Analysis proved the material to be an hydroxydimethoxybenzoic acid. Methylation of the free hydroxyl group gave a trimethoxybenzoic acid which was shown by its melting point and derivatives obtained by bromination and nitration to be asaronic acid, 2,4,5-trimethoxybenzoic acid.

The hydroxydimethoxybenzoic acids which could give this acid are 2-hydroxy-4,5-dimethoxy-, 5-hydroxy-2,4-dimethoxy- or 4-hydroxy-2,5-dimethoxybenzoic acid. It is thought that because of the ferric chloride reaction given by the acid from dehydrodeguelin it is 2-hydroxy-4,5-dimethoxybenzoic acid. Work upon its synthesis is in progress, and it is hoped that a report upon its structure can be made shortly.

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SYNTHESIS OF GAS–METAL COMPOUNDS BY SPUTTERING

Sir:

In connection with a somewhat extensive study of cathodic sputtering [see *Phys. Rev.*, **32,** 649 (1928); **34,** 972 (1929); *Nature*, **126,** 204 (1930)], the writer has recently found that this process has remarkable possibilities as a method of chemical synthesis. This applies particularly to the formation of metal–gas compounds such as nickel and similar metals with hydrogen, nitrogen, etc. Nickel sputtered in nitrogen under rather special conditions of current, voltage and gas pressure gives a dark, somewhat metallic-looking film which shows on x-ray examination a crystal structure distinctly different from that of the pure metal. Heating to about 350° decomposes this compound, which gives off its gas and reduces to metallic nickel. Upon heating such a nitride film to 150° in hydrogen, ammonia is formed and in an amount which agrees reasonably well with the quantity of nitrogen absorbed in sputtering. Compounds of cobalt and iron with nitrogen have likewise been produced, as well as of nickel and hydrogen—this latter showing on crystal structure examination a lattice spacing some 6% larger than for pure nickel.

It seems certain then that we are dealing here with such unusual compounds as nitrides and hydrides of these metals. Moreover, they are formed, not at the expense of a difficult and special technique of synthesis [see A. C. Vournasos, *Compt. rend.*, **168,** 889 (1919)] but by a simple process of wide applicability, for the conditions encountered in sputtering, with the metal in the vapor state and the gas largely excited by the discharge, would seem to be ideal for the formation of a compound if this is chemically possible. Indeed one series of experiments yielded considerable evidence for the formation of compounds with even helium and argon, and, while this evidence was later vitiated by the discovery of impurities, the question is by no means as yet settled in the negative. Compounds with excited helium or argon are at least not unthinkable, and this is probably the most promising way of forming them.

A word of caution may not be out of place as to the use of this method of synthesis. Metals ordinarily contain a great deal of absorbed gas and while the usual baking (at say 500°) may remove the bulk of such impurity adsorbed on the surface, it will probably take little from the interior. Then as layer after layer of atoms is removed from the cathode in the sputtering process, fresh supplies of gaseous impurity are released, so when purity of product is a main factor some provision must be made to eliminate this source of trouble. It may be possible to secure nearly gas-free metal for the cathode, or to outgas it effectively by having it in the form of a thin strip which can be heated electrically to a high temperature, but probably the most feasible method is to dilute the impurity to a point where it becomes negligible by a continuous flow of fresh gas through the chamber during the sputtering.

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A RELATION CONCERNING ATOMIC NUCLEI

Sir:

An interesting numerical relation of known atomic species is to be found in the helium–thorium series. The atomic nuclei of this series have a composition represented by the general equation

$$a_{(Z/2+n/4)} + (e_2)_{n/4}$$

in which e is an electron, a represents a group of 4 protons and 2 electrons, Z is the atomic, and n, the isotopic number. For thorium Z is 90 and n is 26, so the specific formula is $a_{58}e_{26}$. In a recent paper Latimer develops a model for the nuclei of this series. He bases his model not only on the general hydrogen–helium theory[1] developed in 1915 by the writer, but he also makes use of the very specific features of this theory, such as the pairing of the nuclear electrons,[2] the introduction of the first pair of extra or cementing electrons in the argon nucleus[3] of mass 40, and the later addition of still other pairs of electrons as the atomic number increases.[4]

Latimer also uses the idea that the abundance of an atomic species is

[1] Harkins and Wilson, This Journal, **37**, 1367–1396 (1915).

[2] Harkins, *ibid.*, **39**, 859 (1917); **42**, 1958, 1963–1964, 1991–1993 (1920).

[3] Harkins, *ibid.*, **39**, 859, Table II (1917): *Phil. Mag.*, **43**, 305 (1921).

[4] Harkins, *Phil. Mag.*, **42**, 1976 (1920).