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after a small-scale 1979 experiment.

Another innovation may be just around the corner: the chord keyboard, on which various keys identify syllables, words, and even phrases. IBM may soon market a device measuring less than three inches by six inches with 10 keys capable of creating 4,407 chords at 80 words per minute (still slower than top QWERTY typists).

Further in the future are voice-activated word processors. Matsushita of Japan may introduce one such system with a small vocabulary (that could handle, say, numbers and a business's standard inventory) by 1983. But QWERTY will be here to gripe about, predicts Litterick—at least for a few more decades.

Science as Evolution

"The Evolutionary Development of Science" by Douglas Shrader, in *Review of Metaphysics* (Dec. 1980), Catholic University of America, Washington, D.C. 20064.

Henry Cavendish, James Watt, and Antoine Lavoisier independently hit upon the compound nature of water in the late 18th century. Austrian monk Gregor Mendel's long-ignored experiments in plant genetics in the 1860s were appreciated only after they were invented anew by three separate researchers in 1900. Why are simultaneous breakthroughs so common? Shrader, a graduate student in philosophy at the University of Illinois, Chicago Circle, answers by likening the development of scientific theory to the evolution of infectious parasites.

Shrader portrays scientists as organisms that can be broken down into species (such as biologists) and varieties (e.g., molecular biologists). Similarly, he describes theories as "parasites" that infect members of the scientific community. "Theory species" compete with one another (as the theory of evolution competes with creation theory) and among themselves (as two schools of evolutionary theory might).

Scientific progress comes as new theory-parasites join the competition for survival. As in evolution, variants often arise by chance or error. The accidental flash of an electrical spark in Luigi Galvani's laboratory caused a frog-leg specimen to twitch and led Galvani to discover electric current in 1791. Only the inadvertent contamination of a bacteria culture enabled Alexander Fleming to discover penicillin in 1928.

Whatever the process, progress is slow. Just as a dramatically mutant parasite cannot reproduce or long survive inside its host organism, truly radical discoveries are—even when true—by definition unintelligible (if relativity theory had *really* sprung from Einstein's genius alone, no one would have understood it). This accounts for the frequency of multiple discoveries: Many scientists share common background knowledge and investigate the same problems.

Just as evolutionary pressures (such as climate) favor certain organisms and their parasites over others, financial and political pressures favor certain scientists and theory species. (Witness recent advances in particle physics aided by funding of costly cyclotrons.) The parasite

analogy, according to Shrader, suggests that "science fares best and the chances for progress are greatest" when society nurtures a broad range of research efforts and allows them to stand or fall on their merits.

RESOURCES & ENVIRONMENT

Energy Taxes at Cross Purposes

"Nonneutral Features of Energy Taxation" by William E. Morgan and Dennis Olson, in *Natural Resources Journal* (Oct. 1980), School of Law, University of New Mexico, Albuquerque, N.M. 87131.

Washington and the states seem to be working at cross purposes on energy matters. The federal government gives oil, natural gas, coal, and uranium producers tax breaks that are the envy of other industries, in order to speed domestic energy production. But most states levy special charges for fuel extraction, report Morgan and Olson, economists at the University of Wyoming and Texas Tech, respectively.

Federal tax incentives to domestic energy firms vary. A percentage depletion allowance exempts from taxation a portion of the resource extracted. Though the major oil companies lost their percentage depletion break in 1976, the independent oil producers (with a 22 percent allowance limited to 1,200 barrels a day) and miners of coal (with 10 percent), shale oil (15 percent), and uranium (22 percent) still qualify. A second exemption, the cost depletion allowance, is available to all extractors and is based on the ratio of fuel withdrawn to retrievable reserves left. (Eligible companies may choose between percentage and cost depletion.) Other federal tax benefits in the energy field include the writing off of "intangible" oil and gas drilling costs (e.g., lease payments) and of hard mineral exploration and development costs.

But state governments heavily tax extraction at the wellhead and mine mouth, primarily to raise revenue. Fifteen states impose "severance" fees on coal, ranging from 2 cents per ton in Arkansas to 85 cents per ton in North Dakota. Montana demands a steep 30 percent of gross value. State coal taxes added up to $192 million, nationwide, in 1978. By contrast, the 25 states that tax oil and gas raked in $2 billion that year. Oil tax rates varied from a penny per barrel in Idaho to 45 cents per barrel in New Mexico. Louisiana takes the highest share of gross value—12.5 percent. State natural gas taxes range from 2 to 10 percent of gross value.

Washington is abandoning its "live and let live" posture. The federal government has successfully challenged Louisiana's "first use" tax of 7 cents per thousand cubic feet on natural gas sold outside the state and is suing Montana, charging that its 30 percent coal tax represents unconstitutional interference in interstate commerce.