values of α and R for which, according to Lin, the flow should be unstable.

It was suggested three or four years ago by J. von Neumann, C. C. Lin, and C. L. Pekeris, that this question could be settled by numerical work and an attempt was then made which was successful in finding c only up to $R=1600$. We have now found it possible to integrate the equation successfully for larger values of R and have obtained the results for c given in Table I, which

TABLE I. Characteristic values of c.

α \ R	1600	2500	6400	10,000	35,000
0.9		$0.2857+0.0211i$	$0.2444+0.0012i$	$0.2261-0.0040i$	
1.0	$0.3231+0.0262i$	$0.3011+0.0142i$	$0.2569-0.0009i$	$0.2375-0.0037i$	$0.1886+0.0009i$
1.1	$0.3384+0.0206i$	$0.3148+0.0108i$	$0.2677+0.0007i$	$0.2470+0.0003i$	$0.1911+0.0116i$
1.2		$0.3267+0.0107i$	$0.2763+0.0056i$	$0.2535+0.0075i$	

For $\alpha=1.05$, $R=8000$, $c=0.2524-0.0017i$

are believed accurate to 0.5 in the last place. Interpolation gives a critical Reynolds number $R=5780$ for $\alpha=1.02$, which has been checked by integrations. These numbers confirm Lin's results closely, and it may now be regarded as proved that plane Poiseuille flow becomes unstable at about $R=5800$. It may be noted that for a given value of α the flow is unstable only for a finite range of Reynolds numbers as was also found by Lin.

This latest work was done on International Business Machines Corporation's Selective Sequence Electronic Calculator by Donald A. Quarles, Jr. and Phyllis K. Brown. The numerical work was done to 13 digits using a step of 0.01 in y with an integration formula having an error per step proportional to the 8th derivative. The problem took about 150 hours of operating time, equivalent to about 100 years of hand computing.

[1] C. C. Lin, Quart. Appl. Math. 3, 288 (1946).
[2] C. L. Pekeris, Phys. Rev. 74, 191 (1948).

Radiations from Nb^{97}†

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THE properties of the 17-hr Zr^{97} and of its daughter element, the 70-minute Nb^{97}, have been the subject of considerable investigation.[1–5] Spectrometric measurements[5] have yielded beta-ray energies of 1.91±0.02 Mev and 1.267±0.02 Mev, and gamma-ray energies of 0.747±0.005 Mev for Zr^{97} and 0.665±0.005 Mev for Nb^{97}. The gamma-ray at 0.747±0.005 Mev was shown to be emitted from an isomeric level in Nb^{97} of half-period 60 sec.

In the present investigation $Zr^{96}O_2$ (isotopic concentration 90 percent in Zr^{96}), obtained from the Y-12 plant, Carbide and Carbon Chemicals Division, Union Carbide and Carbon Corporation, Oak Ridge, Tennessee, was irradiated by slow neutrons in the Oak Ridge pile. The radioactive materials were received within twenty-four hours after cessation of irradiation and chemical separations were immediately commenced. The slow neutron irradiated zirconium dioxide was dissolved by potassium pyrosulfate fusion, and the separation of the niobium daughter activity from zirconium was effected by the use of Steinberg's "oxalate" procedure.[6]

The decay of Nb^{97}, freshly separated from its parent element, was followed for ten half-periods, and the half-period, taken from the slope of the decay curve was found to be 72.1±0.7 minutes. This value is to be compared with previously reported values of 68 minutes[7] and 75 minutes.[2] The decay of Zr^{97} was followed for 200 hours, and the resulting half-period was calculated to be 17.0±0.2 hours, in agreement with the earlier measurements.

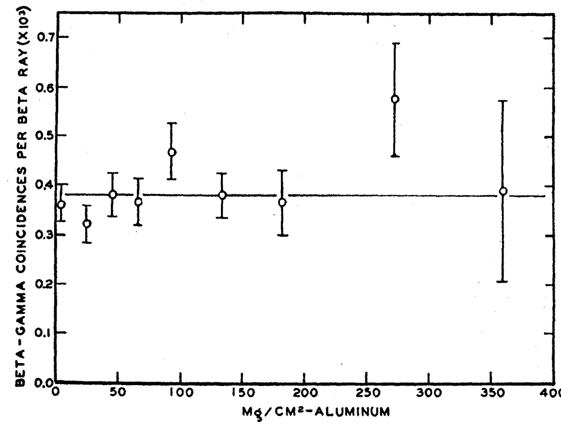

FIG. 1. Beta-gamma coincidence rate of Nb^{97} as a function of the surface density of aluminum placed before the beta-ray counter.

The beta-rays of Nb^{97}, freshly separated from its parent element, were absorbed in aluminum, and a Feather[8] plot of the data gave a maximum beta-ray energy of 1.40 Mev.

The beta-gamma coincidence rate of the 72-minute Nb^{97} is shown as a function of absorber thickness before the beta-ray counter in Fig. 1. It is seen to be constant, independent of the beta-ray energy, suggesting that the beta-ray spectrum of Nb^{97} is simple. Calibration of the beta-gamma coincidence counting arrangement by the beta-gamma coincidence rate of Sc^{46} showed that each beta-ray of Nb^{97} is followed, on the average, by 0.7 Mev of gamma-ray energy. Each point of Fig. 1 was, of course, properly corrected for decay of the source.

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* Frankford Arsenal, Philadelphia, Pennsylvania.
[1] Sagane, Kojima, Mijamoto, and Ikawa, Phys. Rev. 57, 1179 (1940).
[2] A. V. Grosse and E. T. Booth, Phys. Rev. 57, 664 (1940).
[3] S. Katcoff and B. Finkle, *Radiochemical Studies: The Fission Products* (McGraw-Hill Book Company, Inc., New York, 1951), Paper No. 83, National Nuclear Energy Series, Plutonium Project Record, Vol. 9, Div. IV.
[4] O. Hahn and F. Strassman, Naturwiss. 29, 285 (1941).
[5] Burgus, Knight, and Prestwood, Phys. Rev. 79, 104 (1950).
[6] E. P. Steinberg, *Radiochemical Studies: The Fission Products* (McGraw-Hill Book Company, Inc., New York, 1951), Paper No. 243, National Nuclear Energy Series, Plutonium Project Record, Vol. 9, Div. IV.
[7] G. E. Boyd, communication to G. T. Seaborg and I. Perlman, Revs. Modern Phys. 20, 585 (1948).
[8] N. Feather, Proc. Cambridge Phil. Soc. 30, 599 (1938).

Microwave Spectroscopy at High Temperature-Spectra of CsCl and NaCl*

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A SPECTROMETER for measurement of microwave absorption by gases at high temperature has been constructed,[1,2] and with it spectra of gaseous NaCl, KCl, CsCl, and TlCl have been obtained. Microwaves pass through a 5-foot absorption cell which can be held at temperatures at least as high as 875°C. Absorption lines are modulated by Stark effect to give sensitive detection.

At approximately 775°C the pure rotational transition $J=1\rightarrow 2$ of NaCl was observed. Frequencies for the two Cl isotopes and various vibrational states are listed in Table I. These give $B_e(Cl^{35})=6536.9\pm0.3$ Mc, $\alpha_e(Cl^{35})=48.1\pm0.1$ Mc, and the internuclear distance $r_e=2.3606\pm0.0003$A. Frequency measurements of the absorption lines were made with a frequency standard. However, experimental conditions gave lines several megacycles broad, which limited the precision of measurements which could be easily obtained to that indicated in Table I.