9 Stockinger HE, Wagner WD, Dobrogorski OJ. Toxicity studies: III. Chronic injury to lungs of animals following exposure at low level. Arch Industr Health 1957; 16:514-22
12 Flopper CC, Dungworth DL, Tyler WS. Pulmonary alterations in rats exposed to 0.2 and 0.1 ppm ozone: a correlated morphological and biochemical study. Arch Environ Health 1979; 34:390-95
15 Sorensen RJ, Campbell IR, Tepper L, Ling RD. Aluminum in the environment and human health. Environ Health Persp 1974; 8:3-95

To the Editor:

In Chest, March, 1982, I note with interest a report by Vallyathan et al describing a case of pulmonary fibrosis in an aluminum welder. I would like to make the following comments.

(1) Neither qualitative nor quantitative ambient air analyses were obtained or reported; however, it would be most unusual for such a worker to be exposed "exclusively" to aluminum. Other substances would almost certainly be present including ozone, oxides of nitrogen as well as components of the alloy used.

(2) Aluminum oxide does not have a "metallic sheen" as is described in this case.

(3) Although no x-ray picture is shown, the lesion appears to be confined to the left upper lobe. If this were truly a pneumoconiotic lesion caused by exposure to air-borne dust, one would expect to have seen a diffuse rather than localized lesion, especially after 17 years' exposure.

(4) Gross et al (Ref 18) reported no pulmonary fibrosis in laboratory animals exposed to aluminum powder and aluminum oxide by inhalation. Intratracheal injection did produce fibrosis.

(5) The general experience of the N.A. aluminum industry and in the world's literature is that neither metallic aluminum nor aluminum oxide is fibrogenic. In our opinion, this report does not present sufficient data to confirm exposure to aluminum or to connect aluminum in the lung to the pathology reported. Unfortunately, the report will further confuse the literature concerning the fibrogenicity of aluminum.

G. Kaine, M.D.; Retired Medical Director, ALCAN Smelters & Chemicals Ltd, Ottawa, Canada

To the Editor:

We appreciate the comments of Mr. Cole and Dr. Kaine and their colleagues with regard to our recent case report. The issues they raise are complex and can only be addressed incompletely because we were unable to obtain a detailed occupational exposure history for this patient. The complexity of welding processes is well stated in a recent publication by Stern. "There exist approximately 20 major technologies within the welding industry which are used on 10 major classes of materials providing the possibility of the order of 5,000-10,000 different working environments, due to the possible variations in composition of workpiece, consumables and welding variables." In this context, we have attempted to provide clinical and analytic information to alert the scientific community to previously undocumented potential hazards in the workplace.

Two important questions are addressed by Mr. Cole and Dr. Kaine. These relate to the possible effects of silica fumes as a fibrogenic agent and the adverse pulmonary effects of various gases generated by the arc. To the best of our knowledge, the patient in question was involved in metal inert gas welding, a procedure which does not require the use of silica as a flux. Data from the Welding Research Council indicate silica levels of less than 0.5 percent in coated aluminum electrodes. Accordingly, only aluminum oxide and ozone are generated, although the possibility exists that oxides of nitrogen and carbon monoxide are also produced. However, with regard to gases, variations arise because a given electrode can be welded over a range of currents and voltages. Thus, absolute rates of fume production at maximum currents and voltages are approximately four times those at minimal values. One can only speculate regarding the possible concentrations of various inert and biologically active gases in the environment of the patient under consideration. Oxides of nitrogen and ozone are known to damage the respiratory epithelium when experimental animals are exposed to relatively high concentrations. We do not know whether these concentrations were attained in the working environment of our patient. Inhalation of 1-2 ppm of ozone for two hours produces headache or chest pain; and acute exposure results in edema. A search of the patient's medical records does not indicate any complaints of chest pain or headache. Also, the patient's heavy use of cigarettes introduces a confounding factor which makes it difficult to evaluate the possible effects of these gases.

With regard to the comments of Dr. Kaine, we have no way to respond to the comment that a "metallic sheen" was observed on dissection of the lung tissue by the surgical pathologist. We accepted his comment as stated. It is curious that a single lobe was sufficiently affected by the disease process to warrant lobectomy, but, of course, that does not exclude the existence of aluminum deposits elsewhere in the lung that are not radiologically evident.

X-ray spectrometry was employed to analyze qualitatively the inorganic mineral materials in alveolar macrophages. Increased levels of silicon were not detected in tissues examined. The techniques employed in our laboratory are sufficiently sensitive to detect rather small amounts of both aluminum and silicon for they have been used in studies which have demonstrated the presence of aluminum silicates in lung tissue. The processing and techniques have been amply described elsewhere.

Obviously, we are pleased to respond to these two representatives of industry inasmuch as we share their concern that unverifiable and unsubstantiated implications regarding the potential toxicity of aluminum should not find their way into the literature. In this regard we make no claims as to the broad implications of our observations to the working populations of aluminum arc welders.

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REFERENCES
2 Welding Research Council, New York, Bulletin #190, page 11, December, 1973
4 The welding environment, American Welding Society, 1973; 12
5 Brody AR, Vallyathan NV, Craighead JE. Distribution and elemental analysis of inorganic particulates in pulmonary tissue. SEM 1976; III:477-84
6 Vallyathan NV, Green FHY, Craighead JE. Recent advances in the study of mineral pneumoconiosis. Path Annual 1980; 15:77-104