existing methods, we feel that this procedure will prove very valuable to those interested in obtaining hafnium compounds free of zirconium.

Although the conditions which give satisfactory separation were first worked out using microgram amounts of material and the radioactive tracer technique, the run described below, involving milligrams of material, illustrates the applicability of the method to the production of significant amounts of pure hafnium and zirconium.

Thirty-five milligrams of zirconium oxide and 15 mg. of hafnium oxide were dissolved in sulfuric and hydrofluoric acids, hafnium and zirconium tracer added, and the mixture fumed to dryness. The residue was taken up in concentrated hydrochloric acid and the hydroxides precipitated with ammonium hydroxide and washed. The hydroxides were again dissolved in hydrochloric acid and the oxychlorides crystallized by evaporation. One cubic centimeter of 250 to 500 mesh Dowex 50 spheres, in the ammonium form, was suspended in 30 cc. of 2 *M* perchloric acid and the oxychlorides added a few milligrams at a time over a period of fifteen minutes, the mixture being continually agitated by bubbling air through it. Under these conditions, *i. e.*, dilute solution of zirconium and hafnium in 2 *M* perchloric acid, the zirconium and hafnium are not appreciably polymerized[1] and about 80% of each went on the resin. The slurry of resin was placed on the top of an ion-exchange column 1 sq. cm. in area and 30 cm. long which had been packed with the same resin and washed with 6 *M* hydrochloric acid to convert it to the acid form. On elution with 6 *M* hydrochloric acid the curve shown in Fig. 1 was obtained. The outline of the curve was obtained by counting the tracers (65-day Zr^{95} and 46-day Hf^{181}) and the dotted portions by optical spectrographic analysis.

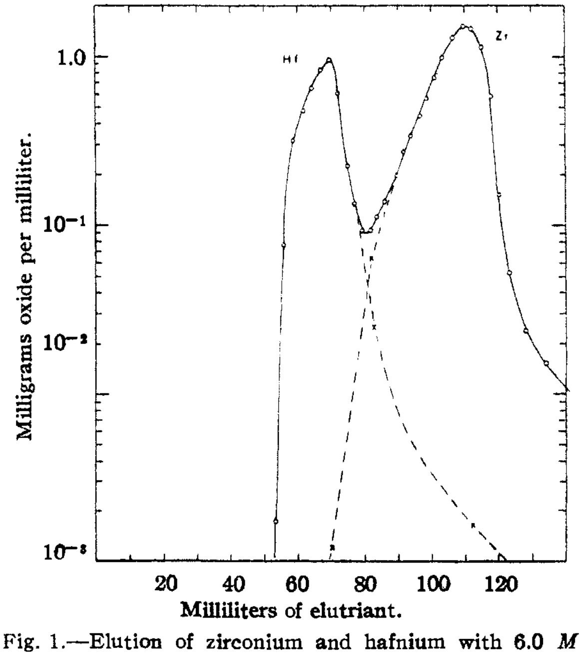

Fig. 1.—Elution of zirconium and hafnium with 6.0 *M* HCl.

Thus it can be seen that ~66% of the starting hafnium oxide, *i. e.*, 10 mg., is obtained containing ~0.1% zirconium oxide by weight. The column used in these experiments was relatively small and thus gram amounts of material should be easily handled on columns of only moderate size.

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[1] R. E. Connick and W. H. McVey, private communication.

THE ISOLATION OF METHYL ARACHIDONATE BY CHROMATOGRAPHIC ADSORPTION. THE OCCURRENCE OF EICOSAPENTENOIC ACID IN ADRENAL LIPIDS

Sir:

The purest specimens of methyl arachidonate (MA) hitherto isolated have been made by debromination of methyl octabromoarachidate[1-5] which is best obtained by brominating the methyl esters of the fatty acids of beef adrenal phosphatides. The arachidonate thus prepared is likely to be contaminated with geometric and other isomers, in line with our experience with linoleic and linolenic acids.[6] Methyl arachidonate prepared solely by physical procedures,[3,4] has not been obtained more than 90–95% pure.

We have isolated methyl arachidonate of high purity by chromatographic adsorption. The arachidonate in the methyl esters of adrenal phosphatides was first concentrated by low temperature crystallization to a product of iodine number 247 containing 65 per cent. methyl arachidonate, methyl oleate and other unsaturated esters. This mixture was separated by passage over Harshaw alumina (Al-2) by the flowing chromatogram technique, the solvents being petroleum ether containing 1.5% of ethyl ether, and ethyl ether. Operations were carried out in an atmosphere of nitrogen gas. Separations and compositions of fractions were followed roughly from the refractive indices.

To illustrate the efficacy of separation by the adsorption technique, the first main fractionation was carried out by passing 98.8 g. of the concentrate over 2000 g. of alumina with 8 l. of petroleum ether–ethyl ether to give the following fractions (iod. no. in parentheses): 0.8 g. (135); 1.3 g. (152); 8.9 g. (216); 42.2 g. (246); 10.8 g. (252); 8.0 g. (265); 8.6 g. (291); 11.0 g. (313). By selected refractionations we finally obtained 8.6 g. of ester of iodine number 319.2 and the three small

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(1) Brown, *J. Biol. Chem.*, **80**, 455 (1928).

(2) Ault and Brown, *ibid.*, **107**, 615 (1934).

(3) Shinowara and Brown, *ibid.*, **134**, 331 (1940).

(4) Mowry, Brode and Brown, *ibid.*, **142**, 671 (1942).

(5) White, Orians and Brown, *J. Am. Oil Chem. Soc.*, in press.

(6) Matthews, Brode and Brown, THIS JOURNAL, **63**, 1064 (1941).

fractions (3.6 g. total) of iodine number 330–340. The 8.6 g. was again passed over adsorbent and was collected practically entirely (8.3 g.) as a single fraction of iodine number 319.1; sap. equiv. 319.2 (theory 318.5); n^{25} 1.4828; yield of octabromides upon brominating 0.382 g. in ether, 92% which is 10% higher than we have described for methyl arachidonate prepared by debromination.[5] From these data, we believe this to be the purest specimen of methyl arachidonate so far isolated.

The combined fractions of iodine number 330–340, noted previously, were further separated to give 1.0 g. of iodine number 375; sap. equiv. 318.1; polybromide yield, 110%; 70.1% bromine; n^{25} 1.4853. On the basis of these data this fraction is believed to be mainly methyl eicosapentenoate. This is the first evidence we have obtained in this Laboratory for the presence of eicosapentenoic acid in adrenal lipids.

We are now applying the method to a specimen of the ester prepared by debromination which is likely to contain isomeric eicosatetrenoates of the geometric type as well as more unsaturated esters of this series.

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NEW BOOKS

Supplement to the United States Naval Medical Bulletin on Preparation and Measurement of Isotopes and Some of their Medical Aspects. Published by Bureau of Medicine and Surgery, U. S. Navy, 1948. 215 pages. Copies can be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., for $0.65.

Most of the papers in the Supplement were part of a symposium of the Division of Biological Chemistry of the American Chemical Society in coöperation with the Office of Naval Research at the 1947 New York meeting of the Society. They have been printed through the interest and coöperation of the Editor of the Naval Medical Bulletin, Dr. Louis H. Roddis, as the March–April 1948 Supplement to the Naval Medical Bulletin.

The introduction of the supplement, which contains a short review of the historical development of the applications of isotopic indicators and some remarks of general interest, is written by Harold C. Urey. It is, as usual, both instructive and refreshing to read statements of that great pioneer of nuclear sciences. The fundamentals of isotope separation are discussed by Karl Cohen, thermal diffusion and other methods of isotope separation by William W. Watson, while Harold W. Wasburn describes a new mass spectrometer for isotope-ratio measurements. Most useful statements are those of David B. Sprinson and David Rittenberg. These authors have unique experience in the preparation of gas samples for mass spectrometric analysis of isotope abundance some of which they communicate in 12 pages. The mass spectrometric analyst can be expected to save a lot of trouble and disappointment by taking due regard of the suggestions of these authors.

In his article on the chemical methods of isotope separation, A. F. Reid presents among other things a description of a commercial plant used for the production of heavy carbon and discusses also the natural separation of C^{12} and C^{13}. As to the natural variation in the C^{13} content of carbon of diverse origin, it is shown to amount to almost 3%. More and more regard will have to be taken of these variations in the investigation of biological specimens in the future when the precision of analysis can be expected to increase.

The fascinating subject of pile production of radioactive isotopes is presented by Waldo E. Cohn. In a very lucid contribution, beside the considerations in the choice of pile targets and such in the isolation of a carrier-free radioisotope, specific processes for the production of the more important radioisotopes as C^{14}, P^{32}, S^{35}, Ca^{45}, Fe^{59} and fission products are described. Improvements of his original method of the pile production of P^{32} are described. These include the substitution of the cation-exchange column for the ether extraction to convert the metal phosphate solution to phosphoric acid. This substitution rendered iron less unique as a carrier and made its replacement by lanthanum possible. The serious disadvantages that attended the use of iron: peptization, causing incomplete precipitation and cation exchange adsorption, and the retention of considerable quantities of P^{32} on the cation exchange itself, can thereby be eliminated. Statements as to the separation of fission products by an ion-exchange adaption–elution process are presented. All fission products but ruthenium, iron, iodine and technetium can be and are being separated by such a process. Production of radioactive isotopes by the cyclotron and other methods is the subject of the contribution of John W. Irvine, Jr., the application of radioisotopes to problems of naval medicine of that of Robert Emrie Smith. While Richard D. Present gives a synopsis of basic ideas in the theory of radioactivity and the detection of radiation, the determination of hard and soft radiation, respectively, including preparation of samples is described by William F. Bale and Arthur K. Solomon, respectively.

Martin D. Kamen, discussing the detection of intermediates and criteria of purity, demonstrates difficulties encountered when faced with the task of isolating in sufficient purity products of low specific activity, if high specific activity products labeled by the same indicator are present as well. His final conclusion that there is no substitute for good chemistry can be expected to find universal approval. Dorothy J. Axelrod and Joseph G. Hamilton are the authors of a paper on the radioautographic technique. This important method found extended application and a remarkable development in recent years. The paper gives a full description of the four general types of radioautographs: thick slices of tissue in contact with the photographic film; histological sections in contact with the film; histological sections covered with a photographic emulsion; histological sections mounted on a photographic film. The paper is illustrated by numerous instructive figures including the radio-autographies of pigskin exposed to labeled lewisite taken by the authors. This contribution can be expected to be a very profitable reading to anyone interested in radioautography.

An illustration of the power of isotopes in a biochemical problem is the title of the contribution of Vincent du Vigneaud, and it is a beautiful illustration indeed. The author traces the problem of the mechanism of the con-