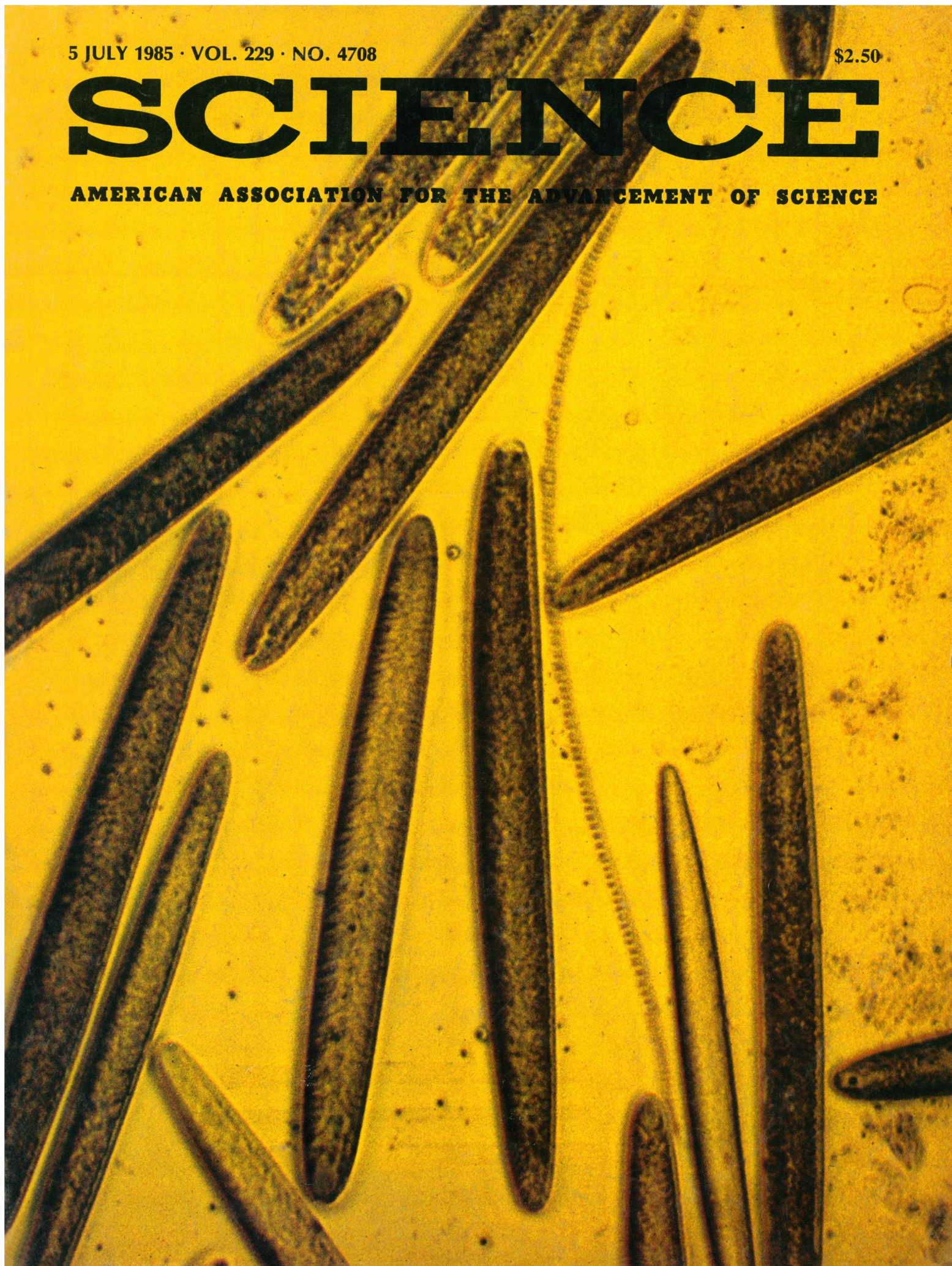


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COVER

Live specimens of an undescribed symbiont from the gut of the most common surgeonfish in the northern Red Sea; photographs were taken 15 to 20 minutes after capture of the host. Little information is available about the identity or possible roles of intestinal symbionts of herbivorous reef fishes. See page 49. [Yehuda Cohen, Steinitz Marine Biological Laboratory, Eilat, Israel]

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Protein stability

Aromatic interactions, occurring when amino acids with side chains containing phenyl ring structures meet, contribute to the stability of proteins (page 23). They form a fourth class, along with hydrogen bonds, electrostatic interactions, and van der Waals forces, of energetically favorable interactions in proteins. Burley and Petsko analyzed the interactions of phenylalanine, tyrosine, and tryptophan in proteins; more than half the time that these amino acids were present, they were involved in aromatic pairing. Pairs usually formed inside the molecules and brought the centers of rings to within 5.5 angstroms of each other at almost 90° angles—distinguishing them from the parallel stacking of bases in DNA at 3.4-angstrom distances. Aromatic pairs were found in the portion of the globin molecule that binds heme and at the site in an antibody molecule where antigen binds. They may form when a specific inhibitor binds to an enzyme and inactivates it. In these and other groups of related proteins, pairing is conserved and may be an important determinant of structure and stabilizer of protein conformation.

Earth currents

An opportunity to learn more about the magnetic and electric properties of the earth's core was afforded when the latest transatlantic telecommunications cable was laid from New Jersey to England (page 47). The unpowered cable was long enough (4476 kilometers) for detecting currents that might be leaking from the interior. Once in service, however, electric power associated with the telecommunications functions of the cable would obscure other signals. Lanzerotti *et al.* did not find evidence of currents generated within the core. Current patterns in the cable varied daily and could be accounted for by regular electric variations in the ionosphere. A screening layer, thought to exist in the earth above the core and below the crust, might be blocking currents generated in the core.

Gut symbionts in marine fish

Cigar-shaped microorganisms (cover), referred to as protists but eluding precise classification, were found in the guts of surgeonfish in the Red Sea but not in other fish that eat the same food (page 49). Fishelson *et al.* thus describe symbiotic organisms in a plant-eating marine fish. Daily the surgeonfish eat algae from beds over which they have first expelled a shower of young protists and undigested algae from the previous day. Such continuous reinfection may sustain the symbiotic relation. In the gut, the protists, as many as 100,000 per centimeter, cluster near the lining while algae are in the center. Thus, unlike other gut symbionts, the protists may not participate directly in digesting algae by ingesting them but may only indirectly aid in digestion.

Hormone control of cell death

Ecdysone, a steroid hormone, is responsible for the survival of nerve cells in insects (page 58). When an adult moth emerges from its pupal-stage casing and the concentration of ecdysone drops, 40 percent of the cells in its abdominal nervous system die. Bennett and Truman compared deaths of cells removed from ganglia on the last day of adult development and put in culture with cell deaths in the intact insect. Similar numbers and types of nerve cells died in a fixed temporal sequence. When ecdysone was added to the cultures, most cells remained alive; the few that died under these conditions may have already been programmed for death before they were put in culture. Nerve cells that remain alive in the absence of ecdysone serve the needs of the adult moth; those that die are presumed to have been important earlier in development.

Dopamine and motor control

The concentration of the neurotransmitter dopamine increases in distinct regions of the brain during specific locomotor activities (page 62). The effects of dopamine are dramatically illustrated in Parkinson's disease, in which the ability to move is reduced as dopamine is depleted. Freed and Yamamoto placed rats in powered treadmills designed to control the speed and posture of the animals. Concentrations of dopamine and one of its metabolites increased significantly in the nucleus accumbens of the brain as speed increased, in the caudate nucleus as body curvature increased, in both areas as the direction of motion changed, but in neither area when the head was moved without locomotion. This neurotransmitter system may prove useful in the mapping of brain regions that are associated with distinct motor functions.

Sugars in hormones

When the large sugar components are removed from α chains of hormones that are active in sexual development, the hormones are no longer biologically active (page 65). Sairam and Bhargavi studied follicle-stimulating hormone and luteinizing hormone, both of which have an α and a β chain. If the sugar components are removed from the α chain the hormone still binds to the appropriate cell, but the hormone's message is not communicated to the interior. The α chains of these hormones are identical within a species and similar between species; the β chains differ. Conservation of the α structure suggests that it performs identical functions for different hormones at different cell surfaces. Binding to appropriate cellular receptors is determined by the specificity of β chains. Signals sent to the interior of the cell through intermediate chemicals may be similar in all affected cells, but cellular responses will differ depending on the target cell.

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The Undesirability Principle

In physics, the Uncertainty Principle states that the product of the uncertainties in two related quantities—the momentum of a particle and its position in space—is equal to or greater than a constant. This means that any choice that investigators make to increase the certainty in one variable is automatically paid for by increased uncertainty in the other variable. If one determines the position of the particle to high accuracy, one can only know the velocity of the particle to very low accuracy. There seems to be an equivalent principle operating in society, which I shall call the Undesirability Principle. It states that the product of the costs of two or more conflicting courses of action is a constant. Society, therefore, can obtain one goal to whatever degree of desirability it wishes provided that it is willing to pay the price in loss of desirability in other goals.

The newspaper headlines illustrate daily the importance of this principle, which is usually ignored by special-interest groups who lobby for their own particular commitments. Some industrial companies, for example, would like to dump toxic wastes for the lowest cost possible and with minimum government regulation. Some environmental groups would like to place severe restraints on dumping to prevent any conceivable pollution in this and future generations. Consumer groups would like to buy the products of industry at the lowest possible prices. Trial lawyers want the greatest possible freedom for individuals to sue companies for damages. Society can have any one or two of these factors to a high degree of desirability, but only at a price of undesirability in some other part of the system. We can enact, for instance, strict environmental standards to reduce almost all chance of contamination now and in the indefinite future. We can establish standards stating that if these limits prove, at some later time, inadequate, an individual who becomes ill can sue a company even if that company conformed to all of the original standards. In fact, just such a bill is before Congress at this moment, loudly supported by its protagonists. It can, of course, go into effect, but only at a substantial price to the consumer.

On balance, it seems obvious that companies must continue to bear restraints on the dumping of toxic chemicals. We live together too closely and there are too many chemicals to allow careless waste disposal. Responsible chemical companies would and do agree. Moreover, a company that flagrantly or willfully disregards the laws should be punished by the legal system and be vulnerable to lawsuits by victims. On the other hand, is it reasonable to write into a law that victims should be allowed to sue a company when it has conformed to all the existing rules because later the limits change as a result of new scientific evidence? Or should companies with the expertise be expected to foresee possible effects? Environmentalists and industrialists will argue their viewpoints with passion, denouncing each other for recklessness or impracticality of what, in fact, is a matter of economics. Contingency funds can be set aside at any level by industry or government. It just means that current customers will be paying a high price to protect customers of the future. It is not simply a matter of right and wrong. There is a point at which the desirability of one goal has created an out-of-proportion undesirability in another goal.

The solution is clear. Congress should enact an Undesirability Impact Law requiring protagonists of one desired goal to state clearly to society the undesirable aspects of their proposal. For example, chemical companies advocating less regulation would be required to detail the dangers to water supplies of minimal regulation. Environmentalists advocating stringent precautions would be required to state the cost to the consumer. A society educated to the Undesirability Principle would become skeptical of single-minded advocates. The process of applying the Undesirability Principle might even introduce a welcome degree of uncertainty into the more closed-minded political lobbyists.—DANIEL A. KOSHLAND, JR.

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