment and the computer system using a DSS or MIS will be able to provide the data to answer them.

14. The information which the computer can provide, however, depends on what data has been placed in the computer's memory store as well as what queries the user is permitted to make against the database. If there are few records available to the database management system, that system can produce little information. Moreover, the design of the files, the data placed in them, or the constraints on questions that the system allows users to ask can all sharply limit the utility of the system in the decision-making process. Database management systems is one of the newest and most rapidly evolving components of the discipline known as computer science.

15. An expert system is one which uses the deductive principles of a science to draw logical conclusions based on those principles from data provided it. Thus, a medical expert system would use the results of patient interviews and laboratory tests to determine the most probable diagnoses and the treatment which has the maximum likelihood of success under the circumstances. The conclusions drawn by medical expert systems have compared favorably with conclusions drawn by human specialists. Of course, the expert systems get their rules of deduction from human specialists to begin with, but once they have them, they can draw conclusions without recourse to a specialist's guidance. The systems must still be used under the guidance of a licensed practitioner. However, once they have proven themselves more reliable than the human who oversees their use, little reason exists why such systems could not be made available for self-help medicines, or to serve as the source of automated medical care for locales which are too

vanced expert systems and so-called "intelligent systems" is intense. The latter systems have received considerable press recently because of the concerted effort of the Japanese to produce "Fifth Generation" computer systems, systems which will be capable of drawing millions of logical inferences per second from whatever data is available to them.[16] These machines coupled with the ability of such machines to learn — that is, to acquire new data on their own initiative through sensors or queries to other computer databases networked with them — will provide systems of speed and logical power which can now only be dimly perceived.

Researchers in artificial intelligence must admit that thus far computers and robots have extremely limited capabilities. The success of expert systems depends on the narrow range of facts and deductive principles with which they deal. An expert system which is a "generalist" is still far in the future. It is counted a significant advancement when a robot painstakingly can build a structure of blocks which any normal four-year-old child could construct in less than a minute. The human mind is (still) capable of storing more information than the largest of today's computers. The pattern recognition abilities of the human brain vastly exceed those of the most powerful hardware and software combinations now available.[17] However, with new architectures, vastly larger memory stores,[18] and faster central processors, the computer's logical abilities will even more closely approximate those of human beings.[19]

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isolated or poor to afford a human doctor.

16. For a discussion of the Fifth Generation computer systems which is accessible to the lay person, see E. FEIGENBAUM & P. MCCORDUCK, THE FIFTH GENERATION: ARTIFICIAL INTELLIGENCE AND JAPAN'S COMPUTER CHALLENGE TO THE WORLD (1983).

17. A computer can search a file for the presence of some particular string of symbols far faster than can a human being. Thus, if one wanted to know how many times the word "compatible" occurred in the Encyclopedia Brittanica, he would be well advised to turn the assignment over to a computer. Conversely, if one wanted to find a pair of pliers in a tool box, the job is much better accomplished by a human. The identification of the names of famous people from their photographs is all but impossible now, even for the largest computers. Current computer designs are based on processing strings of symbols in a linear fashion, that is, sequentially one at a time. Programs and data files can be thought of as a long sequence of symbols which are handled by the machine one symbol at a time. Human thought, however, is more holistic. The action of the computer can be compared to generating a television picture one pixel at a time through a linear scan of the screen, while the human mind is capable of assimilating the entire picture. (A pixel is a specific point on the television screen which is illuminated or left dark by the electron gun in the tube, depending on what image is to be formed. A television picture consists of a large number of pixels appropriately illuminated.)

18. A memory store is the content of a computer's memory.

19. Computers of any architecture or technology have inherent physical limitations, such as the fact that nothing can travel faster than the speed of light. Inasmuch as

Some writers have warned that the use of robots may ultimately result in a lowered standard of living for most citizens.[20] First, widespread job displacement will exist as computers and robots take over more and more of the work currently performed by human beings. In order to remain competitive in the world market, industrialized countries will be forced to resort to robotics. The Third World countries will scarcely be able to compete, and the gulf between the technologically advanced countries and the Third World will grow ever greater.[21]

With computers and robots doing much of the work that previously required skilled humans, essentially two classes of jobs will exist: those which concern the technology which dominates the economy and those which involve unskilled labor, such as janitorial positions.[22] Unemployment will also grow. Even the technological elite will not be exempt because, as computers gain in intelligence, they will become more capable of programming themselves and even designing and building new generations of machines. Within several such generations, the structure and operation of computers will be incomprehensible even to the most highly skilled scientist.

If this scenario is an accurate picture of the future, then we are trapped in a dilemma. If our society fails to computerize and does not increase its dependence on robots, our goods will not be competitive and unemployment will increase since other countries have begun to use this new technology to increase their productivity. If our society does computerize, widespread economic dislocation may still occur, possibly leading to a major societal upheaval. Moreover, the underdeveloped countries will probably fall even further behind the developed countries as they find the new industries they have just begun to build already obsolete and non-competitive. This will, in

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light can only travel about one foot in a billionth of a second, super fast computers must be very compact to minimize the distance that signals must travel to carry out an operation or transfer data to and from memory. The human mind is also subject to these same physical limitations. Although they are still far in the future, computers based on organic molecules similar to those found in humans and other living creatures are a possibility. The power and speed of such computers come from the amount of information that could be stored in a single molecule; moreover, the small size of the molecule — smaller than any transistor now found on a microchip — would allow extremely fast switching and information transfer. Could a computer duplicate the human brain? Here, one is faced with profound metaphysical questions such as whether there is a dichotomy between the "mind" and the brain. If so, we might be able to create a brain, but not a "mind." A corresponding legal issue is whether anyone should be permitted to try to build an artificial brain. If such a brain were built and seemed to be functioning, would it then have the rights associated with a sentient human being?

20. *See, e.g.*, Gotlieb, *Computers — A Gift of Fire*, INFORMATION PROCESSING 80, at 863 (1980).

21. *Id.*

22. This may be unduly pessimistic inasmuch as expanding communications and leisure time industries will absorb some workers.

turn, lead to disruption on a global scale and, possibly, to a world-wide conflict.[23] Stevens makes this prediction although he dismisses the four most popular of the "dismal" futures: total unemployment, the revolt of the robots, the misapplication of genetic engineering, and the ultimate Terminal Man.[24] Stevens sees civilization threatened by the isolation that the computer will create: humans will cease dealing closely with other humans and the effects will be ruinous.[25]

How seriously should these forecasts of doom be taken? Men in every age have predicted the imminent end of the world. Every new technology has caused some people to warn that it will bring about the destruction of the current order, and these Cassandras have sometimes been right. Society has assumed new shapes; new technology has brought profound and irreversible changes in the way people live and think. Mankind has celebrated when these changes have been beneficial. Technologies developed to this point, however, have never had the potential for such sweeping effects as do those of our present age. If the technology genie proves to be an evil spirit, we cannot force him back into the bottle. Civilization as we know it and want it to remain may succumb before we recognize that the illness is terminal.

Such conjectures are the content of philosophy courses, but they must also be incorporated into the study of the law. If the law will not protect society, then what will? If the law cannot respond to threats to the society it is supposed to serve, it will die along with that society, a soldier fallen but without honor.

There are more conventional legal questions concerning robots than those considered thus far. Consider, for example, the protection of intellectual property. Already, computers have been programmed to write poetry, prose, and music.[26] If computers become authors,

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23. In discussing the possibilitly of social catastrophe, David Stevens makes the following ominous statement:
   It is also my belief that one of the consequences of the development of the microcomputer will be the severance of one of the most crucial of these threads [essential to Western civilization]. I believe that the ensuing disruption will cause the whole fabric to tear in an irreparable fashion. That the result will be the end of civilization I much doubt, although the possibility should not be dismissed out of hand; that it will be the end of Western civilization I have no doubt whatsoever.
Stevens, *The Menace of Micros*, COMPUTERWORLD, Nov. 30, 1980, at 1.
   24. *Id.*
   25. *Id.* at 9.
   26. Timothy Butler begins an article on copyright aspects of artificial intelligence with a piece written by RACTER, one of the more sophisticated prose generation pro-

composers and inventors, who owns the work they produce? And, can this work be protected? Unfortunately, the obvious answers prove flawed on closer examination.

One approach suggests that the author of the creative program deserves the copyright or patent on the products of that program. But the author of the original program often has little control over the output of the program. Many random factors are introduced by the machine itself as part of the "creative" process. If the program was designed to produce only one work time and time again, that one work reasonably could be attributed to the program's author who designed the end product in the process of designing the program to produce it. However, programs which have choices to make and whose output is determined in part by chance are not designed to produce only one work. Here, the author of the program has little idea what the program will produce. He only knows whether the output will be prose, poetry, music, etc.

Some programs which provide new works as their output are licensed to others. A current example of this is the program-generating program. The user[27] describes in a quasi-conversational way what he wants a program to do, and the program-generating program will write such a program for him. In this instance, there is a contribution from the author of the program-generating program as well as the user who must describe the problem to be solved in appropriate and correct language.[28] The program-generating program can be thought of as a general purpose die cutting machine. It is informed what die must be cut by the user in his description of the problem. The program-generating program could, therefore, be copyrighted by its author, and the program it produces could be copyrighted independently by the user who designs its specifications by describing what it is to do, provided that the contribution is sufficiently original to support a copyright. Nevertheless, the program-generating program is acting under human control just as the die cutting machine is. The more difficult copyright issues arise when the authoring program acts independently.

An original writing of an author is required to copyright subject

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grams. The selection begins:
> Helene watched John and cogitated: A supper with him? Disgusting! A supper would facilitate a dissertation and a dissertation or tale was what John carefully wanted to have.

Butler, *Can a Computer be an Author? Copyright Aspects of Artificial Intelligence*, 4 COMMENT 707 (1982).

27. A "user" or "end user" in computer terminology is simply someone who is a consumer of computer services.

28. The expression must be correct in the sense that it is in a form that the program-generating program can "understand," and it must be logically correct in that it must describe adequately the problem that the user really wants to solve. The user, therefore, makes a significant contribution to the end product.

matter.[29] The degree of originality required for copyright is minimal.

> All that is needed to satisfy both the Constitution and the statute is that the "author" contributed something more than a "merely trivial" variation, something recognizably "his own." Originality in this context "means little more than a prohibition of actual copying."[30]

If a monkey seated at a typewriter happened to type a sequence of letters which proved to be a truly exquisite poem, could the owner of the monkey copyright the work? Probably not because the owner of the monkey provided no ideas or originality to the work. The hypothetical is of little concern so long as we are dealing with monkeys.[31] We now are dealing, however, with computers. Writing programs gives computers an enormous advantage over monkeys; the action of the computers is highly structured, not random, and the odds that they will produce something meaningful to humans are great. And yet, almost paradoxically, the more sophisticated the authoring programs, the less input from a human is necessary. From this stems the copyright problem.[32]

But if these works do not belong to the programmer, or to the user who runs the program, to whom do they belong? Should these works be placed in the public domain as soon as they are created? Should we warp the concept of copyright and award them to the programmer or user regardless of the lack of contribution? If computers become sufficiently "intelligent," would we feel comfortable granting the computer itself ownership of a copyright and, if so, how would we pay it royalties?[33]

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29. 17 U.S.C. § 102(a) (Supp. V 1981).
30. Alfred Bell & Co. v. Catalda Fine Arts, Inc., 191 F.2d 99, 102-03 (2d Cir. 1951) (footnotes omitted).
31. The odds of a monkey being seated at a typewriter are small enough, but the odds of the monkey randomly typing even a short, grammatically correct sentence in the space of a human lifetime are astronomical.
32. As one commentator phrased it:
As previously noted, the trend in code generation, automatic programming and automatic storywriting is towards a minimization of human input into the production of an apparently creative result. Although the resulting program may embody an intricate, unique algorithm or the story a seemingly coherent plot, these "expressions" produced by [artificial intelligence] software cannot be said to be expressions of ideas "adopted by the programmer" as intended by the [Copyright] Act. The computer software, not the programmer, selectively "adopts" the particular form of expression evidenced in its product. To the extent the programmer has less and less control over the expression ultimately "adopted," the programmer loses possible copyright protection.
Butler, *supra* note 26, at 727-28.
33. Perhaps such royalties could go into a public trust fund to feed unemployed writers, composers, and artists.

Butler argues against disallowing copyright completely. Calling the computer or a man-machine hybrid the "author," he proposes that courts create a fictional human author which would own the copyright and then apportion "appropriate fractions of the copyrights to the owner of the AI software copyrights, the problem-specifier or the computer owner, either individually, jointly or in part."[34] The issue of who owns computer-generated intellectual property when the computer itself is acting "independently" will become more pressing with time. Computers may not merely be writing poetry, prose and music, but may invent things of immense commercial value. If a user simply says, "design me a machine which does thus and so," or "create the genetic configuration that will accomplish this effect," and the computer performs the task commanded, who should own the patent? There is no simple answer.

The related philosophical questions also defy easy answers. What effect will computers have on human creativity and self-image if a machine assumes the inventive role reserved until now for the human mind? Will we become too dependent on our machines and forget how to think? Will technology pass our species by and become the exclusive preserve of a breed of supercomputers? We could become slaves to the machines which were once our tools because we had given them the knowledge they needed to grow "intellectually." They could use our own knowledge to create more knowledge which we could no longer understand. Our freedom and perhaps our lives would be lost if we depended on this knowledge for survival. There would be no "revolt of the robots" as some have feared. Machines would continue to perform in their efficient, emotionless way, but they would no longer be under our control because we could no longer understand them nor turn them off.

If machines outstrip our understanding, who will bear the liability when they malfunction? Should anyone have to pay if a computer-controlled robot goes berzerk and destroys human lives? Consider, for example, strict liability in tort. The policies underlying this theory were first articulated by Justice Traynor in *Escola v. Coca Cola Bottling Co.*,[35] and the theory is now found in its best-known and most widely adopted form in Section 402A of the Restatement (Second) of Torts.[36] Rationales underlying strict liability in tort include a desire to spread the risk of injury from a defective but socially desir-

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34. Butler, *supra* note 26, at 744-45. Courts often must determine the portions of copyrights that authors own.

35. 24 Cal. 2d 453, 150 P.2d 436 (1944). The theory was later adopted by the California courts in Greenman v. Yuba Power Products, Inc., 59 Cal. 2d 57, 377 P.2d 897, 27 Cal. Rptr. 697 (1963).

36. "One who sells any product in a defective condition . . . is subject to liability for physical harm thereby caused . . . ." RESTATEMENT (SECOND) OF TORTS § 402A (1965).

able product, to hold liable the party most able to pay, to force man-ufacturers to police their own products for safety, and to remove from the injured consumer the often impossible task of proving that the manufacturer was negligent in designing or manufacturing the product which caused his injury. What do the reasons given for strict liability mean in a machine-dominated world, particularly if the ma-chines themselves have become self-reproducing?

Strict liability as we use it here pertains to products,[37] and does not apply to the actions of human beings. A medical doctor or attor-ney may be liable for malpractice, and an engineer or construction worker may be liable in negligence, but persons are not subject to strict liability when they err.

How then shall we treat the "intelligent" machine with respect to strict liability? Will the robot of the future be a "product," or will it have a more exalted status? Is a defective robot "unreasonably dan-gerous to the user or consumer or to his property"? The more re-sponsibility we turn over to robots, the more dangerous a defective robot will become. If robots stand guard over nuclear power plants or control airplanes and other forms of transportation, a defect in a robot could lead to injury. On the other hand, it is humbling to con-sider that robots may be much more reliable than their human coun-terparts. At some point in the future, planes may fly so fast and have to respond so quickly to avoid hazards that humans will be unfit to fly them. Many airplane accidents are caused by defects in the human pilots. If airline safety improves by placing robots at the con-trols, are we to hold the robots' manufacturers strictly liable for ac-cidents produced by a defect in the wiring of a particular robot's controls? Or should we say that a defective robot pilot is not unrea-sonably dangerous to the passengers who depend on that robot for safety? And what about the basic concept of placing machines in control of situations which will jeopardize human life and safety if they go awry because human beings do not have the adequate skills to do the job? Should we allow our technology to outstrip our ability to control it?

This last question is perhaps at the very heart of the issue of ro-bots, computers, and other modern technologies. The human race has produced tools of immense power. The understanding of these tools is limited to the scientific elite.[38] Possibly, in a few years, even

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37. There can be strict liability imposed as well, for example, when one engages in an abnormally hazardous activity, or keeps ferocious animals.

38. Those who formulate the law and policy concerning the use of these tools are

the scientific elite will be unable to fathom the architecture of a computer-designed robot or supercomputer. Ignorance will be coupled with lack of control, and lack of control will almost certainly lead to catastrophic consequences. Even now, we are uncertain about how much control we really have over the power our technology has provided us. With a lack of understanding of, and perhaps control over, robots who seemingly do all things better than their human counterparts, human dignity and discipline are sure to erode.[39] Even if the robots serve the human race by providing all of its basic needs, what form will society take under such a regime? Will human beings become a race of philosopher kings once they are freed from the more mundane quest of working for a living, or will there be a time of unprecedented decadence and a failure of the moral principles now the foundations of our society?

This writer hopes that the society of the future with its scientific wonders which we see now in incipient form will be a time of prosperity. Robots, computers, genetic engineering, fusion energy, space travel, and enormous gains in communications links between humans and other humans, humans and machines, and machines and other machines, will provide a "brave, new world" indeed. But these marvels must exist in harmony with human nature if this new world is not to become nightmarish. The abundance of energy, coupled with machines to augment the natural powers of the mind and body, could produce an environment in which creativity could flourish and the highest capabilities of a human being could be stretched to their

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quite often those who have little understanding of how or why they work. As a result, their views are apt to be narrow and simplistic. As the technology becomes more complex, one defense mechanism that policy makers can adopt to avoid embarrassment at their ignorance is to try to force technology into some traditional and well-tried molds in which it cannot really fit. Ignorance which cloaks itself as knowledge is the most dangerous kind. Allowing someone to decide policy solely on the basis of the end result of a technology's output without an understanding of how the technology achieves the result can be extremely dangerous. We are all aware that nuclear fission and fusion can produce large quantities of energy. We also know that they produce highly dangerous byproducts. If we decided to use them solely because of their energy output, we could open the way for disaster.

39. Joseph Weizenbaum of M.I.T., a pioneer in the field of artificial intelligence and one of its articulate critics, wrote of his amazement that people he knew had begun to "converse" with a computer as if it were another human being. He had written a program, ELIZA, which allowed a computer to seem to respond to statements of a human user. One form of the program simulated a non-directive psychiatric counselor. People began revealing their most intimate thoughts in dialogue with this program. The program, by today's standards, is not even particularly sophisticated. It did not add information to what the human user said, but responded by analyzing the grammatical structure of, and words in, the user's input and creating new sentences from them which seemed like knowing responses. For example, a typical exchange might read:
HUMAN: I DO NOT FEEL WELL TODAY?
COMPUTER: I AM SORRY YOU DO NOT FEEL WELL.
HUMAN: MY WIFE RAN OFF WITH ANOTHER MAN.
COMPUTER: TELL ME ABOUT YOUR WIFE.

most exalted limit. The presence of intelligent and physically capable mechanical companions could mean that even the most handicapped people could enjoy rich and full lives.[40]

The relationship between human and machine of the future should be a form of symbiosis. The life of mankind improves as machines become more human. Yet to use this vast power wisely and to avoid its bringing mankind to destruction, careful planning must take place. Who is better equipped to lead such planning than those trained in the law? Lawyers, scientists, philosophers, all who might have a contribution to make, must begin the great dialogue that will shape the future of this planet.

There are many before who have warned of things we can do, but must not. Often these warnings have spoken of the dangers to the environment and health that some action would pose. Some have gone beyond the hazards to our bodies and have spoken of the dangers to our very self-concept, our humanity. There are those things we ought not to do, not because they will destroy our bodies, but because they will destroy our souls. If such a fate should befall us, then we will all become robots, if we survive at all.

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40. The machines would exercise virtually infinite patience and would not be repelled by any disease or deformity. What guide dogs do now for the blind, for example, a robot will eventually be able to do infinitely better. The robot will be able to converse with his charge and even carry him or her bodily where there is special danger. Such a robot could be even be designed to express sympathy and show emotion, and the human might even come to "love" the machine. What effect would it have if humans develop the same attachment to machines that they have to other humans? If we cannot tell the difference between the responses of a sentient being and a machine, then is the machine entitled to the same respect and rights as the sentient being? Indeed, if the machine seems more witty, stronger, and talented, might the machine receive more respect than its human companion? Might we begin to prefer machines to humans, and would this not have a dramatic effect on society as we know it?