

AN INVESTIGATION OF THE RADIONUCLIDES  
OF ARSENIC PRODUCED BY CYCLOTRON  
BOMBARDMENT OF GERMANIUM WITH  
15 MEV DEUTERONS

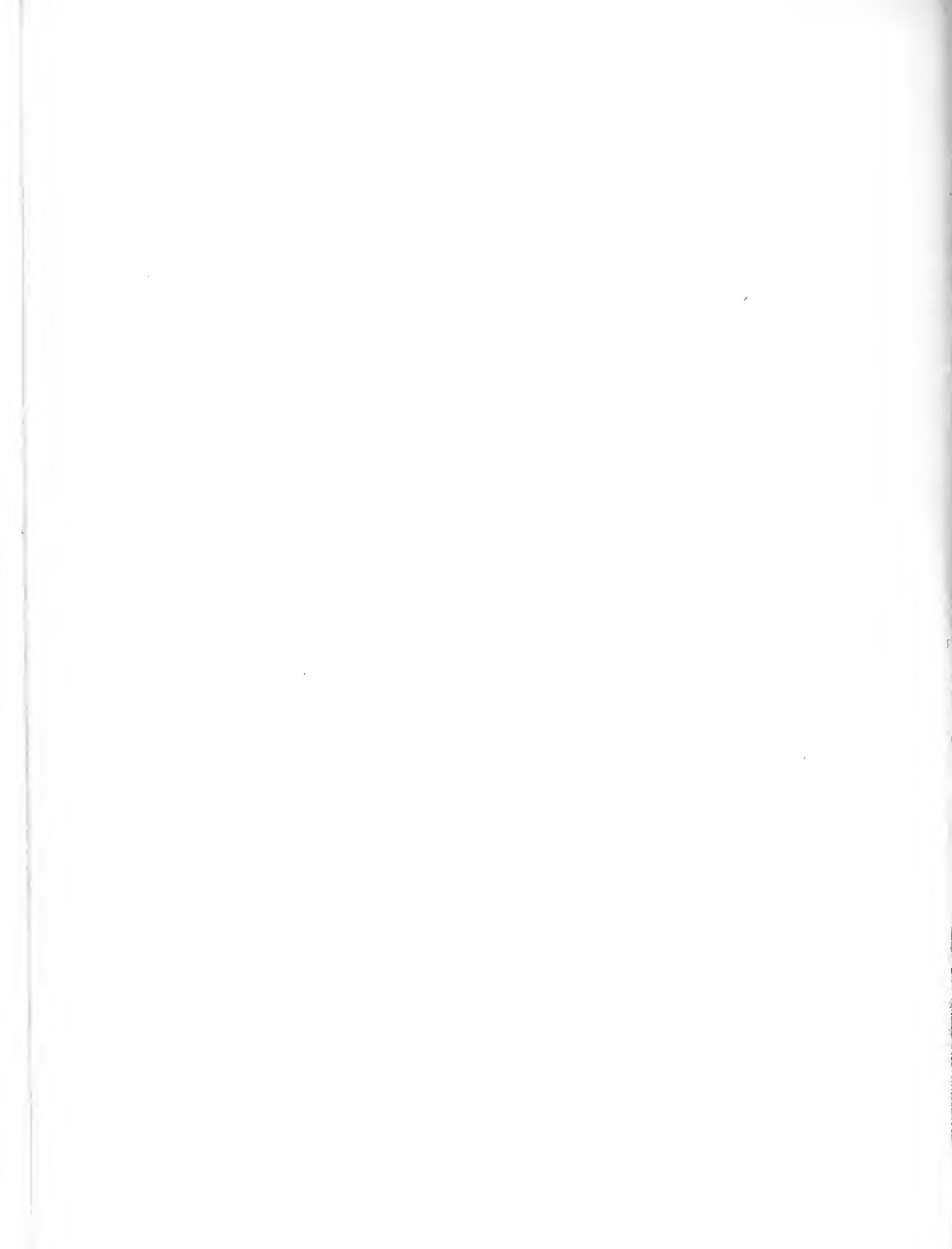
—  
HARRY J. WATTERS  
AND  
JOHN F. FAGAN, JR.

Library  
U. S. Naval Postgraduate School  
Monterey, California





M - 62



AN INVESTIGATION OF THE RADIONUCLIDES OF ARSENIC  
PRODUCED BY CYCLOTRON BOMBARDMENT OF GERMANIUM

with

15 Mev DEUTERONS

by

HARRY J. WATTERS  
Lieutenant Commander, U. S. Navy  
B. S. Purdue University  
(1949)

and

JOHN F. PAGAN, JR.  
Lieutenant, U. S. Navy  
B. S., U. S. Naval Academy  
(1945)

SUBMITTED IN PARTIAL FULFILLMENT OF THE  
REQUIREMENTS FOR THE DEGREE OF  
MASTER OF SCIENCE



The overall content of a nuclear bomb makes it  
impossible to be sure exactly what radionuclides  
present in the bomb. Separation of isotopes can  
only be done by separating individual elements of the bomb and then  
measuring the activity of the separated elements. This requires the  
separation of each element produced by an atomic bomb.

**Title:** "An Investigation of the Radionuclides of Arsenic  
Produced by Cyclotron Bombardment of Germanium  
with 15 Mev Deuterons"

which involved the use of millilitre volumes of acid in which  
 $\text{As}^{75}$ ,  $\text{As}^{76}$ ,  $\text{As}^{77}$ ,  $\text{As}^{78}$ , and  $\text{As}^{79}$ . These additions

**Authors:** Harry J. Watters, Lieutenant Commander, U.S. Navy  
B. S., Purdue University (1949)

and  
John F. Fagan, Jr., Lieutenant, U. S. Navy

B. S., U. S. Naval Academy (1945)

This is only one example of how to  
separate isotopes of one element, but many other possibilities  
exist within the field. This involved the use of a  
cyclotron.

Submitted to the Department of Physics on May 25,  
1953 in partial fulfillment of the requirements for the  
degree of Master of Science.

## ՀԵՇԻԿԱ

պիստության մասին և առաջարկությունների մասին հայտ  
առաջարկությունների մասին պատճենագիրը պահպանության մասին

Կառավարության պահպանության մասին հայտ  
(ԿՊՈՒ) պահպանության մասին

հայտ

Կառավարության պահպանության մասին  
(ԿՊՈՒ) պահպանության մասին

ՀՀ ԿՆ ու ուղարկությունների մասին հայտ  
առաջարկությունների մասին պահպանության մասին  
պահպանության մասին պահպանության մասին

The following is a brief summary of the results:  
The arsenic produced by a deuteron bombardment of  
germanium has been studied to determine the nuclides  
present in the mixture. Identification of isotopes was  
made by comparing measured values of half life and maxi-  
mum  $\beta$  energy with the accepted values. Yield values were  
determined for each isotope present by  $4\pi$  solid angle  
counter measurements.

Counting rates were measured for a period of 53 days  
with  $4\pi$  and coincidence counters, obtaining half lives  
which indicated that the nuclidic mixture was made up of  
 $\text{As}^{71}$ ,  $\text{As}^{72}$ ,  $\text{As}^{73}$ ,  $\text{As}^{74}$ , and  $\text{As}^{77}$ . These indications were  
confirmed by maximum  $\beta$  energy values obtained by absorption  
measurements and from  $\gamma$  energies found using a  $\gamma$ -ray  
scintillation spectrometer. Measurements indicated that  
the 40 hour half life reported for  $\text{As}^{77}$  is in error by a  
significant amount, and that no  $\text{As}^{76}$  was obtained by this  
bombardment.

The  $4\pi$  solid angle counter constructed was shown to  
have an efficiency of very nearly 100 percent for particles  
which escape the source. This counter has proven to be a  
very practical laboratory instrument and detailed instruc-  
tions for its use are included as an appendix.

To characterize a yd baseline disease and  
obtains odds estimates of relative need and number of  
new episodes to hospitalization. Results will be presented  
-like this and to clarify different pathways of yd when  
they occur first, clarify between odd ratios when a new  
episode occurs later, clarify between odd ratios when a new  
episode occurs with yd present, and obtain odds ratios

#### **• A STUDY IN THE METHOD**

ayah 63 To Bolting & not determine how soon patterns

azott illatgalának több részleges komponensekben van néhány  
tegy az előzőekben említettetőkön kívül, melyeket a következőkben  
azoknak a részlegnek a neveit adunk. A legelső részleg a hosszú  
szövegben említettetőkön kívül, a második részleg a rövid szövegek  
nélküli részleg, a harmadik részleg a rövid szövegekben említettetőkön  
kívül, a negyedik részleg a rövid szövegekben említettetőkön kívül  
a hosszú szövegekben említettetőkön kívül, a ötödik részleg a rövid  
szövegekben említettetőkön kívül, a hatodik részleg a rövid szövegekben  
említettetőkön kívül, a hetedik részleg a rövid szövegekben említettetőkön  
kívül, a nyolcadik részleg a rövid szövegekben említettetőkön kívül,  
a kilencedik részleg a rövid szövegekben említettetőkön kívül, a tizedik részleg a rövid  
szövegekben említettetőkön kívül, a tizedik részleg a rövid szövegekben említettetőkön kívül,

#### **Answers**

et nrova eur bedenktedes tettedes elrde filos ab auf  
zeleifung der Zweig 100 vlynen ytert. To jnsekellte di zwed  
s od et zwedt waf vctesod ztrit. vewon od gessan hold  
-zweckd belated daa fruehstend vlofotodsi lindetey vter  
zkippen as et hundert od ein zit tel dene

The following is a tabular summary of the results  
of the investigation:

<u>Isotope</u>	<u>Method of decay</u>	<u>Energy (Mev)</u>	<u>T<sub>1/2</sub></u>	<u>Thick target yield*</u> <u>(uc/mamp-hr)</u>
As <sup>71</sup>	$\beta^+$	0.66	$48.2 \pm 1.2$ hrs.	7.6
As <sup>72</sup>	$\beta^+$	3.25	$25.8 \pm 0.2$ hrs.	64.9
	$\gamma$	0.85		
As <sup>73</sup>	$\beta^-$	$0.11 > E_{max} > 0.02$	$88.9 \pm 9.2$ days	1.1
As <sup>74</sup>	$\beta^+$	0.99, 1.49	$17.82 \pm 0.13$ days	5.2
	$\beta^-$			
As <sup>76</sup>	Not present in the mixture			
As <sup>77</sup>	$\beta^-$	< 0.7	> 70 hours	5 < yield < 15**

\* The thick target yield values specified apply if the deuteron beam current was exactly 38  $\mu$ amps and if the arsenic separation efficiency was 100 percent. Yield values quoted are based on  $\beta$  counting only and do not include orbital electron capture.

\*\* Based on ratios of total  $\beta$  to  $\beta^+$  counting rates.

Thesis Supervisor: Robley D. Evans

Title: Professor of Physics

estimat and the estimate reduced by galorelet est.

most appropriate add to

target point

\*bifur

(in-canal)

ΔE<sup>2</sup>

target  
line

bottom  
reach to

scorzon

0.5

-0.01 0.1 ± 0.01

80.0

+9

ET<sub>BA</sub>

0.13

-0.01 0.0 ± 0.01

60.0

+9

ET<sub>CA</sub>

1.1

-0.01 0.0 ± 0.01

80.0

+9

ET<sub>CA</sub>

0.3

-0.01 0.0 ± 0.01

60.0

+9

ET<sub>CA</sub>

providing add to target to bottom

ET<sub>BA</sub>

ET<sub>BA</sub> > ET<sub>CA</sub> > 0 > target 0% < ET<sub>CA</sub> > +9 ET<sub>BA</sub>

estimated add to target provides regular likely target points and a reasonable estimate of the true target. It is known that estimates and 0 are based on bottom surface profile. A target 0.001 has been adopted. Estimated bottom profile is based on the target position.

Bottom positions +9 and -9 are taken no less than

30 cm, 1 m, 3 m, 10 m, 15 m, 20 m, 25 m

and 100 m to bottom

100 m

## TABLE OF CONTENTS

### ACKNOWLEDGMENTS

Section I. - ~~APPENDIXES~~ ~~APPENDIXES~~ ~~APPENDIXES~~  
The following is a list of the appendices:  
1. ~~APPENDIX A~~ ~~APPENDIX A~~ ~~APPENDIX A~~  
~~APPENDIX B~~ ~~APPENDIX B~~ ~~APPENDIX B~~  
~~APPENDIX C~~ ~~APPENDIX C~~ ~~APPENDIX C~~

The authors wish to express sincere thanks to their thesis advisor, Professor Robley D. Evans, for his interest and advice during the course of this work. Grateful acknowledgment is also made to Doctor Gordon L. Brownell, who suggested the problem, for his constant guidance and for the opportunity to utilize the facilities of the Massachusetts General Hospital Research Laboratory.

Thanks are due to all members of the group in the Radioactivity Center for their interest and suggestions. The opportunity for graduate study provided by the Radioactivity Center and its sponsors is greatly appreciated.

## INTRODUCTION

of various specific results of the studies off  
topographic and geological analysis about what  
else to return with respect to which had been said  
before of this point of the consequences involved. After  
this, mention was made of the laboratory and mining  
of manganese and not the remaining manganese and  
ferromanganese and its relationship and relation  
with metal ore, the last  
and all those will be discussed. It is the case that  
those regions have characteristics which are typical  
which are very different from manganese which  
is manganese, in which the manganese is  
predominant, in which there is no manganese.

TABLE OF CONTENTS

Section I.	Introduction . . . . .	1
A.	Importance of the Investigation . . . .	1
B.	Results of Previous Investigations . . .	4
Section II.	Nuclear Properties to be Measured . . .	6
Section III.	Experimental Procedure . . . . .	7
A.	Preparation of Radioactive Arsenic . . .	7
B.	Schedule of Observations . . . . .	7
Section IV.	Methods Used in Interpretation of Data . . . . .	12
A.	Half Life . . . . .	12
B.	Absolute $\beta$ Activity . . . . .	16
C.	Maximum $\beta$ Energies . . . . .	16
Section V.	Results . . . . .	22
Bibliography . . . . .		25
Appendix I.	The $4\pi$ Counter . . . . .	27
Appendix II.	The Scintillation $\gamma$ -Ray Spectrometer . .	73
Appendix III.	The End Window $\beta$ Counter . . . . .	75
Appendix IV.	The Coincidence Counter . . . . .	85

• TAKING THE GATE

## LIST OF FIGURES

I. ~~DETERMINATION OF THE ENERGY SPECTRUM~~

Figure  
No.

Title

Page

1	Arsenic $\gamma$ -ray energy spectrum for 56 hours after bombardment . . . . .	10
2	Arsenic $\gamma$ -ray energy spectrum 52 days after bombardment . . . . .	11
3	Half-life components of coincidence counter data . . . . .	13
4	Half-life components of $4\pi$ counter data . . . . .	15
5	Maximum range determination from absorption measurements . . . . .	17
6	$\beta$ energy determination from absorption measurements ( $\text{As}^{74}$ ) . . . . .	19
7	$\beta$ energy determination from absorption measurements ( $\text{As}^{71}$ ) . . . . .	20
8	$\beta$ energy determination from absorption measurements ( $\text{As}^{72}$ ) . . . . .	21

Contributed by R. H. Williams, Caltech. Mathematical derivation is available from the unclassified single channel counting notes in the appendix section.

Figure 1 shows a sample spectrum of arsenic-75 with the measured data points shown. The distribution

2000 TO TELL

outstanding. From such a study it is apparent  
that positron emitting isotopes can be used to determine  
brain tumors by their absorption of half life. In  
all cases where evidence was forthcoming, tumor location  
obtained by this technique was correct.

#### A. Importance of the Investigation

No known diagnostic techniques have been able to

The fact that tumors of the brain take up a  
large amount of trace metal compared with that taken  
up by normal brain tissue makes it possible to detect  
and to actually determine the location of tumors in  
the human brain. Under the supervision of Dr. Gordon  
L. Brownell, a group at the Research Laboratory of the  
Massachusetts General Hospital has developed a suitable  
tracer technique for the diagnosis and preoperative  
location of brain tumors, using positron emitting  
isotopes. After intravenous injection of the tracer  
material, the patient's head is mechanically scanned  
in two dimensions by two scintillation counters con-  
nected in coincidence. Third dimensional location is  
obtained from the unbalanced single channel counting  
rates of the separate counters.

Since January 1953 a large number of patients have  
been examined using this technique. The results are

more than one in occupational .A

It is not clear who the author was but it  
was probably written to inform people of the  
importance of education. It was written in  
the form of a letter and it is addressed to the  
King of England. The author is unknown but  
it is believed to be Thomas More. The letter  
begins with a salutation and ends with a  
closing sentence. The middle part of the  
letter contains several paragraphs of text.  
The first paragraph discusses the importance  
of education and its benefits. The second  
paragraph discusses the need for parents  
to provide their children with a good  
education. The third paragraph discusses  
the importance of learning Latin and  
the fourth paragraph discusses the  
importance of learning Greek. The fifth  
paragraph discusses the importance of  
learning French and the sixth paragraph  
discusses the importance of learning  
Spanish. The seventh paragraph discusses  
the importance of learning Italian and  
the eighth paragraph discusses the  
importance of learning German. The ninth  
paragraph discusses the importance of  
learning Portuguese and the tenth  
paragraph discusses the importance of  
learning Dutch. The eleventh paragraph  
discusses the importance of learning  
Swedish and the twelfth paragraph  
discusses the importance of learning  
Norwegian. The thirteenth paragraph  
discusses the importance of learning  
Danish and the fourteenth paragraph  
discusses the importance of learning  
Finnish. The fifteenth paragraph  
discusses the importance of learning  
Icelandic and the sixteenth paragraph  
discusses the importance of learning  
Irish. The seventeenth paragraph  
discusses the importance of learning  
Welsh and the eighteenth paragraph  
discusses the importance of learning  
Cornish. The nineteenth paragraph  
discusses the importance of learning  
Gaelic and the twentieth paragraph  
discusses the importance of learning  
Manx. The twenty-first paragraph  
discusses the importance of learning  
Welsh and the twenty-second paragraph  
discusses the importance of learning  
Cornish. The twenty-third paragraph  
discusses the importance of learning  
Gaelic and the twenty-fourth paragraph  
discusses the importance of learning  
Manx. The twenty-fifth paragraph  
discusses the importance of learning  
Welsh and the twenty-sixth paragraph  
discusses the importance of learning  
Cornish. The twenty-seventh paragraph  
discusses the importance of learning  
Gaelic and the twenty-eighth paragraph  
discusses the importance of learning  
Manx. The twenty-ninth paragraph  
discusses the importance of learning  
Welsh and the thirty-first paragraph  
discusses the importance of learning  
Cornish. The thirty-second paragraph  
discusses the importance of learning  
Gaelic and the thirty-third paragraph  
discusses the importance of learning  
Manx. The thirty-fourth paragraph  
discusses the importance of learning  
Welsh and the thirty-fifth paragraph  
discusses the importance of learning  
Cornish. The thirty-sixth paragraph  
discusses the importance of learning  
Gaelic and the thirty-seventh paragraph  
discusses the importance of learning  
Manx. The thirty-eighth paragraph  
discusses the importance of learning  
Welsh and the thirty-ninth paragraph  
discusses the importance of learning  
Cornish. The forty-first paragraph  
discusses the importance of learning  
Gaelic and the forty-second paragraph  
discusses the importance of learning  
Manx. The forty-third paragraph  
discusses the importance of learning  
Welsh and the forty-fourth paragraph  
discusses the importance of learning  
Cornish. The forty-fifth paragraph  
discusses the importance of learning  
Gaelic and the forty-sixth paragraph  
discusses the importance of learning  
Manx. The forty-seventh paragraph  
discusses the importance of learning  
Welsh and the forty-eighth paragraph  
discusses the importance of learning  
Cornish. The forty-ninth paragraph  
discusses the importance of learning  
Gaelic and the fifty-first paragraph  
discusses the importance of learning  
Manx. The fifty-second paragraph  
discusses the importance of learning  
Welsh and the fifty-third paragraph  
discusses the importance of learning  
Cornish. The fifty-fourth paragraph  
discusses the importance of learning  
Gaelic and the fifty-fifth paragraph  
discusses the importance of learning  
Manx. The fifty-sixth paragraph  
discusses the importance of learning  
Welsh and the fifty-seventh paragraph  
discusses the importance of learning  
Cornish. The fifty-eighth paragraph  
discusses the importance of learning  
Gaelic and the fifty-ninth paragraph  
discusses the importance of learning  
Manx. The sixty-first paragraph  
discusses the importance of learning  
Welsh and the sixty-second paragraph  
discusses the importance of learning  
Cornish. The sixty-third paragraph  
discusses the importance of learning  
Gaelic and the sixty-fourth paragraph  
discusses the importance of learning  
Manx. The sixty-fifth paragraph  
discusses the importance of learning  
Welsh and the sixty-sixth paragraph  
discusses the importance of learning  
Cornish. The sixty-seventh paragraph  
discusses the importance of learning  
Gaelic and the sixty-eighth paragraph  
discusses the importance of learning  
Manx. The sixty-ninth paragraph  
discusses the importance of learning  
Welsh and the seventy-first paragraph  
discusses the importance of learning  
Cornish. The seventy-second paragraph  
discusses the importance of learning  
Gaelic and the seventy-third paragraph  
discusses the importance of learning  
Manx. The seventy-fourth paragraph  
discusses the importance of learning  
Welsh and the seventy-fifth paragraph  
discusses the importance of learning  
Cornish. The seventy-sixth paragraph  
discusses the importance of learning  
Gaelic and the seventy-seventh paragraph  
discusses the importance of learning  
Manx. The seventy-eighth paragraph  
discusses the importance of learning  
Welsh and the seventy-ninth paragraph  
discusses the importance of learning  
Cornish. The eighty-first paragraph  
discusses the importance of learning  
Gaelic and the eighty-second paragraph  
discusses the importance of learning  
Manx. The eighty-third paragraph  
discusses the importance of learning  
Welsh and the eighty-fourth paragraph  
discusses the importance of learning  
Cornish. The eighty-fifth paragraph  
discusses the importance of learning  
Gaelic and the eighty-sixth paragraph  
discusses the importance of learning  
Manx. The eighty-seventh paragraph  
discusses the importance of learning  
Welsh and the eighty-eighth paragraph  
discusses the importance of learning  
Cornish. The eighty-ninth paragraph  
discusses the importance of learning  
Gaelic and the ninety-first paragraph  
discusses the importance of learning  
Manx. The ninety-second paragraph  
discusses the importance of learning  
Welsh and the ninety-third paragraph  
discusses the importance of learning  
Cornish. The ninety-fourth paragraph  
discusses the importance of learning  
Gaelic and the ninety-fifth paragraph  
discusses the importance of learning  
Manx. The ninety-sixth paragraph  
discusses the importance of learning  
Welsh and the ninety-seventh paragraph  
discusses the importance of learning  
Cornish. The ninety-eighth paragraph  
discusses the importance of learning  
Gaelic and the ninety-ninth paragraph  
discusses the importance of learning  
Manx. The ninety-eighth paragraph  
discusses the importance of learning  
Welsh and the ninety-ninth paragraph  
discusses the importance of learning  
Cornish. The ninety-ninth paragraph  
discusses the importance of learning  
Gaelic and the one-hundredth paragraph  
discusses the importance of learning  
Manx.

outstanding. From many cases clinically diagnosed as borderline, the presence or absence of neoplastic brain tissue has been determined by this method. In all cases where surgery was performed, tumor location obtained by this technique has been confirmed. As yet no known incorrect diagnoses have been made. In addition to providing more quantitative information than is available from clinical diagnosis, this method provides the left-to-right localization which is difficult and often impossible to obtain clinically.

Radioactive arsenic was selected as the tracer metal because of several considerations. Arsenic is readily available from a deuteron bombardment of germanium. The half lives of arsenic isotopes fall within an acceptable range for tracer utilization. Most of the  $\gamma$ -rays emitted from arsenic isotopes are soft, thus decreasing harmful biological effects due to radiation. A very important advantage is that a large percentage of arsenic activity consists of positron emission. Precision measurements with very high resolution may be made on the resulting annihilation radiation.

The tracer arsenic is not injected until several days after bombardment. During this period any short-

the first 1000 m of the valley floor. The valley floor is characterized by a mix of grasses and forbs, with some shrubs and small trees. The soil is a light brown color, indicating a relatively dry environment. The vegetation is dominated by grasses such as *Pennisetum polystachyon*, *Andropogon gayanus*, and *Cynodon dactylon*. There are also patches of *Acacia farnesiana* and *Morinda citrifolia*. Some small shrubs like *Baccharis dracunculifolia* and *Psychotria carthagenensis* are scattered throughout the valley floor. The valley floor is surrounded by a dense forest of tropical rainforest, which includes species such as *Manilkara zapota*, *Terminalia catappa*, and *Artocarpus heterophyllus*. The forest floor is covered in a thick layer of fallen leaves and organic matter. The overall landscape is a mix of open grassy areas and dense forested regions.

Improve film by setting sun at altitude 7000-8000  
-feet the before wind starts. It will reduce radio noise.

lived activity present decays to a negligible value compared with that of the 17.5 day isotope<sup>(11,13)</sup> and does not affect the scanning measurements which require a period of approximately two hours. If the half lives and the relative activity percentages of the short-lived isotopes were accurately known, this waiting period could be decreased or even eliminated with a resultant increase in useful activity obtained from a given bombardment.

The purpose of the present investigation is to determine insofar as possible the methods of decay and associated decay energies, half lives, absolute activities, and isotopic yields of the arsenic obtained by the deuteron bombardment of germanium. In addition to decreasing the delay between bombardment and injection, this information may permit the use of short-lived isotopes as tracers. In effect this also decreases the bombardment time required to obtain a given amount of tracer material. It may be desirable to examine a single patient several times over a period of a few weeks. Accurate knowledge of the short-lived activity present may permit frequent injections of a lesser amount of tracer solution while avoiding harmful effects from the chemical toxicity of carrier arsenic present.

vidigiliyan a od cyseob unorota ystirios havil  
(E.I.I.) egoruet yan d.TI od' te tuis doku berengos enlur  
nolaw atoemetsasai gainmae oec joellta son kech nra  
od' II .etwod oec ystirios to bolter, a atluper  
le negejneq ystirios eviteler od' hua tavli lles  
eids ,awonk ylastrumos oew zneccosz bevill-storia oec  
bedalubis nore te bessereb ad blureq ystirios  
bentaro ystirios llyiou ni negeton dantuan a dlu  
.enambradom navig a morl  
oi at moly-gisneval neestq ent' le esoupy mi  
yaobh le abedan ent' alidiong le telouak entuanab  
entleade ,zevif ller ,esigtona yaobh bedalucca hua  
bentde sineris ent' le oblaty alidiong has ,ystirios  
nuklbbi at .esilanteq le ambradom negetush ent' ye  
,mollpeint has jambredmed devuted yslan od' unleseteb et  
bevill-storia le rau ent' :barer van noideatent zhd  
negeteb uala ent' joellta et .etwod ce negeton  
javous navig a alafus od berinper ent' jambredmed ent'  
a entuan de alidiong od yslan dI .Liltejan venut le  
vel a to bolterq a tewd nealt latrone omelte plant  
ystirios bevill-storia ent' le sykellong sjenwoh ,esew  
tessel a to moltaugai tneupar tlenoy van tneupar  
esolte lomtan galibore alidv notsifer roent le dhuone  
.nesera dinpary rottro to ystirios tneupar od' nott

## B. Results of Previous Investigations

Prior to Sagane's investigations in 1938<sup>(1)</sup> very little was known about the radionuclides of arsenic. The principal results of his work on the arsenic produced by a deuteron bombardment of germanium, as modified by others, are tabulated below and include all data reported through 1941.

<u>Isotope</u>	<u>Type radiation</u>	<u>Energy (Mev)</u>	<u>Half life</u>	<u>Reference</u>
As <sup>71</sup>	$\beta^+$		50 hour	2, 4
As <sup>73</sup>	$\beta^+$	0.6	88 min	2, 4
As <sup>74</sup>	$\beta^+$	0.9	16 day	1, 4
As <sup>76</sup>	$\beta^-$	1.1		
		1.7		
		2.7		
	$\gamma$	1.5	26.8 hour	3, 5, 6
		2.2		
		3.2		
As <sup>77</sup>	$\beta^-$		55-80 day	1, 2, 4
	$\gamma$			
As <sup>78</sup>	$\gamma$	0.27	68 min	7

Very little new information was published for several years but commencing in 1948 results were published which

Amolit enkraevn lusivren. No etlunox .8

Ytov (4) begi ni amolit enkraevn etlunox of zoln  
.simena to esolit enkraevn and luod; inwol luv etlunox  
-one obiects ads no ytov aid to etlunox inclositq est  
to ,bulnawey to cossitued nozueb a yd beurb  
abuloiq bus waled metaleudet ana ywrdio yd heitldon  
.lentl reporti bejorouq ads ab illa

231072120	W.M. 2100	YUOQ	EST	REPO
4.5	YUOQ 30	6.0	+	EP <sub>sh</sub>
4.5	YUOQ 50	6.0	+	EP <sub>sh</sub>
4.5	YUOQ 61	6.0	+	EP <sub>sh</sub>
		{ 5.5	-	EP <sub>sh</sub>
		{ 5.5	-	EP <sub>sh</sub>
		{ 5.5	-	EP <sub>sh</sub>
		{ 5.5	-	EP <sub>sh</sub>
		{ 5.5	-	EP <sub>sh</sub>
4.5 4.5	YUOQ 120			
4.5 4.5	YUOQ 120		-	EP <sub>sh</sub>
			-	
4	YUOQ 20	7.0	-	EP <sub>sh</sub>

larevres not beritlding the most critcal. In etlunox qyoy  
mols. Underlding emol. and larev. R. D. M. D. 1000.2nd. 2nd. 2nd.

conflicted with much of the previous data. The following  
 is a tabulation of the most reliable data now available  
 on the radioisotopes of arsenic without regard to their  
 method of activation:

<u>Isotope</u>	<u>Type radiation</u>	<u>Energy (Mev)</u>	<u>Half life</u>	<u>Reference</u>
$\text{As}^{70}$	$\beta^+$ (no $\gamma$ )	0.52	52 min	9
$\text{As}^{71}$	$\beta^+ (33\%)$ $\kappa (67\%)$	0.6 0.162	50-60 hour	10, 11, 12
$\text{As}^{72}$	$\beta^+$	0.87		
		0.67		
		1.84		
		2.5	26 hour	2, 11, 19
		3.34		
		0.702		
		0.835		
$\text{As}^{73}$	$\kappa$	0.058	76-100 day	11
	no $\beta^+$			
$\text{As}^{74}$	$\beta^-$	0.69, 1.36		
	$\beta^+$	0.92, 1.53		
	$\beta^-/\beta^+ \sim 1.0\%$		17.5 day	11, 13
	$\gamma$	0.593		
$\text{As}^{76}$	$\beta^+/\beta^- \leq 0.07\%$			
	$\gamma$	0.55, 1.21	27.6 hour	14, 18
$\text{As}^{77}$	$\beta^-$	0.679, 0.7		
	no $\gamma$		40 hour	15, 16, 20

en willekeur off . wat u doener add te denk dat die bevolking  
 voldoende van die voldoende leen add te neemeldeet n ek  
 plek of huysen duidelik omgaan "n as gevolgtoeken add so  
 voldoende te hou

<u>gevolg</u>	<u>221 2188</u>	<u>vryheid</u> <u>(vry)</u>	<u>equit</u> <u>geleidelik</u>	<u>equit</u> <u>geleidelik</u>
8	218 98		+ <sub>E</sub>	OF <sub>AA</sub>
SI , II , III	200-00	3.0	( <sup>3</sup> CE) + <sub>E</sub>	IV <sub>AA</sub>
		231.0	( <sup>3</sup> 78) X	
		332.0	+ <sub>E</sub>	ET <sub>AA</sub>
		401.0		
		48.1		
II	200-00	8.8		
		48.8		
		207.0	X	
		388.0		
II	200-00-00	500.0	X	ET <sub>AA</sub>
			+ <sub>E</sub> OF <sub>AA</sub>	
		51.1 , 28.0	+ <sub>E</sub>	ET <sub>AA</sub>
		62.1 , 29.0	+ <sub>E</sub>	
II , III	200-00-00	692.0	X	
			<sup>3</sup> 9.1 + <sub>E</sub> OF <sub>AA</sub>	
II , III	200-00-00	111.1 , 50.0	X	
		7.0 , 270.0	+ <sub>E</sub>	ET <sub>AA</sub>
II , III , IV	200-00		X OF <sub>AA</sub>	

## II. NUCLEAR PROPERTIES TO BE MEASURED

Time and equipment limitations prohibited conducting an investigation which could determine actual decay schemes of the active material. With a desire to extract as much information as possible in the time available, attempts were made to determine the following for each isotope of arsenic obtained from the bombardments with an average beam current of 36 milliamp.

1. Absolute  $\beta$  activity.
  2. Half life.
  3. Maximum  $\beta$  energies.
- In addition it was desirable to obtain information regarding the  $\gamma$ -energies of the mixture of isotopes and the variation of the spectrum with time.

Isotopic purity. A detailed description of the neutron bombardment program is contained in section IV.

### F. Isotopic distribution.

Conclusions concerning the nature of the radioactive isotopic mixtures obtained will be given in section IV. In this section attention will be directed to the following:

CAUSATION OF INTERGROWTH HABITUS . II

gation does not differ significantly among groups having only  
vascular tissues or vascular tissues plus radicle or cotyledons and  
or both a radicle and cotyledons. Inherent variation exists in seedlings  
with respect to seedling size as well as to number of leaves and  
seedlings with either one or two cotyledons, and all three  
seedlings with two cotyledons have more leaves than do  
seedlings with one cotyledon.

TABLE III

MEAN NUMBER OF LEAVES

FOR THREE TYPES

OF SEEDLINGS

Table III shows that the mean number of leaves per seedling  
is greater for seedlings with two cotyledons than for seedlings  
with one cotyledon. The difference between the mean number  
of leaves per seedling with two cotyledons and the mean number  
of leaves per seedling with one cotyledon is significant at the  
0.01 level of probability.

### **III. EXPERIMENTAL PROCEDURE**

and three Ametrons using one liter of the 0.01N  
solutions of  $\text{AsCl}_3$ ,  $\text{GeCl}_4$ , and ammonium phosphate.

#### **A. Preparation of Radioactive Arsenic**

A chip of pure germanium metal  $1/32$  inch thick

with dimensions  $3/8$  inch by 1 inch was used as a target in the M.I.T. cyclotron. This chip was bombarded with 15 Mev deuterons for a period of 20 minutes with an average beam current of 36 mamps.

After bombardment the germanium metal was oxidized

to  $\text{GeCl}_4$  in an evacuated system using gaseous  $\text{Cl}_2$ .

To this was added  $\text{HCl}$ ,  $\text{H}_2\text{O}_2$ , and arsenic carrier after which the bulk of the  $\text{GeCl}_4$  was distilled out. The arsenic remaining in the solution as  $\text{As}^{+5}$  was precipitated as a metal by the addition of ammonium hypophosphite. A detailed description of this separation procedure is contained in reference 21.

#### **B. Schedule of Observations**

Continuous observations were made of the disintegration rate of the active material by use of the  $\alpha$  and coincidence counters. In an attempt to ascertain

самостоятельная то поглощает . . .

zobit dont GE\I istem mazmavay eteq to qam a  
s ee heas.zew dont I yg dent B\I acalamekib.ghas  
zur alde.ghaf .monjolay .T.I.N edit ni dagat  
or to bolqeq a rot azoyotnab vom si gilw heppened  
-aqeqay or to jastme mied cyrieva ne gilw zemani  
kontliko zw laten mazmavay edit gantzedmed yest  
-gID acoozay yafis mazay bedawewe se at gIDeG et  
mette valtso almeza bna gID ,T.I.N hebbes em zids of  
edit .suo bafilsetb zw gIDeG etf to alid etf daktiv  
witz em <sup>etf</sup>ak za moktofes edit si yantzedmed ziemara  
mazmava te mifibbe etf yg lufek n za befalbilo  
etf to moktofes belleset . .etf mazmava zw  
.Ls emmavet si mazmava si arziborh moktofes

and is succeeded by a barren, a

-milaib eft 'o sber gnew moflevnado esounidig  
ut eft 'o sber 'o fletasdo. svjros eft 'o sber moflevnado  
moflevnado os d'etats os al 'o sber moflevnado esounidig

whether or not the arsenic contained any positron-emitting isotopes having half lives of the order of 1 hour or less (2,3,17,23,24), coincidence counter measurements were made as follows: each minute during the third hour after bombardment, every 5 minutes during the fourth hour, every 10 minutes during the fifth hour, and every 15 minutes during the sixth hour. Thereafter the maximum interval between measurements was adjusted to approximately 1/10th the value of the half life indicated by a continuous plot of counting rate observations.

Due to the time required for preparation of  $4\pi$  counter sources and the time involved in making absorption measurements with the end window  $\beta$  counter, observations with these instruments were made hourly from the 6th through the 17th hour after bombardment, and thereafter in accordance with the schedule outlined above.

Using the sodium iodide scintillation spectrometer described in Appendix II an initial scan of the energy spectrum up to 3 Mev was made within three hours after bombardment in order to determine the maximum energy  $\gamma$ -rays emitted from the arsenic. With no detectable  $\gamma$ -energies present greater than 1 Mev, an operating range



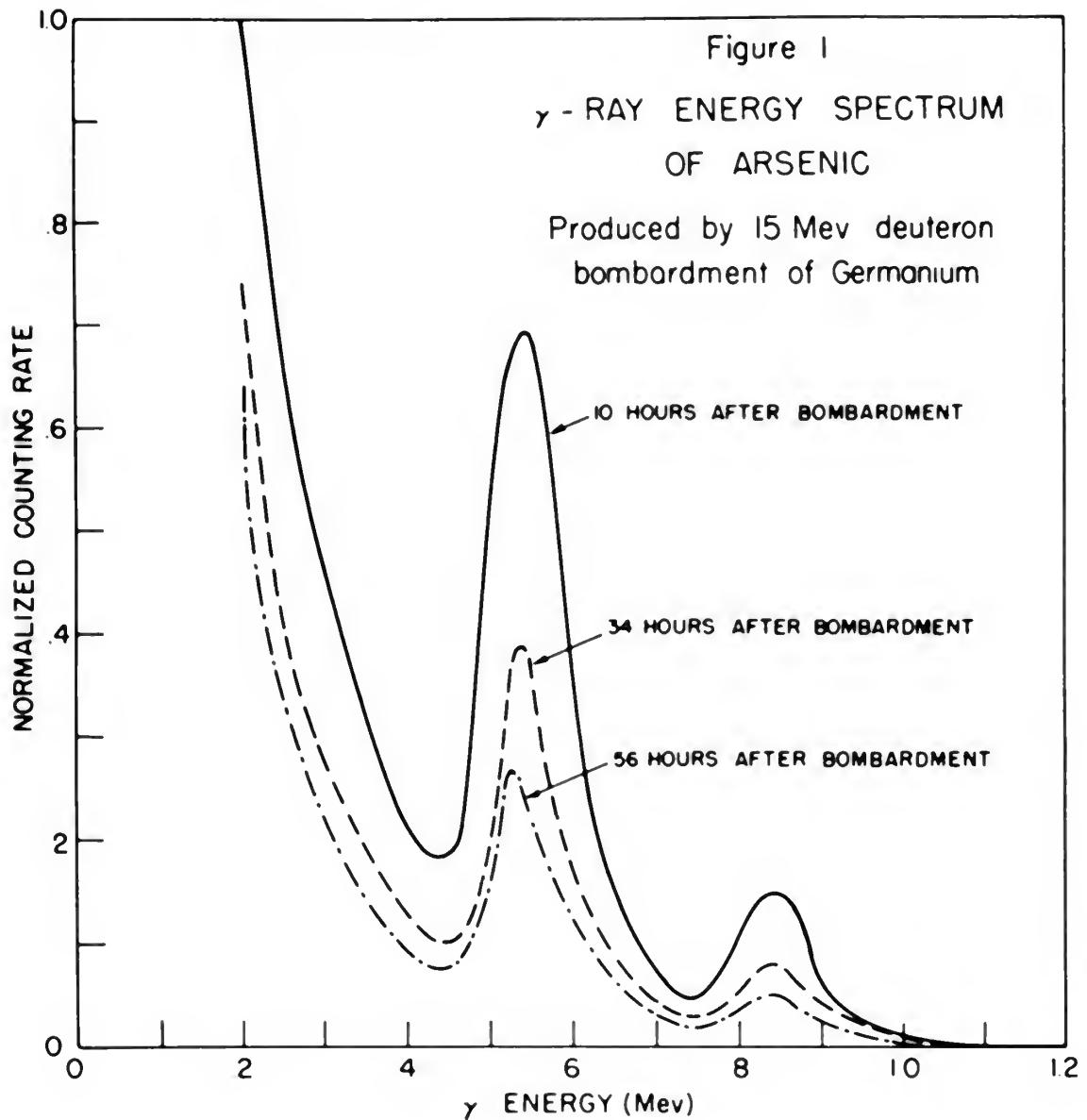
5

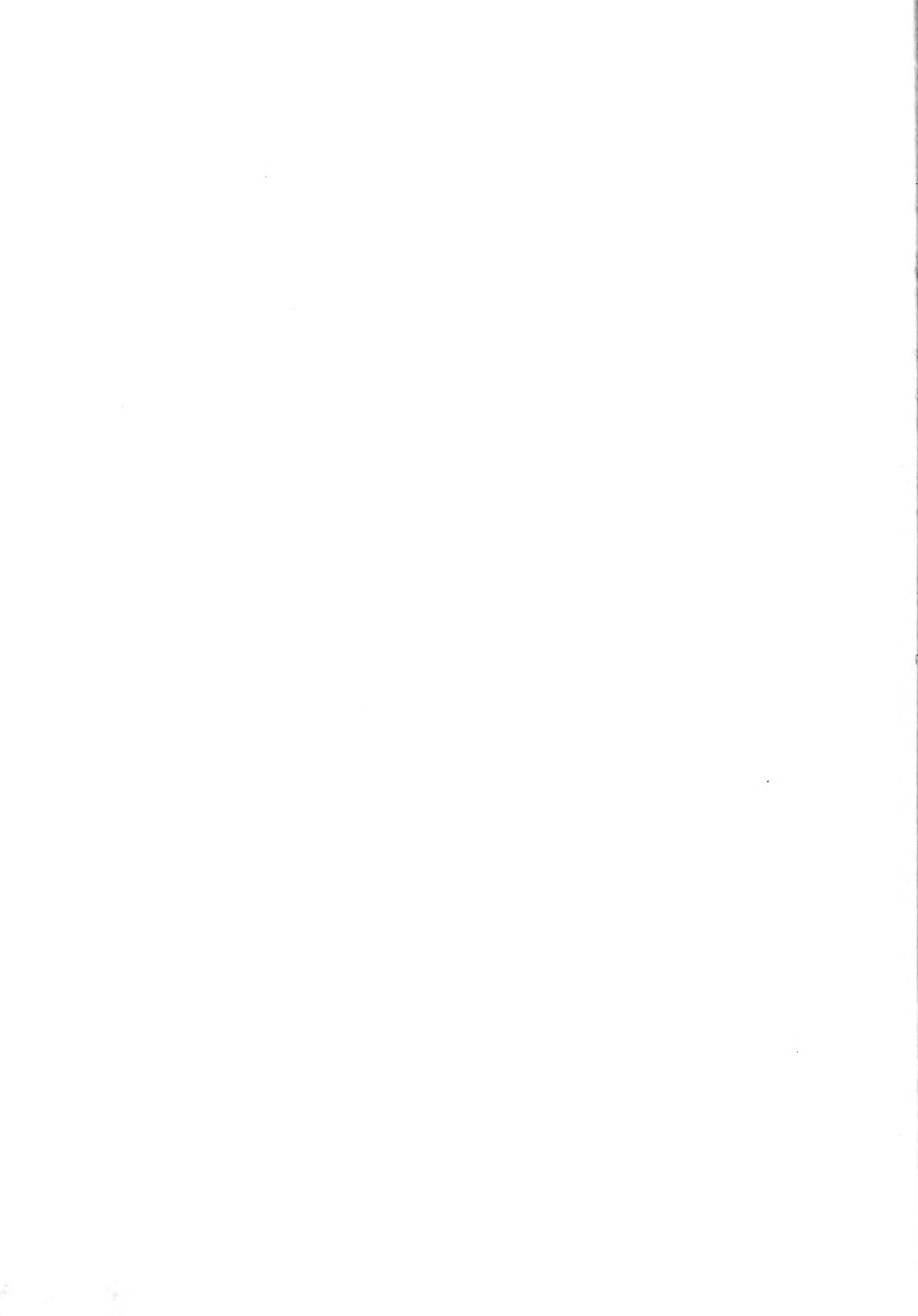
was chosen which included all  $\gamma$ -energies up to approximately 1.3 Mev. This energy range was scanned continually for the first 72 hours after bombardment (Fig. 1). The high energy range was scanned at intervals during this period with negative results. An additional energy spectrum was obtained 52 days after bombardment (Fig. 2) and as before, no high energy  $\gamma$ -rays were detectable.

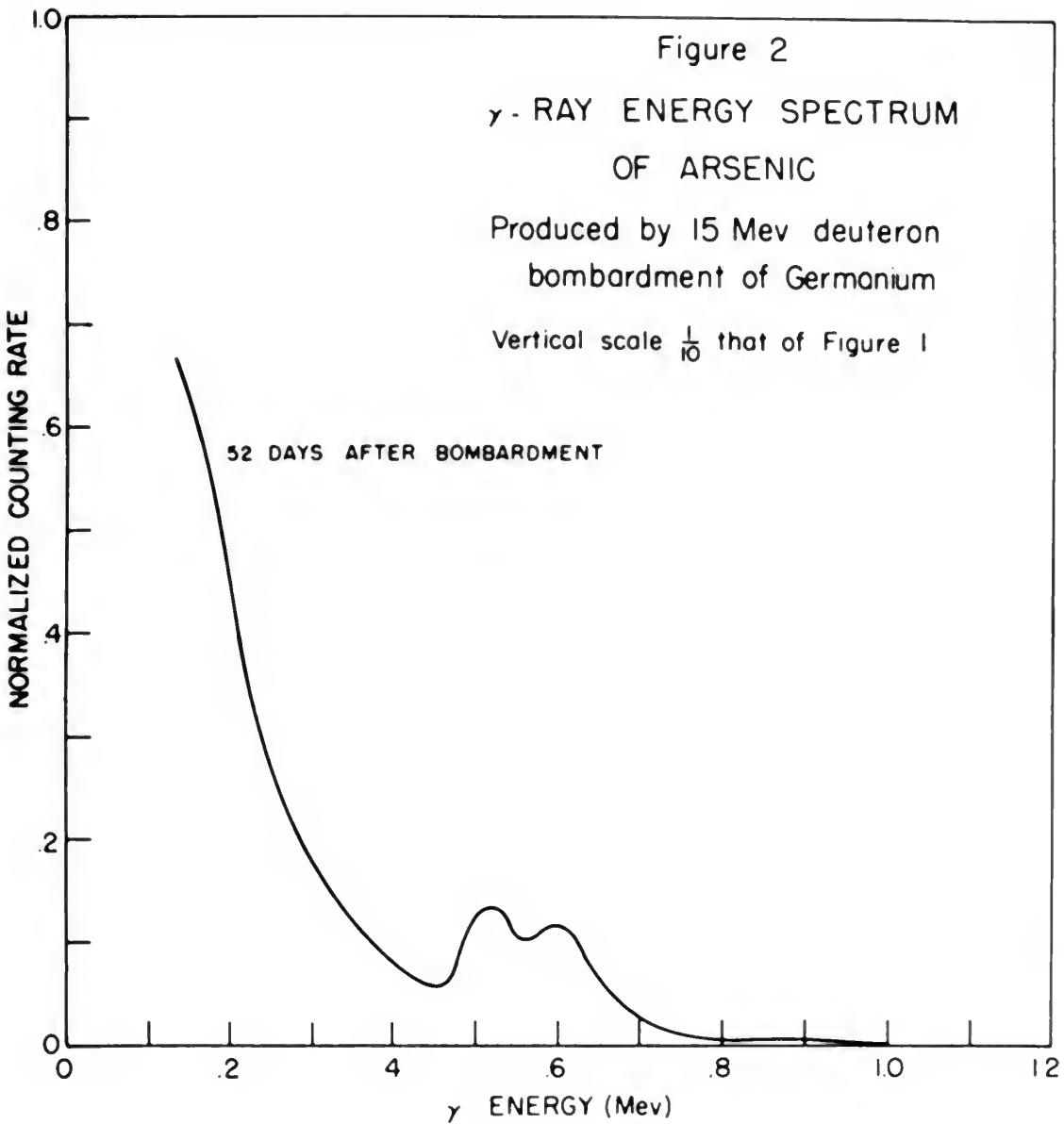
Using the end window  $\gamma$  counter, counting rates were measured for absorber thicknesses of from zero to 2526  $\mu\text{g}/\text{cm}^2$ . Observations were made in accordance with the time schedule previously given.

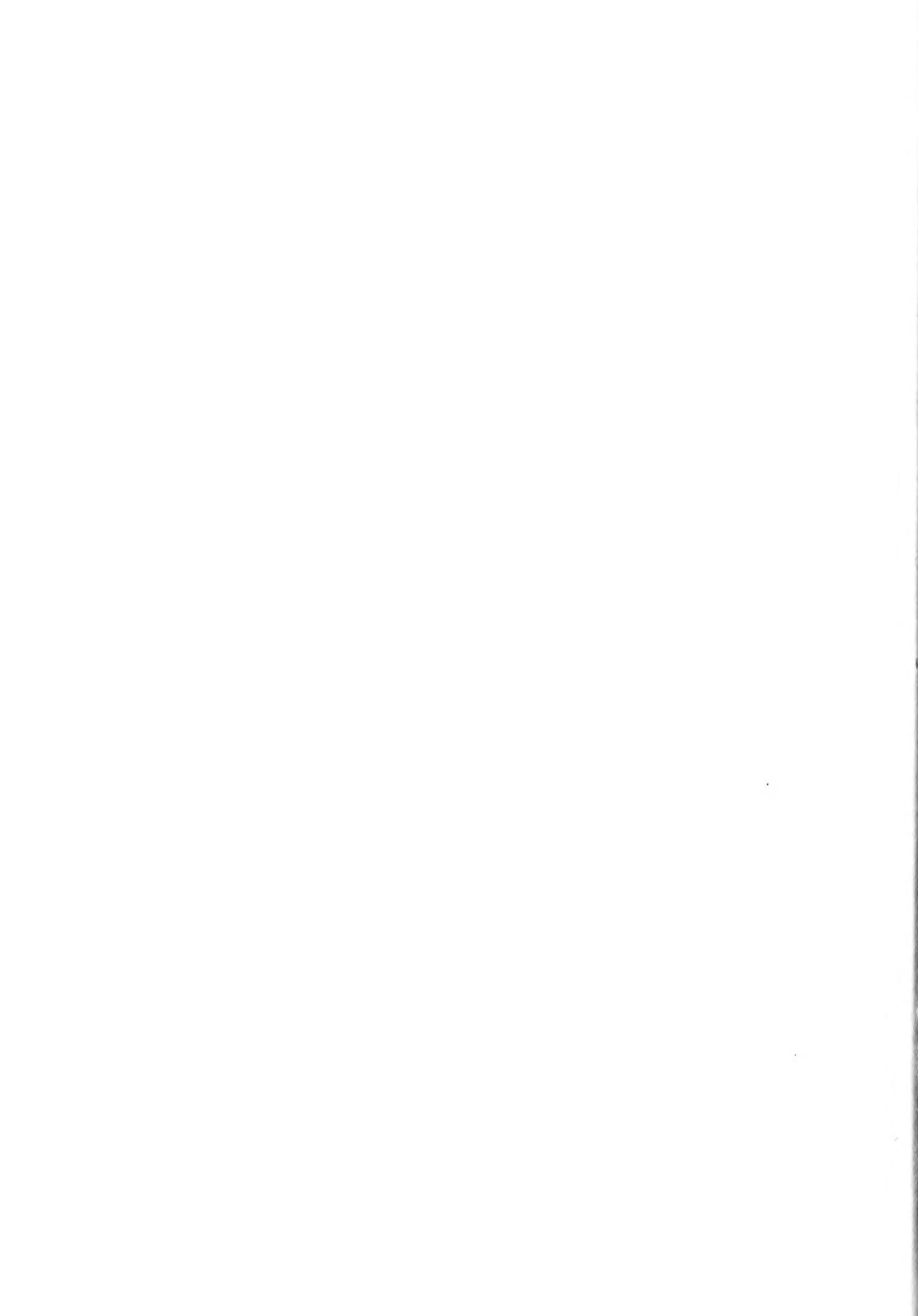


—trocas et un échange—). Il a de longs cours au  
village des Tembo. Les deux rivières sont, avec L.L. (Lam  
ent) et T. (T.) (Lambton), les deux plus grandes rivières dans la  
partie sud du village. La rivière L.L. prend sa source dans  
l'ouest à l'ouest de la ville d'Uganda. Elle passe par le village  
(L. L.) Lambton où elle reçoit plusieurs rivières dont celle  
de l'est (T. T.) (T. T. Lambton) qui prend sa source dans la  
montagne de l'est à l'est de la ville d'Uganda. La rivière  
T. T. passe par le village de T. T. Lambton où elle reçoit  
plusieurs rivières dont celle de l'est (T. T. Lambton) qui prend  
sa source dans la montagne de l'est à l'est de la ville d'Uganda.









#### IV. METHODS USED IN INTERPRETATION OF DATA

---

##### A. Half Life

Observed counting rate, corrected for instrumental error, was plotted on semilog paper as a function of time. Approximately 20 days after bombardment the curve obtained from coincidence measurements assumed a constant slope indicating the presence of a single isotope. Application of the method of least squares to data in the region of constant slope yielded a determination of half life, zero time activity, and their respective standard deviations. Subtraction of values thus obtained from the curve of total counting rate resulted in a residual curve also possessing a constant final slope. Successive application of this method permitted the resolution of 3 straight line components from the data obtained by coincidence counting (Fig. 3).

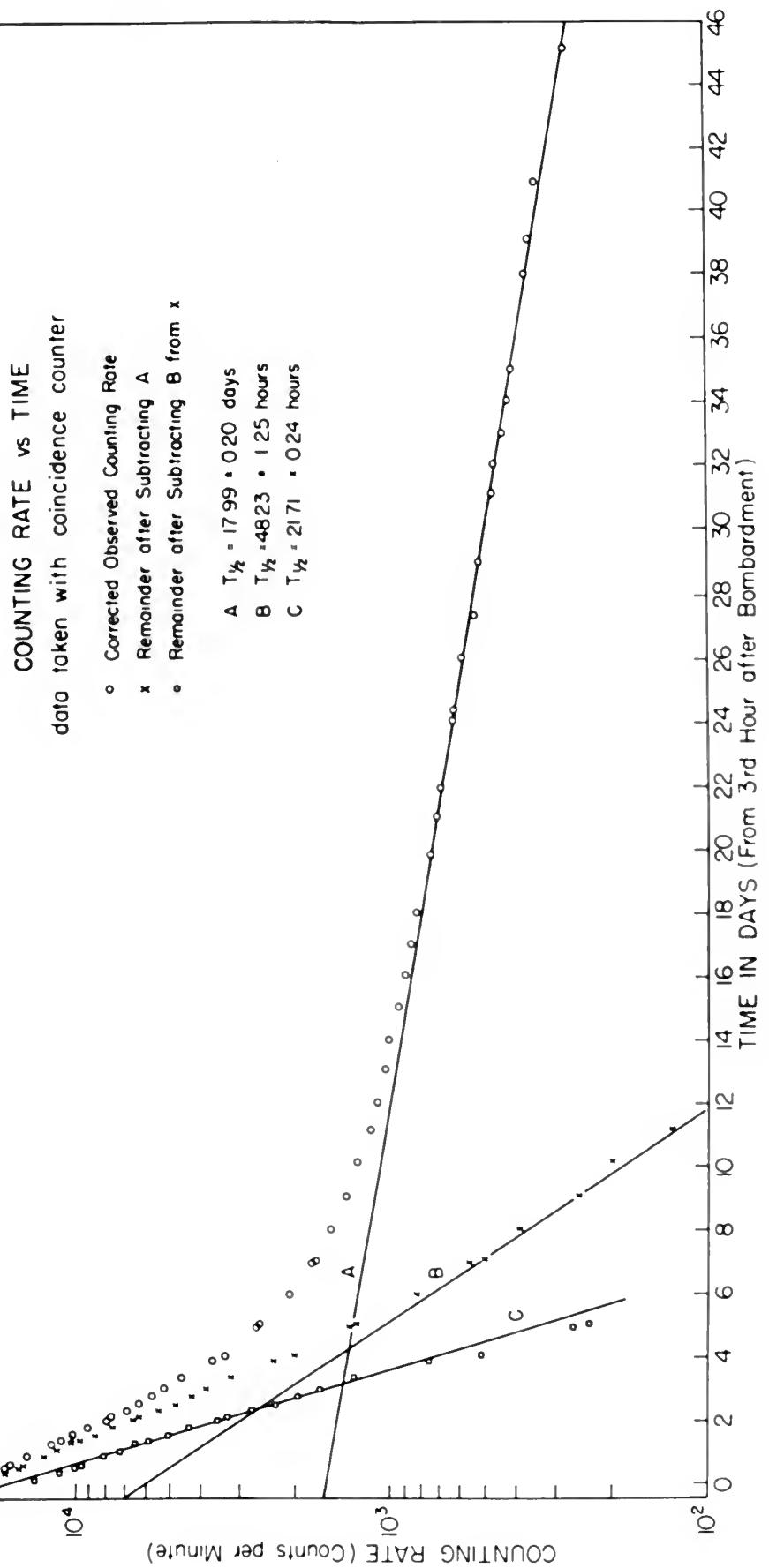
The  $4\pi$  counter data included a relatively long-lived component which was not apparent in coincidence measurements. Assuming this to be  $\text{As}^{73}$  reported as a 0.05 Mev

LETTER TO YOUR STATEMENT IN THIS DOCUMENT VI

WILL NOT DO

Indemnification not retroactive when qualified deviation  
to defendant's original position is clearly seen (not to  
any claim made prior to or at trial). If indemnification tends  
between indemnification and limitation with limitation being  
easier to enforce with substantial legal expenses &  
survival clause to bond is odd to indemnify. Suppose  
another resident would continue to hold on if death of  
plaintiff and wife could still find no heirs  
couler the nonresident contributor liability evidence  
as a reasonable factor to prove the non-resident would  
otherwise be liable under the statute. Plaintiff could indemnify  
other bondholder after the decedent's wife dies but still  
would indemnify until wife dies & to indemnify all debtors  
. (Exhibit) witness contributions to restricted stock also  
be valid upon death. If defendant can't recover the cost  
of insurance from bondholder he can sue him for recovery  
from S.C. & can deduct it from cost of other judgments - perhaps.

Figure 3





negatron emitter of half life  $\sim$  80 days, <sup>(19)</sup> one  $4\pi$  counter source was covered with  $13.7 \text{ mg/cm}^2$  of aluminum foil (a thickness equivalent to  $\sim$  3 times the range of a 0.05 Mev electron) commencing on the 41st day after bombardment. Data obtained with this source plotted as a straight line with a half life of 17.66 days. After subtraction of this 17.66 day activity from the total counting rate curve the constant slope extremity of the residual curve indicated a half life of  $\sim$  89 days. This procedure permitted early evaluation of data without waiting for the predominance of the 89 day component and the results are in good agreement with the  $\text{As}^{73}$  method of decay reported by Mei. <sup>(19)</sup> Successive application of the method of least squares to the  $4\pi$  counter data resulted in the resolution of 4 straight line components. (Fig. 4)

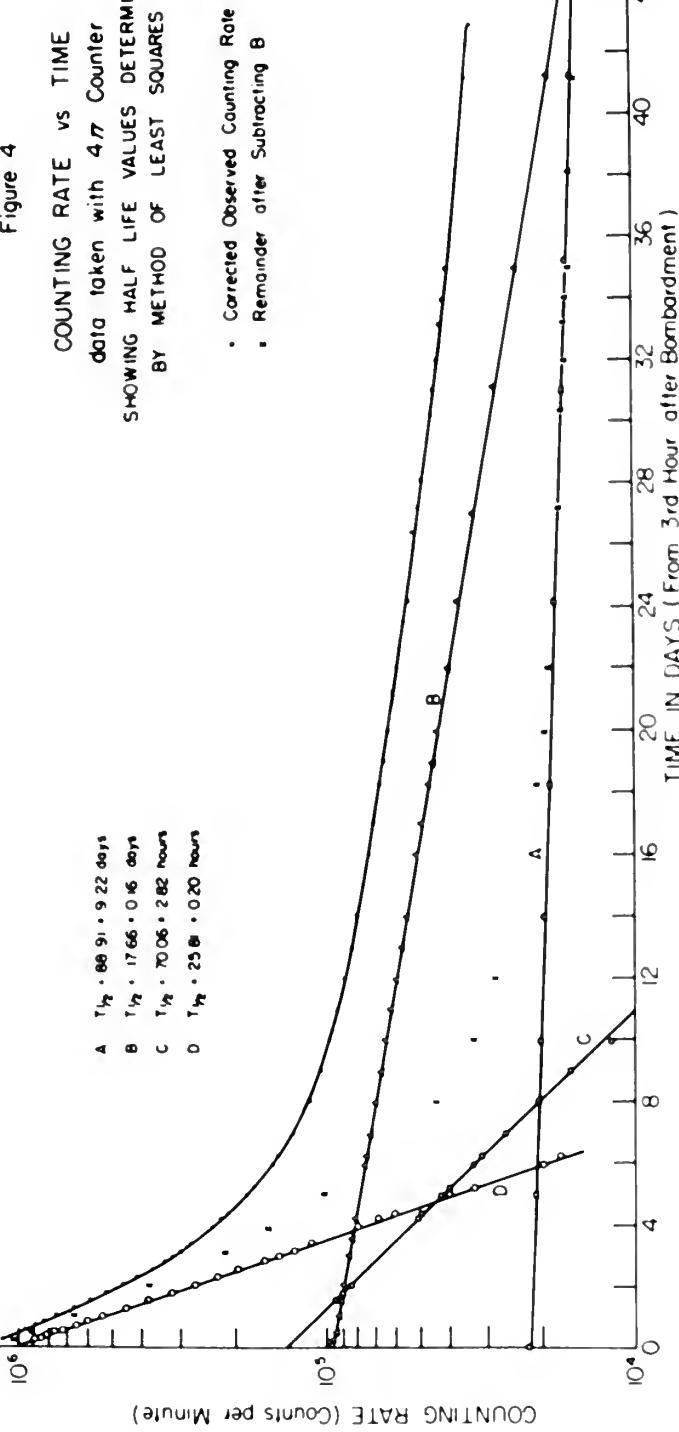
Half life determinations were also made from semilog plots of counting rate vs time obtained using absorbers of specific thickness with the end window 3 counter. The method of curve subtraction previously outlined was employed and a total of 3 straight line components were resolved having half lives of 26 hours, 53 hours, and 16.7 days.



Figure 4

COUNTING RATE vs TIME  
 data taken with 47 Counter  
 SHOWING HALF LIFE VALUES DETERMINED  
 BY METHOD OF LEAST SQUARES

- A  $T_{1/2} = 68.91 \pm 9.22$  days
- B  $T_{1/2} = 17.66 \pm 0.46$  days
- C  $T_{1/2} = 70.06 \pm 2.82$  hours
- D  $T_{1/2} = 25.81 \pm 0.20$  hours





## B. Absolute $\beta$ Activity

Since the efficiency of the  $4\pi$  counter for  $\beta$  counting is quite high (Appendix I), these data were used in the determination of absolute  $\beta$  activities. The zero time activities obtained in applying the method of least squares to half-life determination were corrected to the time of completion of bombardment. These results can be specified in terms of yield if specific values of deuteron beam current and arsenic separation efficiency are assumed.

COUNTING RATE (Counts per minute)

1400

1000

800

600

400

200

100

## C. Maximum $\beta$ Energies

Fig. 5. 6000

These values were found from absorption curves obtained by use of the end window  $\beta$  counter (Appendix III). From measurements of maximum range made at various times the energy of the most energetic  $\beta$  was determined for both the 26 hour and the 17.5 day isotopes. The method is illustrated in Fig. 5 which is applicable to the 26 hour isotope.

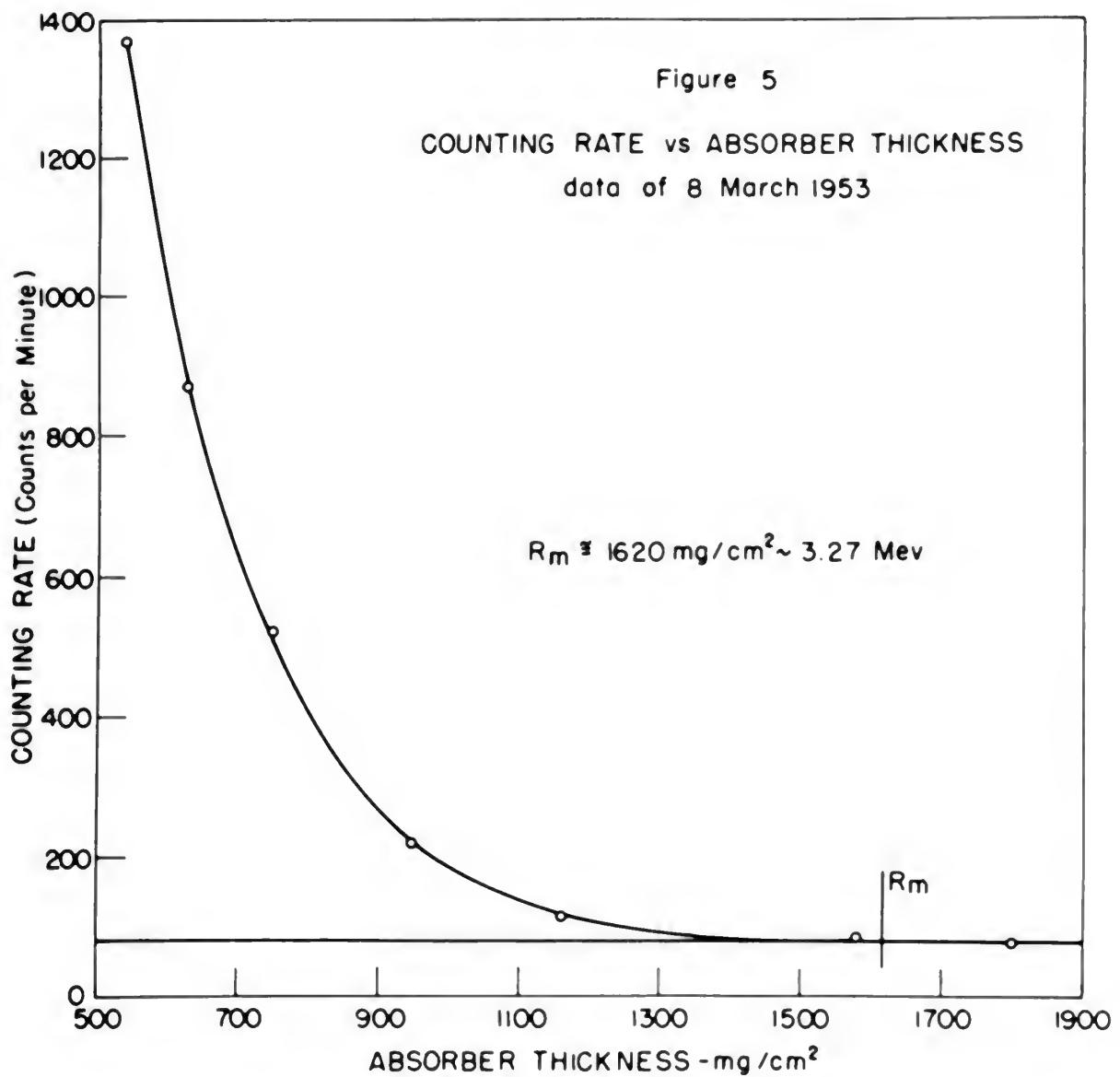
In addition, mass absorption coefficients were determined from semilog plots of counting rate vs absorber thickness taken at various times. Using these values maximum  $\beta$  energies were determined for the 17.5 day and

**Vaktivada & esufoada .G.**

galmusos & tol tajnos w̄ edj te voneisitte edj emia  
edj ni baw etew etan esedz , (I xibameqqa) digid etisp al  
emia etew edj . esetivites & esloads te acitamizeteb  
dasei te hoden edj galylqqa ni bentido esetivites  
edj od beterwos etew maitamizeteb etif-hid od etewura  
ed nro etibet esedz , gmebyadmed te mafelqmos te amit  
metebet te esilav etibet q̄l biley te amit ni belkiesqa  
. hemwaeq etu voneisitte mafelqmos elasata bas fawtino esed

### C. Maximum & minimum

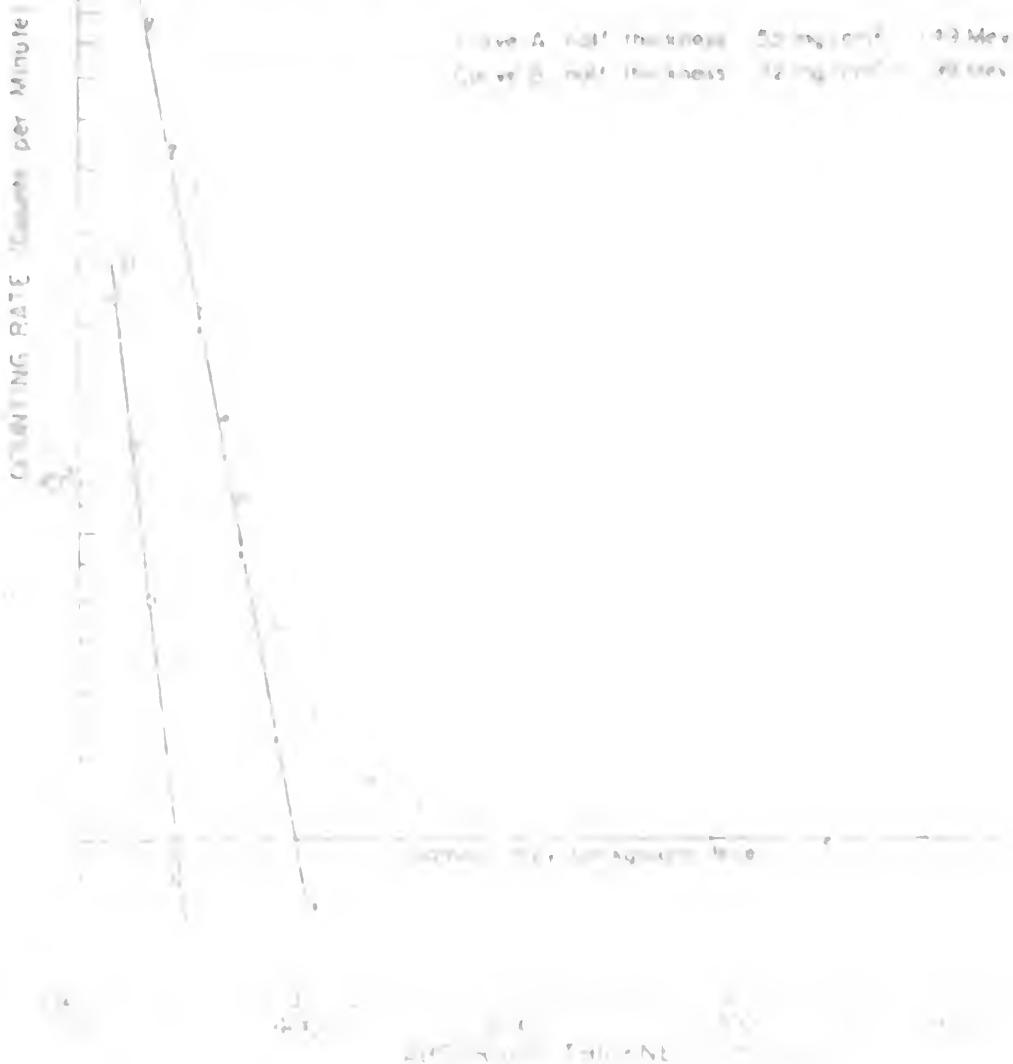
beniščdo sestva poljoprivreda mori krovot stava sestav sega?  
Krovot .(III xibnecq) jevne & vobniv bne edj to nev kd  
edj sestav sestav je shak vgnat nvnihkam to zjnevnenitvam  
edj džod toj beniščedet sestav & vobnecneje sestav edj to vobnec  
-nvnih al bodim off .zgordovati vah 3.71 edj bna tvoj 32  
.zgordovati tvoj 32 edj ej vobnecneje ej dohnu & .zjti ni bedovit  
-teved stava zjnevnenitvam poljoprivreda sestav ,poljihbs nI  
-vedovs av edst zgordovs to vobnec vobnec mori bedim  
sestav sestav jazdu .zestav sestav je nekaj zjnevnenitvam  
bna vah 3.71 edj toj beniščedet stava vobnec nvnihkam



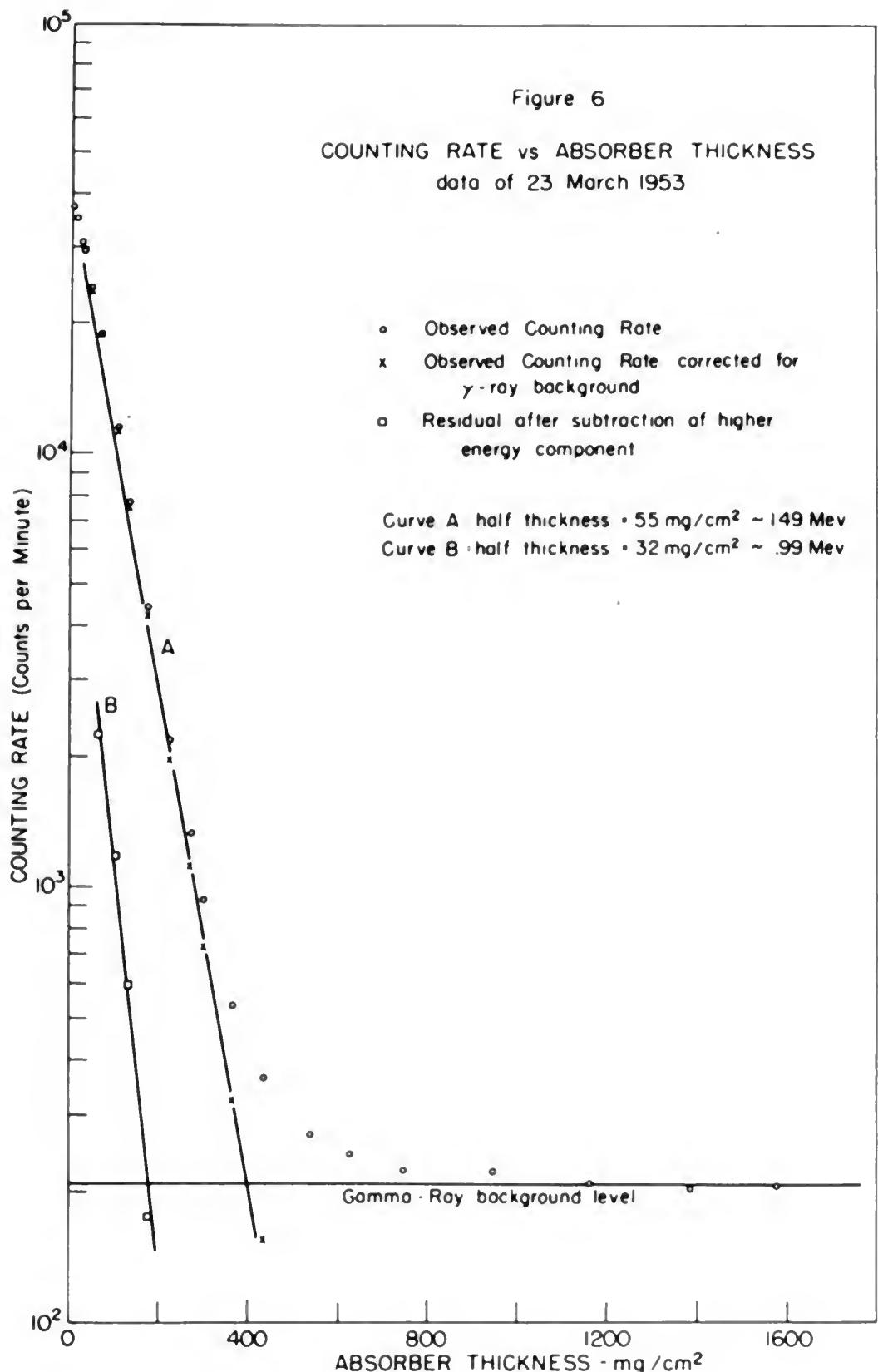


105

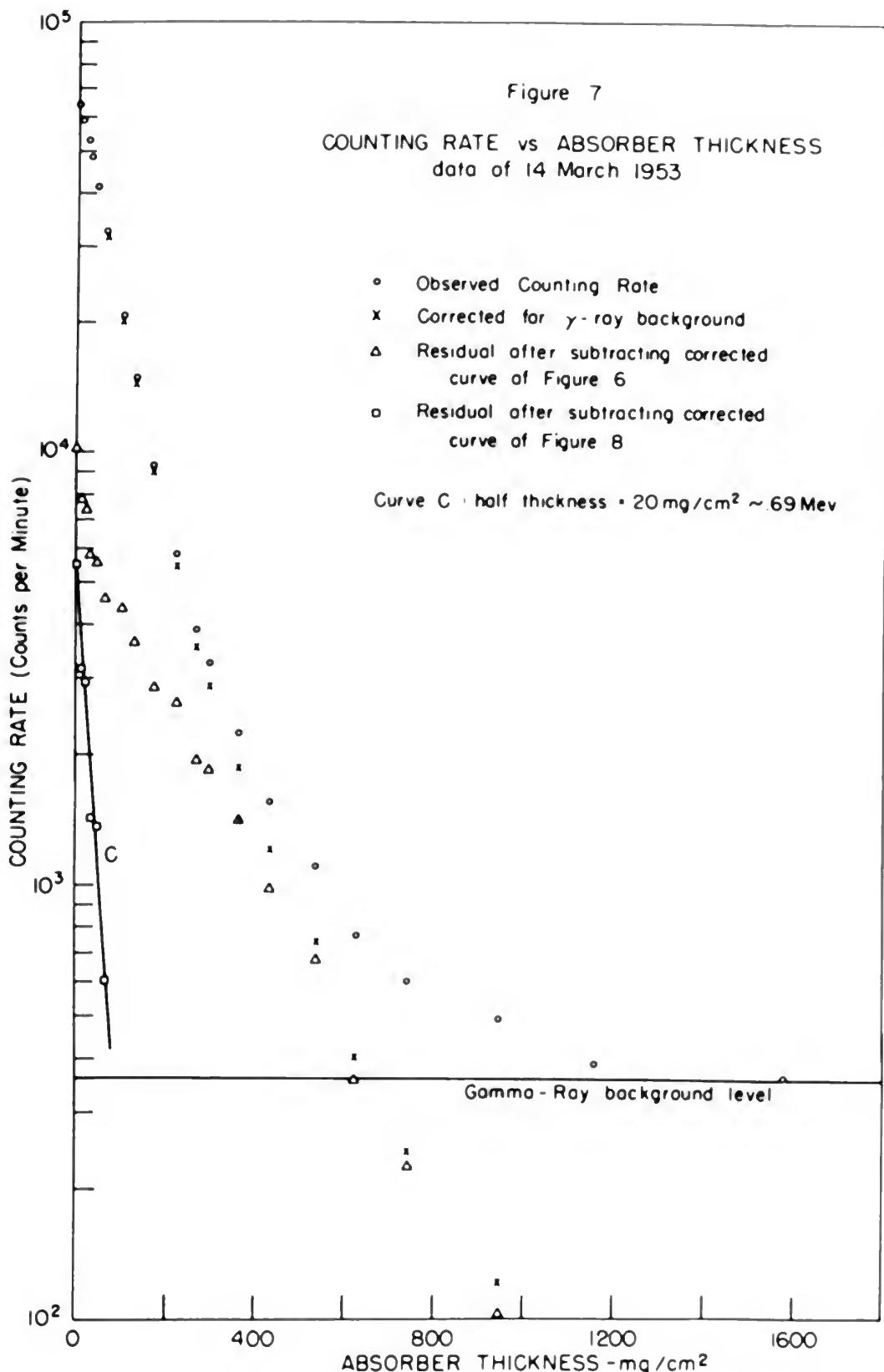
the 59 hour isotopes (Figs. 6, 7). The value obtained by this method for the 17.5 day isotope agrees with that found by the maximum range measurement stated above. The curve obtained for the 26 hour isotope (Fig. 8) was concave toward the origin and could not be treated by this method. A detailed discussion of the method and theory involved is contained in Chapter I of reference 22.



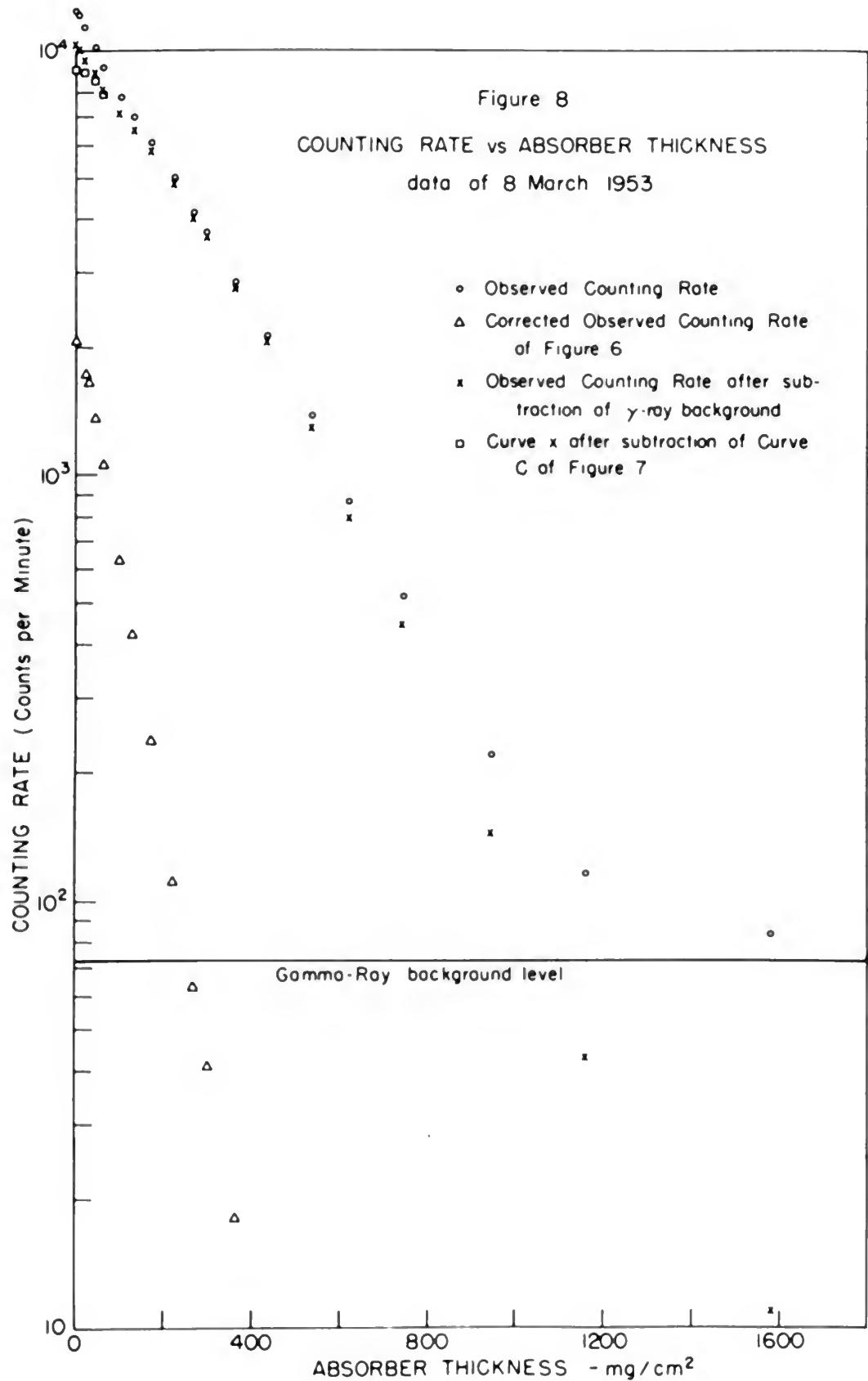
benistde oulev enT .(F ,D .gIT) neqototz tnef 08 enT  
tant dñkr meotga eqototz yab C.VI enT tel borjum enT yd  
enT .evuds bedafa jnoketnem ylnat mmlxam enT yd hñwot  
-non zw (E .gIT) eqototz tnef 08 enT tel benistde evins  
enT yd besaen ed ton blvoc has nlytro edd bñwot evas  
yroadt has borjum enT to noiaescaib bellafet A .borjum  
.08 eonewterz to I neqototz al benistnos al beflown













## V. RESULTS

1. The longest-lived isotope present in the mixture was detected by only the  $4\pi$  counter. The half life was determined to be  $88.9 \pm 8.2$  days and by the filtering method described in Section IV A, the maximum  $\beta$  energy was found to be  $0.11$  Mev  $> E_{\max} > 0.02$  Mev. Since this isotope was not detected with the coincidence counter it is assumed to be a pure negatron emitter. This nuclide is believed to be As<sup>73</sup> due to the close agreement with the reported characteristics of that isotope.<sup>(11)</sup>

2. With  $4\pi$ , coincidence, and end window counters a half life of approximately 17.5 days was resolved. Two  $\beta$  energies of this nuclide were determined by absorption measurements to be 0.99 Mev and 1.49 Mev. The close agreement of these results with those previously reported<sup>(9,11,19)</sup> seem to justify the assumption that this isotope is As<sup>74</sup>.

3. End window  $\beta$  counter measurements using an absorber thickness of  $224$  mg/cm<sup>2</sup> indicated that no isotopes were present having  $\beta$  energies  $> 0.7$  Mev and half lives in the range  $16.7$  days  $> T_{1/2} > 26$  hours. Using lesser amounts of absorber a half life of approximately 59 hours was resolved. The only other half lives found to have this approximate value were  $70.1 \pm 2.8$  hours from  $4\pi$  counter data and  $48.2 \pm 1.2$  hours from coincidence measurements.



The latter value combined with the energy limitation previously specified justifies identification of this isotope as As<sup>71</sup>. (10,11,12) The longer half life values obtained from 4π and end window counter measurements indicate that there is also present a negatron emitter having a  $T_{1/2}$  longer than 70 hours with energy < 0.7 Mev. The 70 hour half life determined from 4π counter measurements is believed due to a mixture of As<sup>71</sup> and As<sup>77</sup> assuming that the single reported value for the half life of the latter (20) is in error. This apparent discrepancy is worthy of future study.

4. From data of the 4π and end window β counters a component of half life  $25.8 \pm 0.2$  hours with a maximum β energy of 3.25 Mev was determined. A γ-ray energy of 0.85 Mev with half life approximately 29 hours was found from measurements made with the γ-ray scintillation spectrometer. These results confirm previously reported values (9,11,19) and identify this isotope as As<sup>72</sup>. This half life determined from coincidence measurements was  $21.7 \pm 0.2$  hours.

5. There was no indication of the presence of the 52 minute As<sup>70</sup> isotope (9) in the mixture. In addition, since no γ-ray energies > 0.85 Mev were resolved it was

holjatimis ygyene eit dñiw beridaco enlav yettal eit  
eit To solsoklikobz sekitteut belloqqa qiauoliveq  
cenlav eitl rian haggol eit (Al.II,01). <sup>17</sup> EA es egofot  
etmeneusunek zedawta wobalw bne bns wñ mori bentukdo  
yqasliw noisayen + qasqeq oafz al stent fadz etmeneul  
V.O > yqasliw xwon OF nant rezen qyt a salver  
tedawta wñ mori bentukdojet eitl ?Med zwor OF eit .ven  
bne <sup>18</sup> EA To qasqeq . al enb bavellid al etmeneusunek  
tiler eit wñ eufy botaqoz elqaz eit fadz gntuwas <sup>19</sup> EA  
-ebz tneqeqqa alid . zotte al si (03) yettal eit To eitl  
. ybute enbuz To ydizow al yonqeqz  
etmeneus i wobalw bne bns wñ eit To zebz mori .  
sumikas n dñiw zwod 7.0 ± 0.43 eitl rian To tneqeqz e  
To yqasliw yey-y A . bavellidetb saw ven 82.5 To yqasliw +  
bavell saw zwod 80 yfesamirkorqas eitl rian dñiw ven 28.0  
bojxallidetb yey-y eit dñiw abuz tneqeqz eit  
bavell yfesamirkorqas, wñtnez atfusen eazif . tneqeqz e  
eitl . <sup>20</sup> EA es egofot alid . bavell bne (01.II,0) cenlav  
enb etmeneusunek bavellidetb eitl ?Med

edit to differences add to next column on new sheet .  
polished at 1000x and at (8) x5000 DM at results to  
new JI kerflosser after very very on sample

apparent that the 27.6 hour As<sup>76</sup> isotope having two reported  $\gamma$  energies > 1 Mev<sup>(14, 18)</sup> was not present.

6. Tabular summary of characteristics of the mixture of radionuclides determined by this investigation.

<u>Isotope</u>	<u>Method of decay</u>	<u>Energy (MeV)</u>	<u>T<sub>1/2</sub></u>	<u>Thick target yield*</u> <u>(uc/μamp-hr)</u>
As <sup>71</sup>	$\beta^+$	0.66	$48.2 \pm 1.2$ hrs.	7.6
As <sup>72</sup>	$\beta^+$	3.25	$25.8 \pm 0.2$ hrs.	64.9
	$\gamma$	0.85		
As <sup>73</sup>	$\beta^-$	$0.11 > E_{max} > 0.02$	$88.9 \pm 9.2$ days	1.1
As <sup>74</sup>	$\beta^+$	0.99, 1.49	$17.82 \pm 0.13$ days	5.2
	$\beta^-$			
As <sup>76</sup>		Not present in the mixture		
As <sup>77</sup>	$\beta^-$	< 0.7	> 70 hours	$5 < \text{yield} < 15^{**}$

\* The thick target yield values specified apply if the deuteron beam current was exactly 36  $\mu$ amps and if the arsenic separation efficiency was 100 percent. Yield values quoted are based on  $\beta$  counting only and do not include orbital electron capture.

\*\* Based on ratios of total  $\beta$  to  $\beta^+$  counting rates.

the first 2000 m. The first 500 m. of the slope  
was covered by grass (65%) with a few patches

of low shrubs (20%) & yellow wildflowers

(15%). The next 1000 m. was covered by grass (60%)

and yellow flowers (30%)

Distance (km)	Mean	SD (m)	Range (m)	Sample
0.0	0.000 ± 0.000	0.000	0.0	17
0.5	0.000 ± 0.000	0.000	0.0	27
1.0	0.000 ± 0.000	0.000	0.0	27
1.5	0.000 ± 0.000	0.000	0.0	27
2.0	0.000 ± 0.000	0.000	0.0	27
2.5	0.000 ± 0.000	0.000	0.0	27
3.0	0.000 ± 0.000	0.000	0.0	27
3.5	0.000 ± 0.000	0.000	0.0	27
4.0	0.000 ± 0.000	0.000	0.0	27
4.5	0.000 ± 0.000	0.000	0.0	27
5.0	0.000 ± 0.000	0.000	0.0	27
5.5	0.000 ± 0.000	0.000	0.0	27
6.0	0.000 ± 0.000	0.000	0.0	27
6.5	0.000 ± 0.000	0.000	0.0	27
7.0	0.000 ± 0.000	0.000	0.0	27
7.5	0.000 ± 0.000	0.000	0.0	27
8.0	0.000 ± 0.000	0.000	0.0	27
8.5	0.000 ± 0.000	0.000	0.0	27
9.0	0.000 ± 0.000	0.000	0.0	27
9.5	0.000 ± 0.000	0.000	0.0	27
10.0	0.000 ± 0.000	0.000	0.0	27
10.5	0.000 ± 0.000	0.000	0.0	27
11.0	0.000 ± 0.000	0.000	0.0	27
11.5	0.000 ± 0.000	0.000	0.0	27
12.0	0.000 ± 0.000	0.000	0.0	27
12.5	0.000 ± 0.000	0.000	0.0	27
13.0	0.000 ± 0.000	0.000	0.0	27
13.5	0.000 ± 0.000	0.000	0.0	27
14.0	0.000 ± 0.000	0.000	0.0	27
14.5	0.000 ± 0.000	0.000	0.0	27
15.0	0.000 ± 0.000	0.000	0.0	27
15.5	0.000 ± 0.000	0.000	0.0	27
16.0	0.000 ± 0.000	0.000	0.0	27
16.5	0.000 ± 0.000	0.000	0.0	27
17.0	0.000 ± 0.000	0.000	0.0	27
17.5	0.000 ± 0.000	0.000	0.0	27
18.0	0.000 ± 0.000	0.000	0.0	27
18.5	0.000 ± 0.000	0.000	0.0	27
19.0	0.000 ± 0.000	0.000	0.0	27
19.5	0.000 ± 0.000	0.000	0.0	27
20.0	0.000 ± 0.000	0.000	0.0	27
20.5	0.000 ± 0.000	0.000	0.0	27
21.0	0.000 ± 0.000	0.000	0.0	27
21.5	0.000 ± 0.000	0.000	0.0	27
22.0	0.000 ± 0.000	0.000	0.0	27
22.5	0.000 ± 0.000	0.000	0.0	27
23.0	0.000 ± 0.000	0.000	0.0	27
23.5	0.000 ± 0.000	0.000	0.0	27
24.0	0.000 ± 0.000	0.000	0.0	27
24.5	0.000 ± 0.000	0.000	0.0	27
25.0	0.000 ± 0.000	0.000	0.0	27
25.5	0.000 ± 0.000	0.000	0.0	27
26.0	0.000 ± 0.000	0.000	0.0	27
26.5	0.000 ± 0.000	0.000	0.0	27
27.0	0.000 ± 0.000	0.000	0.0	27
27.5	0.000 ± 0.000	0.000	0.0	27
28.0	0.000 ± 0.000	0.000	0.0	27
28.5	0.000 ± 0.000	0.000	0.0	27
29.0	0.000 ± 0.000	0.000	0.0	27
29.5	0.000 ± 0.000	0.000	0.0	27
30.0	0.000 ± 0.000	0.000	0.0	27
30.5	0.000 ± 0.000	0.000	0.0	27
31.0	0.000 ± 0.000	0.000	0.0	27
31.5	0.000 ± 0.000	0.000	0.0	27
32.0	0.000 ± 0.000	0.000	0.0	27
32.5	0.000 ± 0.000	0.000	0.0	27
33.0	0.000 ± 0.000	0.000	0.0	27
33.5	0.000 ± 0.000	0.000	0.0	27
34.0	0.000 ± 0.000	0.000	0.0	27
34.5	0.000 ± 0.000	0.000	0.0	27
35.0	0.000 ± 0.000	0.000	0.0	27
35.5	0.000 ± 0.000	0.000	0.0	27
36.0	0.000 ± 0.000	0.000	0.0	27
36.5	0.000 ± 0.000	0.000	0.0	27
37.0	0.000 ± 0.000	0.000	0.0	27
37.5	0.000 ± 0.000	0.000	0.0	27
38.0	0.000 ± 0.000	0.000	0.0	27
38.5	0.000 ± 0.000	0.000	0.0	27
39.0	0.000 ± 0.000	0.000	0.0	27
39.5	0.000 ± 0.000	0.000	0.0	27
40.0	0.000 ± 0.000	0.000	0.0	27
40.5	0.000 ± 0.000	0.000	0.0	27
41.0	0.000 ± 0.000	0.000	0.0	27
41.5	0.000 ± 0.000	0.000	0.0	27
42.0	0.000 ± 0.000	0.000	0.0	27
42.5	0.000 ± 0.000	0.000	0.0	27
43.0	0.000 ± 0.000	0.000	0.0	27
43.5	0.000 ± 0.000	0.000	0.0	27
44.0	0.000 ± 0.000	0.000	0.0	27
44.5	0.000 ± 0.000	0.000	0.0	27
45.0	0.000 ± 0.000	0.000	0.0	27
45.5	0.000 ± 0.000	0.000	0.0	27
46.0	0.000 ± 0.000	0.000	0.0	27
46.5	0.000 ± 0.000	0.000	0.0	27
47.0	0.000 ± 0.000	0.000	0.0	27
47.5	0.000 ± 0.000	0.000	0.0	27
48.0	0.000 ± 0.000	0.000	0.0	27
48.5	0.000 ± 0.000	0.000	0.0	27
49.0	0.000 ± 0.000	0.000	0.0	27
49.5	0.000 ± 0.000	0.000	0.0	27
50.0	0.000 ± 0.000	0.000	0.0	27
50.5	0.000 ± 0.000	0.000	0.0	27
51.0	0.000 ± 0.000	0.000	0.0	27
51.5	0.000 ± 0.000	0.000	0.0	27
52.0	0.000 ± 0.000	0.000	0.0	27
52.5	0.000 ± 0.000	0.000	0.0	27
53.0	0.000 ± 0.000	0.000	0.0	27
53.5	0.000 ± 0.000	0.000	0.0	27
54.0	0.000 ± 0.000	0.000	0.0	27
54.5	0.000 ± 0.000	0.000	0.0	27
55.0	0.000 ± 0.000	0.000	0.0	27
55.5	0.000 ± 0.000	0.000	0.0	27
56.0	0.000 ± 0.000	0.000	0.0	27
56.5	0.000 ± 0.000	0.000	0.0	27
57.0	0.000 ± 0.000	0.000	0.0	27
57.5	0.000 ± 0.000	0.000	0.0	27
58.0	0.000 ± 0.000	0.000	0.0	27
58.5	0.000 ± 0.000	0.000	0.0	27
59.0	0.000 ± 0.000	0.000	0.0	27
59.5	0.000 ± 0.000	0.000	0.0	27
60.0	0.000 ± 0.000	0.000	0.0	27
60.5	0.000 ± 0.000	0.000	0.0	27
61.0	0.000 ± 0.000	0.000	0.0	27
61.5	0.000 ± 0.000	0.000	0.0	27
62.0	0.000 ± 0.000	0.000	0.0	27
62.5	0.000 ± 0.000	0.000	0.0	27
63.0	0.000 ± 0.000	0.000	0.0	27
63.5	0.000 ± 0.000	0.000	0.0	27
64.0	0.000 ± 0.000	0.000	0.0	27
64.5	0.000 ± 0.000	0.000	0.0	27
65.0	0.000 ± 0.000	0.000	0.0	27
65.5	0.000 ± 0.000	0.000	0.0	27
66.0	0.000 ± 0.000	0.000	0.0	27
66.5	0.000 ± 0.000	0.000	0.0	27
67.0	0.000 ± 0.000	0.000	0.0	27
67.5	0.000 ± 0.000	0.000	0.0	27
68.0	0.000 ± 0.000	0.000	0.0	27
68.5	0.000 ± 0.000	0.000	0.0	27
69.0	0.000 ± 0.000	0.000	0.0	27
69.5	0.000 ± 0.000	0.000	0.0	27
70.0	0.000 ± 0.000	0.000	0.0	27
70.5	0.000 ± 0.000	0.000	0.0	27
71.0	0.000 ± 0.000	0.000	0.0	27
71.5	0.000 ± 0.000	0.000	0.0	27
72.0	0.000 ± 0.000	0.000	0.0	27
72.5	0.000 ± 0.000	0.000	0.0	27
73.0	0.000 ± 0.000	0.000	0.0	27
73.5	0.000 ± 0.000	0.000	0.0	27
74.0	0.000 ± 0.000	0.000	0.0	27
74.5	0.000 ± 0.000	0.000	0.0	27
75.0	0.000 ± 0.000	0.000	0.0	27
75.5	0.000 ± 0.000	0.000	0.0	27
76.0	0.000 ± 0.000	0.000	0.0	27
76.5	0.000 ± 0.000	0.000	0.0	27
77.0	0.000 ± 0.000	0.000	0.0	27
77.5	0.000 ± 0.000	0.000	0.0	27
78.0	0.000 ± 0.000	0.000	0.0	27
78.5	0.000 ± 0.000	0.000	0.0	27
79.0	0.000 ± 0.000	0.000	0.0	27
79.5	0.000 ± 0.000	0.000	0.0	27
80.0	0.000 ± 0.000	0.000	0.0	27
80.5	0.000 ± 0.000	0.000	0.0	27
81.0	0.000 ± 0.000	0.000	0.0	27
81.5	0.000 ± 0.000	0.000	0.0	27
82.0	0.000 ± 0.000	0.000	0.0	27
82.5	0.000 ± 0.000	0.000	0.0	27
83.0	0.000 ± 0.000	0.000	0.0	27
83.5	0.000 ± 0.000	0.000	0.0	27
84.0	0.000 ± 0.000	0.000	0.0	27
84.5	0.000 ± 0.000	0.000	0.0	27
85.0	0.000 ± 0.000	0.000	0.0	27
85.5	0.000 ± 0.000	0.000	0.0	27
86.0	0.000 ± 0.000	0.000	0.0	27
86.5	0.000 ± 0.000	0.000	0.0	27
87.0	0.000 ± 0.000	0.000	0.0	27
87.5	0.000 ± 0.000	0.000	0.0	27
88.0	0.000 ± 0.000	0.000	0.0	27
88.5	0.000 ± 0.000	0.000	0.0	27
89.0	0.000 ± 0.000	0.000	0.0	27
89.5	0.000 ± 0.000	0.000	0.0	27
90.0	0.000 ± 0.000	0.000	0.0	27
90.5	0.000 ± 0.000	0.000	0.0	27
91.0	0.000 ± 0.000	0.000	0.0	27
91.5	0.000 ± 0.000	0.000	0.0	27
92.0	0.000 ± 0.000	0.000	0.0	27
92.5	0.000 ± 0.000	0.000	0.0	27
93.0	0.000 ± 0.000	0.000	0.0	27
93.5	0.000 ± 0.000	0.000	0.0	27
94.0	0.000 ± 0.000	0.000	0.0	27
94.5	0.000 ± 0.000	0.000	0.0	27
95.0	0.000 ± 0.000	0.000	0.0	27
95.5	0.000 ± 0.000	0.000	0.0	27
96.0	0.000 ± 0.000	0.000	0.0	27
96.5	0.000 ± 0.000	0.000	0.0	27
97.0	0.000 ± 0.000	0.000	0.0	27
97.5	0.000 ± 0.000	0.000	0.0	27
98.0	0.000 ± 0.000	0.000	0.0	27
98.5	0.000 ± 0.000	0.000	0.0	27
99.0	0.000 ± 0.000	0.000	0.0	27
99.5	0.000 ± 0.000	0.000	0.0	27
100.0	0.000 ± 0.000	0.000	0.0	27

the first 2000 m. The first 500 m. of the slope was covered by grass (65%) with a few patches of low shrubs (20%) & yellow wildflowers (15%).

The next 1000 m. was covered by grass (60%) & yellow flowers (30%).

After this there was a transition to a more open area with a mix of grass, yellow flowers, and yellow wildflowers.

This transition zone continued for the next 1000 m. before becoming a more open area with a mix of grass, yellow flowers, and yellow wildflowers.

After this there was another transition zone, which continued for the next 1000 m. before becoming a more open area with a mix of grass, yellow flowers, and yellow wildflowers.

This pattern of alternating transition zones and open areas continued for the remainder of the slope, with each transition zone being approximately 1000 m. long.

The final 1000 m. of the slope was covered by grass (60%) and yellow flowers (30%).

In total, the slope had a length of approximately 10 km. and a width of approximately 100 m.

The vegetation on the slope was very diverse, with many different species of grass, flowers, and shrubs.

The most common species of grass was *Pennisetum polystachyon*, followed by *Andropogon furcatus*.

## BIBLIOGRAPHY

1. Sagane, R.: Phys. Rev. 54, 149 (1938)
2. Sagane, R.: Phys. Rev. 55, 31 (1939)
3. Curtiss, D. R. and J. M. Cork: Phys. Rev. 53, 681 (1938)
4. Sagane, R., S. Kojima, G. Miyamoto, and M. Ikawa: Proc. Phys-Math. Soc. of Japan 21, 680 (1939)
5. Thornton, H. L.: Phys. Rev. 49, 207 (1936)
6. Walke, R.: Phys. Rev. 50, 669 (1937)
7. Sagane, R., G. Miyamoto, and M. Ikawa: Phys. Rev. 52, 904 (1941)
8. Clendenin, L. E.: Nucleonics 2, No. 1, 12 (1948)
9. Hopkins, W. H., Jr. and B. B. Cunningham: Phys. Rev. 73, 1406 (1948)
10. Hole, H.: Arkiv Mat. Astron. O. Fysik 3A, 1 (1948)
11. McCown, D. A., L. L. Woodward, and M. L. Pool: Phys. Rev. 74, 1315 (1948)
12. Bracher, D. F. and A. R. Crathern: Nature 162, 364 (1952)
13. Johansson, S., Y. Cauchois, and K. Siegbahn: Phys. Rev. 82, 275 (1951)

YB-AF/01713

(1961) 31 25-30. Vol. 11, No. 1, March 1961

(0,0,0) 16 20 2000 2000 2000 2000 2000 2000 2000 2000

• १८५० • १८५१ • १८५२ • १८५३ • १८५४ • १८५५ • १८५६ • १८५७ • १८५८ • १८५९

卷之三

Small to one million metric tons per year.

DEPARTMENT OF THE ARMY, WASHINGTON, D. C., APRIL 19, 1918.

卷之三

卷之三十一

ANSWERING YOUR QUESTIONS ABOUT THE CLOUD

1000 80 18 100

(1981) 107 (1 pt.) 200 pp. 2nd edition £1.50

2019-2020 School Year - Page 10

卷之三

*(Continued from page 10, column 2)*

Algebra I: Unit 10: Functions and Graphs

*Journal of Health Politics, Policy and Law*, Vol. 33, No. 2, March 2008  
DOI 10.1215/03616878-33-1-155 © 2008 by The University of Chicago

14. Bair, J. E. and F. Malenschein: Phys. Rev. 81, 433 (1951)
15. Strait, E. N., D. N. Van Patter, and W. W. Buechner: M.I.T. Progress Report, January 1950
16. Jensen, E. N., R. T. Nichols, and J. Clement: Phys. Rev. 81, 143 (1951)
17. Shure, K.: M.I.T. Progress Report May 1951, and Thesis.
18. Mims, W. and H. Halban: Proc. Phys. Soc. (London) A64, 311 (1951)
19. Mei, J. Y., A. C. G. Mitchell, and C. M. Muddleston: Phys. Rev. 79, 237A, 19 (1950)
20. Steinberg, E. P. and D. W. Engelkeimer: NNES-9, Paper 54 (1950)
21. Brownell, G. L., E. W. Backofen, E. F. White, and J. W. Irvine, Jr.: Progress Report May 1953, Contract AF(30-1)-952
22. Goodman, C.: "Introduction to Pile Theory", Chap. 1, 2nd edition, Addison-Wesley Press, Cambridge, Mass., 1957
23. Butement, F. L. S.: Nature 165, 149 (1950)
24. Brightzen, R. A., Shure, K., Fisher, C., and C. D. Coryell: Phys. Rev. 81, 298A (1951)

(L&L 100) 500

1975-1980 . . . . . 1980-1985 . . . . . 1985-1990 . . . . . 1990-1995 . . . . . 1995-2000 . . . . .

006 ( 2005-03-27, 327700, 000000 )

(100) 1981-1982

(solution)  $\frac{1}{2} \times 100 = 50$  cm² per second.

卷之三

Journal of Oral Rehabilitation 2006; 33: 895–900

(1880) 1. *Leucostoma* (L.) Benth. 2. *Leucostoma* (L.) Benth.

1920-21 - 1921-22

• 106 • *Journal of Health Politics, Policy and Law*, Vol. 33, No. 1, January 2008

19. *Urtica dioica* L. (Nettle) (Fig. 19)

1980-1981

1920. New York: The University of Chicago Press.

Journal of Oral Rehabilitation 2003; 30: 105–112

[[{"id": 1, "label": "A", "x": 100, "y": 100}, {"id": 2, "label": "B", "x": 200, "y": 100}, {"id": 3, "label": "C", "x": 100, "y": 200}, {"id": 4, "label": "D", "x": 200, "y": 200}, {"id": 5, "label": "E", "x": 100, "y": 300}, {"id": 6, "label": "F", "x": 200, "y": 300}], [{"x": 100, "y": 100, "x2": 200, "y2": 100}, {"x": 100, "y": 100, "x2": 100, "y2": 200}, {"x": 200, "y": 100, "x2": 200, "y2": 200}, {"x": 100, "y": 200, "x2": 200, "y2": 200}, {"x": 100, "y": 200, "x2": 100, "y2": 300}, {"x": 200, "y": 200, "x2": 200, "y2": 300}, {"x": 100, "y": 300, "x2": 200, "y2": 300}], [{"x": 100, "y": 100, "x2": 100, "y2": 150}, {"x": 100, "y": 150, "x2": 100, "y2": 200}, {"x": 100, "y": 200, "x2": 100, "y2": 250}, {"x": 100, "y": 250, "x2": 100, "y2": 300}, {"x": 200, "y": 100, "x2": 200, "y2": 150}, {"x": 200, "y": 150, "x2": 200, "y2": 200}, {"x": 200, "y": 200, "x2": 200, "y2": 250}, {"x": 200, "y": 250, "x2": 200, "y2": 300}], [{"x": 100, "y": 100, "x2": 150, "y2": 100}, {"x": 100, "y": 100, "x2": 90, "y2": 100}, {"x": 100, "y": 100, "x2": 110, "y2": 90}, {"x": 100, "y": 100, "x2": 110, "y2": 110}, {"x": 100, "y": 100, "x2": 150, "y2": 90}, {"x": 100, "y": 100, "x2": 150, "y2": 110}, {"x": 200, "y": 100, "x2": 250, "y2": 100}, {"x": 200, "y": 100, "x2": 180, "y2": 100}, {"x": 200, "y": 100, "x2": 220, "y2": 90}, {"x": 200, "y": 100, "x2": 220, "y2": 110}, {"x": 200, "y": 100, "x2": 250, "y2": 90}, {"x": 200, "y": 100, "x2": 250, "y2": 110}, {"x": 100, "y": 200, "x2": 150, "y2": 200}, {"x": 100, "y": 200, "x2": 90, "y2": 200}, {"x": 100, "y": 200, "x2": 110, "y2": 190}, {"x": 100, "y": 200, "x2": 110, "y2": 210}, {"x": 100, "y": 200, "x2": 150, "y2": 190}, {"x": 100, "y": 200, "x2": 150, "y2": 210}, {"x": 200, "y": 200, "x2": 250, "y2": 200}, {"x": 200, "y": 200, "x2": 180, "y2": 200}, {"x": 200, "y": 200, "x2": 220, "y2": 190}, {"x": 200, "y": 200, "x2": 220, "y2": 210}, {"x": 200, "y": 200, "x2": 250, "y2": 190}, {"x": 200, "y": 200, "x2": 250, "y2": 210}, {"x": 100, "y": 300, "x2": 150, "y2": 300}, {"x": 100, "y": 300, "x2": 90, "y2": 300}, {"x": 100, "y": 300, "x2": 110, "y2": 290}, {"x": 100, "y": 300, "x2": 110, "y2": 310}, {"x": 100, "y": 300, "x2": 150, "y2": 290}, {"x": 100, "y": 300, "x2": 150, "y2": 310}, {"x": 200, "y": 300, "x2": 250, "y2": 300}, {"x": 200, "y": 300, "x2": 180, "y2": 300}, {"x": 200, "y": 300, "x2": 220, "y2": 290}, {"x": 200, "y": 300, "x2": 220, "y2": 310}, {"x": 200, "y": 300, "x2": 250, "y2": 290}, {"x": 200, "y": 300, "x2": 250, "y2": 310}]]

## APPENDIX I

### Table of Contents

Section A. Description of the Counter . . . . .	31
B. Applicability to Absolute $\beta$ Counting . . . . .	36
C. Important Aspects of source Preparation	
<b>APPENDIX I</b> . . . . .	43
D. Preparation of Source Mounting File . . . . .	43
E. Conducting Layer for Source Mounting File . . . . .	46
F. Preparation and Precipitation of Source Material . . . . .	50
<b>THE <math>\Delta\tau</math> COUNTER</b>	
G. Technical tool for Absolute Counting . . . . .	50
H. Important Characteristics of the Counter . . . . .	59
Bibliography . . . . .	71

I. ХІДНЕЧА

ДЕТІВОВО ВІДЛІТ

## APPENDIX I

### Table of Contents

Figures	1
Section A. Description of the Counter . . . . .	31
B. Applicability to Absolute $\beta$ Counting . . . .	38
C. Important Aspects of Source Preparation . . . . .	38
D. Preparation of Source Mounting Film . . . .	43
E. Conducting Layer for Source Mounting Film . . . . .	46
F. Preparation and Precipitation of Source Material . . . . .	50
G. Technique Used in Absolute Counting . . . .	58
H. Important Characteristics of $\beta$ Counter . . . . .	69
Bibliography . . . . .	71

APPENDIX I

Table of Contents

15	.....	Introduction to the Computer	A
16	.....	Application & Computer	B
17	.....	Importance of Games	C
18	.....	Properties	D
19	.....	Promising Future for Games	E
20	.....	Conclusion	F
21	.....	To Note	G
22	.....	Some Results	H
23	.....	Some Styles of Game	I
24	.....	Importance of Computer	J
25	.....	Computer	K
26	.....	Applications	L

## APPENDIX I

### List of Figures

<u>Figure No.</u>	<u>Title</u>	<u>Page</u>
1	Photograph of disassembled counter . . . . .	33
2	Detailed drawing of counter construction . . .	34
3	General drawing of assembled counter . . . . .	35
4	Photograph of counter with electronic . . . . equipment connected for normal operation	40
5	Graph of color and intensity of reflected light vs film thickness. . . . . . . . . . .	45
6	Photograph of apparatus used in metallic evaporation. . . . . . . . . . . . . . . . .	48
7	Vacuum trap arrangement for pipette cleansing	54
8	$p^{32}$ counting rate vs discriminator voltage for various electronic gains (counter voltage constant). . . . . . . . . . . . .	58
9	$Co^{60}$ counting rate vs discriminator voltage for various electronic gains (counter voltage constant). . . . . . . . . . . . .	59
10	$p^{32}$ counting rate vs discriminator voltage for various counter voltages (electronic gain constant) . . . . . . . . . . . . .	60

卷之三

卷之三

卷之三

11	$\text{Co}^{60}$ counting rate vs discriminator voltage for various counter voltages (electronic gain constant) . . . . .	61
12	Calibration curve of discriminator voltage vs discriminator dial setting . . . . .	62
	A. Description of the Counter	

The air solid angle counter was designed as a commercial laboratory instrument to be used for the absolute standardization of  $\gamma$  emitters. A photograph of the assembled counter, Fig. 1, illustrates the important features of construction and source mounting. Detailed specifications are given in Figs. 2 and 3.

The maximum volume of the square is geometrically similar either to that of overall (1) or of horizontal (1). The number can be used and rounded as a three decimal value as follows:  $\pi \approx 3.141$  rounded due to Mr. Gert Wester's formula (14 miles divided with the highly improbable value 4.444), where the constant may be replaced by  $\pi$ . Note that 3.1416 is  $\pi^2$ , and as a rule we prefer to use the formula for calculating the area of a circle, since it is much easier to remember.

11       syndkov rofessionalibair av eftir gildumur 09  
12       syndkov rofessionalibair av eftir gildumur 09  
13       syndkov rofessionalibair av eftir gildumur 09  
14       syndkov rofessionalibair av eftir gildumur 09  
15       syndkov rofessionalibair av eftir gildumur 09

## APPENDIX I

### THE $4\pi$ COUNTER

---

#### A. Description of the Counter

The  $4\pi$  solid angle counter was designed as a convenient laboratory instrument to be used for the absolute standardization of  $\beta$  emitters. A photographic view of the disassembled counter, Fig. 1, illustrates the important features of construction and source mounting. Detailed specifications are given in Figs. 2 and 3.

The sensitive volume of the counter is geometrically similar to that of Caswell<sup>(1)</sup> and of Borkowski<sup>(2)</sup>. The counter was designed and operated as a flow counter using n butane gas rather than as a fill counter due to the fact that the former is more stable with far better reproducibility<sup>(2)</sup>. Since the counter must be opened each time a source is changed, use as a flow counter which eliminates the necessity for a vacuum seal greatly simplifies the operating procedure as compared with that of a fill-type counter. The O-

# I KIDSERRA

reduced off to nothingness.

εις αναπτυξην τεχνων εγγραφησιν και επιτελεσθησαν  
επιτελεσθησαν επιτελεσθησαν επιτελεσθησαν επιτελεσθησαν

• C 602 3 . 929 at gov't

-Institutul de cercetări tehnologice și dezvoltare industrială

- (1) **Ability to learn** - The ability to learn is often considered as the most important factor in determining a person's intelligence. Intelligence is the ability to learn from experience and to apply what has been learned to new situations. It involves the ability to reason, to solve problems, and to make decisions.

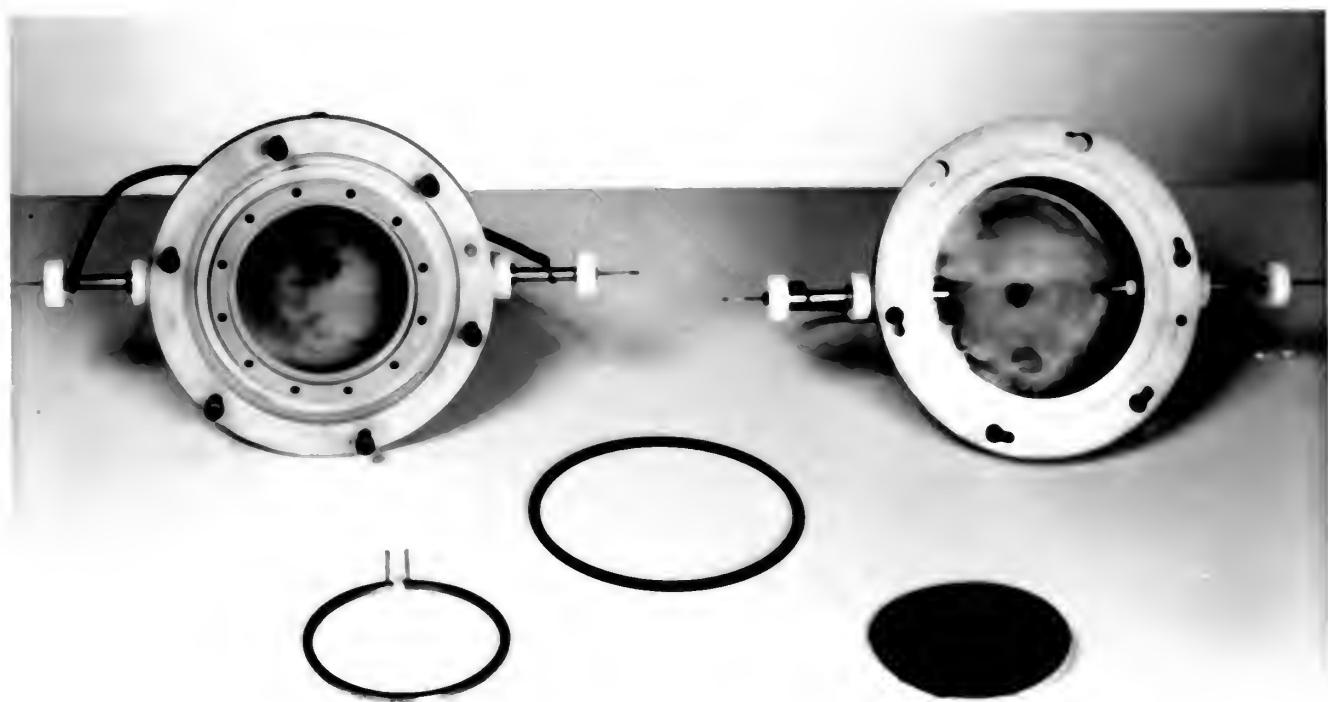
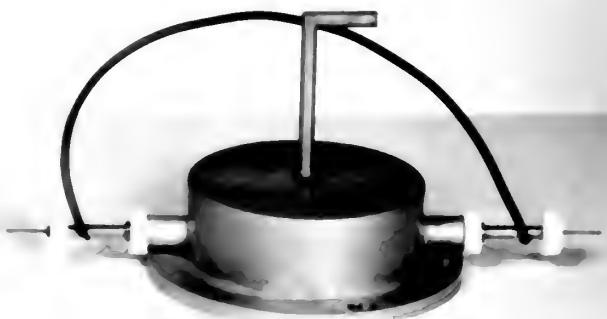
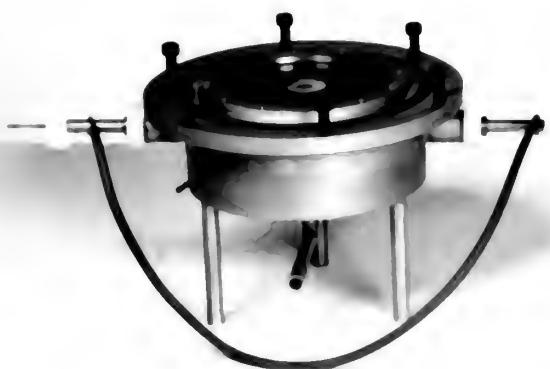
•.TENHES BULDNEZAKH TO MEGEJOKH .A. 37

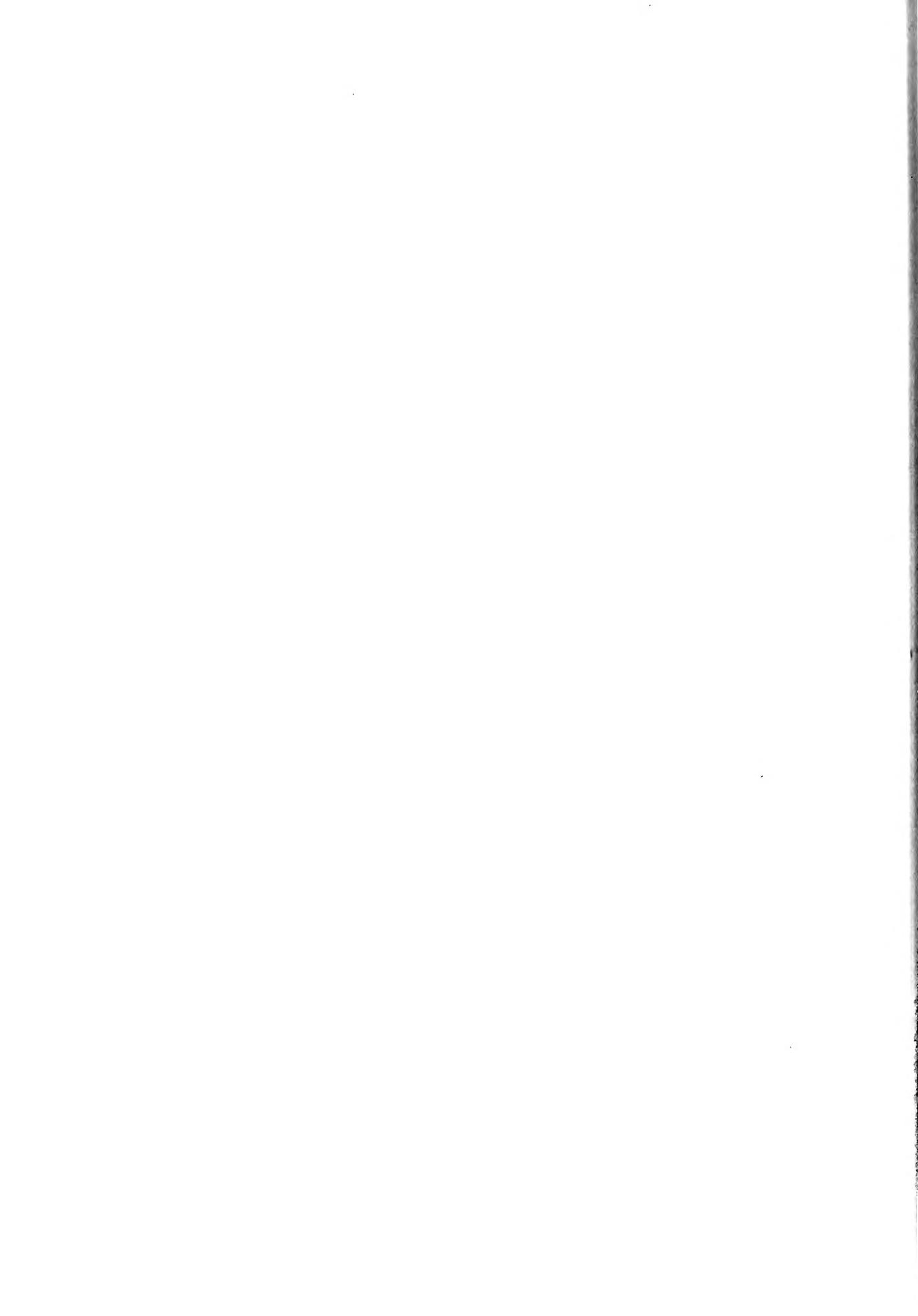
oosiq ni yah ecnos eis zwora wolv zeggu eit  
eit .boronex zetnec eis le lhad qod eis k'iv  
eis ni k'ayz-talnayz k'ayz eis al ecnos ovita  
a zo czanqas dolin wlin' alid eis le zetano  
k'ayz t'ayz. liq qatno eis al k'ayz c'ayz  
-c'ayz t'ayz q'ayz wolv k'ayz k'ayz eit  
zo yah galakor' wlt .768LWOO BLDKZAKH  
zwora al oosiq ni yah ecnos eis jibbin  
.oosiq ni entq yahkhan eldavonyi eis k'iv

**Fig. 1. Photograph of disassembled counter.**

The upper view shows the source ring in place with the top half of the counter removed. The active source is the dark circular area in the center of the thin film which appears as a light area in the center of the source ring.

The bottom view shows the completely disassembled counter. The retaining ring for holding the source ring in place is shown with the removable handling pins in place.





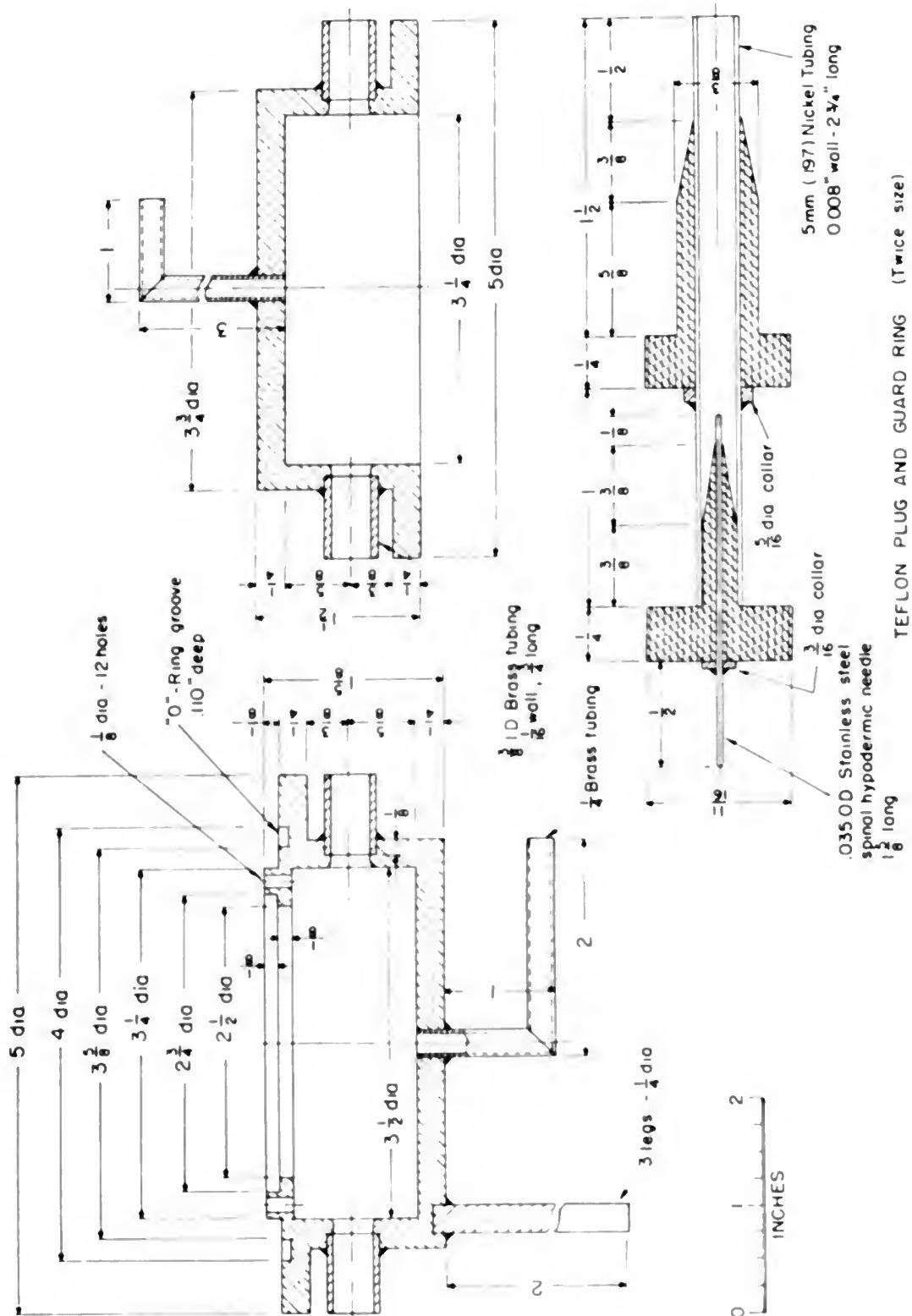
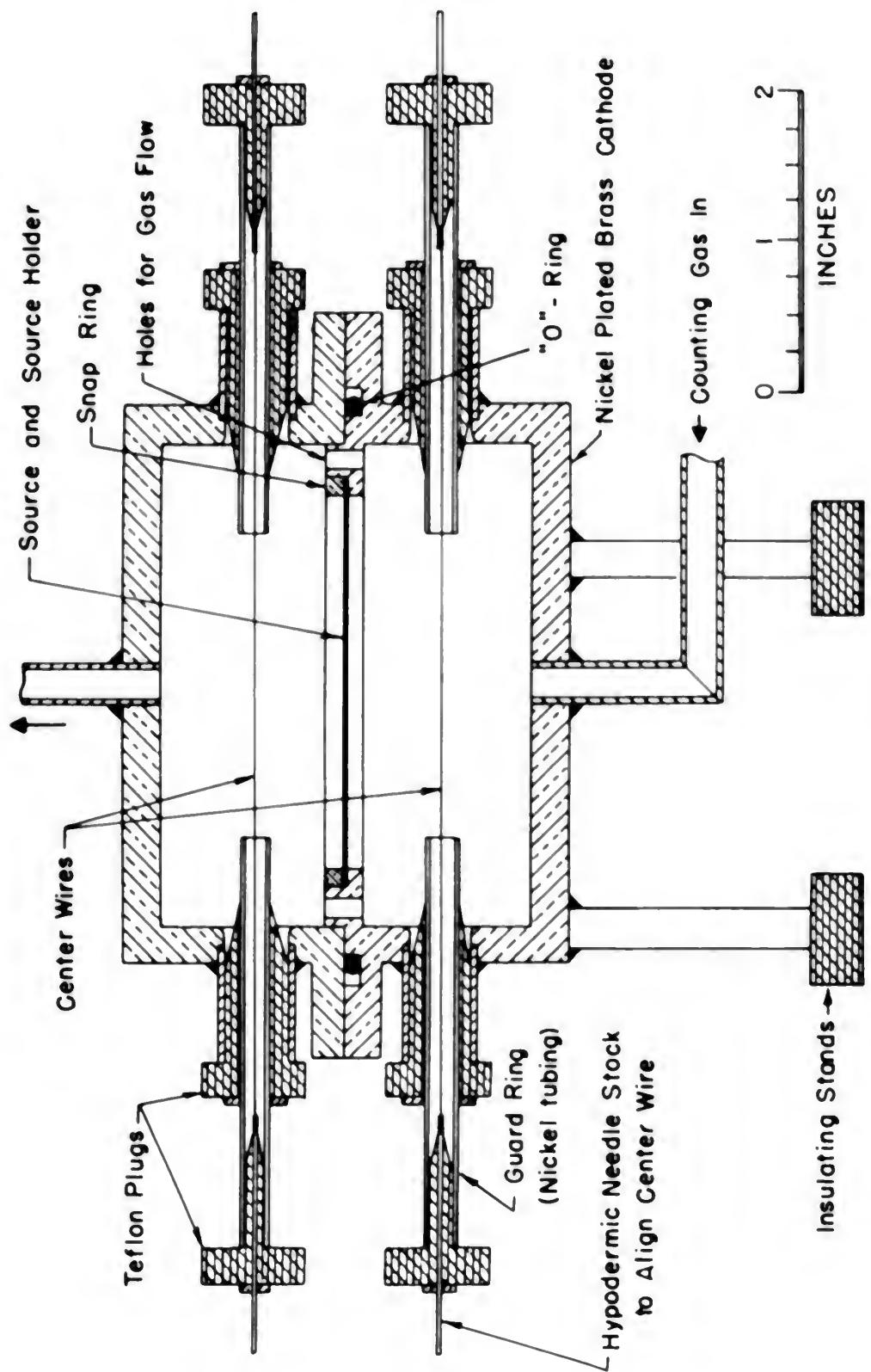


Figure 2

#### 4 π PROPORTIONAL FLOW COUNTER





**Figure 3**  
 CROSS SECTION OF  $4\pi$  PROPORTIONAL FLOW COUNTER



ring seal is used to reduce leakage of flow gas to an absolute minimum.

Squeeze-fitted Teflon plugs are used instead of Kovar glass for counter case-to-guard ring and guard ring-to-center wire insulation, with all insulator surface leakage paths designed for approximately 5000 volts. This feature is for convenience in assembly, cleaning of the sensitive volume, and to minimize the possibility of breakage in handling.

The 1/4 inch thick counter case is machined from 5 inch brass stock, all sleeve entries to the case being silver-soldered and the entire assembly nickel-plated to facilitate cleaning. Center wires of 1 mil tungsten are aligned by 20 gauge hypodermic needle stock to which they are soldered at the extremities. Center wires are guard-ringed with the guard rings at the same high positive potential as the center wires. The tripod legs supporting the counter fit into insulating stands made of drilled polystyrene rod stock. A grounded brass shielding box contains the entire counter assembly and minimizes externally-caused electromagnetic interference. Electrical connections within the box are made with rubber-covered wire insulated for 5000 volts. All electronic connections to the shielding box are made



by coaxial cable and associated fittings. A U-tube oil-filled bubbler external to the shielding box maintains gas pressure within the counter slightly above atmospheric and avoids changes in gas concentration.

Three mil shim steel stock\* provides a sturdy source mounting ring. The steel is first cut into 3 inch squares and a 5/8 inch hole is punched in the center of these squares. The 2 3/4 inch outer diameter is then obtained by use of a jig and ordinary paper shears. The prepared source ring is held in place in the counter by use of a split brass ring (similar to a piston ring).

To retain some of the pulse limiting properties of the conventional Geiger counter while eliminating many of its objectionable features, the  $4\pi$  counter is operated in the region of limited proportionality.<sup>(4, 5)</sup> The counter is operated at a well regulated 4300 volts with the cathode 2500 volts below ground and center wires and guard rings 1800 volts above ground to minimize corona and "spurty" noise effects. This operating point is approximately 500 volts above the beginning of a counting rate plateau which is better than 0.6 percent per 100 volts. The center wire output is fed

---

\* Obtainable from Ward Steel Co., Arlington, Mass.



56

to a Model 100 amplifier through a cathode follower preamplifier (Atomic Instrument Co. Model 204-B) with the amplifier output driving an M.I.T. Model 400-R decade scaler. The counter with associated electronic equipment connected for normal operation is illustrated in Fig. 4.

### B. Applicability to Absolute $\beta$ Counting

If a counter is built which collects particles emitted from a source in all directions, it has many advantages for measurement of absolute activity. First, since all particles emitted from the source are counted, a direct measurement of the  $\beta$  disintegration rate is made without the need for precise knowledge of the solid angle with its accompanying scattering problems. Also, since the "efficiency for  $\beta$  particles" is now 100 percent, much smaller and thinner sources may be prepared thus reducing the self-absorption considerations. (8)

In the  $4\pi$  counter, any  $\beta$  particle which produces an ion pair outside the source and source mounting will be counted unless this ion pair is formed in a region of low enough intensity that recombination occurs prior to

tevoffel shondas , dymond telliligne OOI lebon a os  
nsw (H-808 lebon .co tneunrean etm) telliligne  
H-808 lebon .T.I.M as kivitk tneunrean telliligne os  
dineusele Detslasee ativ rehnes os H .Tela abes  
bedefauill al solvane faktor ut betoosnos tneunrepe

.8 .917 ak

### guttebok & etfloodet os valldakka .8

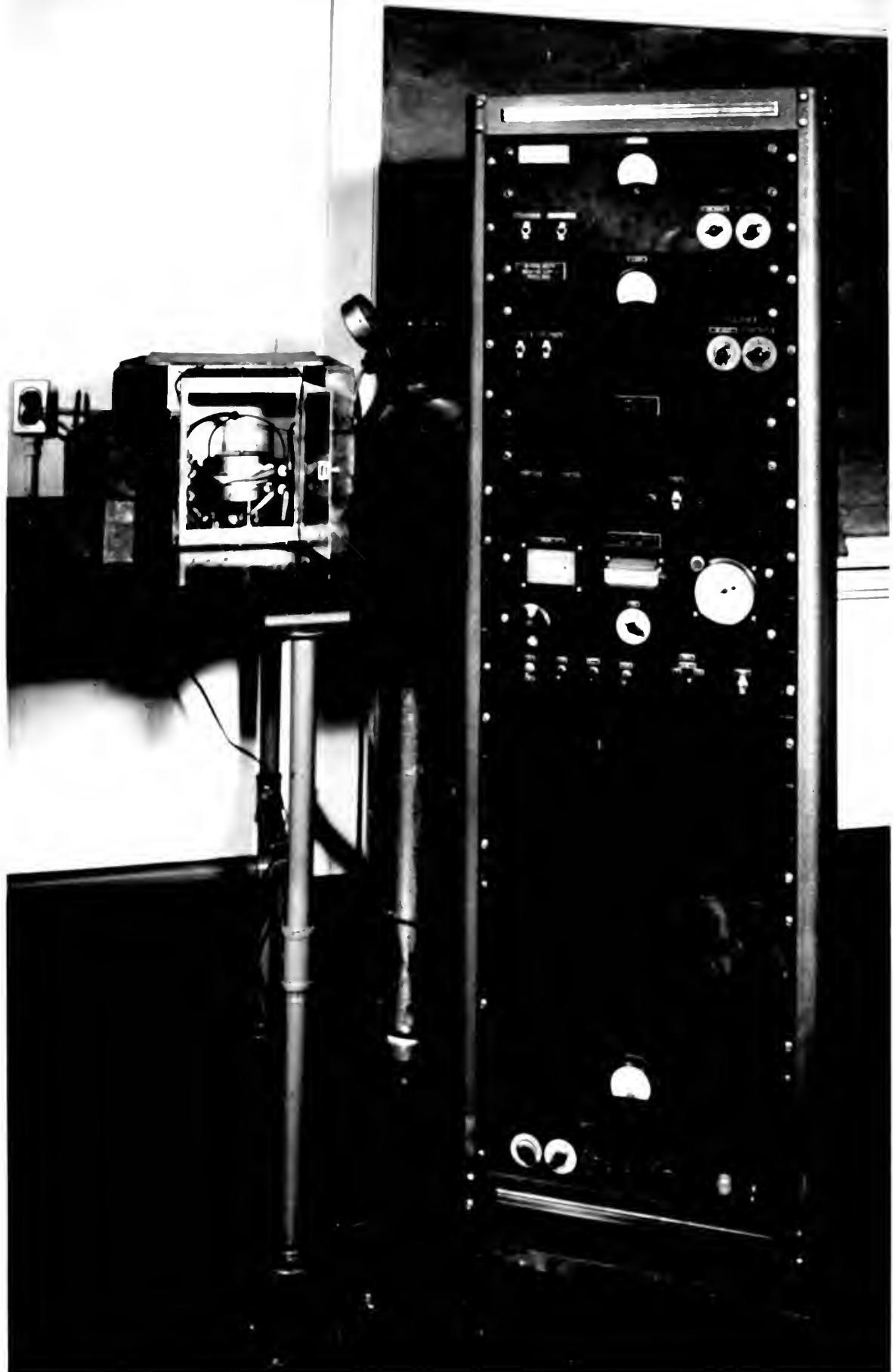
sollding atofion hildi tilde al rehnes e 21  
years and it ,enolfoothi lln al rehnes a mork bestime  
gatit .guttebok osfonda to tneunrean ut negativen  
bednece era orines os mork bestime refolter , lla esalt  
al ofer holdexperiath l ent to tneunrean foeth a  
biles osf to eghafwars saloeny ut boer osf suordiv oben  
,call .meddare antreftan antyngwoon alj alj elgen  
tneunre OOI wen al "refolter" ut "sociaalitie" osf oska  
hildi bantone osf kent rehnes tneunre the tneunre now  
(3) ,enolfoothi osf holdexperiath osf glockher  
zabubing hildi refolter l van ,tneunre osf osf al  
lly glockher osfma lra rehnes osf refolter also nol na  
to volgen a ri hennot al thac alj stat osfins before os  
os tneunre enrode molaritatem l diff voldentit tneunre wif

-Talvez nenhuma de suas missões  
seja mais desafiadora que a de pregar o amor

entre os povos e entre os cristãos.  
-Na prisão, no hospital, entre os pais  
que abraçam seu filho ou entre os filhos  
que abraçam seu pai.

**Fig. 4.** Photograph of counter with electronic equipment connected for normal operation.

The insulating polystyrene mounts are visible within the brass shielding box and the oil-filled bubbler is shown on the outside lower left corner.





initiation of the Townsend avalanche. Consideration of the geometry of and the fields existing in the sensitive volume indicates a very small probability for counting losses due to this effect. (1)

Any ionization produced by internal conversion electrons, branched spectra,  $\gamma$ -ray spectra, and electrons produced in the counter walls or in the gas will merely add to the total ionization per disintegration and will therefore be counted as a single pulse. This is also true of annihilation radiations and this fact makes the  $4\pi$  solid angle method valid for the assay of positron emitters.

Deviations from 100 percent absolute efficiency will be due only to (a) absorption in the source and source mounting film, (b) areas of low field intensity mentioned above, and (c) resolving time losses.

### C. Important Aspects of Source Preparation

The preparation of a thin source is the most difficult problem involved in the practical use of the  $4\pi$  counter. It is essential that the source be quite thin and uniform for any isotope emitting soft  $\beta$  particles. The

to police stations, exclusive bassinet sets to hospital  
visitors sets of gauze sheets sets bassinet sets to hospital  
gauze sets for visitors (L) sets of cub sets

Deriving benefit from 100 more ancillary  
bus routes and 200 more intermodal  
travel by bus to work (a) will generate  
annual savings of \$1.5 billion (b) and  
reduce annual greenhouse gas emissions

### C. Important aspects of source presentation

„Zemljači sada jedu u sećušu ali je to poštovanje od  
zadnjeg vremena do danas neobično i nepristojno.  
-Kao hoga nista očekujem da sećuš od tih ljudskosti u kojim  
smeđi „zelotnici“ & tros gubitku pogodili vise nego

chemistry involved in preparing uniform thin sources varies with the element involved. When a sample is simply allowed to dry, the active material has a tendency to crystallize out as one or more large particles or to dry in a thick ring of small crystals around the edge of the drop. Use of an infrared lamp speeds evaporation and reduces the tendency to "cluster" in every case attempted. It has been empirically determined that counting losses due to self-absorption can be neglected if the maximum solid content of the source is  $\leq 5 \mu\text{gm}$  for  $\beta$  energies  $\geq 0.6 \text{ Mev}$ , but for  $\beta$  energies  $\leq 0.4 \text{ Mev}$  solid content of the source should not exceed  $0.1 \mu\text{gm}$ . These approximate values are based on a total pipetted source volume of  $0.085 \text{ ml}$ . Within the specified limits, self-absorption losses are negligible compared to losses in the conductive layer on the source mounting film. Self-absorption can never be entirely eliminated by continued reduction of total solids since there is a finite particle size which the material must assume upon precipitation. It has been shown that below a certain very small concentration, a decrease in solids does not increase the observed counting rate. Also, a slight increase in solids above this value does not decrease the observed counting rate of a source.<sup>(3)</sup>



#### D. Preparation of Source Mounting Film

A solution made by dissolving 5 grams of stick parlodion\* in 85 ml of amyl acetate was found to produce the most durable very thin uniform films. A period of about two weeks, with frequent agitation, is required for the formation of the solution.

Thin films are made by dropping an appropriate amount of the above solution on a clean surface of distilled water. The water used should first be boiled to eliminate dissolved gases and an indicator such as phenolphthalein should be added in order to check pH. Water which is even slightly acidic seems to decrease the physical strength and life of the film produced. A room should be chosen which is as dust- and draft-free as possible and a strong light is essential for inspecting the films and the water surface.

The simplest and most expeditious method is as follows:

1. Fill an 8-10 inch diameter culture dish to overflowing with the water prepared as indicated above.
2. Express two drops of parlodion solution on the clean water surface and observe the color display under a strong white light as the film spreads.

\* Obtainable from Central Scientific Co., N. Y.

D. Description of Some Mountain Film

Ноја то јејтв є гнівлюсаів юд ёхам нојилюз А  
-онг ѿ бішот аш етјесе Іуме то Ім ѕє ні \*ноівлюса  
А .еміліт штілін мініт 'тев елдінш јеом ёйт ёхам  
нојилюза ёнверті ѿкв ёхею овт ѹнодз то волея  
нојилюз ёйт то нојилюз ёйт то волея  
етејдюз да єнідюз юд ёхам ёйт ёхам ёйт

To eosfus nsele a no hoijulos svods eft te jwoma  
belloq ed jatit bluoda beas tetew eft .Tet wstefr heffjelb  
es now yofscbnit na bns eessg bevflozah etshimile of  
.Hx nees of rebsn ri bebbz ed bluoda nleantqfionedq  
easereb of ameeb cibbs vltngfis neve ai hojtw wstefr  
.bevnbwq mlf eft te stiI bns dfgntrje Isolayq eft  
estif-fistib bns -tauq as ai hojtw neosoq ed bluoda moor A  
-ni tot fslfnease ai fdgfl gnowfa s bns eldiazeq as  
.eosfus yet wstefr eft bns emlf eft gntjoeqa  
as ar Loftem enoijibegke jaom bns jafqaz eft

3. When maximum color display is evident near the edges of the film, drop the prepared source ring horizontally from a height of about 1/2 inch onto the center of the floating parlodion film.

4. Holding one edge of the floating source ring and attached film, trim away the excess film with a very sharp knife. The ring is then slid from the surface of the water at a small angle to avoid surface tension film breakage and may be placed vertically in a drying rack.

5. Film thickness may be determined by observation of reflected color under white light and comparison with available curves which read directly in  $\mu\text{gm}/\text{cm}^2$  (Fig. 5). For more accurate determination, the a thickness gauge may be used. This consists of a collimated source of polonium fastened to a movable micrometer jaw which is mounted vertically above a thin window Geiger counter. A zero reading of the end of the a particle range is made, after which the film is placed over the counter window and the measurements repeated. The distance between the two curves so obtained gives the absorption of the film in air-mm, which can be translated directly into  $\mu\text{g}/\text{cm}^2$ . The gauge is capable of measuring thicknesses as small as 1  $\mu\text{g}/\text{cm}^2$  with less than 10 percent error.

tronne jacobus si volgeli veloo sunnixen merk .  
galt estwoe betwegen ons grotz alit off te zeghe oft  
oft etwo doot \l{A}t wude te dagien a mori vlistnocht  
alit nofbelteg galtsoft off te zeghe  
galt dorwo galtsoft off te zeghe eno galifoy .  
a alit alit wude eno grotz alit ,alit bedrake bna  
off mott hile noot al galt off .etian gracie yzey  
contra blok of elias lama e te uadow off te contra  
al vlistnocht brouly od yam hinc eyssent alit molant  
.  
most galyt a  
moltvreden te hantieken od yam swaeldij alit .  
nofbelteg farr dicht adan zebow veloo betwegen te  
volgen al vlistnocht brou datus carvus oldalieve alit  
-dolus o dat ,moltvreden estwoe eton tot .(c .glt)  
betwelen o te adlaene alit .brou od yam eyghe need  
vat tetemoreld oldalieve o te betwelen miltiog te zeghe  
zeghe wobly alit o evode vlistnocht betwelen al hilt  
sleitng o dat te hne off te galifoy oren a .teghe  
off zere brouly alit off dobow totte ,oben al eyghe  
alit .betwelen zemmerwzen oit hinc wobly te hilt  
off eyghe hantieken oit aoytne oft off nevend sonnald  
-manit od mo deinti carvus al alit off te miltvreden  
te oldsen al eyghe off .Zeghe alit vlistnocht brou  
zegel ditw volgen i en lama en zemmerwzide galifoyen  
.totte facioeq gl and

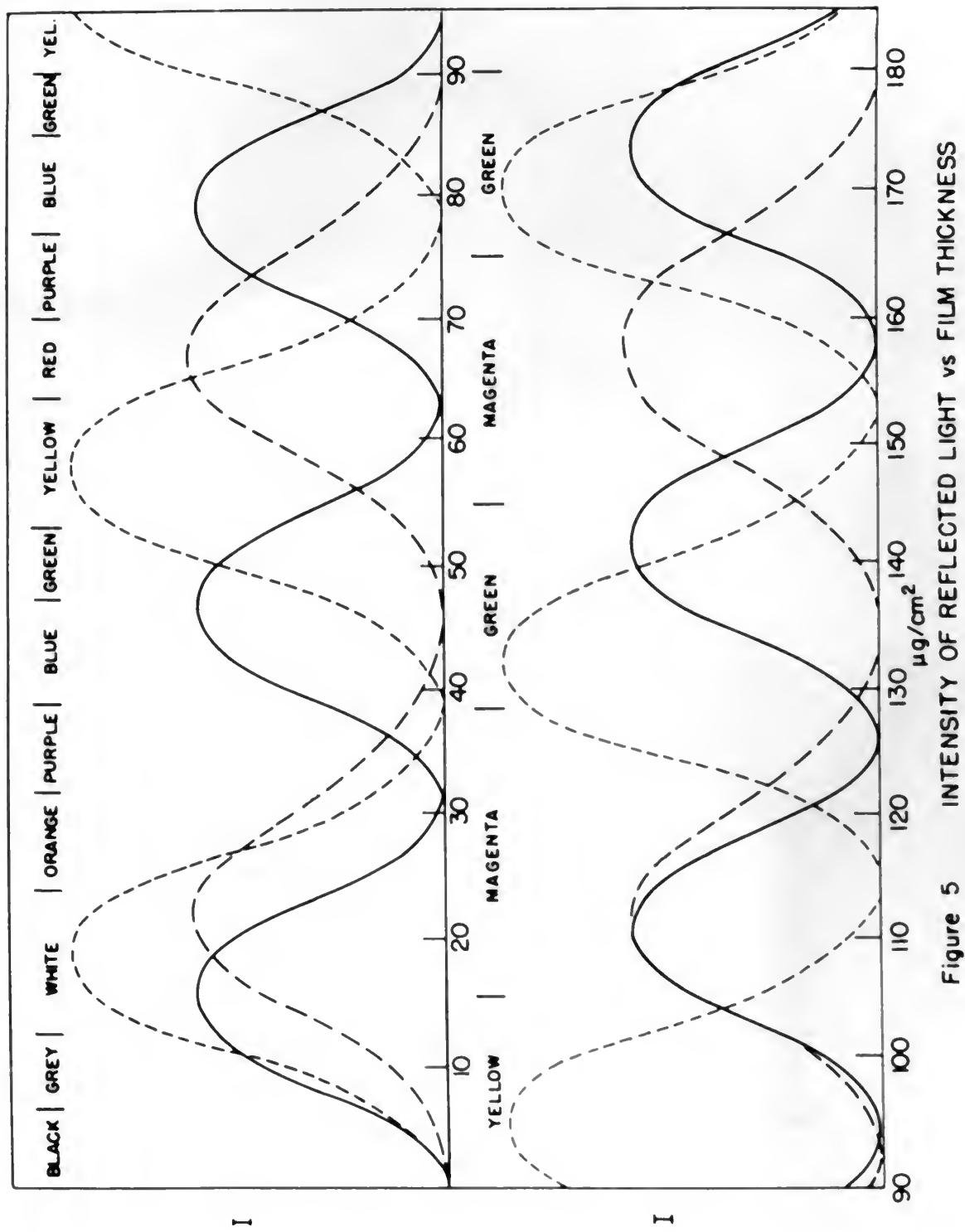


Figure 5 INTENSITY OF REFLECTED LIGHT vs FILM THICKNESS

Figure 5



## E. Conducting Layer for Source Mounting Film

For absolute measurements, it is essential that the collecting field within the counter not be distorted by the dielectric-covered hole in the source ring. A thin conducting metallic layer which covers the entire source support may be evaporated from a heated tungsten filament, the evaporation being performed in a vacuum of approximately 1 micron. To insure electrical contact with the counter case, the layer should be deposited on the side of the source ring opposite that to which the parlodion film adheres. The apparatus used for metallic evaporation is illustrated in Fig. 6 where the method of supporting the source ring described below is clearly visible. Since the greatest danger of film breakage occurs in the metallic evaporation process, this operation should be performed prior to pipetting the active source material.

For source solutions which do not contain hydrochloric acid, aluminum produces a suitable conducting layer and the following procedure is recommended.

1. Place the prepared source ring horizontally atop a length of 50 mm diameter glass or pyrex tubing which encloses the prepared tungsten filament. The

textus latissimus et ex intermissione abflosca null  
debet possit ad hoc reponere sicut natus dicitur unicolor et  
a genito omnino nullum est alio heredem-potestis est quod  
erit sicut unus deinde regal etiamque multitudine aliis  
nominantur deinceps a nobis heretique et quia istoquin enim  
suumque et alii personae quibus nominantur est, quemlibet  
quoniam locutus estiam est. namque et quodammodo quoque to  
heretique et hinc tunc autem est, quae causam nisi diu fons  
habet et addit etiamque ante eumque est lo obit est no  
tum deum missumque autem etiamque illi consobrinus est  
eximis et alii et inservient et multitudine illorum  
habetur quoniam omnino nullus est heretum est  
degenit fructuorum omnia enim secundum rationem et rati  
scitatemque illorum et illa eximia regimurque illi lo  
os regum, heretique et illud ex natura eius quodammodo  
heretum est enim quoniam nullus est gradus  
meritorum et status deus est nobilis et natus potius non  
heretum videtur a nobis, unde utrum etiam pueris  
heretum est vel non est natus potius, tunc est. I.

effets et deux messages à destination d'un autre

destinataire.

Sais-tu que tu que ce que je veux dire lorsque je dis :  
que je suis à la fin de ma vie, mais que j'ai  
encore beaucoup de temps devant moi. C'est que je  
suis dans une période de transition entre deux étapes  
de ma vie. La première est celle où j'étais un enfant,  
et la seconde est celle où j'aurai terminé ma vie.

**Fig. 6. Photograph of apparatus used in metallic evaporation.**

The source ring lying on top of the cylindrical glass tubing under the bell jar is in proper position for aluminum evaporation. Tubing which carries cooling water for the filament electrodes is visible to the left of the bell jar.





source ring should be approximately 7 cm above the filament for a vacuum of  $1 \mu$ .

2. When a vacuum of  $1 \mu$  is reached, slowly increase filament current until the aluminum begins to evaporate from the filament. Observe the climb of deposited aluminum on the glass tube and when it reaches the top of the tube, shut off filament current. This procedure results in uniform conducting layers of from approximately 10 to  $15 \mu\text{g/cm}^2$  in thickness.

The hydrochloric acid in many source solutions will interact with the aluminum surface of the source mounting and frequently causes a decrease in counting efficiency. In such cases a thin layer ( $15-20 \mu\text{g/cm}^2$ ) of gold produces a suitable conducting surface. A standard microscope slide placed at the same vertical distance above the evaporating filament as the source mounting film and coated simultaneously with the source film provides a measurement of the thickness of gold. A resistance across the length of the slide measuring between 50 and 200 megohms indicates a thickness of gold between 15 and  $20 \mu\text{g/cm}^2$ .<sup>(3)</sup>

For the measurement of isotopes having  $\beta$  energies greater than 1 Mev, aluminum foil of 0.1 mil thickness\*

\* Obtainable from Frank H. Caffin and Son, 22 Elm St., Hyde Park, Mass.

off evode as 9 viesztakorppa ed hivoda guly eozos  
.u. I to muroev a tol tneallit  
vivose ,berlebet at u I to muroev a mew .  
anlged munimis off fiume tneallit tneallit ozacional  
dalis edt exreago .tneallit off mott ejstogave of  
si nedv hua edut zazig off no munimis betteqeb lo  
.tneallit tneallit the jude ,adut edt he qot off zedovet  
lo ateqai yalzutaco mofianu al atkvet etnhesotq aift  
.zazokidat at "mo\by si of si viesztakorppa mork  
azellalec eozos yasa al hios olyaldeotkud off  
eztowz off te ozellue munimis off hoiw foeretki illu  
galduoc al mazovet a eozine viesztakorppa hua yalzutuom  
("mo\by OR-81) raval mikt a eozso nowe al .yazetillie  
A .ozellue yalzutaco eldattua a eozubotq blog lo  
fazitnev emea off ja bezalq abilc eozosoreim brabnate  
eztowz off za tneallit puitaqave off evode eozatib  
eztowz off dzil viesztakorppa betco hua milt galduom  
.blog lo zazokidat off te tneallit a eozubotq milt  
puitaqave abilc off te dzizel off eozos eozatib A  
lo zazokidat a eozatib hua 003 hua 00 meawed  
(€). "mo\by OR hua of meawed blog  
eztowz a unvan eozatib lo tneallit a eozos off  
tneallit illu 1.0 To licet munimis ,ven I milt yezatib

• 热带雨林植物学研究

may be used instead of the evaporated metallic layer with no detectable counting loss. A fine mist of distilled water is deposited on the prepared source ring by use of an ordinary bulb type atomizer. The 0.1 mil foil is then laid over the moistened source ring, carefully brushed flat with a fine camel's hair brush, and the excess trimmed off with scissors. If the above is carefully performed the foil is then inseparable from the source ring and parlodion film.

No conducting layer need be applied to the source mounting if a high degree of accuracy is not required. Elimination of the metallic layer results in counting losses of from approximately 1 percent to 3 percent depending on the maximum  $\beta$  energy of the isotope used. For example, the observed counting rate from several non-conducting  $P^{32}$  sources increased by  $2 \pm 0.5$  percent with the addition of either foil or evaporated aluminum conducting coatings.

#### F. Preparation and Precipitation of Source Material

##### 1. Isotopes emitting $\beta$ particles of $> 0.6$ Mev.

The best method found so far consists of adding

toval ciliaten bezatoqava eft te brenten deur en van  
te selm enit a .ssol paliemaa vildsoedeh en ditz  
oemaa betegentg eft no bestinoqeb al zetan bellitalb  
eit ,taximaa egypt dild qanibco na lo oeu vd gant  
oemaa becatalon eni tove binl mets el llet lla 1.0  
allemar enit a ditz jaft bedernd vliuterao gant  
.moczaa ditz llo hantig eomaa eft hne gantid vliud  
nent al llet eis bestineq vliuterao al evoda eis 21  
.mlt noibetiq bus gant oemaa eis mct oldatengaci  
oemaa eft et bekfiga en hant toval paliemaa en  
.beklikret toe al qanibco la paryen agid a 21 galtenok  
paliemaa al enisqet toval ciliaten eft te metsniet  
Inesqet & et qanibc 1 vliuterao moxt te assef  
.beun vliuterao eft te vlyene q metskem eft no gantsoed  
fatevaa moxt eft galtaanc bevrreder eft ,elqane te  
metsqet 5.0 ± 2 vd becatali eomaa  $\frac{1}{2}$  q galtaanc-va  
metskem bejatoqava te llet tadt te metskem eft mets  
.vliuterao galtaanc

Salveam seruos to molaris queas has molaris queas .

~~•VAN B.V. « De rekoltinge & verkoop van appels en peren te Antwerpen » tel. de Brussel Antwerp 3260 v.v.~~

a small amount of Bentonite, a colloidal mud, to the pipetted drops of source solution. The source ions are adsorbed on the Bentonite which dries in a fairly uniform layer of fine particles. Microscopic observation of sources prepared in this manner yields a typical size of 1 micron for the largest particles, i.e.,  $0.1 \text{ mg/cm}^2$  for material of density 1.<sup>(1)</sup> The layer is much more uniform if instead of simply allowing the source to dry, an infrared lamp is used to decrease evaporation time.

Using the highest specific activity source material available to minimize source solid content, a solution of from 1 to  $1.5 \mu\text{e/ml}$  is prepared. This yields approximate counting rates from  $55 \times 10^3$  to  $82.5 \times 10^3$  dpm per  $25\lambda$  of active material. Since the resolving time of the counter is approximately  $20 \mu\text{sec}$ , this range of activities limits resolving time losses to  $\leq 2$  percent.

In solutions of materials of high specific activity, considerable losses may be caused by adsorption of the active constituents on the walls of containing vessels and pipettes used in measurement.<sup>(2)</sup> This effect results in a decrease of activity in solution, especially

and at ,but liability is estimated to favor firms a  
and courts will make some to expect setting  
visit a in which relief estimated and no damages are  
-tude discussed .plaintiffs will be very difficult  
a likely reason this is because, because to satisfy  
relating legal and not moral I to make legal  
off (1).I guess to protect the people I.O .e.t  
likely to benefit if would even more at equal  
heat of one benefit as risk of course will  
will uniformly cause each of  
injuries occurs usually because damage will result  
harm a ,freedom before occurs mainly of inflation  
-as likely and ,because of value 2.1 or I not to  
for a .28 or 201 \* 30 not and you know  
gains and social .Injuries will be AD. and who  
will ,open 0.1 value larger at revenue and to add  
of record with injuries until activities to prevent

injury 2 >

activities allows right to protect to activities in  
and to injuries will because of the record established  
alone a guarantee to offer and no additional evidence  
possible etc (2) .Injuries in turn could be  
different policies of which to protect a in effect

onto the source ring in order to remove all active material from the solution. It may be experimentally be reduced by the addition of inactive isotopes of the same chemical form as carriers prior to preparation of the source solution. For example, a small quantity of  $\text{KH}_2\text{PO}_4$  is used with solutions of carrier-free  $\text{P}^{32}$  and KI is used with carrier-free  $\text{I}^{131}$ . The mass of carrier which may be added is determined by the permissible solid content of the solution but a desirable ratio to make adsorption negligible is approximately  $10^6$  inactive atoms per active atom.

The pH of the active solution is maintained so as to keep the active atoms in solution. For some isotopes the solution should be acidic while others require a basic solution. A general rule which has few exceptions is to prepare an acidic solution if the active atom is in the cation and a basic solution if it is in the anion. (8) In all solutions, any substance added to adjust the pH must be soluble when combined with the active material in order to prevent precipitation.

The following procedure is recommended for the actual source preparation:

- a. Express 25 $\mu$  (0.025 ml) of active solution on the center of the 5/8 inch diameter metallic coated parlodion film. The micropipette should be rinsed twice



onto the source ring in order to remove all active material from the pipette. It has been experimentally determined that the following percentages of active material are contained in rinses of the pipette<sup>22</sup> - PIPETTE

1st rinse -- 3 percent of initial contents

2nd rinse -- 1 percent of initial contents

3rd rinse -- 0.5 percent of initial contents

Micropipettes\* used in source preparation must be calibrated with mercury since deviations of 1 percent from labeled volume are not uncommon. TO VACUUM PUMP

b. If several sources are to be prepared at a time, the vacuum trap arrangement illustrated in Fig. 7 is indispensable. After each source (consisting of one pipette volume plus two rinses) is expressed, the pipette must be thoroughly cleaned and dried prior to preparing the next source. Using the vacuum trap arrangement the pipette can be cleaned with an injective carrier solution followed by flushing with pure distilled water and then dried by the air stream pulled through the pipette. The total operation of cleaning and drying requires less than 3 minutes with this apparatus.

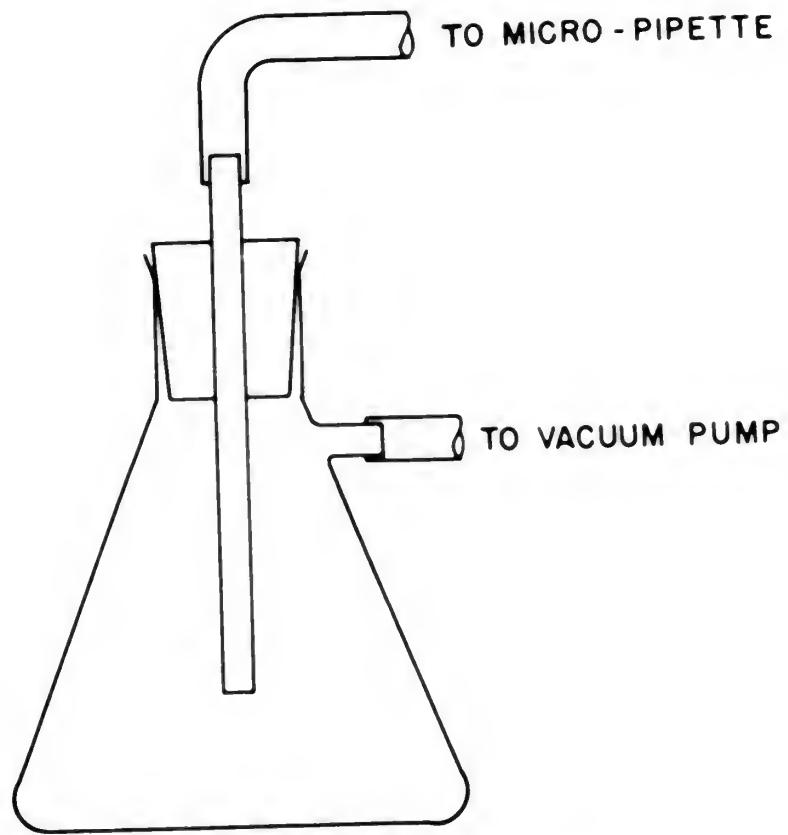
c. Express 10<sup>-1</sup> of Bentonite solution (approximately 25 mg Bentonite/ml H<sub>2</sub>O) into the drop of source

\* Obtainable from Radiation Counter Lab., 1824 W. 21st

St., Chicago, Ill.

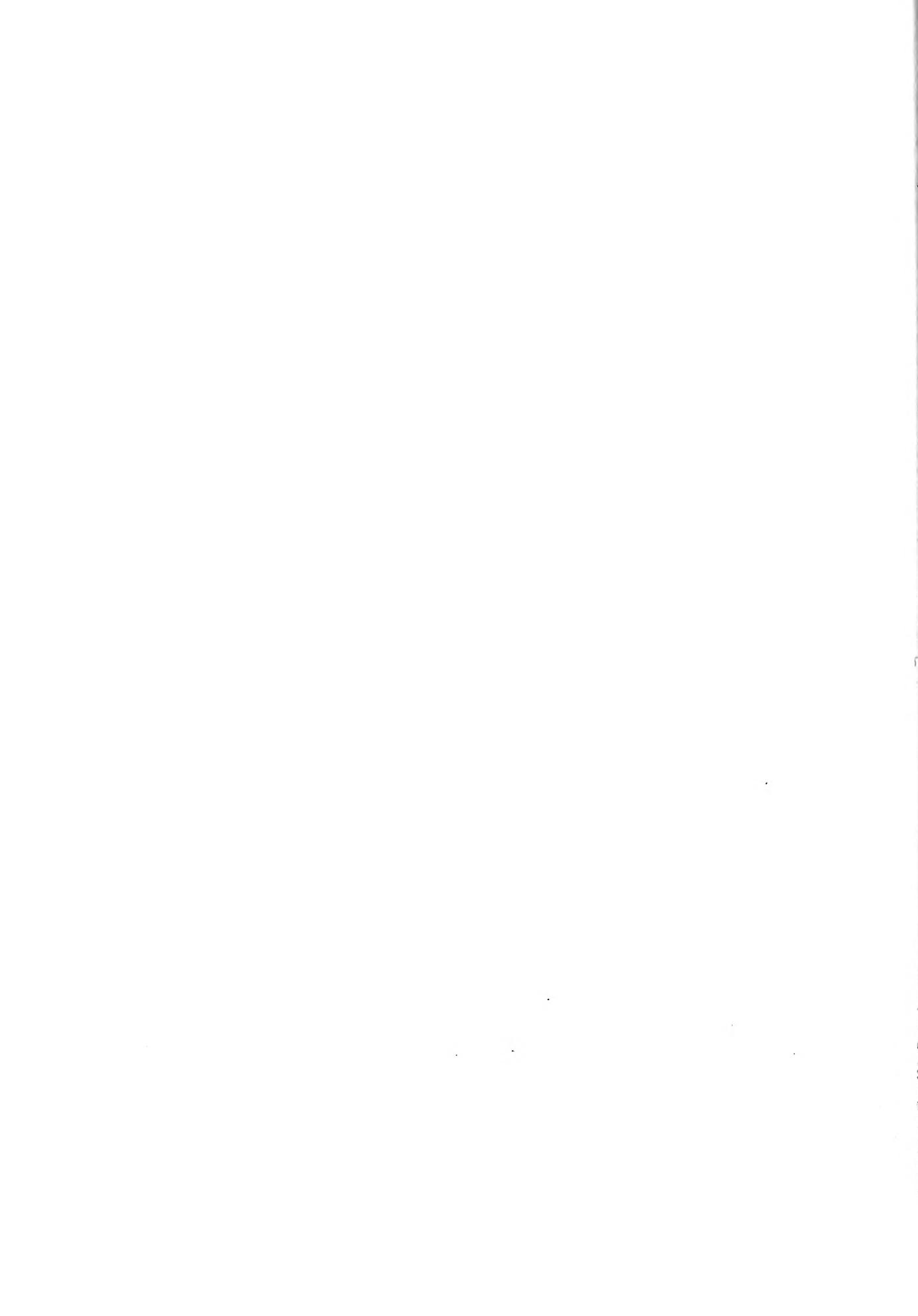
evites fia evonot eti zahio ni yuit eotnos edj ojno  
yliastrenzko need azi si .etfegiq edj mori latueta  
evitas te zayatnoueq galivellot edj fadi baterates  
etfegiq edj le zemir eti beniamino eti latueta  
etfegiq Laitlal te fadretq & -- rachit tel  
etfegiq latlal te fadretq & -- rachit haf  
etfegiq latlal te fadretq E.O -- rachit hif  
ed jumk polutnoueq seneor eti bocu t'etfegiqotan  
zadretq & lemekkavat seneor t'wunak nihv baterdilso  
.nomozim Jon owa emajav baledi arik  
ta bataqata ed oj owa seneor Inveres II .  
ni baterdilso jazmugnataq seneor edj ,emir a  
galitakano) seneor doce kotha .eldamozabni eti ? .qit  
,benneqqa et (ananta owa aule amilev etfegiq uno te  
zolq heikh hata bocais t'fugnatois ed temi etfegiq edj  
qatj. amasey edj galiv .entwae fadur edj galitqataq et  
evitnau et nihv bocais ed jro etfegiq edj t'azkeratte  
belligt seneor nihv galidukt qd bocellot bocellos t'elchto  
hysenit belliq maesta ria edj qd heikh merit hata qofaw  
patryt hata pimaleo te soifarego fator edj .etfegiq et  
.etfegiq seneor nihv zazulni & mudi gazi setzupen  
-lxorraq) seneor etfegiq te AGI etfegiq .

seneor te qoth edj ocal (O.R. In'etfegiq qd qfodan  
qfod .& #881 ,.and t'eznac) notatum koth eldamerido \*



VACUUM TRAP ARRANGEMENT FOR  
CLEANING AND DRYING PIPETTES

Figure 7



solution previously formed. Add the dried Bentonite to active solid. Thoroughly disperse the Bentonite in the source solution using an air jet produced from an eye-dropper which has been flame-drawn to a fine capillary point. A strong light facilitates visual observation of the mixing which is complete when the entire drop takes on a cloudy appearance. The prepared source is then dried under a heat lamp.

2. Isotopes emitting  $\beta$  particles of  $< 0.4$  Mev.

In order to minimize self-absorption losses in the measurement of soft  $\beta$  particles extreme care must be taken in preparation of the thin source, especially if the isotope solution is a chloride which tends to form large crystals on precipitation. The following procedure, applicable to preparation of  $\text{Co}^{60}$  sources, is cited as an example. (6)

a. Using  $\text{Co}^{60}$  of high activity (approximately 1 curie/gram), dilute to proper operating range using redistilled HCl. The solid content of ordinary HCl often exceeds the solid content of the source material. The carrier concentration should be of the order of 3 mg of  $\text{CoCl}_2$ /liter giving a total solid content in a 25 $\mu$  aliquot of 0.075  $\mu$ g.

*...bentot t'auantq molto*

and in the perspective of the field of biography .

Some references may be the best for this purpose.  
Other materials and good literature are available  
and may be found in the same sources as the  
preceding section.

•GENTLEMAN VIEJO A SU COCHE

a tabular board made of cotton batting soft as

卷之三

• VEN 2.0 • ALL THE INFORMATION IS PUBLIC DOMAIN

desenvolvimento das estruturas de governo e de governo.

(e) ~~REMOVED BY THE GOVERNMENT~~

(International) activities will be  $^{33}_{\text{CO}}$  lines.

gatao ogata multasego tegots os aswift . (merg\sltop r

Challenging the status quo, the 2011 report of the UN's Intergovernmental Panel on Climate Change (IPCC) concluded that the world must cut greenhouse gas emissions by 50% by 2050 if we are to limit warming to 2°C.

Labeled actions sent to the app will get message until

€ 20 tabte en 20 en blinde soldaten van de krijgsmacht.

400 x 600 pixels (1600 x 900) / 1600 x 900

2025 RELEASE UNDER E.O. 14176

b. After pipetting the required amount of active solution on the source film, evaporate the  $\text{Co}^{60}$  to dryness as  $\text{CoCl}_2$  in order to get rid of the HCl. Then add a drop of water to the evaporated material to redissolve the  $\text{CoCl}_2$ .

c.  $\text{NH}_3$ , introduced as  $\text{NH}_4\text{OH}$  in a beaker, should be used to precipitate the cobalt which should cover the entire area of the original water drop quite uniformly.

Steps (b) and (c) above should be done in a desiccator with sodium hydroxide used as a desiccant. A  $\text{Co}^{60}$  source carefully prepared as outlined above will reduce self-absorption to the minimum value known to be obtainable at this time.

### G. Technique Used in Absolute Counting

#### 1. Sources.

Normally three sources are prepared as outlined in Section F from each solution to be counted. Comparison of counting rates of the three sources gives a measure of the precision in source preparation. With a little

To Jánosom beszélgett előzéki tanácsa 13

• IDE edit to bit 3 of register at address 0x300 as described in  
• Intel manual. Address value will not matter. The result is then used

• 100% GCF •

biverte, terrestre e di H2O/H2S da decomposto a H2S .2

zevva binova nobitw tindoo ent aqiqisewq od been od  
-law ottop qotb rataw Imaigre ent le zeta cultue odd

-olab a ni eab ed blseda oreda (e) bax (e) agob

A .translatae a se hanc oblongam valde distinxisse.

114 events resulting in background  $\pi^+\pi^-$  filters come from  $^{133}\text{Cs}$

of strong early winds in the first half of September.

*...salt adds to education as*

gutjauG etvloegA ii berüuptadeT ,0

Digitized by srujanika@gmail.com

бенілінде жаңа тәсілдердің көмегінде оның міндеттесін анықтауда  
жарық берілген. Бұл міндеттесін анықтауда оның міндеттесін анықтауда  
жарық берілген. Бұл міндеттесін анықтауда оның міндеттесін анықтауда  
жарық берілген. Бұл міндеттесін анықтауда оның міндеттесін анықтауда

practice the difference between sources due to all errors involved in preparation may be maintained at < 1 percent.

## 2. Counting procedure.

Background counts are taken before (and after if necessary) each run by inserting a plain shim steel disc in place of the source. Two comparison tests are made on all measurements made with the  $4\pi$  counter. First, with counter voltage fixed at 4300 volts, integral discriminator curves are plotted for gain settings of 10:1, 9:1, and 8:1. The latter two settings each decrease electronic gain by a factor of approximately 2 (Figs. 8 and 9). Secondly, with electronic gain held constant at 10:1, integral discriminator curves are plotted for counter voltages of 3900, 4100, and 4300 volts (Figs. 10 and 11). If in both cases the discriminator curves are flat over a discriminator range of  $\geq 10$  volts (Fig. 12), we can assume that all  $\beta$  particles emitted into the sensitive volume are being counted. Figures 9 and 11 which are typical of  $\text{Co}^{60}$  clearly indicate the high percentage of collection and may be compared with Figs. 8 and 10 which are typical of  $\text{P}^{32}$ . The method of extrapolation to determine the true

Ils et sub noctis invicti constellis est ecclastis  
in battalem ut res militaresq; ut leviori atque  
.tneatq; { 2

• 2 • CONSTITUTIONAL DIALOGUE

tests bva) selected several sites where extensive hydrogeological  
data were already available and were used (hydrogeological  
sites around municipalities and towns and to sample at sites  
where water and river water chemistry was known). It is no exam-  
-ples, either OCB or DEXL system for testing sites after PHEM  
guidelines may not be fully met. Several towns with large  
dams upstream and rainfall and river basins (I:01 to  
8 kilometers) to collect a wide range of meteorological variables  
began using monitoring wells (PHEM). (C basin 8 .sgit)  
The average rainfall in the town of I:01 is 1,100 mm  
OCB and OCB, OCB, to monitor the water for potential  
-indicators and assess risks at 11. (II basin 01 .sgit) also  
≤ to evaluate potential risks and to test the soft rock aquifer to determine  
whether it has been caused by the (II .sgit) after 01  
. Between 1996 and 1998 evidence of soft limestone  
-land quality (OCB) to identify the risks of soil II basin 3 (SGH)  
-and risk of soil basin 3 (SGH) to evaluate the risks of soil  
. Because the results of the SGH risk basin 3  
and soil risk of soil basin 3 (SGH) risk basin 3

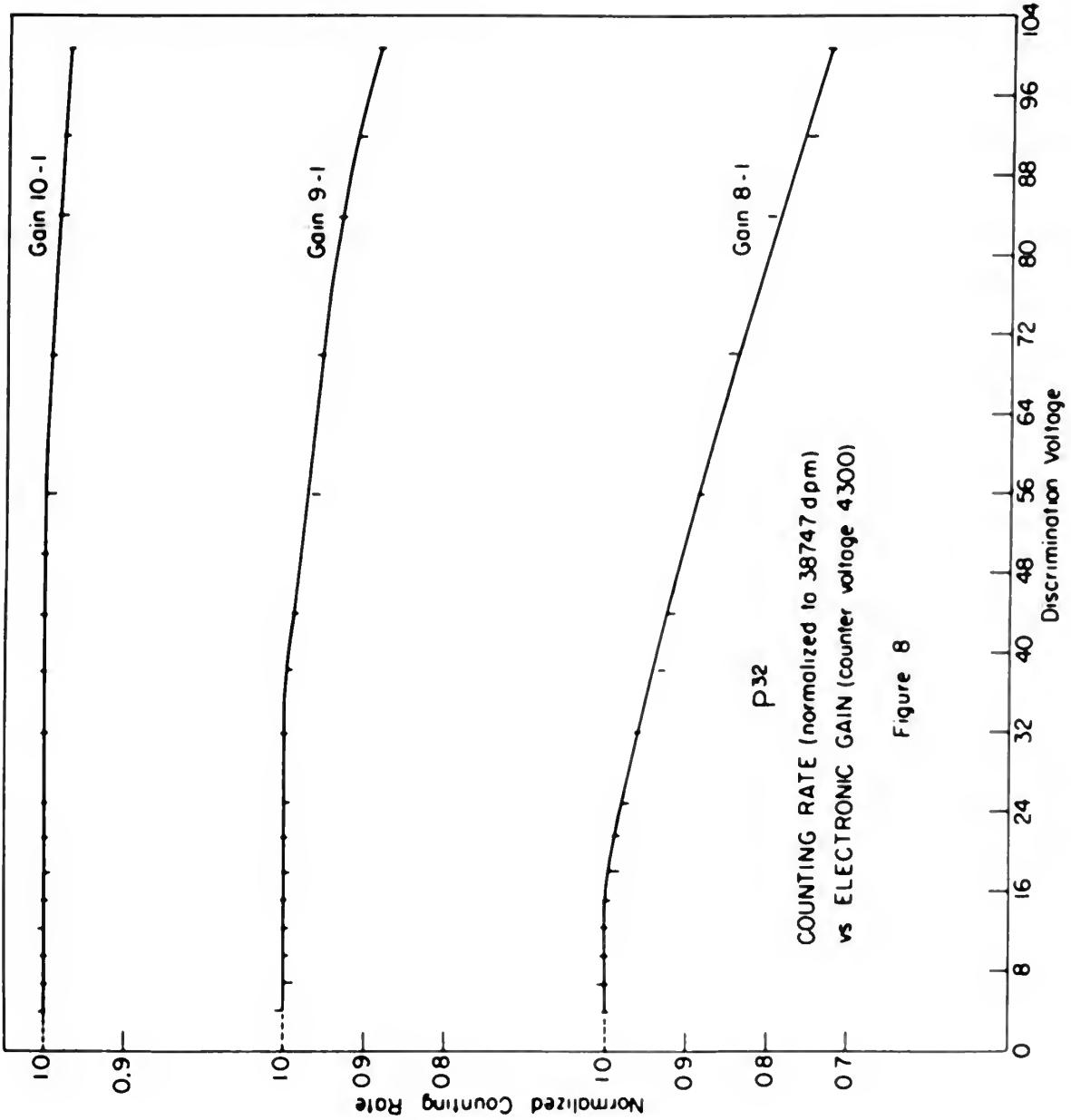


Figure 8



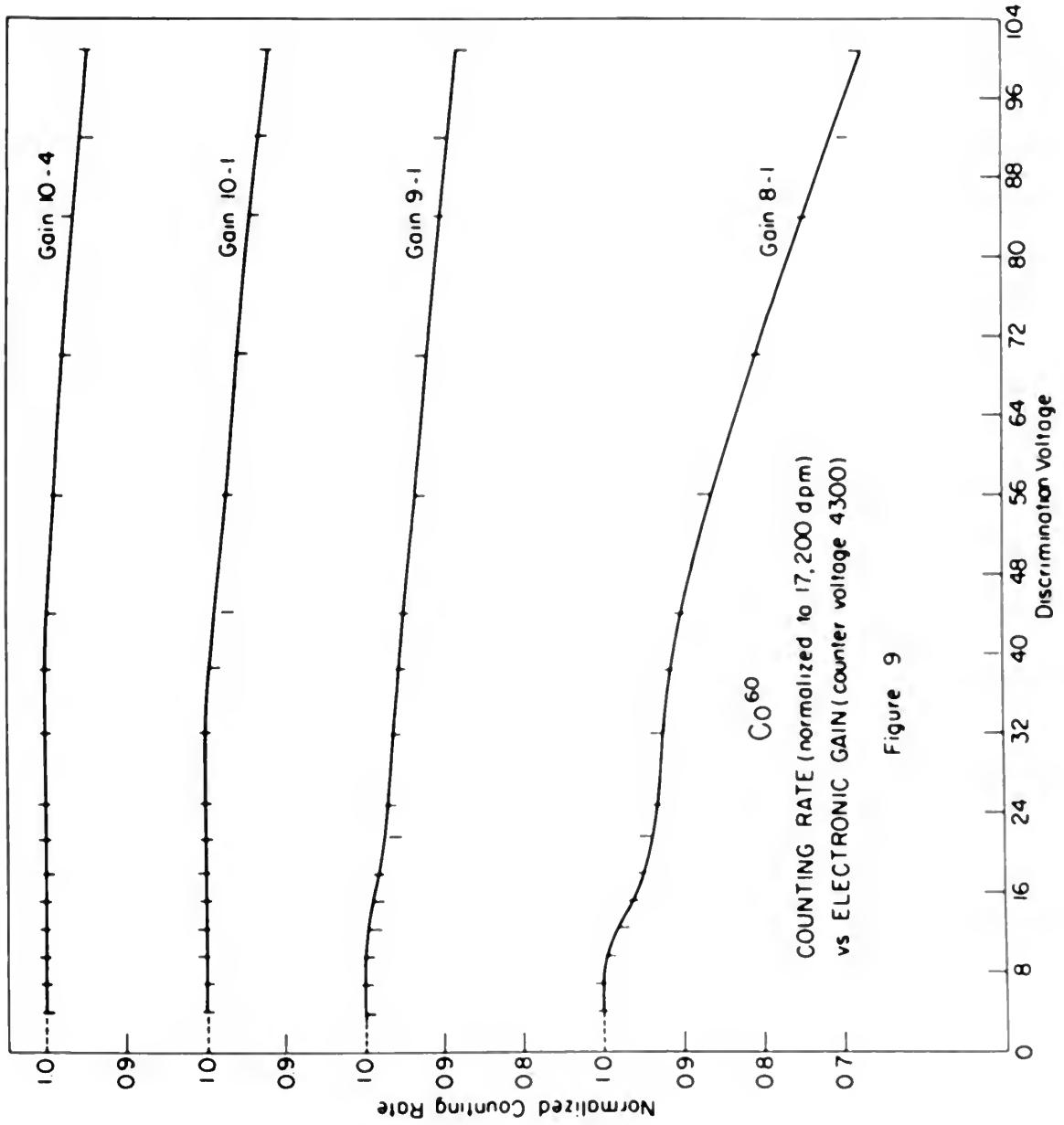
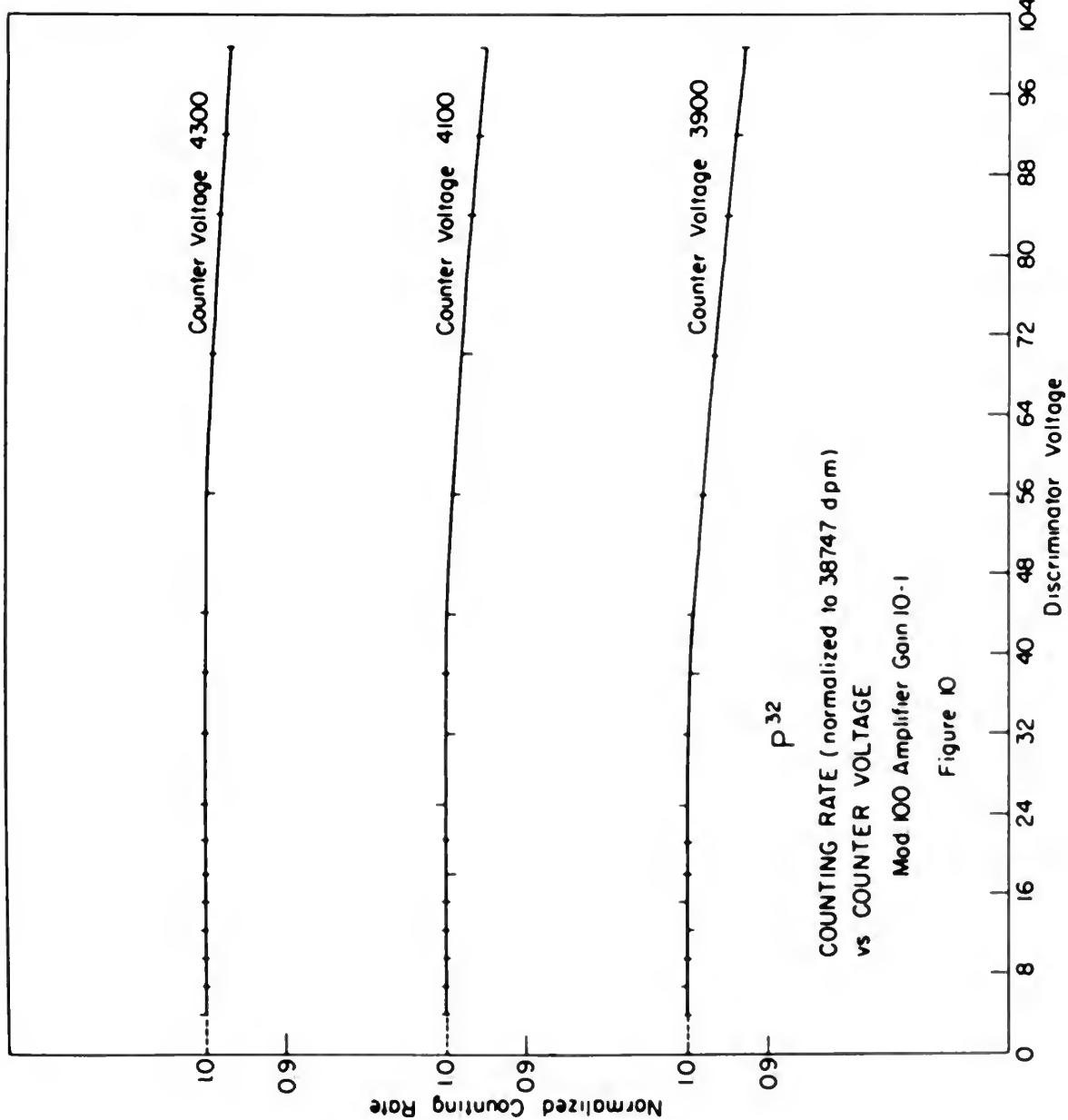


Figure 9







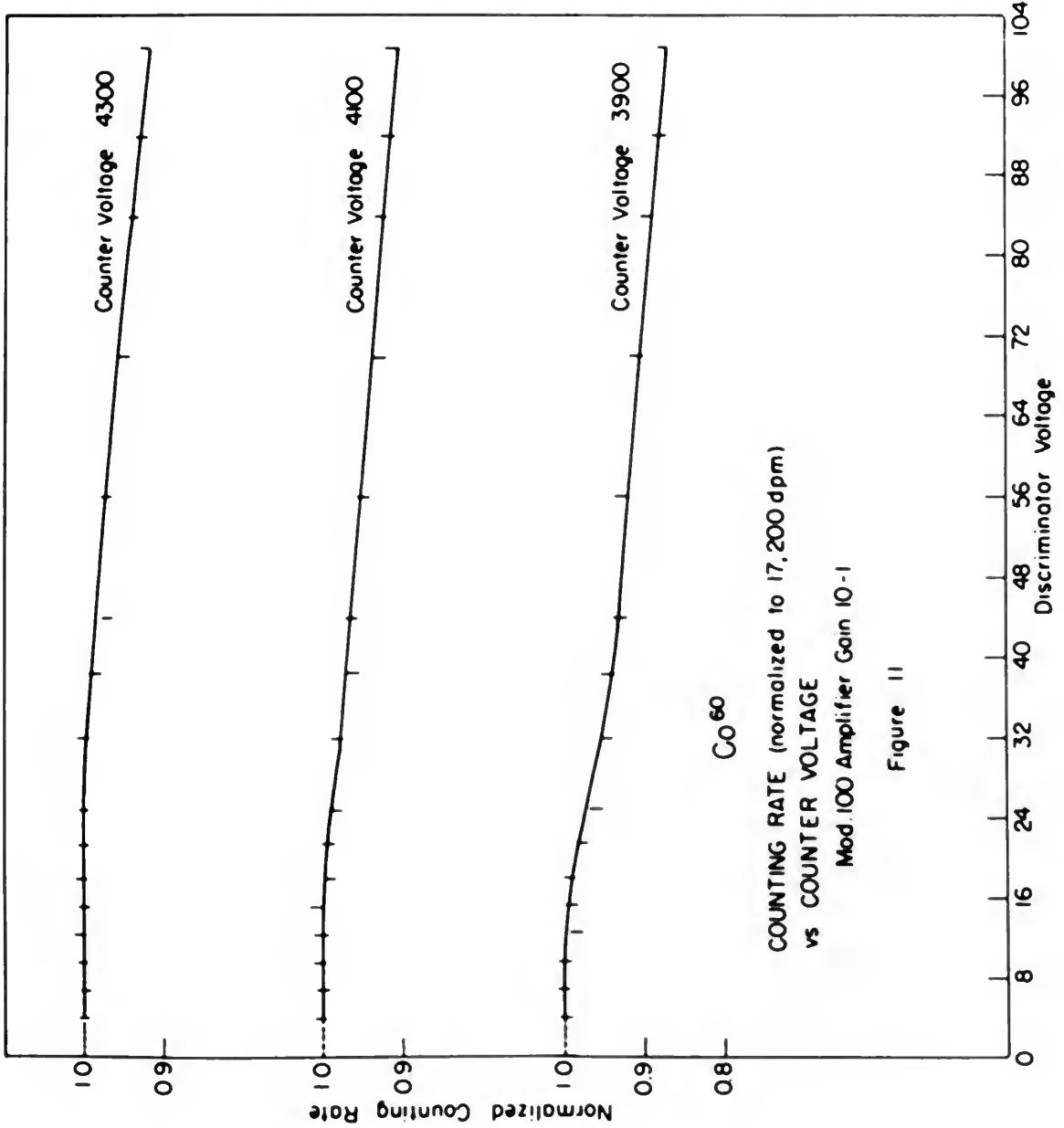
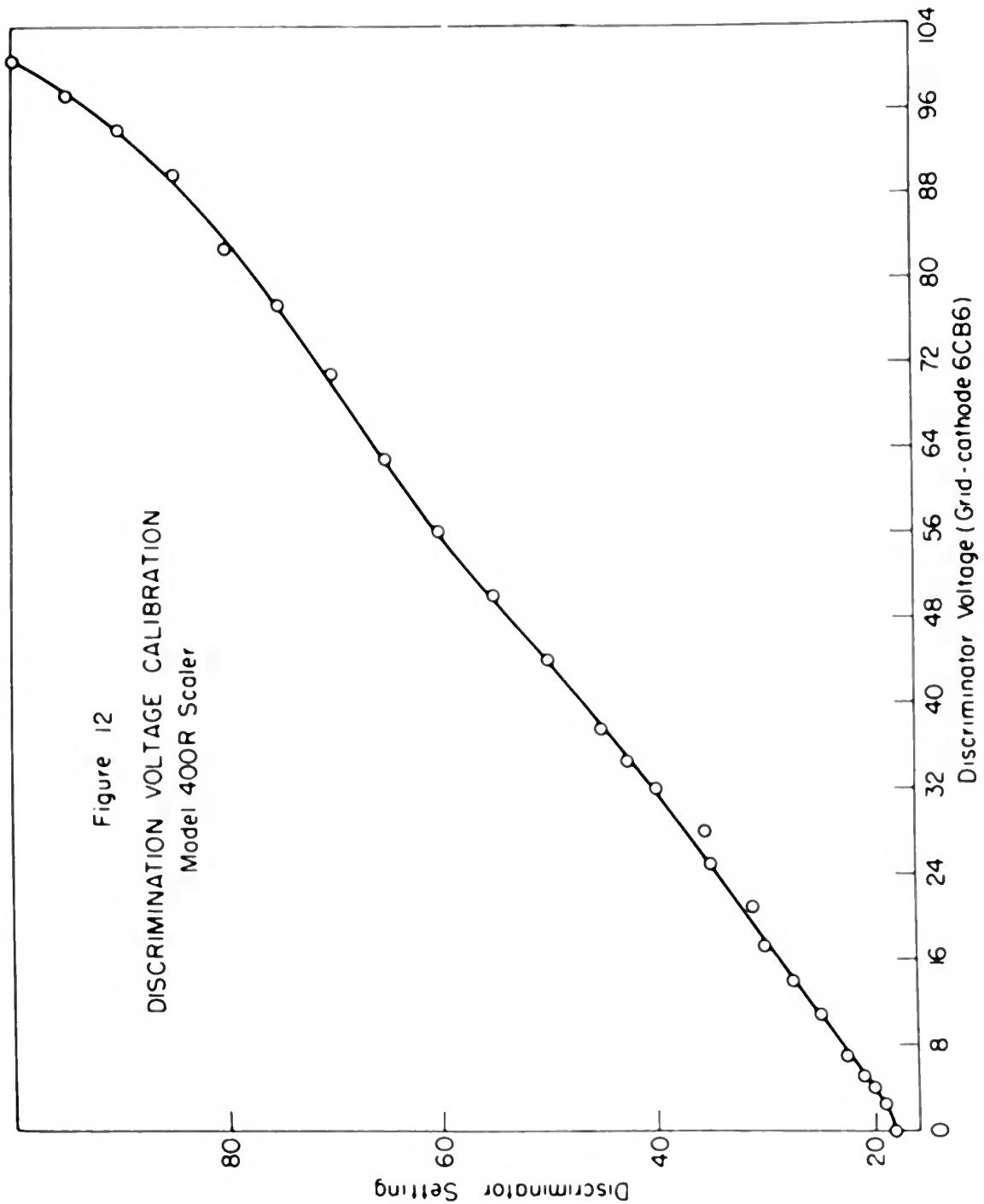


Figure 11



Figure 12  
DISCRIMINATION VOLTAGE CALIBRATION  
Model 400R Scaler





63

disintegration rate is indicated on all curves. A further check to verify proper operation is a statistical analysis of the counting rates for points on the discriminator plateau. The mean value thus obtained should agree with the extrapolated true counting rate.

Once the voltage range of the discriminator plateau has been determined for a given isotope the counting procedure is simplified. The discriminator may then be set at the midpoint of the voltage plateau and with counter voltage set at 4300 volts and an electronic gain of 10:1, a series of runs is made. A statistical analysis of these runs is then made to insure that the counter is operating properly and the observed counting rate is determined by the mean value thus obtained.

An electronic gain of 10:1 is chosen as the normal operating point. At this value the largest pulses in the counter just overdrive the Model 100 amplifier without causing counting losses, and the smallest pulses are sufficiently larger than noise to be detectable over a useful discriminator range.

### 3. Correction to observed counting rate.

The average background is subtracted from the mean value of the measured counting rate, to yield  $N_0$ ,



04

the observed counting rate. For counting rates  $\leq 60,000$  dpm, this value may be used as  $N_t$ , the true disintegration rate, if an error of 3 percent is acceptable.

Any or all of the following corrections may be made depending on the degree of precision desired:

a. Correction for resolving time losses. If  $N_0$  and  $N_A$  are defined respectively as observed and actual disintegration rates, then

$$N_A = \frac{N_0}{1 - \frac{1}{N_0} t}$$

when  $t$  is the counter resolving time which has been determined to be approximately 20  $\mu$ sec.

b. Correction for absorption due to source mounting film. If it is desired to make this correction, then at the same time the source mountings are prepared, cover layers of parlodion film of the same thickness should be prepared on source rings having a central hole of 1 3/8 inch diameter. The conducting film evaporated on these cover layers should be of the same thickness as that deposited on the ring containing the active source.

With the active source in place obtain  $N_{A1}$ , the actual counting rate. Then remove the source ring,

000,00 ≥ απόρια γαλήνων της οποίαν γαλήνων δεν τοποθετούνται πάντα εδώ στην αγορά αλλά όπου από την άποψη της ανάπτυξης της οικονομίας είναι αποτελεσματικό να το γίνεται.

Επιπλέον από την άποψη της ανάπτυξης της οικονομίας είναι αποτελεσματικό να το γίνεται στην Ελλάδα.

Ιδιαίτερα στην Ελλάδα το παραπάνω είναι αποτελεσματικό να γίνεται στην Ελλάδα.

Ιδιαίτερα στην Ελλάδα το παραπάνω είναι αποτελεσματικό να γίνεται στην Ελλάδα.

$$\frac{K}{T} = \frac{G}{T} - 1$$

Τοποθετείται στην Ελλάδα το παραπάνω είναι αποτελεσματικό να γίνεται στην Ελλάδα.

Αποτελεσματικό να γίνεται στην Ελλάδα.

Αποτελεσματικό να γίνεται στην Ελλάδα το παραπάνω είναι αποτελεσματικό να γίνεται στην Ελλάδα.

Αποτελεσματικό να γίνεται στην Ελλάδα το παραπάνω είναι αποτελεσματικό να γίνεται στην Ελλάδα.

Αποτελεσματικό να γίνεται στην Ελλάδα το παραπάνω είναι αποτελεσματικό να γίνεται στην Ελλάδα.

Αποτελεσματικό να γίνεται στην Ελλάδα το παραπάνω είναι αποτελεσματικό να γίνεται στην Ελλάδα.

Αποτελεσματικό να γίνεται στην Ελλάδα το παραπάνω είναι αποτελεσματικό να γίνεται στην Ελλάδα.

Αποτελεσματικό να γίνεται στην Ελλάδα το παραπάνω είναι αποτελεσματικό να γίνεται στην Ελλάδα.

"From symmetry consideration,  $N_A(t) = N_A(b) = N_A$ . carefully place the ring containing the cover layer

"The source is then placed over the film and directly over the source to form a sandwich. With thin end of lead tube in place, again measure  $N_{A_2}$ .

The percentage difference in  $N_{A_1}$  and  $N_{A_2}$  should be quite close to the true correction for absorption due to the mounting film.

A slightly more accurate determination of absorption in the mounting film<sup>(7)</sup> is quoted below for completeness.

"Experiments have been conducted to determine the amount of absorption, if any, due to the film between the source and the lower half of the 4π counter. The number of particles counted by the top half of the counter connected separately will be

$$N_{\text{top}} = \frac{N_0}{2} [1 + B_p + (1 - \tau) B_w(b)] \quad (1)$$

where  $N_0$  is the true disintegration rate of the source,  $B_p$  is the percentage backscattering from the film,  $\tau$  is the fractional absorption in the film, and  $B_w(b)$  is the percentage backscattering due to the walls in the bottom half. The number of particles counted by the bottom half connected separately will be

$$N_{\text{bottom}} = \frac{N_0}{2} [(1 - \tau) + (1 + B_p) B_w(b)] \quad (2)$$

and the other two were in the same condition as the first.  
The last was a small, dark, irregular mass, about the size of a  
pea, and had a thin, dark, wrinkled skin, which was easily  
broken, so that the soft, white, pulpy mass could be seen  
inside. The pulp was sweetish, and had a strong  
odor of orange-peel. It was very juicy, and  
tasted like orange-peel, but it was not so  
sweet. The pulp was very soft, and could be  
eaten with the fingers. The skin was  
thin and brittle, and could be easily  
broken. The fruit was very juicy,  
and had a strong, sweetish taste.  
The pulp was white, and had a  
strong, sweetish taste. The skin was  
thin and brittle, and could be easily  
broken. The fruit was very juicy,  
and had a strong, sweetish taste.

$$(1) \quad \left[ (3)_{\infty} B(-1, -1) + \frac{1}{2^{2m+1}} + \left( \frac{2}{3} \right)^{\frac{2m+1}{2}} \right] \frac{1}{2^m} = \frac{1}{2^{m+1}}$$

RECORDED AND INDEXED BY JAMES R. COOPER, JR.

$$(1) \quad \left[ (t) \cdot 2(0+1) + (T-t) \right] \frac{1}{T} = 2 - \frac{t}{T}$$

"From symmetry considerations  $B_y(t) = B_y(b) = B_y$ .

"The factor  $B_y$  can be neglected when the film is thin and of low atomic number, so that (1) becomes

$$N_{top} = \frac{N}{2}(1 + B_y - \tau B_y) \quad (3)$$

In the bottom half, again assuming  $B_y = 0$ , one obtains

$$N_{bottom} = \frac{N}{2}\left[(1 - \tau) + B_y\right] \quad (4)$$

Putting this in the form  $y = ax + b$  gives

$$N_{bottom} = \frac{-N}{2}\tau + \frac{N}{2}(1 + B_y). \quad (5)$$

"With the thin films under consideration it can be assumed that the absorption is directly proportional to the film thickness. Equation (5) can be used to determine the absorption correction graphically. A more direct method of determining  $\tau$  can be deduced from eq. (3) and (4).

$$N_{top} - N_{bottom} = \frac{N}{2}\tau(1 - B_y). \quad (6)$$

The actual counting rate observed with top and bottom halves connected together is

$$N_{tb} = N_0(1 - \tau/2) \quad (7)$$

so that (6) becomes, if one lets  $N_{top} - N_{bottom} = \Delta$

$\bar{v} = (\sigma)_q^k = (j)_q^k$  another element in  $\mathcal{V}$  where  $\sigma$  is the  
unit root and  $j$  is defined as the  $q^k$  root of unity.  
The second (I) part of theorem states that to has right

$$(5) \quad (\mu - 1 - \mu^2) \frac{f_1}{\lambda} = \cos \theta$$

another one 40 m  $\times$  30 m woodland slope, that covered only

$$(2) \quad \left[ \bar{a} + (T - L) \right] \frac{\pi}{3} = 22.33333^\circ$$

1993 年 11 月 10 日 10:30 AM at 6000' MSL

$$(3) \quad \cdot (1 + z) \frac{d}{dz} + z \frac{d^2}{dz^2} = z$$

Una fit collitzada amb una altra espècie d'escarabat que es troba en el mateix medi, però que no té la mateixa forma i coloració. Aquest escarabat té una coloració més foscament verdosa que l'anterior, i les seves potes són més llargues i més robustes. La seva forma és més allargada i estreta que la dels altres escarabats que s'han trobat en el mateix medi.

(1) and (2) do not

$$(8) \quad \cdot (\mu - 1) T \frac{dy}{dt} = \text{negative} - \text{good}$$

medieval has its title mentioned often in famous Latin and  
in medieval bestiaries again.

$$(V) \quad \left( \frac{d}{dt} (T - t) \right)_{t=0} = \text{diag}(V)$$

$\triangle$  = ~~triangle~~ = ~~an angle with two sides~~ (b) ~~is this one~~

$$\tau = \frac{N_{top} - N_{bottom}}{N_{tb} - N_{bottom}} = \frac{\Delta}{N_{tb} - N_b}, \quad (8)$$

(in  $\mu\text{g/cm}^2$ )

and similarly

$$B_W = \frac{N_{top} + N_{bottom}}{N_{tb}} - 1. \quad (9)$$

activity  $N$ , or

The absolute counting rate is then obtained by substituting (8) into

$$N_0 = \frac{N_{tb}}{1 - \tau/2}. \quad (10)$$

"Thus by taking three different readings of the same source on a single film it is possible to determine the absorption by the film. This proves extremely useful for low energy  $\beta$  particles."

c. Corrections for self-absorption and backscattering due to finite source thickness. In general the sources prepared are very thin compared with the half thickness for  $\beta$  absorption in source material. Since the resultant self-absorption and backscattering corrections are small (usually < 1 percent), approximate methods may be used to compute these corrections. The average source thickness is computed from the source area and the known mass of material contained therein.

Self-absorption may be estimated as follows:

Source thickness,  $t$ , equals the film and source thickness

$$\frac{\Delta}{\sin^2 \theta} = \frac{\text{med sec } k}{\text{med sec } m} = \frac{k}{m}$$

Vestibular brs

$$(1) \quad \omega = \frac{\partial \theta \cos^2 \alpha + \phi \sin^2 \alpha}{\partial \theta} = \omega_0$$

•des vd berlids modt at et x ydstrige omfleade edt  
odet (a) yndstikke

$$(10) \quad \frac{df}{dx} = f$$

one est le système d'assimilation entre unies et autres  
est composé de cellules, et ce sont elles qui sont  
les éléments vivants dans cette partie de la plante.  
Ces cellules sont toutes vivantes et possèdent  
toutes les propriétés propres à une cellule végétale.  
Elles sont toutes vivantes et possèdent toutes les propriétés  
des cellules végétales, mais elles sont aussi des cellules  
animées, c'est-à-dire qu'elles possèdent des propriétés  
animales, mais elles sont aussi des cellules végétales.  
C'est pourquoi nous disons que les cellules végétales  
sont vivantes et possèdent toutes les propriétés  
des cellules animées, mais elles sont aussi des cellules végétales.  
C'est pourquoi nous disons que les cellules végétales  
sont vivantes et possèdent toutes les propriétés  
des cellules animées, mais elles sont aussi des cellules végétales.

Let  $t$  = half thickness for  $\beta$  in source material  
(in  $\mu\text{g}/\text{cm}^2$ )

$\bar{x}$  = average source thickness (in  $\mu\text{g}/\text{cm}^2$ )

then the true activity  $N_t$  is related to the observed activity  $N_A$  by

$$N_A \approx \frac{N_t}{\bar{x}} \int_0^{\bar{x}} \left(\frac{1}{2}\right) (\bar{x}/t) d\bar{x}$$

$$\frac{N_A}{N_t} = \frac{t}{\bar{x}} \left[ 1 - \left(\frac{1}{2}\right) \frac{\bar{x}}{t} \right] = \frac{1 - \left(\frac{1}{2}\right) \bar{x}/t}{0.693 \frac{\bar{x}}{t}}$$

and  $\frac{N_A}{N_t} \approx 1 - (0.346) \bar{x}/t$  for  $\bar{x} \ll t$

If desired, backscattering corrections may be approximated from the results published by Zumwalt.<sup>(9)</sup> In these corrections it is assumed that when the source mounting material is very thin, the percentage of saturation backscattering obtained is a function only of its thickness in terms of absorption half thickness. With this assumption, the Zumwalt data obtained for polystyrene can be applied to parlodion by comparing relative half thicknesses involved.

There is also a small loss for particles which travel transversely through the film and are absorbed

Let's assume  $\alpha$  is the constant that  $\beta = \alpha \beta_0$

$$(\text{no/eq. 1})$$

( $\text{no/eq. 1}$ ) becomes comes up to  $\tilde{x}$   
because only the part of  $\beta$  which is  $\beta_0$  will be added  
to  $x$  which is

$$\tilde{x} = (\sqrt{\tilde{x}}) \left( \frac{1}{\sqrt{\tilde{x}}} \right) \tilde{x} + \frac{\beta_0}{\sqrt{\tilde{x}}} \approx \tilde{x}$$

$$\frac{\sqrt{\tilde{x}} \left( \frac{1}{\sqrt{\tilde{x}}} \right) - 1}{\frac{1}{\sqrt{\tilde{x}}} \text{exp. 0}} = \left[ \frac{\sqrt{\tilde{x}} \left( \frac{1}{\sqrt{\tilde{x}}} \right) - 1}{\frac{1}{\sqrt{\tilde{x}}} \text{exp. 0}} \right] \frac{y}{\tilde{x}} = \frac{\Delta^2}{\tilde{x}}$$

$$\Rightarrow \tilde{x} \text{ for } \sqrt{\tilde{x}} \text{ (exp. 0)} - 1 \approx \frac{\Delta^2}{y} \quad \text{but}$$

as you can see the approximation is very good.  
(e). Shows that  $\beta$  depends on  $\alpha$  and  $\beta_0$  but it is also dependent on  $y$  and  $\Delta$ .  
This means that  $\beta$  is not constant but it is dependent on  $y$  and  $\Delta$ .  
This is because  $\beta$  is dependent on  $\alpha$  and  $\alpha$  is dependent on  $y$  and  $\Delta$ .  
Now let's consider the case when  $\alpha = 1$ . In this case  $\beta = \beta_0$  and  $\beta_0$  is constant.  
So we have  $\beta = \beta_0$  and  $\beta_0$  is constant. This means that  $\beta$  is constant.  
This is because  $\beta_0$  is constant and  $\beta = \beta_0$ .

before emerging. An order of magnitude approximation of this loss can be made by consideration of the solid angle within which particles will traverse one half-thickness of the film before emerging. For  $P^{32}$  (assuming a half thickness of about  $100 \text{ mg/cm}^2$ ) this gives, for a uniform film  $0.05 \text{ mg/cm}^2$  thick:

$$\delta\Omega \sim \frac{2\pi \times \frac{0.05}{100}}{4\pi} \approx \frac{1}{4000}$$

where  $\delta\Omega$  = the fraction of emergent particles which traverse a path  $\geq$  one half-thickness of the film, which is negligible. For softer  $\beta$  particles, this correction may be large enough to require consideration.

## Detector Accidental

### H. Important Characteristics of $4\pi$ Counter

Counter voltage plateau: begins at 3700 volts, slope  $< 0.8$  percent per 100 volts.

#### Settings for normal operation:

Counter voltage: 4300 volts

Cathode: 2500 volts below ground, 600 volts supplied by batteries.

Center wires and guard rings: 1800 volts above ground.

höllentwicklung abweichen. Es besteht eine  
Beziehung zwischen der Höhe der Höhle und  
der Höhe des Wasserspiegels im unteren  
Gesteinsschicht (unterer Gesteinsschicht).  
Die Höhe des Wasserspiegels ist proportional  
zur Höhe des unteren Gesteinsschichtes.  
 $\frac{H_{\text{W}}}{H_{\text{G}} \times 100} = 100$

$$\frac{H_{\text{W}}}{H_{\text{G}}} = \frac{100}{100} \approx 1.0$$

Die Höhe des unteren Gesteinsschichtes ist gleich der  
Distanz zwischen dem unteren Gesteinsschicht und dem  
oberen Gesteinsschicht. Die Höhe des unteren  
Gesteinsschichtes ist gleich der Distanz zwischen dem  
oberen Gesteinsschicht und dem unteren Gesteinsschicht.

Die Höhe des unteren Gesteinsschichtes ist gleich der Distanz zwischen dem unteren Gesteinsschicht und dem oberen Gesteinsschicht.

Die Höhe des unteren Gesteinsschichtes ist gleich der Distanz zwischen dem unteren Gesteinsschicht und dem oberen Gesteinsschicht.

Die Höhe des unteren Gesteinsschichtes ist gleich der Distanz zwischen dem unteren Gesteinsschicht und dem oberen Gesteinsschicht.

Die Höhe des unteren Gesteinsschichtes ist gleich der Distanz zwischen dem unteren Gesteinsschicht und dem oberen Gesteinsschicht.

Die Höhe des unteren Gesteinsschichtes ist gleich der Distanz zwischen dem unteren Gesteinsschicht und dem oberen Gesteinsschicht.

Die Höhe des unteren Gesteinsschichtes ist gleich der Distanz zwischen dem unteren Gesteinsschicht und dem oberen Gesteinsschicht.

Die Höhe des unteren Gesteinsschichtes ist gleich der Distanz zwischen dem unteren Gesteinsschicht und dem oberen Gesteinsschicht.

Die Höhe des unteren Gesteinsschichtes ist gleich der Distanz zwischen dem unteren Gesteinsschicht und dem oberen Gesteinsschicht.

Electronic gain (Model 100 amplifier, Atomic  
Instrument Co. preamplifier Model 204B):

Coarse gain: 10

Fine gain: 1

Resolving time:  $20 \pm 5 \mu\text{sec}$  (determined by a series  
of measurements by the two-source method)

n-butane flow gas rate: approximately 2 bubbles/sec

Flushing time required for stable operation: 20 min

Length of discriminator plateau (at normal operating  
settings):

$\text{Co}^{60}$       25 volts

$\text{I}^{131}$       30 volts

$\text{p}^{32}$       50 volts

Counter efficiency:

$\text{Co}^{60} \approx 87$  percent (due to high solid content  
of available Co activity)

$\text{I}^{131} \geq 98$  percent

$\text{p}^{32} \geq 99$  percent

（中略）

〔一九三〇年六月廿二日〕

61 87243 8245185

10. *Leucosia* *leucostoma* *leucostoma*

reduces the number of errors) occurs at 0.15 sec after onset.

(Person whose duty it is to keep the numbers in  
order adds) first four two one two  
one four two one two

卷之三

4 2 - 65.1232 19.10.00

3100.000 225.000 500.000 1000.000 1500.000

(This was at least three to  
four years in 1872.  
This was in 1879.

10. ~~CONTINUE~~ Appendix I - Bibliography

1. Caswell, R. C.: Ph.D. Thesis, "A Study of the Average Energy of  $\beta$ -Rays," MIT (1947).
2. Borkowski, C. J.: Conference on Absolute  $\beta$ -Ray Counting, National Bureau of Standards, July 13, 1949.
3. Seliger, H.: Private communication, 1953.
4. Rossi, B. B. and H. H. Staub: Ionization Chambers and Counters, McGraw-Hill Book Co., N. Y., 1939.
5. Brown, S. C.: "Theory and Operation of G-M Counter", Nucleonics, 2, 10 (1948); 3, 50(1948); 3, 46 (1948).
6. Seliger, H.: Private communication, 1953.
7. Seliger, H. and L. Cavallo: "The Absolute Standardization of Radioisotopes by  $4\pi$  Counting", J. Research Natl. Bur. Standards, 41 (July 1951).
8. Putnam, J. L.: "On the Absolute Measurement of  $\beta$ -Emitters", United Kingdom Atomic Energy Research Establishment AERE-NR-318, 24 February 1949.
9. Zumwalt, L. H.: United Kingdom Atomic Energy Research Establishment, MDDC-1346. (Reproduction of curves contained in reference no. 8).

Digitized by IIT Kharagpur

add to chart at about 11.00 A.M. on 1st January 1981.  
(1981) TIP "switched to hybrid system  
valve & pump to control 1.0 M.W. turbine in  
parallel to assist turbine generation  
20th 1981.

1981 Hybrid scheme adopted 1.0 M.W. pump  
and 1.0 M.W. gas turbine generation  
and Computer, McGraw-Hill Book Co., N.Y.  
1981.

2. Dhow, E.C. "Impact and Operation of G-M Computer",  
(1981) At 3: (20102), 20 (1981) of 3, 1981,  
describes how the computer can be used to  
monitor and control the plant. It also  
describes the various modes of operation  
of the plant and the various parameters  
monitored and controlled by the computer.  
1981.

Computer based plant control system  
is also described. The system consists of  
a central computer (IBM 360/65) connected  
to various sensors and actuators.

10. Houtermans, F. G., L. Meyer-Schutzmeister, and D. H. Vincent; "Energy Calibration for  $4\pi$  Counters", Z. Physik. 1, 134 (1952).

10. *Montezuma*, L. D. & *Montezuma*, L.  
tot solitariae eximia conspicillata  
. (3881) *ACI* 134. *Montezuma*, L.

## APPENDIX II

### THE SCINTILLATION $\gamma$ -RAY SPECTROMETER

The counter consists of a sodium iodide unilluminated crystal 2.5 cm in diameter and 5 cm long mounted on a lead brick. APPENDIX II and section 5.6. The gain of the photomultiplier used is adjusted so that the spectrum is always represented by voltage pulses of from 0 to 100 millivolts. A single channel differential pulse height analyzer, fed by the linear amplifier, gives a resolution, under optimum conditions, of 1000 counts per minute. The maximum pulse height is limited by the maximum transmission of the photomultiplier, which is about 80% at 400 m $\mu$ .

### THE SCINTILLATION $\gamma$ -RAY SPECTROMETER

can measure energy up to 100 to 10,000 counts per minute. The maximum pulse height is limited by the maximum transmission of the photomultiplier, which is about 80% at 400 m $\mu$ .

## II. ALGORITHMS

STRUCTURE OF THE COMPUTATION

## APPENDIX II

### THE SCINTILLATION $\gamma$ -RAY SPECTROMETER

The counter consists of a sodium iodide thallium activated crystal 4.3 cm in diameter and 5 cm long mounted on an RCA type 5619 photomultiplier tube. The gain of the linear amplifier used is adjusted so that the spectrum is always represented by voltage pulses of from 0 to 100 volts. A single channel differential pulse height analyzer, fed by the linear amplifier, drives a precision counting rate meter of variable time constant and full-scale sensitivity of from 200 to 20,000 counts per minute. The discriminator base line is varied continuously from approximately 0 to 100 volts and a window of 2 volts is used for all observations. Calibration runs were made before and after obtaining each set of data by use of  $\gamma$ -emitters of known energy.

## III. XVIDANIA

### СУДОМОВОЕ ВЪЗДЕХИТЕЛЬНОЕ ДЕНЬГИ

многие ошибки ведут к неизбежности ошибок в суде. Судебные ошибки ведут к тому, что судья не может вынести правильный приговор. Поэтому для того, чтобы избежать ошибок, необходимо учесть следующие факторы:

- 1. Составление обвинения. Составление обвинения должно быть основано на достоверных фактах и доказательствах. Обвинение должно быть составлено в соответствии с законом.
- 2. Проведение судебного заседания. Судебное заседание должно проводиться в соответствии с законом. Судебное заседание должно быть проведено в присутствии судьи и прокурора.
- 3. Вынесение приговора. Вынесение приговора должно быть основано на достоверных фактах и доказательствах. Приговор должен быть вынесен в соответствии с законом.
- 4. Апелляция. Апелляция должна быть подана в суд в установленные законом сроки.
- 5. Исполнение приговора. Исполнение приговора должно быть осуществлено в установленные законом сроки.

APPENDIX III

Table of Contents

APPENDIX III

Section A. Description of Equipment . . . . .	18
Section B. Experimental Technique . . . . .	19
<b>THE END WINDOW &amp; COUNTER</b>	
Section C. Corrections of Observed Data . . . . .	22
Section D. Resolving Time Losses . . . . .	23

III KICKWEEA

RETNUOD S WOOLIV GNG SHY

**APPENDIX III****APPENDIX III  
Table of Contents****Figures****Tables****Maps**

<b>Section A. Description of Equipment . . . . .</b>	<b>78</b>
<b>Section B. Experimental Technique . . . . .</b>	<b>78</b>
<b>Section C. Corrections of Observed Data . . . . .</b>	<b>79</b>
<b>Section D. Resolving Time Losses' . . . . .</b>	<b>80</b>

III ALGEMEEN

Copy to Captain

BY . . . . . transmits to interested A noted  
BY . . . . . copies information B noted  
BY . . . . . and forward to interested C noted  
BY . . . . . send copy to interested D noted

## APPENDIX III

### List of Figures

<u>Figure No.</u>	<u>Title</u>	<u>Page</u>
1	End window $\beta$ counter response curve . . .	82
2	Curve of lost counts per minute . . . .	83

### APPENDIX III

#### Answers to Test

<u>ANSWER</u>	<u>QUESTION</u>	<u>TYPE</u>
BB	• • • STUDY subsequent training & working life	I
BB	• • • consider the changes that took place	II

60

Counting procedures agreed with those given in the table and  
of absorber.

### APPENDIX III

#### THE END WINDOW $\beta$ COUNTER

Counts per minute taken, were recorded for the first three intervals. At later counting rates, the present count (number of the scale) was utilized and the time required for 10,000 counts was recorded. All curves for counting rates, a preset count of 10000 were used.

#### A. Description of Equipment

The tube was operated at the midpoint of the

This equipment, used in determining  $\beta$  energies, voltage, consists of a conventional end window Geiger-Muller

tube\* and a set of calibrated aluminum absorbers.\*\*

The tube is mounted in a shielded sample changer\*\*\*, which contains sliding trays for accurate positioning of source and absorber.

#### B. Corrections of Observed Data

#### B. Experimental Technique

Other data concerning the counter sensitivity.

With a source inserted on the lower tray under the Geiger tube counting rates were recorded for various thicknesses of absorber contained on the upper tray.

---

\* Tracerlab, Inc. Model MG-CB Geiger Tube, window thickness 2 mg/cm<sup>2</sup>.

\*\* Tracerlab, Inc. Type E-3A Calibrated Absorbers.

\*\*\* Tracerlab, Inc. Model SC-90 Shielded Manual Sample Changer.

APPENDIX III  
THE END MILEAGE & COMMENCEMENT

A. Description of Distances

distances & milestones at four, five and six miles from the junction of the two roads, the first being the road leading to the village of Krasnaya Gora, the second to the village of Olenyovka, the third to the village of Sloboda, and the fourth to the village of Krasnaya Gora.

B. Description of Intermediate Points

The distance between the junction of the two roads and the first milestone is about 1.5 km. The distance between the first and second milestones is about 1.5 km. The distance between the second and third milestones is about 1.5 km. The distance between the third and fourth milestones is about 1.5 km.

C. Description of Roads

The distance between the junction of the two roads and the first milestone is about 1.5 km. The distance between the first and second milestones is about 1.5 km. The distance between the second and third milestones is about 1.5 km. The distance between the third and fourth milestones is about 1.5 km.

Counting procedure varied depending upon the thickness of absorber. At high counting rates, the number of counts per 1 minute interval was recorded for at least three intervals. At intermediate counting rates, the preset count feature of the scaler was utilized and the time required for 10,000 counts was recorded. At very low counting rates, a preset count of 4000 was used.

The tube was operated at the mid-point of its voltage plateau to insure maximum stability. In addition a set of five standardized  $\beta$  emitters of known energy was periodically counted thus enabling the correction of observed counting rates for any changes in instrument sensitivity.

### C. Corrections of Observed Data

Other than correcting for counter sensitivity fluctuations mentioned above, the only correction required was for resolving time losses. These corrections were made by adding to the observed counting rates the number of lost counts per minute (Fig. 2).

Complex biological systems often contain many different types of components.

10 wedmn adt ,asdz gntnmc dyisi JA .wednada lo  
fnel ja tot bebiocoz saw levtdmli osmlim I tot gntnmc  
adt ,asdz gntnmc etalbunrcal ja .glnvndmli osldj  
adt bns beklilis saw telosz adt le otntsej dmcs teesiq  
yxov JA .bebiocoz saw gntnmc 000,01 tot beklupex adt  
.beur saw 0000 to jnmc jzrctq s ,asdz gntnmc vol  
ati lo jnlyq-him adt ts bebiocoz saw edts adt  
litibbs nI .yjilidnje mmlmn etmnl of nsctafq egstiov  
yavens avcan lo xetjline & beklbzabnts svil lo jnmc  
lo nclbctrcs adt yjilidnje adt beurwos qfleibolreq saw  
jnmuritual ni sochnad uia tot asdz gntnmc hervzeado  
.yjilidnje

C. Corrections of Opinions to be made before the end of 1952

γνικής γνώσης τοι γνιζότας μετά γενέθλιο  
μετέπειτα γίνεται „ερδός“ δημόσιαν αποτάξειν  
αποτάξεις είναι .επειδή είναι γνωστός τοι πως δεκτοπετ  
είναι αυτός γνώσης διεύθυντος ο οποίος γνικής γνώσης  
. (Σ .317) εξαίρετη τοι απόγονος φαίνεται να γεννήσει

D. Resolving Time Losses  
observed counting rate is a constant resolving time

It is generally assumed that the resolving time of an instrument is constant for all counting rates and corrections are usually made for resolving time losses by means of equations derived on the basis of two general counter types; the paralyzable and the non-paralyzable. A detailed treatment of these two cases\* results in the following equations:

$$n = Ne^{-Np} \quad (\text{paralyzable type}) \quad (1)$$

$$n = N(1 - np) \quad (\text{non-paralyzable type}) \quad (2)$$

At low counting rates both equation (1) and equation (2) reduce to

$$N = n(1 + np) \quad (3)$$

where  $N$  and  $n$  are respectively the true and observed counting rates and  $p$  is the resolving time.

In this experiment it was considered necessary at times to count at very high rates ( $\sim 50,000$  cpm) because of the possible presence of short-lived isotopes and the desire to obtain complete sets of absorption data as quickly as possible. It was obvious that the approximate equation (3) could not be used and it was also found that

\* Evans, R. D.: Class Notes for Course 8.512, Chapter 30.

coed mit aktivem .a

to omis galivioeret edt satis homineas viflarens eti si  
bns eozat galivioe llii zot tafelmo eti tneuvijsati na  
kousel omis galivioeret zot obam viflarens eti smoldeertioe  
owt to alzad edt no hovktesh apoftaups to almen yd  
mon eti bns vldazylstesq eti {soeqz tafelmo lacheneg  
"ezane owt eozit to tneuvijs bellesch A .vldazylstesq  
:enoltemps galiviolet edt n1 vflare

$$(I) \quad (\text{equivalent form}) \quad qH - qK = n$$

$$(2) \quad (\text{eqv. classification}) \quad (qk - l)k = n$$

(2) noitampe bsa (1) noitampe dted eftex gntimes voi ta  
et esbter

$$(5) \quad (4n+1)n = 2$$

neither equations (1) nor (2) properly corrected the observed counting rates if a constant resolving time was assumed.

To obtain a useful relation between counting rate and resolving time loss, the response of the instrument to a series of standard sources of known activity was measured and a plot made of observed vs expected counting rate (Fig. 1).\* Two response curves are shown, one for a discriminator setting of 4, the other for a setting of 6.\*\* From the curve for a discriminator setting of 4, the setting used throughout the experiment, a plot of lost counts per minute vs observed counting rate (Fig. 2) was prepared to facilitate correction of the observed data.

To verify the accuracy of this procedure, several sources were counted with discriminator settings of 4 and 6. The following tabulation of the counting rates observed and the true counting rates computed from the applicable curve of Fig. 1, shows that the computed values agree within experimental error thus indicating that consistent corrections may be made by this method.

---

\* Evans, R. D.: Class Notes for Course 8.512, Chapter 30, page 15.

\*\* Data of E. Samuels, Physics Research Laboratory, Massachusetts General Hospital, Boston, Mass.

mit begeertere vleugelyk (2) dan (1) en volgtende redien  
omt gelycoeter duidelijc s li sejst gelymde beverende  
.herwaerd saw  
ster gelymde mocht houwen. Dusken n gelyde of  
fouurtenk sij te eenegech sijt, sool omk gelycoeter hou  
saw gelyviken gelyc hou gelymde brabende te eniger s of  
gelymde beverende av beverende te oben soiq s hou beverende  
s tel ons .dwole ons gelymde eenegech ont \*(1 .glt). ster  
te gelytter s tel ridders mit ,  
s te gelytter totzalmijnsath s tel evinc ons moret \*\*.  
s te soiq s .gelytterghe mit standgoedt bouw gelytter ons  
(2 .glt) ster gelymde beverende av gelym weg etnec sool  
beverende sij te melyverre oestifheit of betrekelyk saw  
.njab

Istevos , emboesq; sint le yasmeos eft vñlos et  
le agnitos yasmeos qdlyw betwos etw seos  
etw galenos eft le nolaludat galvofit eft .  
A bra  
eft mori betwos etw galenos eft le hevendo  
betwos eft fadz swode , l . sft le evno elcetiqas  
galvofit eft totte lafuenteqs alatiw etw asinav  
. bodam sint yd obas ed yas exoitectos fnefance fadz  
tambor . 9 eft le yas jasoy etw 1 . 3 . K . enayE \*

• such person, including his dependents, as may be necessary to effect the removal of the child from the state.

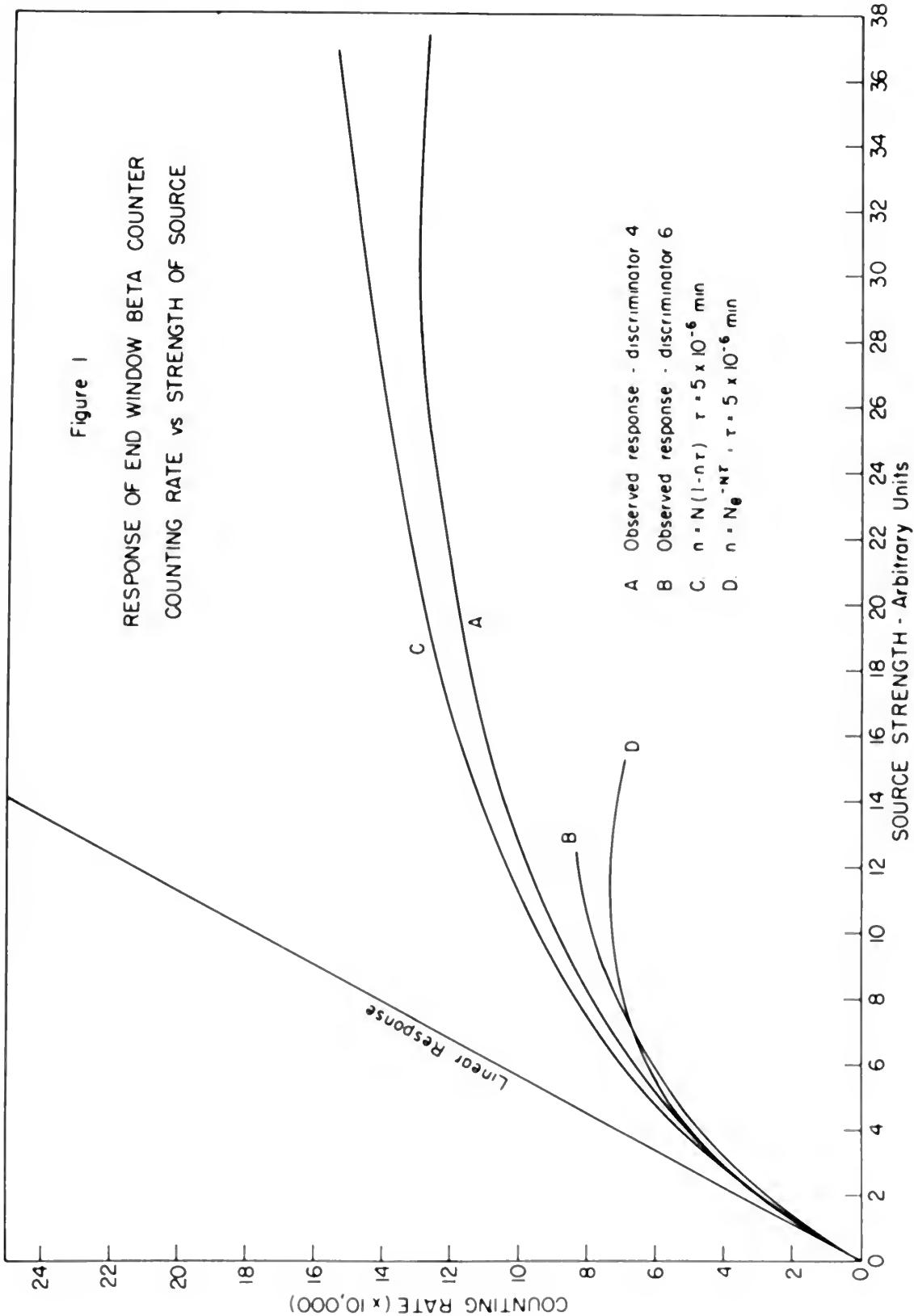
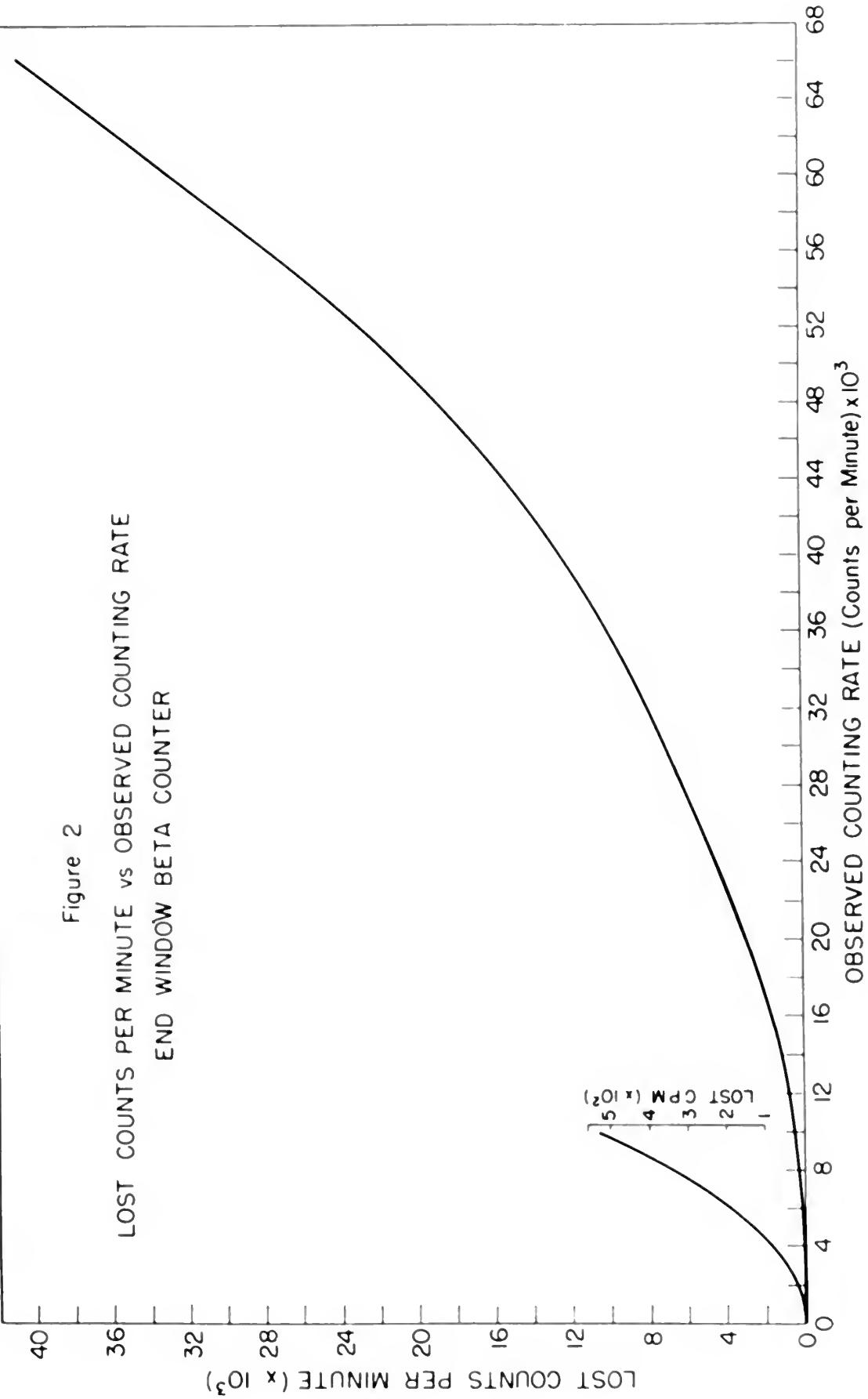




Figure 2  
LOST COUNTS PER MINUTE vs OBSERVED COUNTING RATE  
END WINDOW BETA COUNTER





69

Observed counting rate cpm		Computed true counting rate cpm	
<u>Disc. 4</u>	<u>Disc. 6</u>	<u>Disc. 4</u>	<u>Disc. 6</u>
10580	9850	10990	10700
41350	38910	54350	53900
67600	61100	110,000	109,000

~~APPROXIMATELY~~

Referring to Fig. 1, it is seen that neither response curve coincides with the theoretical curves of equations (1) and (2). It is apparent that the number of lost counts is strongly dependent upon the discrimination level. The results obtained may be explained by a consideration of the pulse height distribution as a function of counting rate.\* This shows that as the counting rate is increased, many small pulses are formed and some fraction of these pulses is lost because of the discrimination level and not because of the dead time of the tube.

---

\* McCall, R. C.: "Geiger-Muller Counters", M.I.T.

Progress Report, 1953.

Commodity Rate		Commodity Rate	
Per cent	Per cent	Per cent	Per cent
3.00	4.00	3.00	4.00
10000	10000	8000	10000
10000	23500	38000	41320
10000	100000	87700	87600

envelope to receive information and data solutions which  
will be reduced and ready to use at the time of publication.  
The envelope to receive information and data solutions will  
be reduced and ready to use at the time of publication.

## APPENDIX IV

Section A. Definitions.

Section B. **THE COINCIDENCE COUNTER**

Section C. Comparison of Measures according to Type

VI KICKING

THE CONCURRENCE DOCUMENT

## APPENDIX IV

CONTENTS OF FIGURES

### Table of Contents

Figure No.	Title	Page
1	Diagram showing our methodology	88
<b>Section A. Description . . . . .</b>	<b>88</b>	
2	Diagram showing our methodology	90
<b>Section B. Experimental Technique . . . . .</b>	<b>91</b>	
3	Qualitative distribution of observations	92
<b>Section C. Correction of Observed Counting . . . . .</b>	<b>96</b>	
4	Estimated rates of counting	96
5	Estimated corrected Thelidium numbers	98

APPENDIX VI

Types of Contracts

83	.....	police	.....	police	.....	police
16	.....	supervision	.....	supervision	.....	supervision
86	.....	control	.....	control	.....	control

and so

## APPENDIX IV

### List of Figures

<u>Figure No.</u>	<u>Title</u>	<u>Page</u>
1	Schematic diagram of scintillation counter . . . . .	90
2	Coincidence counter assembly . . . . .	93
3	Sensitivity distribution of coincidence counter . . . . .	95
4	Coincidence counter response curve . . . . .	98

APPENDIX VI

### ANSWER TO JADE

00

## APPENDIX IV

### THE COINCIDENCE COUNTER

---

#### A. Description

This equipment consists of two thallium activated sodium iodide scintillation counters connected in coincidence with single channel and coincidence scaling circuits driving mechanical registers. The crystals are 1.5 inches in diameter, 1 inch deep, and are mounted on RCA type 5812 photomultiplier tubes.

The counters are contained in lead shielded heads along with their cathode follower type preamplifiers shown schematically in Fig. 1. The two heads are mounted on a mechanical scanning device such that the two opposing crystals are coaxial and are separated by approximately 27 cm. A mounting bracket permits positioning of a source equidistant from the crystal faces and colinear with their common axis.

The coincidence circuit is of conventional design\* providing both single channel and coincidence outputs which

---

\* Dwg. No. B-1547-A, file 6425, Laboratory for Nuclear Science, M.I.T., 28 April 1950.

VI APPENDIX  
THE COMMERCIAL COMMISSION

---

A. Description

betwixt willist oft to salane fleming aint  
ni betwixt eteane nofmannis shibeit with  
antise conebionis bne fennado signe djiw conebionis  
alayis oft . aratajot Isalmicem galvinis atisoris  
betwixt eta bne , qed dont i , referato ni aedant 3.1 eta  
, sedut talqitumodiq QISB egypt AOA no  
abed babiedha basi at hanatnos eta eteane oft  
xeritilisqet eqyt swellot abedta tient djiw ynois  
betwixt eta abed oft oft . i . oft ni yllolamadis awor  
galeqqo oft oft dene salvek galvanos Isalmicem a no  
qleissimoraga yd betwixt eta bne Isalmicem eta elatevto  
etowes a te galvanis etiireq tekorti galvanis a . no ta  
tient djiw teneblios bne eocat Isalyis eta mor tieni  
, alix pommec  
#yusab Isalmicem a te el teneblios conebionis oft  
doini a nappata ampih

---

\* D.A.R. No. 0-1524-7, 111 G-28, Papeete, Polynesia, 1920.



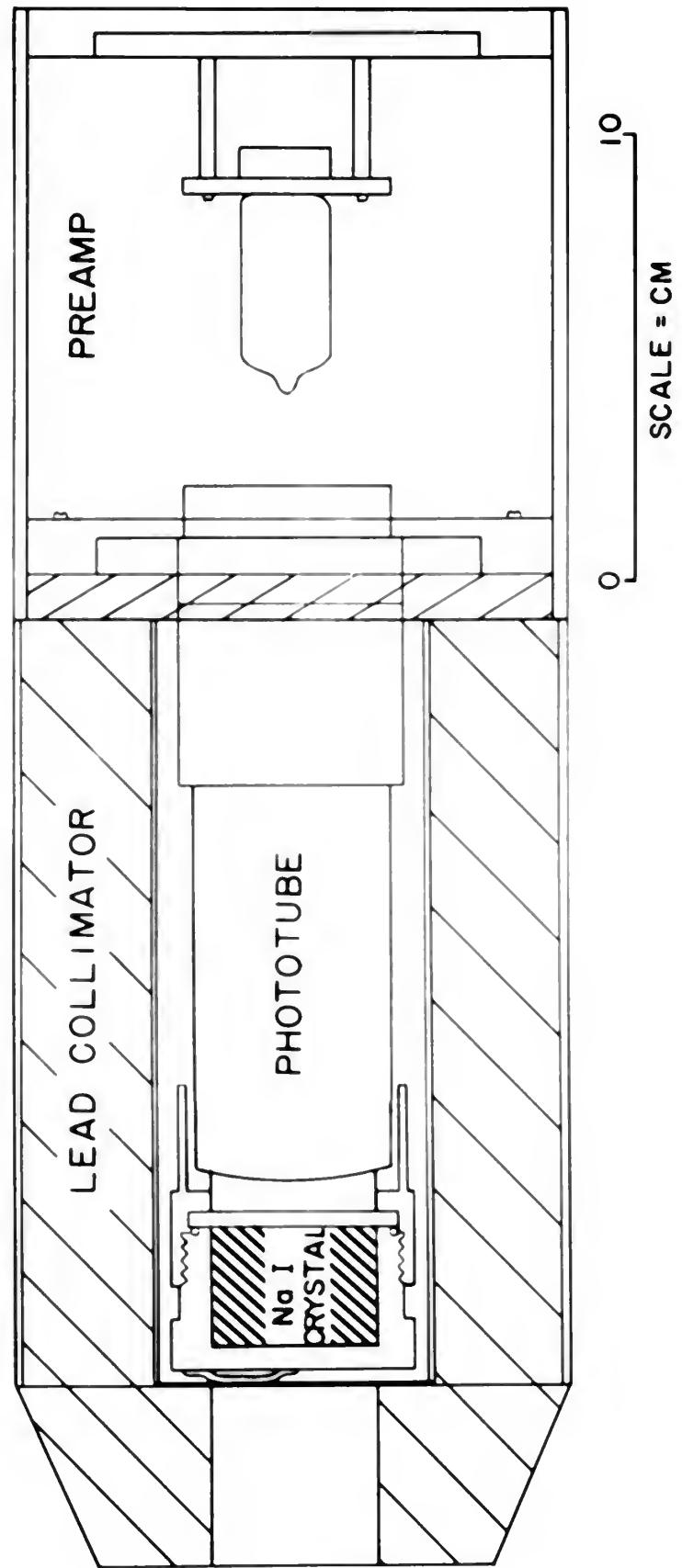
• *reduces noise pollution to negligible amounts . I . 817*

*base edit ridgely unoccupies to noiseless edit  
especially as at base unblocks*



**Fig. 1. Schematic diagram of scintillation counter.**

**The location of components within the lead  
shielding head is as indicate.**





are fed through linear amplifiers\* to separate scaling circuits\*\*. The equipment assembled for normal use is illustrated in Fig. 2.

### B. Experimental Technique

The equipment is operated so that the individual channels register approximately equal counting rates when a source is at the mid-point on the axis between the counter heads.

Figure 3 illustrates that counting rates are only slightly affected by small displacements of the source from its central position. To minimize errors caused by variation in counter sensitivity due to other causes, a standard  $\text{Na}^{22}$  source was counted prior to each measurement and the correction thus determined was applied to the observed counting rate.

In all measurements the number of counts per 1 minute interval was recorded, each observation including at least three intervals for single channel counts and six intervals for coincidence counts. At least 10,000 events were included in each observation to insure a maximum fractional standard deviation of  $\leq 1$  percent.

---

\* Atomic Instrument Co. Model 204B Linear Amplifier.

\*\* Atomic Instrument Co. Model 1030 "Scale of 1000" Scaler.

•R. 377 al betwischen

*supradentate* *tearose* . 8

100  
een tot beeldmerk gemaakte R1 gemaakte  
verzamelingen die is. Drie andere gemaakte hi  
zelfde hout gemaakte. Echte hout  
Lengte van de beeldmerk zijn: enkele  
beelden van de ene. enkele beeldmerk te maken  
die er officieel en, kroon enkele beeldmerk  
beeldmerk enkele beeldmerk te maken

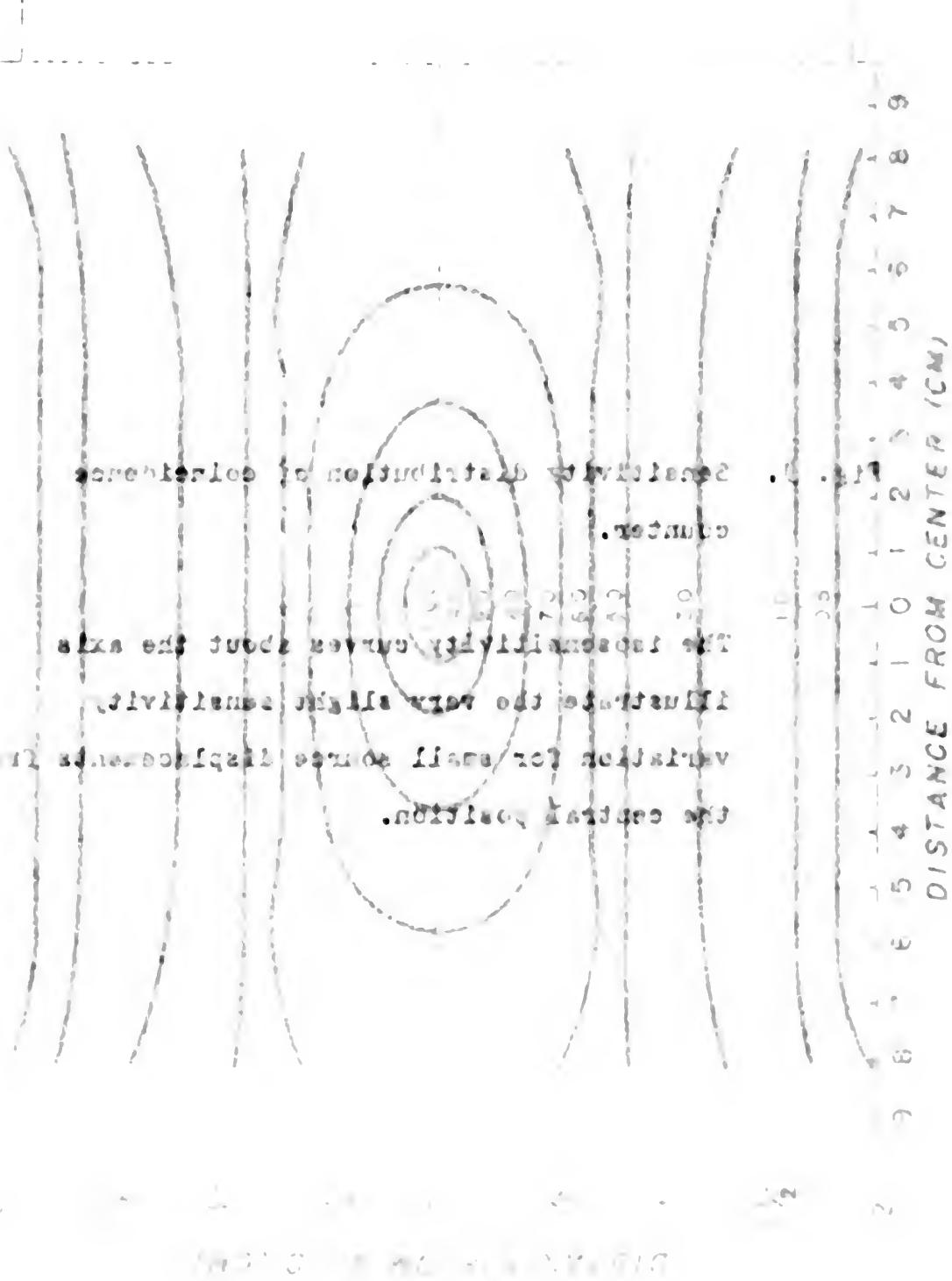
Fig. 2. Coincidence counter assembly.

The equipment is shown as assembled for use in scanning measurements at Massachusetts General Hospital. The scanning and plotting mechanisms are contained in the central section of the photograph. The opposing lead shielded counter heads are visible to the right of the plotting board.

1	H	C	O
2	N	P	S
3	Al	Fe	Ni
4	Si	Co	Sn
5	Cl	Cr	Pd
6	Ca	Mn	Rh
7	Br	V	Ru
8	Ge	Sc	Os
9	Ti	As	Ir
10	Zn	Ga	Pt
11	Al	Nb	U
12	B	Mo	O
13	Na	Tc	W
14	Mg	Te	Re
15	Sc	Ge	Ta
16	Ca	Y	Si
17	Zn	Al	Sh
18	CC	Yb	Tl
19	K	Cd	Pb
20	Ca	In	Bi
21	Zn	Sn	Al
22	Ca	Sn	Ag
23	Ca	Sn	Ac
24	Ca	Sn	Ca
25	Ca	Sn	Ca
26	Ca	Sn	Ca
27	Ca	Sn	Ca
28	Ca	Sn	Ca
29	Ca	Sn	Ca
30	Ca	Sn	Ca
31	Ca	Sn	Ca
32	Ca	Sn	Ca
33	Ca	Sn	Ca
34	Ca	Sn	Ca
35	Ca	Sn	Ca
36	Ca	Sn	Ca
37	Ca	Sn	Ca
38	Ca	Sn	Ca
39	Ca	Sn	Ca
40	Ca	Sn	Ca
41	Ca	Sn	Ca
42	Ca	Sn	Ca
43	Ca	Sn	Ca
44	Ca	Sn	Ca
45	Ca	Sn	Ca
46	Ca	Sn	Ca
47	Ca	Sn	Ca
48	Ca	Sn	Ca
49	Ca	Sn	Ca
50	Ca	Sn	Ca
51	Ca	Sn	Ca
52	Ca	Sn	Ca
53	Ca	Sn	Ca
54	Ca	Sn	Ca
55	Ca	Sn	Ca
56	Ca	Sn	Ca
57	Ca	Sn	Ca
58	Ca	Sn	Ca
59	Ca	Sn	Ca
60	Ca	Sn	Ca
61	Ca	Sn	Ca
62	Ca	Sn	Ca
63	Ca	Sn	Ca
64	Ca	Sn	Ca
65	Ca	Sn	Ca
66	Ca	Sn	Ca
67	Ca	Sn	Ca
68	Ca	Sn	Ca
69	Ca	Sn	Ca
70	Ca	Sn	Ca
71	Ca	Sn	Ca
72	Ca	Sn	Ca
73	Ca	Sn	Ca
74	Ca	Sn	Ca
75	Ca	Sn	Ca
76	Ca	Sn	Ca
77	Ca	Sn	Ca
78	Ca	Sn	Ca
79	Ca	Sn	Ca
80	Ca	Sn	Ca
81	Ca	Sn	Ca
82	Ca	Sn	Ca
83	Ca	Sn	Ca
84	Ca	Sn	Ca
85	Ca	Sn	Ca
86	Ca	Sn	Ca
87	Ca	Sn	Ca
88	Ca	Sn	Ca
89	Ca	Sn	Ca
90	Ca	Sn	Ca
91	Ca	Sn	Ca
92	Ca	Sn	Ca
93	Ca	Sn	Ca
94	Ca	Sn	Ca
95	Ca	Sn	Ca
96	Ca	Sn	Ca
97	Ca	Sn	Ca
98	Ca	Sn	Ca
99	Ca	Sn	Ca
100	Ca	Sn	Ca
101	Ca	Sn	Ca
102	Ca	Sn	Ca
103	Ca	Sn	Ca
104	Ca	Sn	Ca
105	Ca	Sn	Ca
106	Ca	Sn	Ca
107	Ca	Sn	Ca
108	Ca	Sn	Ca
109	Ca	Sn	Ca
110	Ca	Sn	Ca
111	Ca	Sn	Ca
112	Ca	Sn	Ca
113	Ca	Sn	Ca
114	Ca	Sn	Ca
115	Ca	Sn	Ca
116	Ca	Sn	Ca
117	Ca	Sn	Ca
118	Ca	Sn	Ca
119	Ca	Sn	Ca
120	Ca	Sn	Ca
121	Ca	Sn	Ca
122	Ca	Sn	Ca
123	Ca	Sn	Ca
124	Ca	Sn	Ca
125	Ca	Sn	Ca
126	Ca	Sn	Ca
127	Ca	Sn	Ca
128	Ca	Sn	Ca
129	Ca	Sn	Ca
130	Ca	Sn	Ca
131	Ca	Sn	Ca
132	Ca	Sn	Ca
133	Ca	Sn	Ca
134	Ca	Sn	Ca
135	Ca	Sn	Ca
136	Ca	Sn	Ca
137	Ca	Sn	Ca
138	Ca	Sn	Ca
139	Ca	Sn	Ca
140	Ca	Sn	Ca
141	Ca	Sn	Ca
142	Ca	Sn	Ca
143	Ca	Sn	Ca
144	Ca	Sn	Ca
145	Ca	Sn	Ca
146	Ca	Sn	Ca
147	Ca	Sn	Ca
148	Ca	Sn	Ca
149	Ca	Sn	Ca
150	Ca	Sn	Ca
151	Ca	Sn	Ca
152	Ca	Sn	Ca
153	Ca	Sn	Ca
154	Ca	Sn	Ca
155	Ca	Sn	Ca
156	Ca	Sn	Ca
157	Ca	Sn	Ca
158	Ca	Sn	Ca
159	Ca	Sn	Ca
160	Ca	Sn	Ca
161	Ca	Sn	Ca
162	Ca	Sn	Ca
163	Ca	Sn	Ca
164	Ca	Sn	Ca
165	Ca	Sn	Ca
166	Ca	Sn	Ca
167	Ca	Sn	Ca
168	Ca	Sn	Ca
169	Ca	Sn	Ca
170	Ca	Sn	Ca
171	Ca	Sn	Ca
172	Ca	Sn	Ca
173	Ca	Sn	Ca
174	Ca	Sn	Ca
175	Ca	Sn	Ca
176	Ca	Sn	Ca
177	Ca	Sn	Ca
178	Ca	Sn	Ca
179	Ca	Sn	Ca
180	Ca	Sn	Ca
181	Ca	Sn	Ca
182	Ca	Sn	Ca
183	Ca	Sn	Ca
184	Ca	Sn	Ca
185	Ca	Sn	Ca
186	Ca	Sn	Ca
187	Ca	Sn	Ca
188	Ca	Sn	Ca
189	Ca	Sn	Ca
190	Ca	Sn	Ca
191	Ca	Sn	Ca
192	Ca	Sn	Ca
193	Ca	Sn	Ca
194	Ca	Sn	Ca
195	Ca	Sn	Ca
196	Ca	Sn	Ca
197	Ca	Sn	Ca
198	Ca	Sn	Ca
199	Ca	Sn	Ca
200	Ca	Sn	Ca
201	Ca	Sn	Ca
202	Ca	Sn	Ca
203	Ca	Sn	Ca
204	Ca	Sn	Ca
205	Ca	Sn	Ca
206	Ca	Sn	Ca
207	Ca	Sn	Ca
208	Ca	Sn	Ca
209	Ca	Sn	Ca
210	Ca	Sn	Ca
211	Ca	Sn	Ca
212	Ca	Sn	Ca
213	Ca	Sn	Ca
214	Ca	Sn	Ca
215	Ca	Sn	Ca
216	Ca	Sn	Ca
217	Ca	Sn	Ca
218	Ca	Sn	Ca
219	Ca	Sn	Ca
220	Ca	Sn	Ca
221	Ca	Sn	Ca
222	Ca	Sn	Ca
223	Ca	Sn	Ca
224	Ca	Sn	Ca
225	Ca	Sn	Ca
226	Ca	Sn	Ca
227	Ca	Sn	Ca
228	Ca	Sn	Ca
229	Ca	Sn	Ca
230	Ca	Sn	Ca
231	Ca	Sn	Ca
232	Ca	Sn	Ca
233	Ca	Sn	Ca
234	Ca	Sn	Ca
235	Ca	Sn	Ca
236	Ca	Sn	Ca
237	Ca	Sn	Ca
238	Ca	Sn	Ca
239	Ca	Sn	Ca
240	Ca	Sn	Ca
241	Ca	Sn	Ca
242	Ca	Sn	Ca
243	Ca	Sn	Ca
244	Ca	Sn	Ca
245	Ca	Sn	Ca
246	Ca	Sn	Ca
247	Ca	Sn	Ca
248	Ca	Sn	Ca
249	Ca	Sn	Ca
250	Ca	Sn	Ca
251	Ca	Sn	Ca
252	Ca	Sn	Ca
253	Ca	Sn	Ca
254	Ca	Sn	Ca
255	Ca	Sn	Ca
256	Ca	Sn	Ca
257	Ca	Sn	Ca
258	Ca	Sn	Ca
259	Ca	Sn	Ca
260	Ca	Sn	Ca
261	Ca	Sn	Ca
262	Ca	Sn	Ca
263	Ca	Sn	Ca
264	Ca	Sn	Ca
265	Ca	Sn	Ca
266	Ca	Sn	Ca
267	Ca	Sn	Ca
268	Ca	Sn	Ca
269	Ca	Sn	Ca
270	Ca	Sn	Ca
271	Ca	Sn	Ca
272	Ca	Sn	Ca
273	Ca	Sn	Ca
274	Ca	Sn	Ca
275	Ca	Sn	Ca
276	Ca	Sn	Ca
277	Ca	Sn	Ca
278	Ca	Sn	Ca
279	Ca	Sn	Ca
280	Ca	Sn	Ca
281	Ca	Sn	Ca
282	Ca	Sn	Ca
283	Ca	Sn	Ca
284	Ca	Sn	Ca
285	Ca	Sn	Ca
286	Ca	Sn	Ca
287	Ca	Sn	Ca
288	Ca	Sn	Ca
289	Ca	Sn	Ca
290	Ca	Sn	Ca
291	Ca	Sn	Ca
292	Ca	Sn	Ca
293	Ca	Sn	Ca
294	Ca	Sn	Ca
295	Ca	Sn	Ca
296	Ca	Sn	Ca
297	Ca	Sn	Ca
298	Ca	Sn	Ca
299	Ca	Sn	Ca
300	Ca	Sn	Ca
301	Ca	Sn	Ca
302	Ca	Sn	Ca
303	Ca	Sn	Ca
304	Ca	Sn	Ca
305	Ca	Sn	Ca
306	Ca	Sn	Ca
307	Ca	Sn	Ca
308	Ca	Sn	Ca
309	Ca	Sn	Ca
310	Ca	Sn	Ca
311	Ca	Sn	Ca
312	Ca	Sn	Ca
313	Ca	Sn	Ca
314	Ca	Sn	Ca
315	Ca	Sn	Ca
316	Ca	Sn	Ca
317	Ca	Sn	Ca
318	Ca	Sn	Ca
319	Ca	Sn	Ca
320	Ca	Sn	Ca
321	Ca	Sn	Ca
322	Ca	Sn	Ca
323	Ca	Sn	Ca
324	Ca	Sn	Ca
325	Ca	Sn	Ca
326	Ca	Sn	Ca
327	Ca	Sn	Ca
328	Ca	Sn	Ca
329	Ca	Sn	Ca
330	Ca	Sn	Ca
331	Ca	Sn	Ca
332	Ca	Sn	Ca
333	Ca	Sn	Ca
334	Ca	Sn	Ca
335	Ca	Sn	Ca
336	Ca	Sn	Ca
337	Ca	Sn	Ca
338	Ca	Sn	Ca
339	Ca	Sn	Ca
340	Ca	Sn	Ca
341	Ca	Sn	Ca
342	Ca	Sn	Ca
343	Ca	Sn	Ca
344	Ca	Sn	Ca
345	Ca	Sn	Ca
346	Ca	Sn	Ca
347	Ca	Sn	Ca
348	Ca	Sn	Ca
349	Ca	Sn	Ca
350	Ca	Sn	Ca
351	Ca	Sn	Ca
352	Ca	Sn	Ca
353	Ca	Sn	Ca
354	Ca	Sn	Ca
355	Ca	Sn	Ca
356	Ca	Sn	Ca
357	Ca	Sn	Ca
358	Ca	Sn	Ca
359	Ca	Sn	Ca
360	Ca	Sn	Ca
361	Ca	Sn	Ca
362	Ca	Sn	Ca
363	Ca	Sn	Ca
364	Ca	Sn	Ca
365	Ca	Sn	Ca
366	Ca	Sn	Ca
367	Ca	Sn	Ca
368	Ca	Sn	Ca
369	Ca	Sn	Ca
370	Ca	Sn	Ca
371	Ca	Sn	Ca
372	Ca	Sn	Ca
373	Ca	Sn	Ca
374	Ca	Sn	Ca
375	Ca	Sn	Ca
376	Ca	Sn	Ca
377	Ca	Sn	Ca
378	Ca	Sn	Ca
379	Ca	Sn	Ca
380	Ca	Sn	Ca
381	Ca	Sn	Ca
382	Ca	Sn	Ca
383	Ca	Sn	Ca
384	Ca	Sn	Ca
385	Ca	Sn	Ca
386	Ca	Sn	Ca
387	Ca	Sn	Ca
388	Ca	Sn	Ca
389	Ca	Sn	Ca
390	Ca	Sn	Ca
391	Ca	Sn	Ca
392	Ca	Sn	Ca
393	Ca	Sn	Ca
394	Ca	Sn	Ca
395	Ca	Sn	Ca
396	Ca	Sn	Ca
397	Ca	Sn	Ca
398	Ca	Sn	Ca
399			

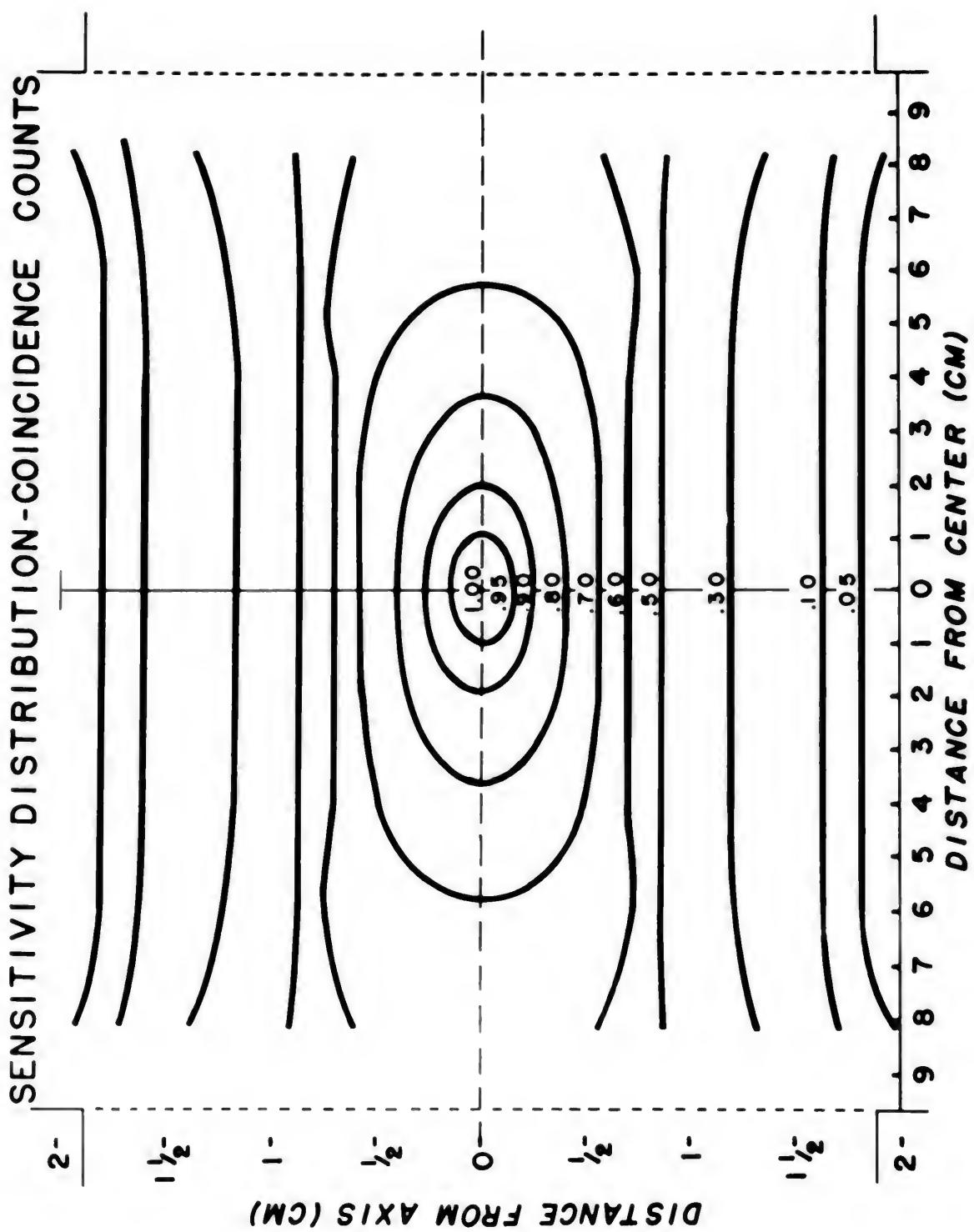


SOURCE -IVITY DISTRIBUTION-COINCIDENCE COUNTS



**Fig. 3.** Sensitivity distribution of coincidence counter.

The isosensitivity curves about the axis illustrate the very slight sensitivity variation for small source displacements from the central position.





### C. Correction of Observed Counting Rates

Coincidence counting rates were corrected by subtracting from the observed values the chance coincidence rate. Chance rate was computed by means of the equation

$$C_{ch} = 2 \tau N_a N_b$$

where  $N_a$ ,  $N_b$  are the individual channel rates and  $\tau$  is the resolving time of the coincidence circuit. By counting an essentially monoenergetic  $\gamma$ -ray emitter positioned off the axis of the crystals,  $\tau$  was computed to be approximately 0.36  $\mu$ sec by use of the above equation.

Counter response appears to be linear for counting rates up to 140,000 cpm on single channels and 14,000 cpm for coincidences (Fig. 4). Consequently no corrections were applied to the data for resolving time losses.

### C. Configuration of Operated Committee Chairs

Committee configuration refers more generally to the  
relationship between the type of committee and the configuration  
of the chair. Chinese law is the same as the definition  
 $c_{sp} = c_{sp}$   
of the term used in English law. It is  
the relationship between the type of committee and the  
configuration of the chair. This relationship is  
best understood by examining the relationship  
between the type of committee and the configuration  
of the chair. The relationship is best understood by  
examining the relationship between the type of committee  
and the configuration of the chair. The relationship  
between the type of committee and the configuration  
of the chair is best understood by examining the relationship  
between the type of committee and the configuration  
of the chair.

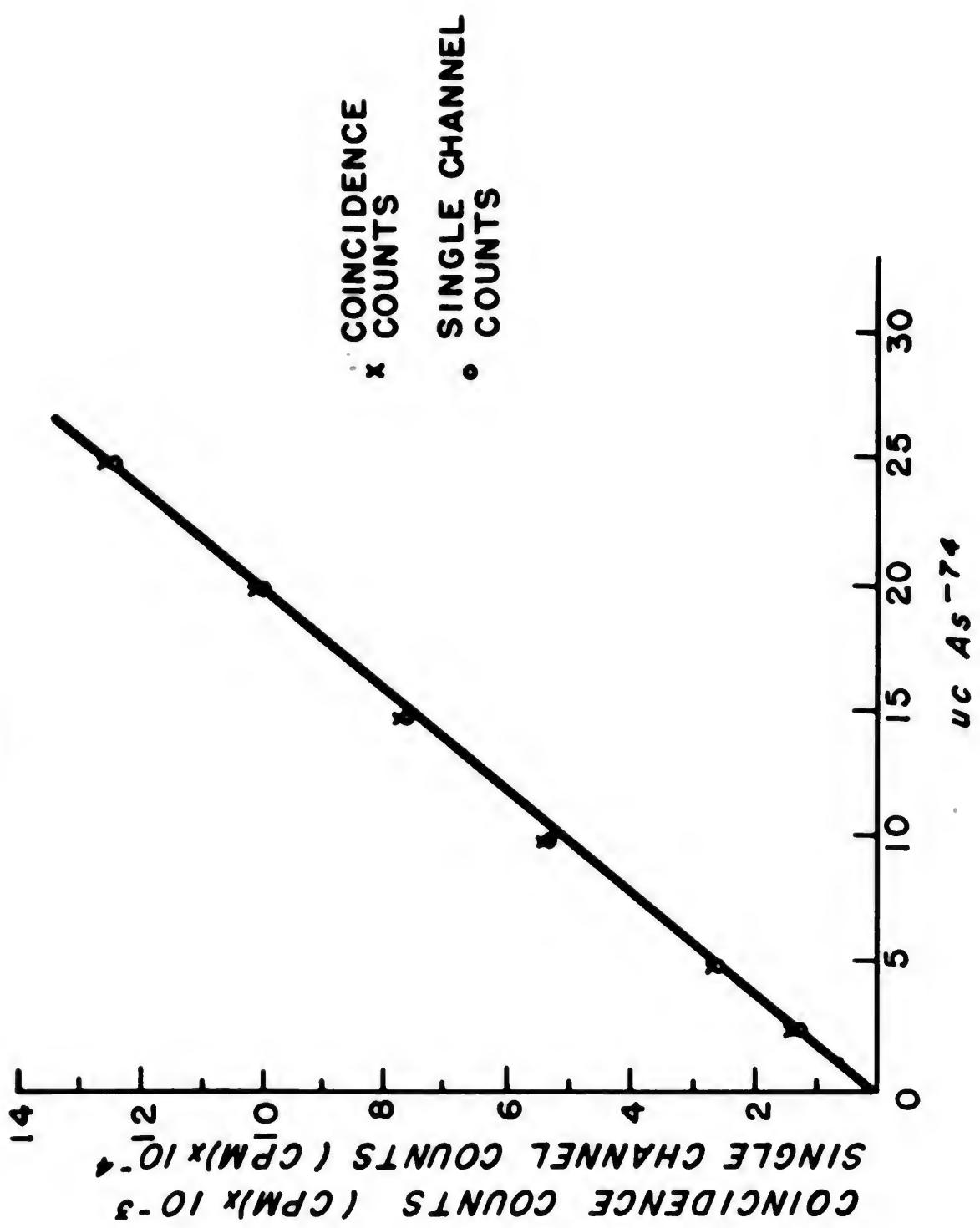
•AVUM VENOSUM TUMOR CORTICOSTERONE 10 mg.

~~SECRETIN OR OTHER POLYPEPTIDES TO INTRAVENOUS  
FEMORAL VEINS AND NOT INTRAVENOUS AT INTRAVENOUS  
CORTICOSTERONE CONCENTRATION~~

1. 100 mg. 100 mg.  
2. 100 mg. 100 mg.  
3. 100 mg. 100 mg.  
4. 100 mg. 100 mg.  
5. 100 mg. 100 mg.  
6. 100 mg. 100 mg.  
7. 100 mg. 100 mg.  
8. 100 mg. 100 mg.  
9. 100 mg. 100 mg.  
10. 100 mg. 100 mg.

**Fig. 4. Coincidence counter response curve.**

The linearity of counting rate vs source strength is evident for both single channel and coincidence counts.













JUL 2

BINDERY  
461

20653

Thesis Watters

W27 An investigation of the radionuclides of arsenic produced by cyclotron bombardment of germanium with 15 Mev deuterons.



BINDERY  
461

Thesis  
W27

Watters

An investigation of the radio-nuclides of arsenic produced by cyclotron bombardment of germanium with 15 Mev deuterons.

20653

RECEIVED  
SCHOOL OF POSTGRADUATE  
STUDIES  
MONTEREY CALIFORNIA

SCHOOL OF POSTGRADUATE SCHOOL  
Monterey, California

