Aspergillus and also in the mammal where it is effected by liver microsomes (*8*). Therefore, a test for bacterial mutagenicity of MD in an animal host (*15*) might reveal positive results in contrast to our negative observations on *Salmonella*. We do not know whether the mutagenicity of MD in the T4 test system, in contrast to the *Salmonella* test system, is due to direct activity, to metabolic conversion, or to altered permeability of infected cells. Miracil D is a weak mutagen in *Drosophila* (*16*) and causes achromatic lesions and chromatid breaks in human leukocyte chromosomes in vitro (*17*).

The high degree of mutagenicity of HC and MD in our microbial test systems and other effects of HC (*7*) lead us to view with alarm the widespread clinical testing of these compounds in humans. Most compounds known to be strongly mutagenic for bacteria are either untested or positively indicated as carcinogenic (*6*).

There is no correlation between mutagenic activity in tests with *Salmonella* and antischistosomal activity. The following agents were found to be inactive in spot tests for mutagenicity with the mutants listed in Table 1: potassium antimony tartrate; a nitrothiazole—niridazole [see (*18*)]; four differently substituted tetrahydroquinolines—UK3883 and UK4271 and their 7-chloro- analogs (*19*); a nitrovinylfuran (SQ18,506) and its *N*-acetyl derivative (SQ19,104) (*20*).

While some studies have been performed on the interaction of MD with DNA and its effects on bacterial metabolism (*21*), we know of no comparable analysis of the action of HC.

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ban students (33 male, 46 female) and 161 rural students (85 male, 76 female) in senior high school. They are a very small sample from a large population, but the results are so far from what one might suspect as to be very disquieting.

A semantic-differential technique (*2*) was used in an attempt to measure attitudes rather than opinions. It is believed that the purpose of the test was not obvious to the population tested. The sample group was not interviewed prior to the test, nor were conventional questionnaires used. Two forms of the test were used for the rural students. The correlation between these forms was $r = 0.97$, indicating a high level of reliability.

It was found that, relative to their self-image, students viewed "man" as cruel, harmful, hard, old, bad, frightening, false, and dishonest. They viewed "scientist" as helpful, wise, and important, but, hard, old, frightening, colourless, and "theirs." The concept "industrialist" was seen most unfavorably—cruel, masculine, hard, foolish, old, bad, frightening, colourless, and dishonest. "Industrialist" was also totally rejected on the mine-theirs scale. Among the 25 percent of urban students that had negative attitudes toward "technology," the ratio of boys to girls was found to be 3 : 1.

What is disturbing is the specter of student activists trying to control the ogre "technology" from a basis of ignorance. We infer from Horn and Knott that activists are essentially "normal" and that they may be reflecting the policies of society at large. If this is so, then the "swing away from science," coupled with the activist ethic, may forecast a serious breakdown in the technological underpinnings of our society.

Surely we must change, but let the change be from an awareness that the facts of existence, which are the subject matter of science, and the facts of consensus, which form our societal structures, are not the same (*3*). A fact of existence is there, implacable and impassable. A fact by consensus is created or modified by agreement, like the spelling of the word "colour."

Much of the revolt against technology is rooted in a confusion between these kinds of facts. The scientist is considered stubborn, the engineer inhuman, because they are unwilling to submit their facts to arbitration. We

Students Reveal Negative Attitudes toward Technology

The juxtaposition of the articles "Taming technology" by Branscomb and "Activist youth of the 1960's" by Horn and Knott (12 March) prompts us to summarize some preliminary findings of a study of student attitudes toward science and technology (*1*). As proposed, the study was intended to examine the factors "affecting not only choice of education and career, but also attitudes towards both science and society." Due to lack of funding, only a preliminary study was carried out.

In the development of the measuring instruments, tests were given to 79 ur-

can laugh at the recent suggestion that the law of gravity be repealed "so everyone can get high," but what can we do when earnest humanists urge us to do all we can to prevent the building of nuclear power stations that "cause thermal pollution"? Is it suggested that we repeal, by consensus, the second law of thermodynamics?

The point is that, by insisting upon our "right" to reproduce, we have committed ourselves irrevocably to an ecological system that we hear little of —the complicated and delicately balanced technological clockwork that keeps us alive.

Ignorance of the law is no excuse. We have already heard too many cries of "but it was the *best* butter!" from overconfident tinkerers with the machinery. In a democracy, Everyman

must be something of a scientist: he must know what is adjustable and what is deplorable.

The issue isn't a complicated one— either we, the scientific community, inform the general public; or the clock strikes 12.

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Highly Polarizable Singlet Excited States of Alkenes

The remarkable polar behavior of the first excited states of the double bonds in cyclohexenes and cycloheptenes discussed by Marshall (*1*) has an interesting explanation which leads to the prediction that singlet rather than triplet excited states will be found responsible.

A symmetrically substituted ethylene $R_2C = CR_2$ has geometrical symmetry group D_{2h} in its ground state. If the CR_2 groups are counterrotated about the double bond (assumed to be the x axis) the symmetry group is reduced to D_2, until the planes defined by the two CR_2 groups intersect at a 90° angle, when it becomes D_{2d} (*2*). In D_{2h} the lowest π orbital spans the b_{1u} representation, and the excited π^* orbital spans b_{2g}. These orbitals, respectively, correlate with b_1 and b_2 orbitals of the group D_2 appropriate to all angles of twist. However, in D_{2d} both orbitals span the same e representation (denoted $2e$).

Thus when the planes of the CR_2 groups become perpendicular, the two orbitals must become degenerate for reasons of symmetry. Even an infinitesimal perturbation can then force a finite change in the wave function if the perturbation contains a b_2 component in D_{2d}. In particular in the one-electron approximation, the presence of any electron-attracting or -repelling ion, molecule, or group near either end of the bond will produce an electric field that will mix the two e functions and

cause a pronounced shift of electron density from one end of the bond to the other in a manner familiar from the Stark effect.

The two independent eigenfunctions of the Stark effect ψ_a, ψ_b are simply p orbitals, p_a on carbon atom a, and p_b on carbon atom b. The orbital p_a is perpendicular to the plane defined by its own CH_2 group; p_b is perpendicular to its CH_2 group. Thus p_a and p_b are perpendicular to each other.

One must therefore expect that, in any ethylenic system, a singly excited double bond will show a very marked increase in polarizability on twisting from the planar to the perpendicular conformation, if the Pauli principle does not force the two π electrons to occupy oppositely polarized e orbitals. On this basis one finds that it is the singlet ($^1A_1$, $^1B_2$) manifold rather than the triplet state which is unusually polarizable.

Kaldor and Shavitt have given an extensive discussion of the known data relative to perpendicular ethylene, and in particular have carried out all-electron LCAO SCF calculations (linear combination of atomic orbitals self-consistent field) [including configuration interaction (CI)] on the $^1A_1$ $(2e^2)$ and $^1B_2(2e^2)$ states, which they find to be separated by only 0.1 ex (*2*, pp. 201–03). The greatest supposed separation of these states is that implicit in the diagrams of Merer and

Mulliken who indicate that their energy 2.1 to 2.7 ev for the $^1A_1$ state is only a rough estimate (*3*). In contrast, the lowest states that could contribute appreciably to the polarizability of the $^3A_2$ state are the high-lying triplet Rydberg states (*4*). Now the $^1B_2$–$^1A_1$ Stark transition matrix element must be of the order (2.56 atomic units) eE where e is the electronic charge, E is the external electric field parallel to the $C = C$ bond, and 2.56 atomic units is the $C = C$ bond length in ethylene. A simple semiempirical LCAO perturbation calculation shows that even in the case of the 2.7-ev separation, the polarizability is very large. The field due to a charge of 0.1 e situated two $C = C$ bond lengths from the end of the twisted double bond causes a charge shift of 0.14 e from one C atom to the other. If the 0.1-ev separation is assumed, the corresponding shift is 0.999 e. This is of course a larger shift than one would find if one made an SCF calculation after including the Stark field in the Hamiltonian.

We conclude that, if a double bond is optically excited to the $\pi\pi^*$ singlet state and begins to twist, it will reach a highly polarizable configuration provided that transition to the triplet state does not occur. We propose therefore that it is the singlet rather than the triplet state that reacts ionically. It may be possible to find substituted ethylenes (such as cyclohexenes or cycloheptenes with heavy atom substituents) in which intersystem crossing is more rapid than the internal rotation of the excited state. If our hypothesis is correct photoionic reactions of such molecules would be inhibited, while if the triplet state is the active species, the opposite could be found to be true.

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Students Reveal Negative Attitudes toward Technology

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