

*On the Presence of Radium in Some Carcinomatous Tumours.*

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In another place\* I brought forward evidence that acceleration of leak occurs when carcinoma tissue, after extraction with acetone or with ether, and subsequently with water, is introduced within an electroscope. The results have been criticised in respect of the smallness of the differences observed, and of their possible explanation by variations in the capacity of the electroscope occasioned by introducing the various substances within it. To meet the last criticism, an electroscope of constant small capacity was designed, which essentially consists of a closed metal box, divided horizontally by a wire grating. The upper part of the box contains the insulated gold leaf, and the various substances can be introduced into the lower part of the instrument through a well-fitting door.

Various non-malignant and malignant tissues, after extraction and in a dry, finely divided state, were then examined as to their possible influence on the leak. The majority of these were without effect outside the range of experimental error, but certain of them afforded evidence of acceleration. Specimens from both classes were then weighed, boiled with 10 c.c. hydrochloric acid and distilled water in a flask with side-piece, sealed, and set aside for four weeks. At the end of that time, the gas given off on vigorous boiling for five minutes was passed into an emanation electroscope in the usual manner and the leak determined.

The results of the examinations in the constant capacity electroscope are given on the opposite page.

A glance at the following table confirms the previous conclusion as regards acceleration, and in certain instances the acceleration is marked. In order to test the point further, Nos. 437, 440, 697C, 697G, 793, 147C, and 791 were examined for emanation, together with a sample of the HCl used for solution. Examination of the acetone, and of the ether used for extraction, was unnecessary, owing to the wide variation of the results obtained, in spite of the fact that one or other of these fluids was used in every case. Nevertheless, all reagents used were tested and found to be radium-free. None of the patients in whose cases radium was found had, during life, been

\* 'Arch. Middlesex Hosp., Eighth Cancer Rep.,' 1909, p. 126 and foll.

treated with radium in any way or form, and care was taken to avoid contamination with radium during the manipulations.

Reference No.	Substance.	Leak of substance (natural leak = 1).
378	Liver, normal human.....	1·07
386	" " .....	1·01
437*	" " .....	0·94
119	Lung " .....	1·02
125	" " .....	1·04
39	Primary sarcoma of adrenal.....	1·06
87	" " femur .....	0·96
433	Lymphatic glands secondary to carcinoma of rectum	1·14
148	" " " " breast...	0·97
792	" " " " " .....	1·09
440*	" " " " " .....	1·29
434	Hepatic metastasis " " rectum	1·14
576	" " " " " .....	0·94
338	" " " " breast...	1·06
790	" " " " " .....	1·02
407	Primary carcinoma of bladder.....	1·04
94	" " cervix .....	1·07
548	" " " " .....	0·85
697, Sample A	" " " " .....	1·01
697 " B	" " " " .....	1·02
697* " C	" " " " .....	21·28
697 " D	" " " " .....	1·71
697 " E	" " " " .....	1·14
697 " F	" " " " .....	1·10
697* " G	" " " " .....	1·06
71	" " ovary .....	1·02
794	" " " " .....	1·06
117	" " tongue .....	1·03
793*	" " " " .....	2·24
575	" " rectum .....	1·11
768	" " " " .....	1·10
796	" " " " .....	0·95
798	" " " " .....	0·97
147, Sample A	" " breast .....	1·43
147 " B	" " " " .....	1·34
147* " C	" " " " .....	1·20
442, Sample A	" " " " .....	1·67
442 " B	" " " " .....	1·07
789	" " " " .....	0·88
791*	" " " " .....	1·48
795	" " " " .....	1·06
797	" " " " .....	0·98

\* Tested for emanation.

The results with the emanation electroscope were as below :—

HCl.	Natural leak.....	0·235 division per minute.
	Experimental leak .....	0·233 " "
No. 437.	Natural leak.....	0·235 " "
	Experimental leak .....	0·215 " "
No. 697 G.	Natural leak.....	0·192 " "
	Experimental leak .....	0·196 " "

No. 147 C.	Natural leak.....	0.192 division per minute.		
	Experimental leak .....	0.196	"	"
No. 440.	Mean natural leak .....	0.239	"	"
	Experimental " 1st hour ...	0.410	"	"
	" " 2nd " ...	0.531	"	"
	" " 3rd " ...	0.484	"	"
No. 791.	Natural leak.....	0.221	"	"
	Experimental leak, 1st hour...	0.237	"	"
	" " 2nd " ...	0.267	"	"
	" " 3rd " ...	0.263	"	"
	Natural leak after exhaustion, 1st half hour	0.201	"	"
	Ditto, 2nd half hour .....	0.177	"	"
(Flask found to be cracked, equilibrium value probably not attained.)				
No. 793.	Mean natural leak .....	0.303 division per minute.		
	Experimental, "immediately" .....	1.227	"	"
	" end of 1st hour	1.376	"	"
	" " 2nd "	1.676	"	"
	" " 3rd "	1.538	"	"
No. 697 C.	Mean natural leak .....	0.318	"	"
	Experimental, "immediately" .....	112.1 divisions per minute.		
	" end of 1st hour	146.3	"	"
	" " 2nd "	153.8	"	"
	" " 3rd "	153.8	"	"
Standard radium solution containing $1.57 \times 10^{-7}$ mgrm. of Ra—				
	Natural leak .....	0.319 division per minute.		
	Experimental, "immediately" .....	1.370 divisions per minute.		
	" end of 1st hour .....	1.714	"	"
	" " 2nd " .....	2.083	"	"
	" " 3rd " .....	2.143	"	"
	" " 4th " .....	2.000	"	"
	Natural leak after exhaustion, "immediately"	0.587 division per minute.		
	Ditto, 1st hour .....	0.412	"	"
	" 2nd " .....	0.307	"	"

Comparing the values obtained by the constant capacity electroscope with the maximum values (*less* mean natural leak) obtained by the emanation electroscope in the case of those substances examined by both methods, it appears that a 20-per-cent. increase over the natural leak in the constant capacity electroscope indicates the presence of radium, but, for values less than this, the presence or absence of radium as detected in the emanation electroscope cannot be predicted with certainty.

Reference No.	Leak of substance (Natural leak = 1). Constant capacity electroscope.	Divisions per minute due to emanation. Emanation electroscope.
437	0·94	0
697 G	1·06	0·004
147 C	1·20	0·004
440	1·29	0·292
*791	1·48	0·068
793	2·24	1·373
697 C	21·28	153·5

\* Flask cracked ; equilibrium value probably not attained.

Of the entire series of five non-malignant and 28 malignant tissues that have been examined, it appears, therefore, that three cases of primary carcinoma and one case of secondary carcinoma yield sufficient evidence that in them radium was present. Comparison with the radium standard ( $1\cdot57 \times 10^{-7}$  mgrm.) shows that they possess the following amounts of radium per gramme of dried extracted carcinoma tissue :—

No. 440.	Spheroidal cell carcinoma, axillary glands secondary to breast	$1\cdot08 \times 10^{-8}$ mgrm.	
No. 791.	Primary spheroidal cell carcinoma, breast .....	$0\cdot188 \times 10^{-8}$	„
		(at least)	
No. 793.	„ squamous „ tongue.....	$3\cdot94 \times 10^{-7}$	„
No. 697.	„ „ „ cervix .....	$2\cdot73 \times 10^{-8}$	„

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