studied. The measurements have been done on samples as small as 0.5 cm^2 of area, and we calculated the *mean* dose over this area (about 165 rem in 25 years, in the example alluded to by Michelson). The higher estimate of 1000 rem or more in 25 years for particular areas was based on the supposition that local regions within the samples we measured could have polonium concentrations three or more times the average value. We believe that this guess of the degree of nonuniformity is probably conservative, because of the fact that the highest mean concentrations have been found at segmental bronchial bifurcations. On anatomical and physiological grounds we expect that chronic retention of smoke particles in the bronchial epithelium would probably be quite sharply localized to the region of the bifurcation itself, in an area of perhaps only a few square millimeters.

Another point should be mentioned with regard to these calculated doses. It is probable that the biological half-life of polonium in the epithelium is approximately 30 days, and therefore the physical half-life (138 days) is unimportant in determining the mean residence time. To make the dose estimates we used a mean residence time of 50 days (half-time 35 days). This figure is based on measurements of lung retention of a polonium-labeled aerosol in dogs [F. A. Smith *et al.*, *Am. Ind. Hyg. Assoc. J.* **22**, 201, (1961)]. Better data are needed to determine bronchial retention times, particularly because the doses localized to small regions are probably much more important than the doses delivered from smoke in transit over the epithelium.

We agree with Michelson's comments about the possible effect of filters in lowering exposure of the smoker to polonium or any other component of smoke, and indeed it is no trick to remove mainstream smoke completely. Whether a relatively "smokeless" cigarette will ever be acceptable to the public is questionable. To standardize comparisons of smoke obtained artificially from various brands of cigarettes, it is important that either the amount of tobacco consumed be the same or the length of butt remaining be constant. Both criteria have been proposed for testing purposes, and we are grateful to Michelson for sending us information concerning cigarette-testing methods. Neither of the above standard criteria was met in our studies, which were designed merely to show that polonium did get into the smoke and that we could account reasonably well for the polonium lost from the cigarettes during smoking. For this reason we knew comparison of results from the four brands would be meaningless. It may be that some kinds of cigarette filters may prove somewhat effective, but we do not believe our results should be used as evidence concerning filter efficiency.

Michelson's letter and the preceding comment raise an important point, we feel, for the scientific community as a whole. The cigarette industry is a multibillion-dollar one, and the stakes are high in terms of the relative sales of different brands of cigarettes. As a result of the Surgeon General's report and the rules for advertising cigarettes proposed by the Federal Trade Commission, it appears likely that increasing emphasis in cigarette sales promotion will be placed on alleged differences in composition of the smoke from the different brands and possible biological consequences of these differences. It is also likely that scientists will be asked by the press to give their opinions concerning the merits of these claims. In the past, evaluating such claims scientifically has been difficult enough, even though they have generally been based simply on amounts of "total tars" or total smoke condensate attributed to cigarettes of the particular brand. As an example of one difficulty, if it is true, as we suspect, that generally a greater amount of tobacco is consumed and a shorter butt results from smoking filter cigarettes than from smoking nonfilter cigarettes, what then is the validity of claims made on the basis of a constant amount of tobacco consumed in tests? When claims are made for *selective* removal of a particular component in smoke or combustion gases from a cigarette, moreover, the scientist should have an especially firm basis on which to judge the claims. In our opinion, the most important basis of judging is quantitative chemical analysis of smoke and other components of the particular brand compared with all other major brands, especially those most closely similar to the brand under discussion; these analyses should preferably have been confirmed in a laboratory independent of the particular company manufacturing the cigarette. If a specific biological effect is claimed for removal of the material from smoke, the theoretical or experimental basis of the effect should be in the field of competence of the scientist.

Finally, because of the great economic implications of remarks made by scientists concerning the relative merits of one cigarette brand or another, we suggest that anyone making such a statement identify himself more completely than is usually necessary. For his own protection, as well as for the good name of the scientific community as a whole, the scientist should, we believe, give at the same time his past or present affiliations with any of the tobacco companies or with the tobacco industry as a whole. Our support has been primarily from the Atomic Energy Commission, the U.S. Public Health Service, and Harvard University. We wish to make part of the public record the fact that we do not now have any financial support from the tobacco industry or a particular cigarette company, nor have we had such support in the past; neither have we acted at any time as consultants to any tobacco company or to the tobacco industry.

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Legislation for Humane Treatment of Laboratory Animals

Elinor Langer's story on humane laws (24 Jan., p. 339) misrepresents the Clark-Neuberger bill on two points. It did not indicate that this bill resembles the proposals of Congressmen Fogarty and Roberts in that it would affect all federal agencies and all recipients of federal grants or contracts. And the Clark-Neuberger bill is not the "strongest" of the many bills pending. Surely, this position is held by the Randall bill, which defines stress and pain and specifies who can administer an anesthetic to animals. The terms of the Clark-Neuberger bill are broader, as is the British legislation upon which it is based.

If the British experience affords a guide, the provision in the Clark-Neuberger bill for unannounced inspection of animal quarters should help considerably to establish reasonable standards of housing. Under the British system, institutions are visited by inspectors (all of whom are M.D.'s) an average of three times a year, although, in fact, reputable laboratories may be visited infrequently

while borderline ones are inspected many times each year. The inspector, of course, must have authority to ensure that his recommendations are carried out, and this is where voluntary accreditation and similar schemes fall down. Admirable though voluntary schemes may be for responsible institutions, they leave untouched precisely those places where improved standards are most needed.

In the hope of stemming effective legislation, many groups have recently advocated voluntary codes for humane treatment of animals. This rush of activity suggests the need for such codes. Unfortunately, many scientists seem to regard a college degree as a certificate not only of professional standing but of moral integrity, the holder of which is henceforth beholden to no man for his actions. The infliction of pain on animals, like the infliction of pain on humans, involves moral and social standards which cannot be left solely to individual judgment but should, in a civilized society, also be governed by law.

Individual licensing of scientists, another provision of the Clark-Neuberger bill, has proved most successful in England for over 80 years. In my own experience as a Ph.D. student in physiology at London University I found that the licensing laws had a beneficial effect upon research, particularly among young scientists. Like good research technique, good standards of animal care must be learned, and they cannot be learned unless they are first defined and, where necessary, enforced. The cordial relations between the Home Office and the British scientific community are founded on a mutual interest in maintaining humane standards for laboratory animals, standards under which fruitful scientific work has not been impaired and under which, indeed, scientists are protected from criticism or prosecution by uninformed or mischievous persons.

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The Randall bill actually is more stringent than the Clark-Neuberger bill. However, its chances of becoming law are infinitesimal, and the Clark-Neuberger bill is the strongest that has any chance whatever of passing.

On the other point, Mrs. Orlans is quite right that all the bills discussed would affect grantees of federal agencies as well as the agencies themselves. The way in which they would be affected, however, is quite different. Under the Fogarty proposal, for example, the investigator would merely affirm in writing his agreement to comply with standards of humane care, handling, and treatment of laboratory animals, set by the Surgeon-General. The Clark-Neuberger proposal would have a far more intimate effect on the laboratory. It requires that animals used in pain-causing experiments be anesthetized whenever this would not interfere with the direct purpose of the experiment, and that animals suffering prolonged pain be painlessly killed. It requires not only the registration of investigators with the Secretary of Health, Education, and Welfare as part of their general responsibilities, but the filing with the Secretary of a project plan before the conduct of each set of experiments in which animals are to be used.—ELINOR LANGER

Advice on Science Fair Projects

As director of the Southeastern Wisconsin Fair, I was somewhat perturbed by a letter that appeared in your issue of 6 March ("Science Fair projects," p. 992). I would suggest that when requests are received from students for advice, they should be told that most, if not all, of the necessary information is to be obtained from their teacher-advisers; that any advice from outsiders is given only after the project has been selected, and then only on minor points. If the project is such that most of the guidance cannot be supplied by the teacher, then it should not be undertaken. The teacher should *certify* that the work is that of the pupil. We have used this system quite extensively and have had good results with it.

It seems to me that it is the teacher's prerogative to insist on a Science Fair project. This is no different from an English teacher's insisting on a book report or an essay from all students, or a speech teacher's requiring all students to participate in a dramatics contest. It would seem advantageous to require some extra work of students in high schools, as this better prepares them for college work.

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