should be neither blamed nor punished for their actions.

Philosophers, Moore argued, should not try to determine what constitutes the good life, because "the good" was a construct that could not be defined. Right and wrong, in Moore's opinion, were not moral absolutes, but simply tools that one could use to predict future behavior. An action was bad not because it was morally wrong, but because it would have unpleasant consequences.

Moore's beliefs, Midgley asserts, provided potent "anti-intellectual weapons" to succeeding generations. Twentieth-century Anglo-American philosophers largely abandoned discussing moral questions, considering them either irrelevant or logically unsolvable. For example, C. L. Stevenson, in *Ethics and Language* (1944), claimed that determining what was right or wrong would "distort a relatively neutral study into a plea for some special code of morals."

But Moore's influence was not limited to intellectuals. Midgley claims that Moore's writings ultimately led to the belief (taught by such psychologists as B. F. Skinner) that "making moral judgments" is a distasteful practice that should be avoided at all costs. Yet proponents of this "self-righteous preoccupation with putting down self-righteousness" have not found a suitable substitute for the moral judgments they condemn.

Philosophers, Midgley concludes, should once again discuss "how we need to think and live." But in resuming philosophy's traditional task, they should reject attitudes that "do not fit our real needs." The formalistic moral relativism of G. E. Moore and his successors, she observes, deflects philosophers from thinking about "large questions."

SCIENCE & TECHNOLOGY

Short Circuits

"Collective Computation in Neuronlike Circuits" by David W. Tank and John J. Hopfield, in *Scientific American* (Dec. 1987), 415 Madison Ave., New York, N.Y. 10017.

Digital computers have existed for only half a century. *Biological* computers—the brain and nervous systems of humans and animals—have evolved over millions of years. For a digital computer, such tasks as reaching for a sandwich and recognizing a face are too complex; for a human brain, they are relatively easy.

How could a digital computer duplicate the capabilities of its organic counterparts? Tank, a physicist at Bell Laboratories, and Hopfield, a chemist and biologist at the California Institute of Technology (C.I.T.), explore the ways that "neuronlike" or "collective-decision" electronic circuits may change the nature and potential of computers.

Computer operations are performed in a chain-like sequence. Each link of the chain passes information on to only one other link. A neuron in the brain, while receiving a signal from one neuron, can simultaneously transmit that signal to as many as a thousand other neurons. To consider how collective-decision circuits work, the authors suggest thinking of a computer as a committee prepared to vote. In most computers, the "committee votes individually"; each operation or "vote" (yes or no, 0 or +1) is performed without affecting any other operation. Collective-decision circuits, using "flip-flop" amplifiers capable of various responses to a question, can work with other circuits to create a *consensus*. This is an answer produced by many circuits operating together rather than as linked chains.

Scientists at the Jet Propulsion Laboratory, Bell Laboratories, and C.I.T. have fabricated collective-decision circuits, the largest being 54 amplifiers. However, it will take a network of hundreds or thousands of "neurons," with thousands or millions of connections, for a circuit "to be useful" as a research tool.

Collective-decision circuits could be used in many ways. A C.I.T. team led by Carver Mead, for example, has created a prototype "artificial retina," which a computer could use efficiently to process images. "Neuron-like" circuits may also be used to create "associative memories," allowing a computer to retrieve memories from a fragment of information by processes analogous to the ways we reconstruct the memory of a friend from a name or a hair color. The authors believe that the study of collective-decision systems is just beginning.

Science and the Courts

"Accuracy v. Advocacy: Expert Testimony Before the Bench" by Michael J. Saks, in *Technology Review* (Aug.-Sept. 1987), Mass. Institute of Technology, Building W59, Cambridge, Mass. 02139.

"The theory of the adversary system," George Bernard Shaw once said, "is that if you set two liars to exposing each other, eventually the truth will come out." But not always, according to Saks, a law professor at the University of Iowa. Justice could be better served if the expert witnesses testifying in court about scientific issues "better understood their role and learned to withstand the pressures" of the legal arena.

"The picture of a case," writes Saks, "can be skewed by what is permitted as expert testimony." Judges should prevent the court from hearing information that is unreliable, but this can be difficult.

Most U.S. courts apply the "Frye Test," named for a 1923 decision, which allows scientific evidence to be admitted if based on a principle that has gained "general acceptance" among specialists in a given field. Yet, the Frye Test itself neither defines the limits of a scientific "field" nor sets standards for "expert" judgment. Judges often view testimony from experimental psychologists as suspect because specialists in that field "argue interminably" about the quality of data. But testimony from clinical psychologists, based on intuitive assumptions rather than rigorous experimentation, is rarely ruled out. The "less controversial though weaker information is," notes Saks, "the more readily [it is] accepted."

Furthermore, the most routine scientific evidence presented in court—that of forensic laboratories—is frequently unreliable. When the National Institute of Justice sent samples to more than 200 police labs in the U.S. and Canada for identification, 71 percent misidentified a blood