
Perspectives

on current developments

A Garden of Earthly Toxics

As Peter Huber points out elsewhere in this issue (page 23), many current methods of risk regulation lack coherence even aside from considerations of cost-benefit balancing. That is because current laws lack any provision for *comparing* risks. Accordingly, they strain at risk gnats, in the form of the "new" or "artificial," while swallowing risk camels that are "old" or "natural." When the "new" risks are substitutes for the "old," banning the new may increase the amount of risk as well as expense in the society.

These contradictions may be seen at their height in the Delaney Clause, which requires the Food and Drug Administration to ban any artificial food additive that causes cancer in animals. Critics of the clause have often pointed out that many natural substances found in food are much more strongly carcinogenic, or otherwise toxic, than additives that have been banned. If cyclamates (which were banned under the Delaney Clause) are indeed safer than their legal substitutes, saccharin and sugar, the ban may have increased overall risk.

Now Bruce Ames, chairman of the biochemistry department at Berkeley, has drawn together the current state of scientific opinion on diet and cancer. His findings, published in the September 23 *Science*, undercut much of the rationale for the current regulatory approach. "There are large numbers of mutagens and carcinogens in every meal, all perfectly natural and traditional," Ames writes. "Nature is not benign." Mushrooms are full of potent hydrazine mutagens and carcinogens. Rhubarb has mutagens; okra has mitogens. A major ingredient in mustard and horseradish is a carcinogen that damages hamster genes even at low concentrations. A toxin in unrefined cottonseed oil promotes male sterility so strongly that it is being tested in China as an oral male con-

traceptive. Nitrites and nitrosamines, which the FDA has required hot dog and beer makers to limit, can be formed from nitrates, which show up naturally in beets, radishes, and even that famously healthy vegetable, spinach.

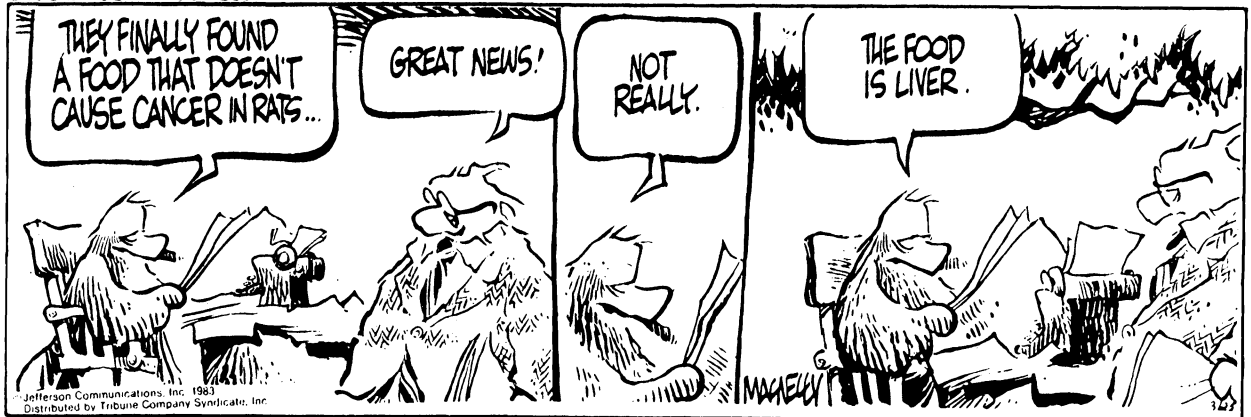
Coffee contains a long list of toxic components, but other beverages are hardly proven safe. Cocoa powder contains about 2 percent theobromine, which inflicts gene damage; tea has it too. Earl Grey tea is scented with oil of bergamot, which contains potent light-activated carcinogens and mutagens that also occur in parsnips, figs, and parsley.

The dosage humans get of natural carcinogens is high enough to set off alarm bells at agencies that customarily set factor-of-100 safety margins. Extracts of black pepper (which contain safrole and related carcinogens) cause tumors in mice at a variety of sites at dosages of about 160 milligrams per kilogram of body weight per day over three months; humans consume an estimated 2 mg/kg of black pepper per day for life.

Aspergillus mold, which affects peanuts, corn, and other crops, produces aflatoxin, which is among the most potent carcinogens and mutagens known. (The Food and Drug Administration controls the level of aflatoxin in foods, but has been unable to eliminate it.) Other mold carcinogens are present in much commercial apple juice and in other foods. Ordinary hamburgers, like other food that is browned or burned during the cooking process, contain a large variety of DNA-damaging agents and carcinogens. We eat and drink even more browned and burnt material than a two-pack-a-day smoker inhales—although, of course, the lungs may be a more sensitive route of entry than the digestive tract.

Epidemiological studies and clinical experience confirm many of these hazards. High fat consumption is strongly linked to colon and breast cancer in epidemiological studies, and some studies have linked coffee consumption

SHOE JEFF MacNELLY



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to increased cancer as well. Even cases of acute poisoning are not at all unknown, especially among those who employ folk remedies and herbal teas. Menthol poisoning has been recorded in a devotee of peppermint candy. "In one rural California family, a baby boy, a litter of puppies, and goat kids all had 'crooked' bone birth-defect abnormalities." At first the birth defects were blamed on pesticide spraying. But then it was discovered that both the pregnant mother and the dog had been drinking milk from the goats, which had been foraging on lupine, a wild legume that contains potent teratogens.

Makers of additives and preservatives worry about the effect of their products on "sensitive populations." Some natural toxins likewise attack those who are genetically susceptible. Millions of people in Mediterranean regions share a genetic factor that confers resistance to malaria but increases sensitivity to the toxins found in fava beans—which may explain, Ames says, why Pythagoras forbade his followers to eat fava beans.

Most toxic chemicals do not turn up in plants as wastes or accidental by-products (even though it might be amusing to perceive a bowl of vegetable soup as a toxic waste depository). Plants synthesize toxins quite deliberately (to put it anthropomorphically) in order to fight off bacterial, fungal, insect, and other animal predators. Ironically, farmers have responded to regulatory curbs on pesticides by developing plant strains that are insect- or disease-resistant, which can quite often mean increasing the levels of plant toxins and ensuring that humans will consume the toxins instead of washing them off. Plant breeders are

now increasing the insect resistance of commercial lettuce by transferring genes from a toxic species. Among potatoes, for which toxic concentration is a major determinant of insect and disease resistance, "one cultivar bred for insect resistance had to be withdrawn from use because of its toxicity to humans," Ames says. "There are health costs for the use of these natural pesticides, just as there are for man-made pesticides, and these must be balanced against the costs of producing food."

Plants that suffer damage typically generate more and different toxins to fend off predators. Celery plants can increase their carcinogen level a hundredfold when they are put under stress, and farm hands commonly develop skin rashes on their arms when they handle diseased celery. Potatoes that are bruised, diseased, or exposed to light develop toxic alkaloids in such quantities that they can be fatal to humans.

It could be argued that humans have evolved to adapt to botanical toxins but not man-made ones. It is not that simple, however. "Many, if not most, of these plant toxins may be 'new' to humans in the sense that the human diet has changed drastically with historic times." Moreover, Ames says, not much is known about the effect of most of the natural plant toxins in our diet, especially given that we are exposed to large doses and that new natural toxins are being discovered all the time. "By comparison, our knowledge of the toxicological effects of new man-made pesticides is extensive, and general exposure is exceedingly low."

In fact, the "human dietary intake of 'nature's pesticides' is likely to be several grams

per day—probably at least 10,000 times higher than the dietary intake of man-made pesticides.” Burnt and browned material alone contributes several grams a day. Flavonoids, which have been linked to cancer in two strains of rats, are extremely widespread in the human diet, with daily levels close to one gram. Quinones are “widespread in the human diet” and “quite toxic.” A serving of beets or spinach provides a fifth of a gram of nitrate. “Pyrrolizidine alkaloids are carcinogenic, mutagenic and teratogenic” and turn up in thousands of plant species.

It might seem surprising that the body survives at all under such assault. But, Ames says, recent research shows that humans are remarkably successful among mammals in staving off the advent of cancer. (About 30 percent of lab mice get cancer by the time they are two to three years old. The corresponding age for humans is eighty-five.) The disease is strongly age-related, increasing with about the fourth power of age in both species.

The body has a number of defense mechanisms against the toxins it consumes. The skin and digestive tract shed their surface cells. Moreover, the body apparently uses a number of compounds to help combat cancer and other degenerative diseases, among them vitamins C and E, beta carotene (the orange pigment in carrots), and the element selenium. Some studies suggest that eating green vegetables helps reduce the cancer risks of alcohol. Many of these substances may work by inhibiting rancidity (oxidation) of fats within the body, which is under suspicion as one prime culprit in carcinogenesis and DNA damage. Much cancer may come about when bodily defenses fail and previously harmless environmental insults begin to break in. The higher rates of cancer in some countries may turn out to be partly due to the absence of anticarcinogens, rather than the presence of carcinogens, in those countries' diets.

Although Ames advises sensible prudence in addressing pollution hazards, his findings do not support those who believe in a chemical-induced “cancer epidemic.” He confirms that aside from the effects of cigarette smoking, which causes 30 percent of cancer deaths, cancer incidence is not going up. Air pollution, in particular, is a relatively minor cancer risk. It takes a week or two of breathing smoggy Los

Angeles air to equal the amount of burnt material from one cigarette. “Epidemiological studies have not shown significant risks from city air pollution alone. Air in the houses of smokers is considerably more polluted than city air outside.”

“Tenant Protection” at HUD: Due Process or Undue Proceduralism?

During the seventies, amid enthusiasm for “tenant’s rights,” the legal balance of power in most cities shifted dramatically from property owners toward renters. In particular, governments made it more difficult for landlords to evict tenants for nonpayment of rent. (New York City made such evictions nearly impossible, as Peter Salins demonstrated in his 1980 book *The Ecology of Housing Destruction*.)

Mostly this was a matter of state and local regulation, aided by state courts, but there is one area—that of public housing—in which the federal government also played a role. In 1975 the Department of Housing and Urban Development adopted regulations that have made it harder for local authorities to evict tenants from public housing projects. Under the regulations, local authorities must grant tenants a right to a hearing before asking a court to evict them, and may not begin the legal process of eviction until the hearing officers have ruled favorably. (Tenants are also entitled to a hearing before the public housing authority, known as a PHA, takes other sorts of “adverse action” against them short of eviction.)

The HUD regulations specify in some detail how these hearings are to be conducted. Even so, they are meant to be informal: they are not necessarily public, and the tenant does not have a right to be given a lawyer, although local legal aid services often supply one. The process, however, involves little risk to the tenant. If he wins the hearing he wins, but if he loses he gets a second chance in state court, where he can not only bring up all the same arguments he brought up at the hearing, but also ask the court to deny the eviction on the ground that the authority failed to comply fully with the HUD regulations on hearings.

The regulations also provide that an authority must give a tenant fourteen days ad-

vance notice of an eviction hearing for non-payment of rent, and thirty days when eviction is for any other cause. These other causes commonly range from such offenses as housing unauthorized live-in guests and refusing to furnish declarations of low income, on the one hand, to fighting, dealing drugs, and destroying property on the other. Failure to evict destructive tenants promptly can result in great damage to buildings and surrounding grounds (as well as lost rents). The authority may waive the thirty-day notice and provide "reasonable" notice instead only if the tenant's continued presence creates "a threat to the health or safety of other tenants or PHA employees." Note that a threat of imminent property damage or other illegality is not enough.

Most tenants apparently do not ask for a hearing at all. But the rules can lead to considerable delays, stretching long past thirty days, when a tenant has a lawyer who knows how to take full advantage of every procedure. To begin with, the hearing has to be conducted before one officer chosen by the authority and another chosen by the tenant—which two then select the third member of the panel. In Dallas, where the authority says it cannot afford to reimburse hearing officers for their time, finding someone willing to hear the case often adds months to the delay.

Finding an officer who is acceptable to the tenant can be even harder. Frank Lofurno of the authority in Hampton, Virginia, says the selection procedure "has become a stalling tactic." He recounts a 1982 case in which a tenant managed to delay a hearing for six months by refusing to accept proposed hearing officers. Frustrated by this incident, the Hampton authority considered a new plan in which the tenant and the authority would each rank the same ten hearing officers in preferred order from one to ten, and the three candidates with the best combined rating would be chosen as the panel. The plan died, however, when local legal aid lawyers objected that it would violate the HUD regulations.

The chief victims of delay are the neighbors of problem tenants. "The 10 percent who are bad tenants—loud, disruptive, bad housekeepers—can drive out the [90 percent] who are good tenants and good people," says Jim Tress, the director of the housing authority in Beaver County, Pennsylvania. The Akron, Ohio,

housing authority says that in one recent case it moved to evict a tenant after she refused to discourage the visits of a boyfriend who had threatened a neighbor at gunpoint. Although the threat to "health and safety" seemed evident, the eviction still took more than two months.

As in disputes over school discipline, there is an inherent difficulty in supervising the relationship between authorities and tenants. Assuming the good faith of the authority may mean allowing some acts of arbitrariness or favoritism toward tenants—who are certainly in a state of dependence, though perhaps not as much so as public school students. On the other hand, the consequences of assuming bad faith on the part of the managers (or teachers) are corrosive. If they do not have the interests of tenants (or students) at heart, it will not solve the problem to make them keep a paper trail; and if no replacement can be found whose good faith can be trusted, the service itself is in big trouble. Local housing officials, of course, bristle at suggestions that they are acting in bad faith. "We never reach the [point] of considering evicting a tenant without going through a lot of struggles, working with the tenant to resolve the problem," says Jack Herrington, who is in charge of Dallas's 7,600 rental units.

The regulations reflect an implicit distrust not only of local officials but also of the due process protection that state courts already offer tenants (since judges will order eviction from public housing units only for cause). Nonetheless, they do their best to keep business coming into those lower courts, by banning various lease clauses intended to speed up or bypass the court system in resolving any disagreements. Specifically, tenants may not sign leases in which they waive their rights to appeal court judgments in connection with the lease, to hold the authority liable for acts done improperly, to get full legal notice periods in any legal action, and so forth.

In August 1981, the regulations were targeted for review by the Reagan administration's Task Force on Regulatory Relief, which argued that they "often duplicate . . . State and local ordinances" and "tend to make it difficult for PHAs to protect the health and safety of tenants." Local administrators also complain that the rules do not apply to other federal housing programs, such as the Section 8 pro-

gram of subsidies for private rental housing, and cite the U.S. Housing Act of 1937, which says administrators should "vest in local public housing agencies the maximum amount of responsibility in the administration of their housing program."

Accordingly, on December 13, 1982, HUD proposed a new set of eviction guidelines to give local authorities more leeway. The guidelines would have, first, eliminated the requirement of a hearing except in cases where the level of tenant income, amount of rent owed, or eligibility for public housing was under challenge. Second, while the authority would still have to give thirty days notice before evicting a tenant for "other good cause," the delay would be reduced because the notice could run concurrently with the notice required by state or local law. The provisions that prevent tenants from signing away due process rights were retained.

Objections to the revision came mostly from national housing groups, led by the National Housing Law Project, one of the "back-up centers" funded by the Legal Services Corporation, and from legal aid offices around the country. Their opposition seems not to have been matched at the local level by the people who have to live in public housing. When the Hampton authority hand-delivered notices to the tenants in one 400-unit complex, inviting them to come to a public meeting to express their views on the issue, only fifteen showed up.

In the event, the HUD proposals were blocked not by local opponents but by Congress. In November that body passed the first omnibus housing bill—with the House Banking Committee working closely with NHLP—to contain tenant protection rules. The new law gives HUD a little of the regulatory relief it had been seeking, but tightens other provisions, and of course makes it much harder to change the rules in the future. Local authorities will now be allowed to evict tenants without a hearing if HUD has certified that the local court procedures for the eviction include "basic elements of due process." However, hearings will still be required—but now by statute—for all other "adverse actions." At these hearings, tenants must have the right to be represented by a third party, to cross-examine witnesses, to look at any relevant documents, and so on. In any case, tenants will have to get at least fourteen days notice before evictions for nonpay-

ment (which HUD had wanted to deregulate) and thirty days notice in all other evictions, unless "the health or safety of other tenants or public housing agency employees is threatened." (Whether these notice periods are to run concurrently with court notice periods is not specified.) Finally, the new statute formally enacts the prohibitions on evictions without "good cause" (or "for serious or repeated violation of the terms or conditions of the lease") and on "unreasonable" lease conditions.

Overall, it looks as if the legal doctrine of "substantive due process"—and perhaps the problem tenants it protects—are better entrenched than ever.

Pension Vesting and the IRS: the Power of Regulatory Persistence

With the Revenue Act of 1942, the Internal Revenue Code began prohibiting employers from offering tax-qualified pensions and profit-sharing plans to their officers, shareholders, or highly paid employees unless they gave employees at all income levels retirement benefits on similar terms. Although this "antidiscrimination" rule probably discouraged some executives from giving themselves pensions, it did not distribute benefits very predictably among particular workers: an employee who stopped working for a firm before "normal retirement age," typically sixty-five, might not get any benefits. (The great majority of plans, however, voluntarily gave at least partial benefits to early leavers.) An employee who changed jobs several times, like an employee of a firm without a pension plan, might well reach sixty-five with no pension at all.

The Employee Retirement Income Security Act of 1974 (ERISA) went much further in bending pension plans to broad social purposes. One of its central provisions required every retirement plan to provide "vesting" of benefits at least as rapid as one of three minimum schedules: full vesting after ten years of service, partial vesting after five years and full vesting after fifteen, or partial vesting when age and service totaled forty-five years and full vesting after another five years of service.

The vesting provisions were among the more controversial elements of ERISA. Many

In Brief-

Inalienable Rights. In 1971, Congress passed a law settling the long-standing claims of the original inhabitants of Alaska. It established thirteen "native corporations" and endowed them with a total of \$962.5 million, along with large tracts of land and other assets. All Americans with one-quarter or more Eskimo, Aleut, or Alaskan Indian lineage got a share in their local corporation or, if they had no local ties, in a special catchall corporation. The law provided that the owners could not sell their shares for twenty years—that is, until 1991.

Eight years from now, accordingly, outside corporations will be free to come in and make offers to individual natives to buy their shares. The offers might be quite tempting, especially since a number of the native corporations, despite rich holdings in land and enterprises, have lost money over the years. A lot of natives might be glad to exchange their economic stake in the tribe for a nice split-

level in Anchorage and a new Land Rover.

That is why a number of tribal leaders have called on Congress to restrict the rights of the native stockholders to sell their individual shares or, failing that, the right of the companies to sell their landholdings. Among the ideas the Alaska Federation of Natives is tossing around, the *New York Times* reports, are "complete prohibition of sale, permitting transfer only back to the corporation, limiting transfer to natives only, requiring corporation approval of stock transfer, limiting the size of individual holdings, requiring that natives only be allowed to vote on corporate matters, creating different classes of stock for natives and non-natives, using voting trusts to preserve native control, or eliminating stock altogether."

Of course, the monetary value of the shares to their current holders would be lower under such restrictions. On the other hand, many holders would derive nonmonetary satisfaction just from knowing that the local salmon cannery or caribou range will remain in tribal hands forever. For some, perhaps even most of the holders, that satisfaction would be worth the financial loss. So the real question for

Congress to consider is what would happen to the other holders, those who would not have voluntarily consented to tie up their shares.

The Securities and Exchange Commission has in the past been vigilant in protecting the rights of minority shareholders. It will be intriguing to see if it takes an interest in a proposal that involves minority shareholders in both senses of the word.

Canadian Press Regulation Shelved.

The Trudeau government in Canada has abandoned its effort to regulate the newspaper business through official monitoring councils and strict limits on chain ownership (for details, see Margaret Laws, "UNESCO of the North: Press Regulation in Canada," *Regulation*, September/October 1983). Parliament adjourned in November without enacting the proposed law, and the government said it would not reintroduce the bill in the new session. Instead it will propose a general antitrust bill that it thinks will be adequate to handle newspaper concentration.

In early December an Ontario Supreme Court judge acquitted Canada's two largest newspaper chains, Thomson and Southam, of antitrust charges the Trudeau gov-

employers saw slow vesting as a useful tool for retaining employees, although, of course, fast vesting, like other benefits, helped attract new employees. On the other side, various "public interest" commentators, joined more recently by some women's groups, have pressed for vesting schedules to be made as rapid as possible. They argued that pension funds "belonged to employees," who presumably desired immediate full vesting.

When Congress was considering ERISA, the Internal Revenue Service pointed out that in most firms lower-level jobs turn over more often than managerial jobs, so that more managers will get their benefits vested than will ordinary workers. In fact, the IRS said, slow vesting might itself be viewed as a violation of the 1942 act's provision barring "discrimination." This concern was something of a departure for the Service: in checking proposed plans

for discrimination, it had frequently approved vesting schedules that were considered quite slow, and its formal regulations had completely ignored the subject. Nevertheless, to prevent doubts as to how the amorphous discrimination standard affected the explicit statutory vesting requirements, Congress included in ERISA a specific section dealing with the relationship between the two:

A plan which satisfies the requirements of [the minimum vesting schedules] shall be treated as satisfying any vesting requirements resulting from the application of [antidiscrimination standards] unless:

(A) there has been a pattern of abuse under the plan (such as a dismissal of employees before their accrued benefits become nonforfeitable) tending to discriminate in favor of employees who are officers, shareholders, or highly compensated, or

ernment had brought against them. The alleged antitrust violations had spurred the proposed newspaper bill.

While Closer to Home. . . . Back in the United States, meanwhile, the First Amendment has been having its ups and downs. The federal government is testing its power to decide who should own big-city newspapers. The case at issue is the Justice Department's effort, under the Sherman and Clayton antitrust acts, to recruit a buyer for the failing St. Louis *Globe-Democrat* against the wishes of that paper's owners, who would rather close it down. The owners, the Newhouse newspaper group, are part of a joint venture with the rival St. Louis *Post-Dispatch* to share in the profits and losses of both papers. A Justice Department spokesman said that when "two newspapers in a town [agree] that one of them is going to fold," it "is very much like a merger or an acquisition."

The department has solicited buyers for other kinds of businesses before, but never for a newspaper. Courts have repeatedly struck down laws that threaten to bring about "excessive entanglement" between church and state, since such entanglement would give the gov-

ernment influence over church affairs (and perhaps vice versa). It will be interesting to see whether the courts develop a similar doctrine on press-and-state relations.

Let it not be said, however, that a casual attitude toward the First Amendment pervades all levels of government—at least not in Iowa. A hearing panel of that state's education department has declared that the Prairie Junior High School violated pupils' First Amendment rights to free speech when it told them they could not pass notes to each other during school hours. The panel ruled that a seventh-grader should not have been suspended for receiving a note in the school lunchroom.

Back to Zero-Effects. One of the Environmental Protection Agency's most important regulatory programs, but also one of its least known, is "premanufacture notification" for new chemicals and new uses of chemicals. The EPA now rules on a thousand chemicals every year—just part of the tremendous expansion of toxics regulation under the Toxic Substances Control Act and similar statutes.

EPA's approach to toxics regulation is coming under increasing criticism. Office of Management and

Budget regulatory chief Christopher DeMuth, in a November 7 letter to EPA administrator William Ruckelshaus, says that EPA has apparently chosen as its objective "to regulate chemical exposure down to a 'no-effects' level of risk—making 'worst-case' assumptions in each stage of analysis and adding a 'safety factor' at the end.

"For example, pyridine derivatives are regulated because they resemble other chemicals that are toxic in rats and rabbits. In determining the level of regulation required, EPA assumes that all of the pyridines are as toxic in humans as the most potent analog chemical in the most sensitive analog species tested. The agency then uses what it describes as a 'worst case' model of possible exposure, and sets a standard one hundred times below the lowest 'no observable effects' level."

DeMuth noted mildly that this "combination of objective and methodology generally leads to excessively conservative decisions." That might itself be called an excessively conservative description of EPA's approach, but it apparently did not budge the agency. In a December 9 letter, Ruckelshaus refused to reconsider EPA's position on the issue.

(B) there have [sic] been, or there is reason to believe there will be, an accrual of benefits or forfeitures tending to discriminate in favor of employees who are officers, shareholders, or highly compensated. [Internal Revenue Code, S. 411(d) (1), as amended by ERISA]

The inclusion of this section is a prime specimen of statutory irresolution. On the one hand, the time and care Congress had devoted to the law's minimum vesting schedules hardly suggests that it wanted the IRS to set them aside and draw up its own. On the other hand, the vague sweep of the last clause seems to invite just such IRS activism, since even under ordinary plans benefit accruals might end up favoring managers as more lower-paid employees quit. Sensing a possible problem, the congressional conference committee, in its report, helpfully added an instruction that, if the IRS

decided to apply antidiscrimination considerations to vesting, it was not normally to require anything faster than 40 percent vesting after four years of service, gradually rising to 100 percent after eleven years. Only in cases of "actual misuse" of a plan—the sole example given being "a pattern of firing employees to avoid vesting"—could the IRS impose a schedule more stringent than this "4/40" rule.

Within a little more than a year after ERISA was signed into law, the IRS announced two revenue procedures that effectively made "4/40" vesting the minimum acceptable standard for most plans established by small corporations, which are the great majority of all plans. Thus the vesting schedules actually set forth in ERISA became, for small employers at least, the exception rather than the rule. Even so, the move did not arouse substantial resistance, since 4/40 vesting was not especially oner-

ous for the typical small plan. Moreover, the IRS announced that it would apply the new standard only to plans that had not received IRS approval after ERISA's effective date.

The application of stricter standards to small plans might seem to violate the general rule that liberal reformers treat small business more gently than big business. But the pension area is an exception to that rule. Reformers have long viewed with alarm the proliferation of tax-qualified plans sponsored by small companies, particularly professional corporations of doctors or lawyers. Many of these plans by their nature granted most of their tax-deferred benefits to their well-to-do principals. With ERISA, Congress bowed to the sentiment against pensions for the well-off by tightening the limits on how much money a plan could salt away on behalf of any particular employee.

After the IRS imposed 4/40 vesting, the matter rested for four years, until April 1980. Then the IRS unexpectedly issued a notice of proposed rulemaking on "the coordination of discrimination and vesting requirements." The proposal provided that IRS would scrutinize what were described vaguely as the "facts and circumstances" of each plan to decide whether the plan's vesting schedule discriminated in its effects in favor of officers, shareholders, or highly compensated employees. To many observers, it appeared that hardly any plans could meet the test; one actuarial firm estimated that fewer than 1 percent of all existing plans could satisfy it. The most alarming thing in the proposal was, ironically, a "safe harbor" schedule which, according to the IRS, would make compliance with the "facts and circumstances" test unnecessary. The safe harbor effectively required 100 percent vesting at the end of three years of service, or incremental vesting of comparable severity—much faster than any previous norm.

This time pension managers reacted with an outcry that by their standards was deafening and that even against the background noise of Washington commanded some attention. Members of both houses of Congress, including some of the architects of ERISA, denounced the Service for its seeming disregard of the legislative history. And the IRS quickly issued a "clarification"—which its critics saw as an attempt to divide the opposition—announcing that the proposed regulation would apply only

to new plans. Not long thereafter the Service issued a revised version of the proposal, with examples of situations where three-year vesting would not be needed. The revision eliminated any realistic danger that the regulation would affect larger plans, but left intact its effect on plans established by small business and professional corporations.

One official who helped frame the proposal charged that the only opponents were a few tycoons who wanted to use retirement plans as tax shelters—but then admitted in a letter to a member of Congress that public reaction (which was running nine to one against the proposed regulations in comments to the IRS) had stopped the Service in its tracks. Congress enacted a brief funding moratorium on any IRS actions to require vesting any faster than 4/40. When the moratorium expired in June 1981, the IRS put the proposal on the back burner, and the matter seemed to be dead.

It was only a temporary retreat. The advent of the Reagan administration did not bring much change in IRS attitudes. In 1982, when Congress turned its attention to "revenue enhancement," the IRS was glad to encourage it to select tax-deferred pensions as a target. Opponents charged that clamping down on tax-deferred pensions would drive income into other sorts of tax-exempt fringe benefits and tax-avoidance schemes, which, unlike pension plan assets, are not always invested productively in financial markets. Nonetheless, the Tax Equity and Fiscal Responsibility Act of 1982 included, among other provisions aimed at "top-heavy" small plans, vesting rules virtually identical to those that the IRS had tried to impose administratively in 1980.

Software Piracy and the Law

From time to time readers ask for stories that tell how, in this imperfect world, government manages to do some things right. This is such a story. It is the tale of how the government—slowly, and with a couple of false starts—came to protect the creations of the writers of computer software.

Today we routinely draw the distinction between hardware (the computer and the physical devices that go with it) and software (the

programs without which the computer cannot act, and their documentation). But in popular usage the distinction really only dates back to about 1969. Before then, most computer makers had "bundled" their programs as a package with the machines they sold. It was only natural for customers to think of the software as just another part of the machine. (The few software companies that existed sold products meant to upgrade the hardware makers' bundled-in programs.) When IBM started selling its software separately in 1969, thus giving the blessing of the world's largest hardware maker to the separate identity of software, the industry suddenly took off. By 1983, more than 5,000 firms were selling software and allied products, with sales in 1982 of more than \$17 billion and an annual growth rate of over 30 percent—far above the comparatively sluggish hardware industry.

But there was a serpent in Eden. It is quite easy to make copies of software programs, either for legitimate "back-up" use or for pirating. Thus individual users commonly exchange copies of software packages with each other, and business users make multiple copies of the programs they buy for use throughout the organization. More flagrantly, some firms simply copy the software another firm writes and sell it under their own name. There are also "software rental" companies, which lend out software for a fraction of its purchase price, while of course proclaiming their innocence of any piratical designs customers may happen to have on the product. Software vendors sometimes try to foil piracy by various technical measures such as encryption, but other vendors sell programs that break through the protective code for purposes of copying.

The software industry, whose major asset is its intellectual property, loses vast amounts to piracy. Ric Giardina, general counsel of MicroPro International, estimates that his firm is paid for "about one out of five copies of WordStar [a popular word processing program] in the U.S., and about one out of ten in Europe." Dan Fylstra, chairman of VisiCorp, the country's largest vendor of microcomputer software, estimates that for each copy of a VisiCorp product that is sold, there is at least one pirate copy. And Synapse Software reports that pirate copies of some of its products reached Europe—over phone lines, no less—

before the company's own shipments had arrived there. The result is that much of the sale price of software, perhaps most, is attributable to the cost of piracy.

While legal protection cannot in itself prevent small-scale copying by users, it can at least curtail the commercial-scale copying that might come to a manufacturer's notice. Moreover, when software property rights are legally ill-defined, even well-meaning users may decide to resolve gray areas in their own favor. Unfortunately, of the three major ways the law provides to secure intellectual property—trade secret law, patent, and copyright—none can easily be stretched to cover the new technology.

Trade secret law offers only limited protection. If a vendor wants to protect its software on the ground that it contains trade secrets, it has to demand that all its customers sign nondisclosure agreements. Since these agreements do not bind anyone who has not signed them, the owner may have no recourse if even one copy falls into the hands of a would-be pirate who has not signed such a contract.

Patent law is closer to what is needed. But it is still inadequate—for two main reasons. First, a patentable invention is supposed to have novelty and nonobviousness. While programming can display great technical virtuosity, it generally relies on known techniques and ideas. Second, patenting an invention requires that the Patent Office conduct an exhaustive search of prior literature to ensure that no one else has invented such a thing before. Such a search can take years, during which time the software almost always becomes obsolete. For these reasons, the government has issued only a handful of software patents. Pansophic Systems, Inc., applied for a patent on its "Easytrieve" system in 1971 and finally got it eleven years later, in 1982—more because of a dogged refusal to give up than from faith in the efficacy of patent protection.

That leaves copyright as the most promising protection for software, but even there considerable straining of conceptual bounds is needed. In general, copyright protects any work that is an original writing or work of authorship and is embodied in a tangible medium. Literary works and music have long been covered by copyright. Photographs were brought under the law's protection in 1865, by stretch-

ing the definition of "writing." Motion pictures were recognized in 1912, and sound recordings in 1972.

In 1976 Congress passed a new copyright act, replacing a 1909 statute. But the law did not specify precisely which creations in the computer medium it covered—and some forms of software can be argued to fail the traditional tests of copyrightability.

The most familiar kind of software is "applications software," which tells the machine how to calculate a payroll or play a game. But even more basic to machine operation is "systems software," which enables the computer to carry out internal organizational tasks, such as communications between various parts of the machine. Recent advances have made it possible to encode both kinds of software directly onto semiconductor chips, giving rise to a hardware-software hybrid sometimes known as "firmware."

Software that is incorporated into the machine itself in this way raises several copyright problems. First, as an embedded component of the machine, it is hardly to be distinguished from a complex mechanical part. Second, although a form of communication, its sole "audience" is the hardware. As with Bishop Berkeley's tree in the forest, no human is present to hear its message.

Even if its message is heard, it is unintelligible to humans on its face. Computers can understand instructions only in the form of a near-endless sequence of precisely timed electronic pulses and absences of pulses, known as *machine code* and represented as strings of ones and zeroes, respectively, in what is known as *object code*. At first, during the 1950s, programmers had to write programs directly in this forbidding format. Not only was this process extremely time-consuming and difficult, but humans found it almost impossible to read the resulting programs and check them for accuracy. Eventually scientists developed much more accessible programming languages, such as Fortran and Cobol, in which a one-word command can equal thousands of ones and zeroes. Software written in such a language, the easy way, is called *source code*.

Even before Congress passed the Copyright Act of 1976, the U.S. Copyright Office had begun to accept programs for copyright registration in both their source code and object code ver-

sions. Source code versions were, indeed, writings or works of authorship, intelligible to (at least some) human readers, and embodied in a tangible medium. A 1980 amendment to the act dispelled all remaining doubts as to the copyrightability of computer programs per se. But pirates continued to copy programs in their object code form, and the copyright office continued to register such versions only under the "rule of doubt"—meaning that in case of an alleged infringement a court would first address the issue of whether the registration was valid.

In *Williams Electronics, Inc. v. Artic International, Inc.*, the first notable case, Williams Electronics charged Artic International with copying the program for the video game DEFENDER in object code and reselling it under the title of DEFENSE COMMAND. The act of copying was done so mechanically that when the Artic programs were printed out in source code, they displayed Williams Electronics' "salted" (hidden) copyright notice.

Artic argued that it had simply duplicated the silicon chips that contained the programs, and that such chips were not covered by copyright because they were neither writings (being, instead, mere utilitarian objects) nor "intelligible to human readers." Judge Dolores Sloviter of the Third Circuit Court of Appeals rejected these arguments, closing what she called "the unlimited loophole" that would otherwise result.

The landmark case in software copyright to date is *Apple Computer, Inc. v. Franklin Computer Corporation*, which the same appeals court decided on August 30, 1983 (and which the parties recently settled out of court). Franklin, a manufacturer of "lookalike" computers that mimic the popular Apple II personal computers, had copied fourteen of Apple's operating system programs and built them into its own machines. Eleven of the programs had been registered with the Copyright Office, but all were distributed with the Apple II computer in object code; in fact, most were embedded on chips.

In July 1982, a federal district court denied Apple's request that it enjoin Franklin from distributing the programs. Its primary grounds were that object code is not intelligible to human readers and is therefore not protected by copyright. The court also ruled that the

chips on which the programs had been encoded were "more like a pictorial three-dimensional object than a literary work" and that operating systems were "an essential element of the machine" and likewise not protected by copyright. Software writers and distributors stood aghast.

A year later, however, the ruling was reversed on appeal to the Third Circuit, before the same Judge Sloviter who had decided *Williams*. On the copyright status of object code, Judge Sloviter noted that the Copyright Act as amended in 1980 defines a computer program as "a set of statements or instructions to be used directly or indirectly in a computer in order to bring about a certain result." Since object code is the only thing the computer can use "directly"—it can use source code only indirectly, after translating or (in computer parlance) "compiling" it—she concluded that Congress indeed intended the Copyright Act to protect programs in object code form. The court also reaffirmed the protection of firmware under *Williams* and other court decisions.

Finally, the court rejected Franklin's contention that operating systems were a "process or method of operation" (such things are not protected under copyright), noting that Apple had never claimed copyright in the *methods* embodied in its operating system programs, just the specific language that implemented those methods. The court also rejected—for similar reasons—Franklin's arguments that operating systems are "purely utilitarian works" and that they are an idea, not an expression as required by copyright. A federal district court in California answered these questions in a similar fashion in another recent case, *Apple Computer, Inc. v. Formula International, Inc.*

After considerable difficulty, then, the United States seems to have arrived at a fairly satisfactory state of affairs. Some Western European countries have evolved copyright interpretations that parallel ours. But not all countries have been so fortunate. In Australia, the federal court in Sydney has just ruled that software is not protected under national copyright law (*Apple Computer et al. v. Computer Edge Pty. Ltd.*). In Japan, the law is in turmoil as legislators debate whether to apply patent or copyright law.

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