This is not a new field for the Public Health Service. One of us was a member of a committee set up about 1925 by Lewis R. Thompson, the former chief of the Industrial Hygiene Division of the PHS. On the committee was the late F. G. Cottrell, whose air-cleaning process is used all over the world. (It is used at Donora.) The late James E. Ives, a very fine physicist from the PHS, and Harry Meller, of the Mellon Institute, were also members of this committee. The question then vexing us was the effect of pollution on sunlight. Ives organized and carried out a nice piece of work which appeared as *U. S. Public Health Service Bulletin No. 224* in 1936. The field and laboratory work actually was done in 1931–33 and included pollution surveys in several major American cities chosen for industrial and topographic reasons. Other pollution studies by the PHS have followed.

Dr. Mills grumbles a bit because a grant he requested from the PHS for a pollution study was refused. Yet such grants are going to institutions in large industrialized areas capable of performing the work needed. What in the world is wrong with that? Where else should they go?

His comment on the effect of age on people in smogged areas is no new discovery. It was featured in the reports on the Meuse Valley (Belgium) disaster. We noted with much interest that W. P. D. Logan, an English investigator, analyzed deaths (*Lancet*, January 8, 1949, page 256) in the period November 26–December 1, 1948, when a heavy fog persisted in London. Deaths from bronchitis and pneumonia were 20%–30% higher than in any of the previous four weeks. It was observed that this increase came in persons over 45 and that infant mortality increased similarly. We realize that the PHS did not treat this aspect as a new discovery—because it wasn't new—but it is obvious to anybody that PHS was thoroughly aware of the facts and their implications.

Dr. Mills' calculations on pollution from nitrogen oxides emanating from steel and zinc plants are, we think, badly in error. The present accepted limits (American Standards Association) for 8-hr daily exposures is 25 ppm, which is equivalent to approximately 47 mg/m^3. Taking our measurements from the maps in the Donora report, the volume of the valley might be estimated as 0.22 cubic miles, based on an area of $2 \times 1\frac{1}{2}$ miles and 400 ft high—this takes in the highest stacks. Based on 4 tons of nitrogen oxides daily and complete diffusion, this could give a maximum theoretical daily concentration of 2.2 mg/m^3—far below the 8-hr threshold. This involves the assumption that the oxides remain unchanged chemically and stay put—which assumption is nonsense. The oxides are highly reactive and have never been found outdoors in significant concentrations.

Dr. Mills' statement that concentrations of zinc oxide and carbon monoxide reached dangerous levels implies that the operators of the plant were not utilizing the fuel value of CO from blast furnaces and were letting go zinc oxide in amounts that were industrially valuable. Neither implication fits the facts—blast furnaces produce enormous quantities of CO that are cleaned and used as fuel. No blast furnace could run if the CO were belched into the atmosphere—it would be economic suicide (See paper by H. O. Johnson in *Blast Furnace and Steel Plant*, 1944, 32, 44, in which a modern gas cleaning installation at Donora is described.) Zinc oxide makes a white smoke but it takes a very heavy concentration, such as 15 mg/m^3 and more, to affect man. Zinc retort plants, such as those at Donora, have been operating all over the world for years, and the health record of men inside the plants and of people in the communities has not been adversely affected.

Los Angeles is worried about its smog, and in that area it is estimated that about 700 tons of sulfur dioxide is emitted daily. Inversion layers occur quite often, yet the SO_2 does not build up to toxic levels. Why? Because it is eliminated and disseminated by natural processes.

The concentration of sulfuric acid mists and of particulate matter in the air determined at Donora is less than that found in London almost every winter. There are areas in England where SO_2 pollution actually has become a serious matter because of erosion of building stone—but the health record of the communities remains good. We've heard British visitors facetiously remark that our city air doesn't have enough body!

We admit that the Donora report has some weaknesses and omissions. We think it would be timely if an attempt were made to duplicate the Donora atmosphere on a pilot plant scale. Nobody proved what was the essential etiologic agent in the Meuse Valley disaster and nobody found it at Donora, although some very able men were on the spot. We do not feel that the Public Health Service's efforts should be belittled. They are of considerable value in pointing out that under usual conditions it is impossible to get disabling smog. Furthermore, we think the suggestion that the PHS continue the studies is timely and that the pollution meeting in Washington was a logical and practical step.

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Dr. Mills' Rejoinder

I am indeed very sorry that Drs. Silverman and Drinker should have been so misled by my remarks on the Public Health Service's Donora report, for I attempted to keep my statement free of ambiguity and inconsistency. Have they done as well?

(1) They disclaim any connection whatever with the Public Health Service—and in the next paragraph detail a former collaboration.

(2) This collaboration a quarter century ago marked the only PHS activity in the *community health aspects* of air pollution, and it dealt only with smoke's exclusion of sunlight, touching not at all on pollution's respiratory tract damage, which is today recognized as of paramount community importance.

(3) Silverman and Drinker show unfamiliarity with nitric oxide gases in claiming that they are never found outdoors in significant amounts. Have they never stood in the dispersion pathway of such gases escaping from

acid plant (chamber process) stacks and experienced their choking effects?

(4) They say my nitric oxide calculations are "badly in error" and then themselves find 8,500 pounds a day to give only 2.2 mg/m³ in a 0.22-cubic-mile air volume, when their figure in reality should be 4.2 mg/m³. Instead of their 900,000,000 m³ of air mass, we had chosen 500,000,000 m³ as a fair estimate (and had been verbally corroborated in this choice by investigators from Kettering Institute of Industrial Health, who also made air analyses at Donora concurrently with the PHS).

(5) Although the American Standards Association has accepted 25 ppm as the maximum allowable concentration of nitric oxides for 8-hr worker exposures, some authorities in the field recommend that this limit be set as low as 5 ppm—which was almost certainly exceeded during the Donora smog (ppm = mg/m³ × 1.88).

(6) If failure to recover blast furnace CO is "economic suicide," then the Donora stack analyses made by the PHS indicate approaching death—at the rate of over 300 tons of blast furnace CO going out into that pocketed valley air mass daily. Salvage of the "industrially valuable" 15 tons of zinc also going up Donora stacks daily would help considerably in covering the cost of operating modern stack-cleansing devices.

(7) The two writers are inconsistent in claiming that SO_2, Zn, and other air pollutants around zinc and acid plants and in London air are not damaging to community health. How else were 60 killed and 4,000 made ill around the Meuse zinc and acid plant in 1930, and 21 killed and 6,000 made ill around the Donora plant in 1948? The writers themselves refer to Logan's London survey which showed over 300 excess deaths (beyond the week's usual) from bronchitis, pneumonia, and heart failure alone during one 1948 week of heavy London smog and in the two succeeding weeks. Their facetious British friends would perhaps do well to look even more closely into the community health aspects of their own pollution problem.

(8) The writers' reference to the Los Angeles SO_2 and smog problem overlooks the fact that the inversion air mass there involved is roughly 1,000 times as great as in the Donora Valley.

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Proposed Uniform Endings for Names of Higher Categories in Zoological Systematics

Nomenclature of the higher categories of zoological systematics, in particular those above the genus level and below the class level, might possibly be improved if a simple and convenient scheme of endings could be adopted. Such a scheme is proposed here.

The categories involved are three: order, family, and tribe. In addition each category has three grades: super-, main-, and subgrade, resulting in nine systematic units: superorder, order, suborder, superfamily, family, subfamily, supertribe, tribe, and subtribe. Of these nine units only two are standardized by the *Rules of Zoological Nomenclature*. These two are family with the prescribed ending of *-idae* and subfamily with the prescribed ending of *-inae*. There is no fixity as to the endings of the other seven units. However, it is customary to construct tribe names in such a way that they have masculine gender. Family and subfamily names are feminine according to the *Rules*. Many order names in use today are of neuter gender. Hence the first step in standardizing and thereby stabilizing the names of the three categories would be to adopt the rule that (1) all tribe names, including subtribe and supertribe, must have masculine gender and end in *i*, (2) all family names, including subfamily and superfamily, must have feminine gender and end in *ae*, and (3) all order names, including suborder and superorder, must have neuter gender and end in *a*. The sequence of tribe, family, and order would be easy to remember, being masculine, feminine, and neuter.

The key to the next step is the endings *-idae* and *-inae* prescribed by the *Rules* for family and subfamily. The two endings differ only in one letter. Hence it would seem convenient to have the ending of superfamily differ from them in one letter only, and the letter *c*, being alphabetically ahead of *d*, would serve very well. Therefore, it is proposed that the standard ending of *-icae* be adopted for superfamily.

This logical method can be extended to all nine systematic units, and it is proposed that in all nine units *c* should denote the supergrade, *d* the maingrade, and *n* the subgrade.

The complete scheme of proposed endings in Table 1 is based on the ideas developed in this communication. It is kept as simple as possible.

TABLE 1

Proposed endings	Categories	Grades	Genders	Examples
-ica	order	super	neuter	Ostreica or Anisomyarica
-ida		main		Ostreida or Anisomyarida
-ina		sub		Ostreina or Anisomyarina
-icae	family	super	feminine	Ostreicae
-idae		main		Ostreidae
-inae		sub		Ostreinae
-ici	tribe	super	masculine	Ostreici
-idi		main		Ostreidi
-ini		sub		Ostreini

These endings are simple, consistent, and a good aid to memory. The latter quality seems to the writer of particular importance in zoological nomenclature, which is so heavily burdened with items that need to be remembered. Whether these proposed endings be optional or mandatory, or mandatory for some and not for all, is for the general public of zoological systematists to decide.

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