possibly possess therapeutic value. We made a preliminary investigation of the action of aqueous and of alcoholic mercuric acetate on pyrrole. Amorphous mercury derivatives were obtained which were extremely difficult to purify because of their colloidal nature. During the preparation of this manuscript we found that a compound claimed to be pyrrole tetramercuric acetate has been prepared very recently.[1] It is interesting to note that certain mercury derivatives of indole, to be used for therapeutic purposes, have been made the subject of a German patent.[2]

Iodole, the proprietary name for tetraiodopyrrole, was the first compound to be used as a substitute for iodoform. Michelman[3] considers that this product would be used to a greater extent if pyrrole could be obtained more cheaply. We are of the opinion that a dichlorodiiodopyrrole might be just as efficient an iodoform substitute as tetraiodopyrrole and could be prepared much cheaper since the cost of chlorine is considerably less than that of iodine. The action of sodium iodide on tetrachloropyrrole is now being investigated in the expectation that dichlorodiiodopyrrole may be obtained in this way.

In conclusion it should be mentioned that the chemistry of pyrrole is of paramount importance in connection with the study of the alkaloids, atropine, cocaine and nicotine and of such physiologically important compounds as chlorophyl and hæmoglobin, since all of these compounds contain modified pyrrole nuclei.

COLLEGE OF PHARMACY,
UNIVERSITY OF MICHIGAN.

THE ANALYSIS AND CHARACTERIZATION OF NEOARSPHENAMINE.

BY A. E. JURIST AND W. G. CHRISTIANSEN.

Neoarsphenamine is described as the condensation product of 3,3′-diamino, 4,4′-dihydroxyarsenobenzene and sodium formaldehyde sulphoxylate. Inasmuch as it is not a chemical individual but a mixture which has been diluted with sodium chloride, the characterization of the various commercial products is difficult. Several investigators have published methods of determining the composition of neoarsphenamine, among them are Macallum,*[1] Raiziss and Falkov,[2] Freedman,[3] de Myttenaere,[4] and Elvove.[5] Of these methods Elvove's gives the most satisfactory results, but it still leaves much to be desired because it is based on certain assumptions which have not been substantiated. Therefore it is proposed to give certain modifications of Elvove's method which enable one to determine the composition of neoarsphenamine and show thereby that different types of neoarsphenamines exist.

---

[1] Ciusa and Grilla, *Gazz. chim. ital.*, 57, 323 (1927). *C. A.*, 21, 2686 (1927).
[2] *D. R. P.*, 236, 893 (1911).
[3] *A. J. P.*, 97, 350 (1925).
* A. D. Macallum, *J. A. C. S.*, 43, 643 (1921).
[1] A. D. Macallum, *Ibid.*, 44, 2578 (1922).
[2] G. W. Raiziss and M. Falkov, *J. Biol. Chem.*, 46, 209 (1921).
[3] L. Freedman, *J. Lab. Clin. Med.*, 11, 6 (1926).
[4] F. de Myttenaere, *J. pharm. Belg.*, 45 (Nov. 8 1925).
[5] E. Elvove, "U. S. P. H. S. Reports" (June 12, 1925); 40, No. 24, p. 1235.

The Elvove method is based on several differential sulphur determinations: (*a*) the total sulphur; (*b*) the sulphur oxidizable by iodine in alkaline solution, this includes both the free and combined sulphoxylate sulphurs; (*c*) the sulphur oxidizable by iodine in so-called neutral[1] solution; (*d*) and the free sulphate sulphur. Elvove considers that the sulphur oxidizable by iodine in neutral solution is the free sulphoxylate sulphur. Freedman[2] questions this, and it has been found in our study that only certain samples of neoarsphenamine react in the manner assumed by Elvove. If neoarsphenamine is oxidized by iodine in neutral solution and the excess iodine is then reduced with excess sodium arsenite instead of being titrated with sodium thiosulphate as in the Elvove method, the resultant sulphate sulphur can be determined in an acid solution as barium sulphate. The sulphur so found is usually larger than that calculated by the Elvove method. The sulphur present as free sulphoxylate and that present as combined sulphoxylate can then be determined from the following equations:

$$x + y = A$$

$$\frac{x}{.8} + \frac{y}{1.6} = B$$

where x is the free sulphoxylate sulphur, y is the combined sulphoxylate sulphur oxidizable by iodine in neutral solution, A is the sulphur found by the method given above less the free sulphate sulphur, and B is the titration in neutral solution in terms of cc. of $N/10$ iodine corrected for arsenic as given by Elvove.

Elvove further assumes that the difference between the total sulphur and the sulphur oxidizable by iodine in alkaline solution represents sulphur present as sulpharsphenamine. But when neoarsphenamine was prepared from base which was low in sulphur and pure sulphoxylate was used no so-called sulpharsphenamine sulfur was found. If, however, the material from which the base was prepared contained 10% of 3-amino,4-hydroxy,5-sulphobenzenearsonic acid, the sulpharsphenamine sulphur then found represented exactly the sulphur introduced by the sulphonic acid group. This shows that the sulpharsphenamine sulphur of Elvove was in reality nuclear sulphur which was introduced in the preparation of the base from which the neoarsphenamine was made.

With these two modifications the results given by the Elvove method can be further expanded to give the percentage composition as well as the distribution of the sulphur in neoarsphenamine. The factors required are given in the following Table I.

TABLE I.

Free Sulphoxylate Sulphur × 3.69%	= % Free Sulphoxylate
Combined Sulphur as Monosubstituted Neoarsphenamine ÷ 6.87	= % Monosubstituted Neo
Combined Sulphur as Disubstituted Neoarsphenamine ÷ 11.31	= % Disubstituted Neo
[As % − As as Monosubstituted Neo] × 2.44	= % Free Base
Free Sulfate Sulphur × 4.44	= Sodium Sulphate

Using the methods given in the foregoing paragraphs a number of experimental and commercial samples of neoarsphenamines of different types have been analyzed. The results obtained are given in Table II. The analyses given are representative of a very large number of samples examined.

[1] It has been found that the p_H of neoarsphenamine solutions varies from 5.8 to 9.0.

[2] L. Freedman, *J. Lab. Clin. Med.*, 11, 6 (1926).

TABLE II.

Number	A 1-P	A 2-E	A 3-E	B 1-P	B 2-P	B 3-P	C 1-E	C2-E	C 3-P	D 1-E	D 2-P	D 3-E
Per cent arsenic	19.53	24.02	23.69	23.10	19.70	19.49	21.33	21.21	24.34	23.90	19.13	25.54
Per cent arsenical	3.66	90.62	89.37	87.14	74.31	73.51	80.43	79.99	91.82	90.16	72.16	96.32
Per cent total sulphur	8.88	10.24	8.73	9.03	9.30	8.42	9.76	9.37	8.54	9.17	9.42	8.35
Per cent sulphur as sulphate by oxidation with iodine in alkaline solution	8.57	9.89	8.79	8.51	8.25	8.61	9.82	8.80	7.92	8.79	8.88	7.87
Per cent nuclear sulphur	0.31	0.35		0.52	1.05			0.57	0.62	0.38	0.54	0.48
Per cent sulpharsphenamine (Elvove)	1.04	1.42		3.02	8.03			3.49	3.97	1.70	3.18	2.64
Per cent free sulphate sulphur	1.22	0.85	1.03	0.69	1.10	0.78	0.73	0.22	1.14	0.70	1.10	0.62
Per cent free sulphoxylate sulphur (Elvove)	2.92	2.67	3.51	6.81	6.62	7.05	4.25	5.01	5.50	6.14	3.98	5.14
Per cent indicated monosubstitution (Elvove)	92.30	73.55	84.10	21.24	14.14	18.77	93.64	80.20	25.77	38.91	97.42	38.83
Per cent indicated disubstitution (Elvove)	7.70	26.45					6.36					
Per cent free sulphoxylate sulphur (arsenite)				6.90	6.62	6.79	1.51	2.40	5.14	4.54	0.39	3.20
Per cent combined sulphoxylate sulphur (arsenite)	6.43	5.41	7.10				5.44	5.22	0.71	3.21	7.58	3.87
Per cent combined sulphur non-sulphoxylate	0.92	3.63	0.76	0.92	0.53	1.04	2.14	0.96	2.07	0.34	0.20	0.18
Per cent monosubstitution (arsenite)	43.40	92.75	59.47				80.45	79.25	15.44	64.16	5.65	73.05
Per cent disubstitution (arsenite)	56.60	7.25	40.53				19.55	20.75			94.35	
Cc. $N/10$ iodine equivalent to the oxidizable sulphur	13.78	16.95	14.55	14.66	13.41	14.68	17.05	16.09	12.72	15.17	14.59	13.60
Cc. $N/10$ iodine equivalent to the excess over the arsphenamine portion	11.15	14.97	8.06	17.57	18.18	20.23	13.95	12.67	15.21	16.07	13.95	14.02
Cc. $N/10$ iodine equivalent to the non-sulphur reducing substances	1.63	0.98	5.49				2.20	2.42				
Cc. $N/10$ iodine equivalent to the non-sulphur reducing substances				1.91	3.77	4.55			1.49			
Per cent free sodium formaldehyde sulphoxylate				25.46	24.43	25.06	5.57	8.86	18.97	16.75	0.74	11.81
Per cent monosubstituted neoarsphenamine	27.80	68.26	43.66				53.27	55.60	10.34	46.72	7.86	56.32
Per cent disubstituted neoarsphenamine	39.99	6.37	36.28				15.75	12.39			61.94	
Per cent free arsphenamine base				56.39	48.08	47.55			49.83	21.55		18.06
Per cent sodium sulphate	5.42	3.36	4.57	3.06	4.88	3.46	3.24	0.98	5.06	3.11	4.88	2.75
Per cent inert material and volatile matter	27.46	21.51	15.49	15.09	22.61	23.93	22.17	22.17	15.80	11.87	24.58	11.06

P = Commercial product. E = Experimental product.

These results disclose definitely the presence of a form of sulphur in neoarsphenamine hitherto unknown which can be oxidized by iodine in strongly alkaline solution but not in weakly alkaline, neutral, or acid solutions. The nature of this sulphur is not yet known; it is probably not due to any form of sulphoxylate sulphur although its origin is probably traceable to decomposition of the sodium formaldehyde sulphoxylate originally used in preparing the neoarsphenamine. The nuclear sulphur, considered to be sulpharsphenamine sulphur by Elvove, is usually of the order of magnitude found by Christiansen[1,2] in his studies on arsphenamine base, cf. the foregoing results.

Elvove's method permits the distinction between only two types of neoarsphenamine, *i. e.*, the monosulphoxylate substituted type and the mixed monosubstituted and disubstituted type. The arsenite method, introduced here for the first time, of determining free sodium formaldehyde sulphoxylate usually shows a greater amount of combined sulphoxylate than the Elvove method and less uncombined sulphoxylate. Furthermore it allows a more exact means of classifying neoarsphenamines, dividing them into at least the four types illustrated by the table.

Type A is distinguished by the presence of a mixture of monosulphoxylate substituted and disubstituted material containing no free arsphenamine base or sulphoxylate but varying amounts of non-sulphoxylate sulphur. Type B contains no combined sulphoxylate by the arsenite method but much free sulphoxylate. It is probable that the free sulphoxylate is partially combined to the arsphenamine nucleus, but not directly to the amino group, and that the form of combination is so loose that the sulphur is oxidized by iodine in neutral solution in the same manner as free sulphoxylate. Type C is a mixture of monosubstituted and disubstituted neoarsphenamine containing free sulphoxylate as well as varying amounts of non-sulphoxylate sulphur. Type D is similar to Type C except that the non-sulphoxylate sulphur is very low; Type D is further characterized by the absence of both oxygenated substances and non-sulphur reducing substances either one of which is present in the other types shown.

A new method for the analysis of neoarsphenamine is given which makes it possible to study its chemical characteristics in greater detail and determine its composition more accurately than has been possible in the past.

RESEARCH LABORATORY OF E. R. SQUIBB & SONS.

EXHIBITION OF PRODUCTS CONNECTED WITH MEDICAL AND SURGICAL PROFESSIONS IN URUGUAY.

The National Congress of the Asistencia-Publica Naçional of Uruguay is being held this month. In connection with this Congress, the Governing Council of the Asistencia Publica Naçional has prepared for an exhibition of national and foreign industries, covering products and manufactures related to the medical and surgical professions and to general hygiene and prophylaxis.

The exhibition is interesting as the Uruguayan Asistencia Publica has constructed and maintains throughout the Republic of Uruguay, 40 hospitals, 23 auxiliary sections, and a number of other offices. Several new hospitals are now under construction and a project has just been presented for the building of a clinical hospital with 1000 beds. (Consul C. Carrigan, Montevideo, Uruguay.)

---

[1] W. G. Christiansen, *J. A. C. S.*, 43, 2202 (1921).

[2] W. G. Christiansen, *Ibid.*, 44, 2334 (1922).