



NATIONAL COMMUNICABLE DISEASE CENTER  
**SMALLPOX ERADICATION PROGRAM**

MEASLES CONTROL IN AFRICA: A PRACTICAL AND THEORETICAL  
EPIDEMIOLOGICAL CHALLENGE

Presented at the  
97th Annual Meeting of the  
American Public Health Association  
Philadelphia, Pennsylvania

November 12, 1969

by

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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

PUBLIC HEALTH SERVICE

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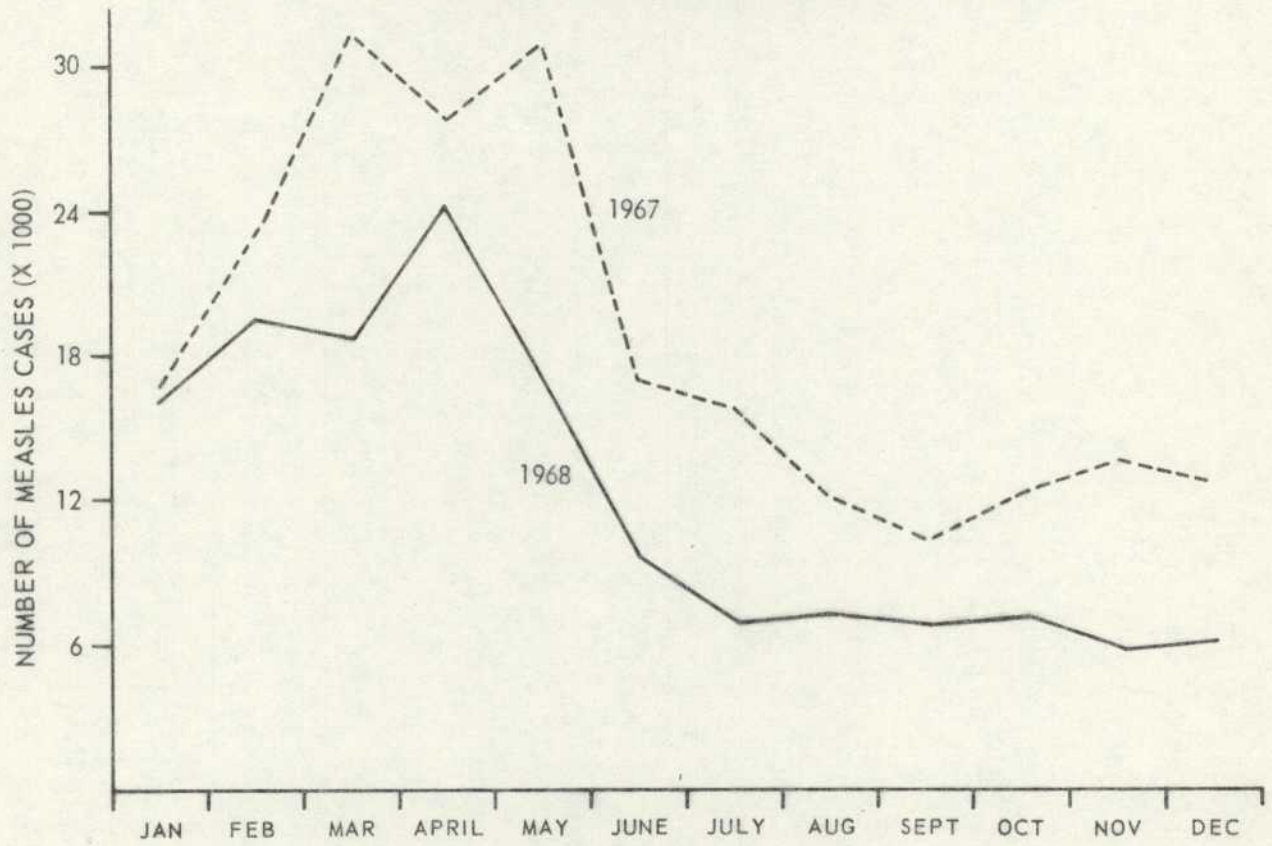
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FIGURE I. SEASONAL DISTRIBUTION OF REPORTED MEASLES,  
WEST AND CENTRAL AFRICA\*



\*The SEP Report, Vol. III, No. 1, February 1969.



FIGURE 1. SEASONAL DISTRIBUTION OF REPORTED MEASLES IN  
 APTL AND CENTRAL KYING.

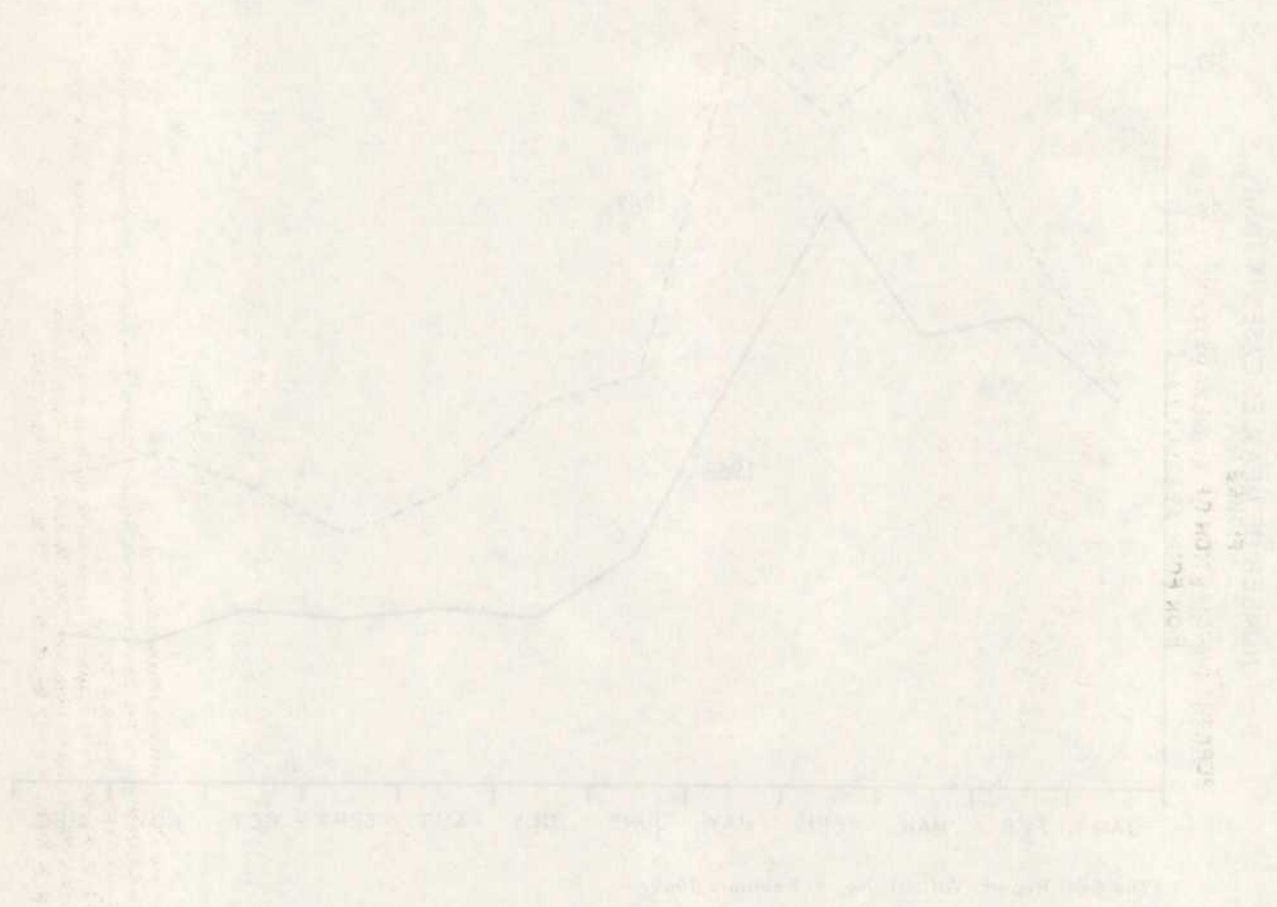
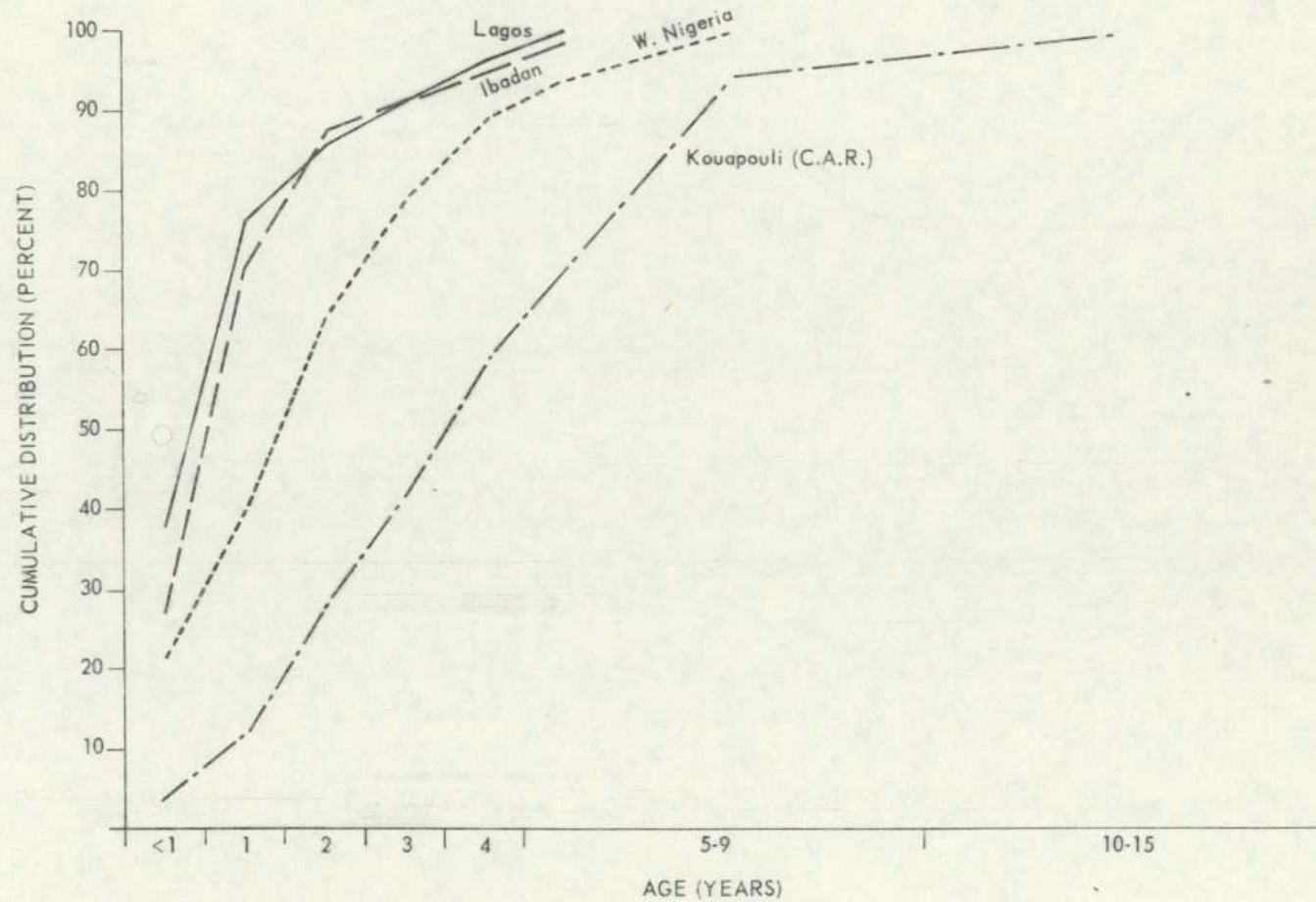
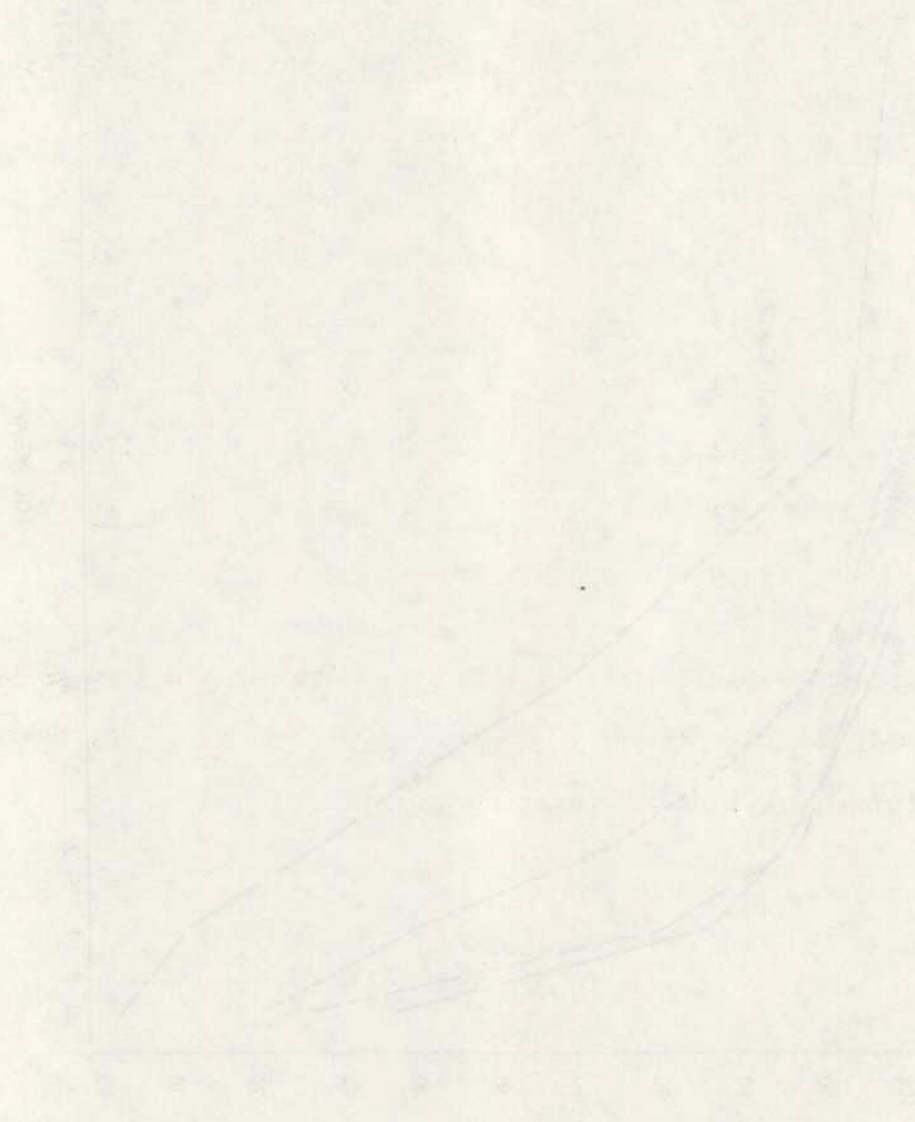


FIGURE II  
 PERCENT DISTRIBUTION OF MEASLES CASES BY AGE  
 FOR FOUR AREAS<sup>1,2,3,4</sup>



1. Grigsby, M., Personal Communication (Western Nigeria)
2. Grigsby, M., West Africa Regional Smallpox Eradication/Measles Control Program, Annual Meeting, May 1968, Abidjan, Ivory Coast (Ibadan, Western Nigeria)
3. E. A. Smith and S. O. Foster: To be published. Presented at the West Africa Regional Smallpox Eradication/Measles Control Program Annual Meeting, May 1968, Abidjan, Ivory Coast (Lagos)
4. Durand, B. and N. H. Ewen, *The SEP Report* 3:1, p. 21-26, Feb. 1969 (CAR)

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Table 1

Measles Epidemic, Kouapouli, Central African Republic\* (October 1967)  
 Percent Distribution of Cases by Age and Age Specific Attack Rates\*\*

<u>Age (Yrs.)</u>	<u>Cases</u>	<u>Percent</u>	<u>Cumulative Percent</u>	<u>Total Residents</u>	<u>A/R(%)</u>
< 1	11	3.4	3.4	34	32.4
1	28	8.8	12.2	32	87.5
2	51	16.0	28.2	57	89.5
3	45	14.2	42.4	53	84.9
4	53	16.7	59.1	62	85.5
5-9	112	35.2	94.3	179	62.6
10-15***	<u>18</u>	<u>5.7</u>	100.0	<u>93</u>	<u>19.4</u>
Total	318	100.0	100.0	510	62.4

\* An Area of subprefecture of Nola (pop. density 1.1 persons/Km.<sup>2</sup>)

\*\* Durand, B. and N.H. Ewen, The SEP Report 3:1, p. 21-26, February 1969.

\*\*\* Excludes case in one 25 year old person.



Table 1

Number of cases of ... (faint text)

Year	...	...	...	...
1950	...	...	...	...
1951	...	...	...	...
1952	...	...	...	...
1953	...	...	...	...
1954	...	...	...	...
1955	...	...	...	...
1956	...	...	...	...
1957	...	...	...	...
1958	...	...	...	...
1959	...	...	...	...
1960	...	...	...	...
Total	...	...	...	...

... (faint text at the bottom of the page)



Table 2

Measles, Cameroon (1965)  
 Cumulative Percent Distribution of Reported Cases by Age and  
 Population Density of Reporting Area\*

Area Density (per Km. <sup>2</sup> )	Cumulative Percent Distribution by Age				Case Total
	<1	1-4	5-9	10+	
< 10	15.5	62.2	89.8	100.0	19014
10-40	20.7	63.2	90.2	100.0	19337
40-80	22.7	73.4	90.9	100.0	9435
80+	26.8	84.6	94.9	100.0	16825

\* Rosenbloom, A., presented at West African Regional Smallpox  
 Eradication/Measles Control Program Annual Meeting, May 1968,  
 Abidjan, Ivory Coast.

TABLE 1  
 Comparison of the results of the 1957  
 and 1958 surveys of the population of  
 the State of New York

Age Group	1957		1958	
	Population	% of Total	Population	% of Total
Under 5	1,200,000	20.0	1,150,000	19.5
5-9	1,100,000	18.5	1,050,000	18.0
10-14	1,000,000	17.0	950,000	16.5
15-19	900,000	15.0	850,000	14.5
20-24	800,000	13.0	750,000	12.5
25-29	700,000	11.5	650,000	11.0
30-34	600,000	9.5	550,000	9.0
35-39	500,000	7.5	450,000	7.0
40-44	400,000	5.5	350,000	5.0
45-49	300,000	4.0	250,000	3.5
50-54	200,000	2.5	150,000	2.0
55-59	150,000	1.5	100,000	1.0
60-64	100,000	1.0	70,000	0.7
65-69	50,000	0.5	30,000	0.3
70-74	20,000	0.2	10,000	0.1
75-79	10,000	0.1	5,000	0.05
80-84	5,000	0.05	2,000	0.02
85-89	2,000	0.02	1,000	0.01
90-94	1,000	0.01	500	0.005
95-99	500	0.005	200	0.002
100+	100	0.001	50	0.0005
<b>Total</b>	<b>6,000,000</b>	<b>100.0</b>	<b>5,900,000</b>	<b>100.0</b>

Source: U.S. Bureau of the Census, "Population of the United States: 1957 and 1958," Current Population Reports, Series PC80-1A, Washington, D.C., 1959.

Table 3

Measles Epidemic  
 Kouapouli, Central African Republic\* (October 1967)  
 Death/Case Ratios by Age\*\*

<u>Age (Yrs.)</u>	<u>Cases</u>	<u>Deaths</u>	<u>Death/Case Ratio (%)</u>
<1	11	3	27.3
1-2	79	11	13.9
3-5	134	7	5.2
6+***	<u>94</u>	<u>0</u>	<u>-</u>
Total	318	21	6.6

\* An area of subprefecture of Nola (pop. density 1.1 persons/  
 Km.<sup>2</sup>)

\*\* Durand, B. and N.H. Ewen, The SEP Report 3:1, p. 21-26,  
 February 1969.

\*\*\* Excludes case in one 25 year old person.



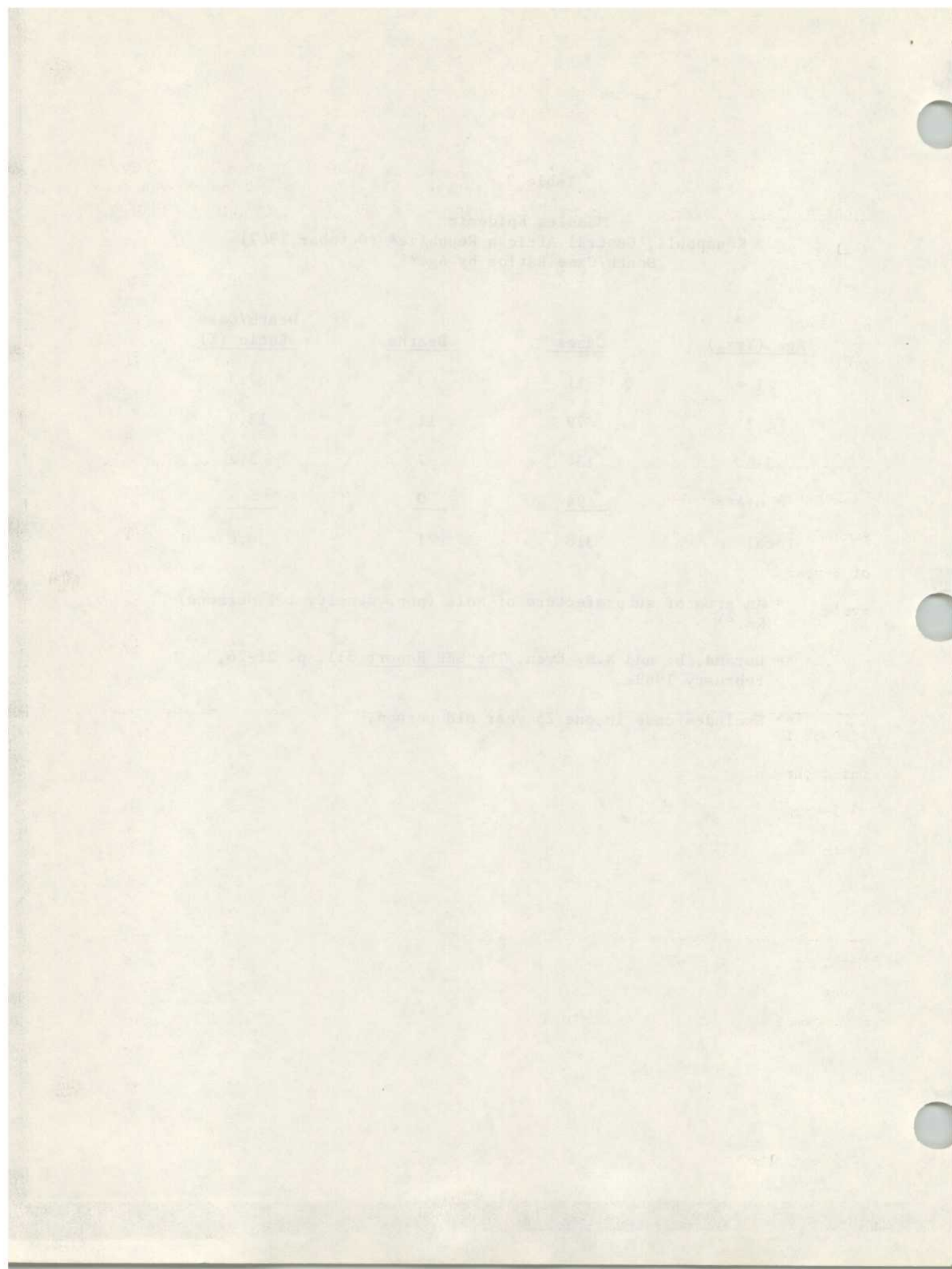


Table 4

Reduction of Measles Susceptibles by  
Vaccination on 3-Year Cycle\*

<u>Program Cycle</u>	<u>Age</u>	(E) Before Vaccination	(F) After 1st Yr. Vacc'n	(G) After 2nd Yr. Vacc'n	(H) After 3rd Yr. Vacc'n	(I) After 4th Yr. Vacc'n
Village in first phase of 3-year cycle	6 mo.	443	62	443	443	62
	1 yr.	770	108	439	770	108
	2	432	60	60	246	60
	3	220	31	31	31	31
	4	97	14	14	14	14
	5	30	4	4	4	4
Village in second phase of 3-year cycle	6 mo.	443	443	62	443	443
	1 yr.	770	770	108	439	770
	2	432	432	60	60	246
	3	220	220	31	31	31
	4	97	97	14	14	14
	5	30	30	4	4	4
Village in third phase of 3-year cycle	6 mo.	443	443	443	62	443
	1 yr.	770	770	770	108	439
	2	432	432	432	60	60
	3	220	220	220	31	31
	4	97	97	97	14	14
	5	30	30	30	4	4
Total of three villages	6 mo.	1329			948	948
	1 yr.	2310			1317	1317
	2	1296			366	366
	3	660			93	93
	4	291			42	42
	5	90			12	12

\*Gelfand, 1967

Summary of the data collected by the experiment on the effect of the treatment on the yield of the crop

Treatment	Yield (kg/ha)	Standard Error	Significance
Control	100	10	
T1	110	10	
T2	120	10	
T3	130	10	
T4	140	10	
T5	150	10	
T6	160	10	
T7	170	10	
T8	180	10	
T9	190	10	
T10	200	10	
T11	210	10	
T12	220	10	
T13	230	10	
T14	240	10	
T15	250	10	
T16	260	10	
T17	270	10	
T18	280	10	
T19	290	10	
T20	300	10	



(E) = Column (D) from Table I.

(F) = Column (D)  $\times$  0.14 after vaccination, column (D)  
before vaccination.

(G), (H), (I) = Same as (F) but carry over from (E) in those age groups  
newly entering the population without prior vaccination.  
Note that in one- and two-year olds after vaccination,  
half the population consists of vaccinated children and  
half unvaccinated children (but only in the first year  
in which unvaccinated children enter these age groups).

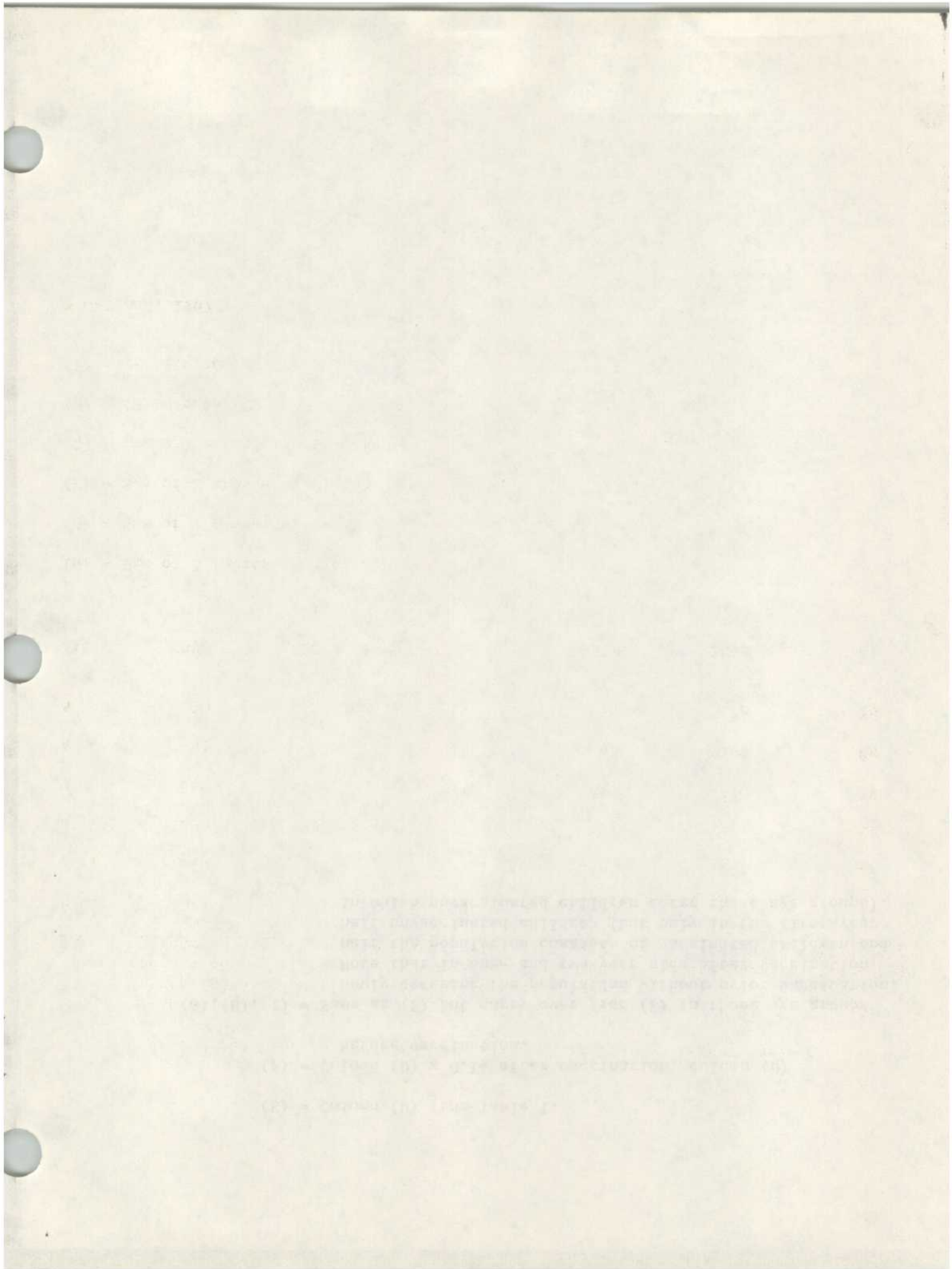


Table 5

Percentage Program Effectiveness after Third Year on 3-Year Cycle \*

Age	(N) Susceptibles Before MC Program	(O) Susceptibles Just Before Vaccination	(P) Susceptibles Just After Vaccination	(Q) Average Number of Susceptibles	(R) Susceptibles Prevented	(S) Percentage Effective
6 mo.	1329	1329	948	1139	190	14
1 yr.	2310	1979	1317	1648	662	29
2	1296	738	366	552	744	57
3	660	187	93	140	520	79
4	291	42	42	42	249	86
5	90	12	12	12	78	86
All	5976	4287	2778	3533	2443	41

(N) = Sum of 3 phases of cycle in (E)

(O) = Sum of 3 phases of cycle in (J)

(P) = Sum of 3 phases of cycle in (K)

(Q) = Average of columns (O) and (P)

(R) = (N) minus (Q)

(S) = (R) divided by (N)

\* Gelfand, 1967

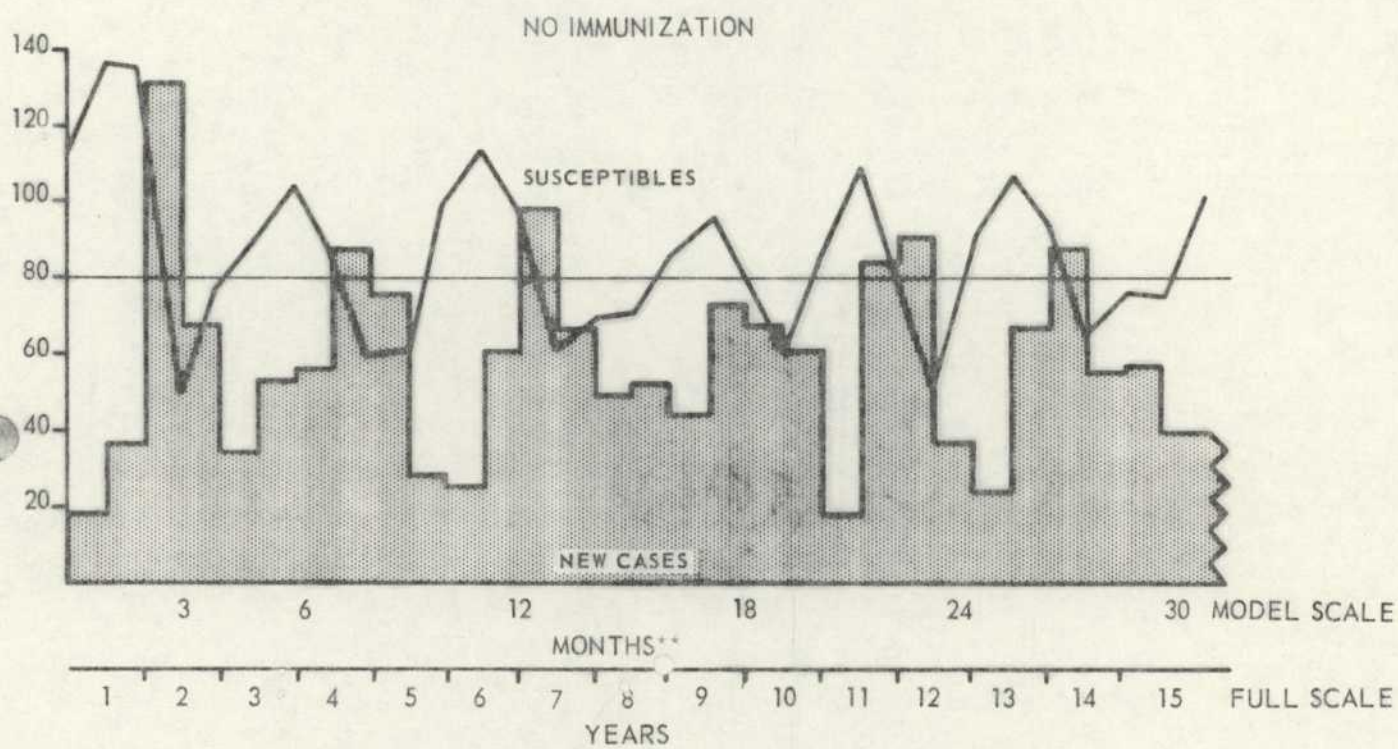


Table 1. Summary of results for the 1950-1951 season.

Year	Number of plants	Number of seeds	Number of seedlings	Number of survivors	Number of fruits
1950	100	1000	100	100	100
1951	100	1000	100	100	100
1952	100	1000	100	100	100
1953	100	1000	100	100	100
1954	100	1000	100	100	100
1955	100	1000	100	100	100
1956	100	1000	100	100	100
1957	100	1000	100	100	100
1958	100	1000	100	100	100
1959	100	1000	100	100	100
1960	100	1000	100	100	100

(1) The number of plants in each year is given in column (1).  
 (2) The number of seeds in each year is given in column (2).  
 (3) The number of seedlings in each year is given in column (3).  
 (4) The number of survivors in each year is given in column (4).  
 (5) The number of fruits in each year is given in column (5).

FIGURE III  
THEORETICAL MEASLES MODEL\*

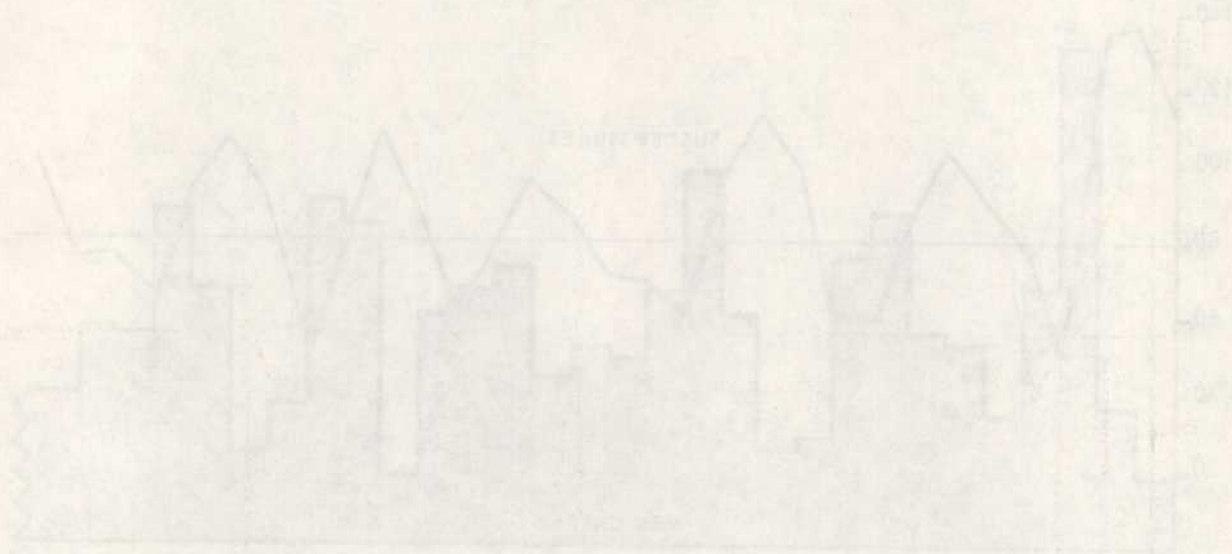


\*Macdonald, G., 1967.

\*\*Model Scale - 3 months equivalent to 18 months in reality.

FIGURE 11  
THEORETICAL MODEL

PERMANENT SECTION



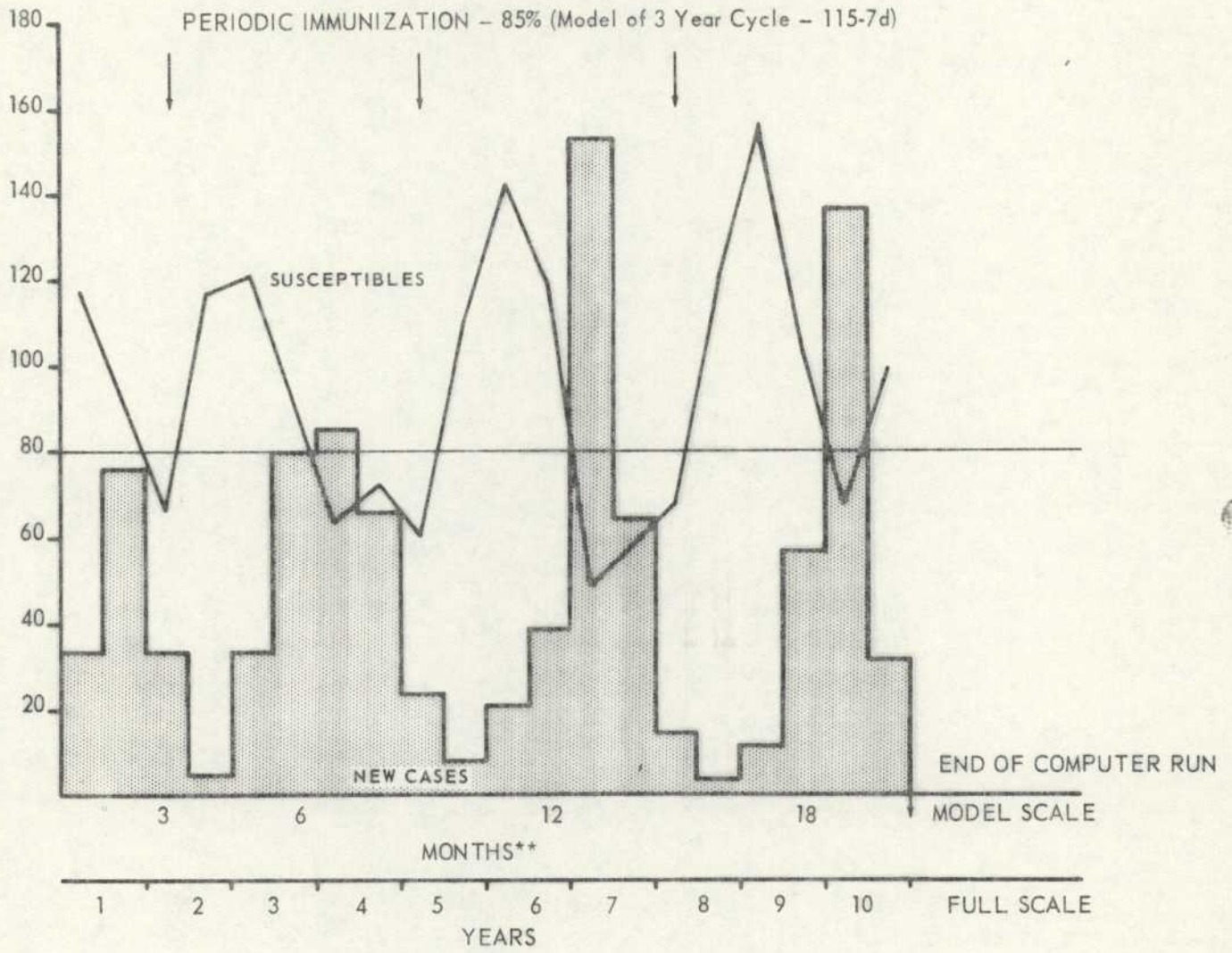
PERMANENT SECTION

FOR SCALE

Scale: 1 inch = 100 feet  
Vertical axis: 0 to 100  
Horizontal axis: 0 to 100



FIGURE IV  
THEORETICAL MEASLES MODEL\*

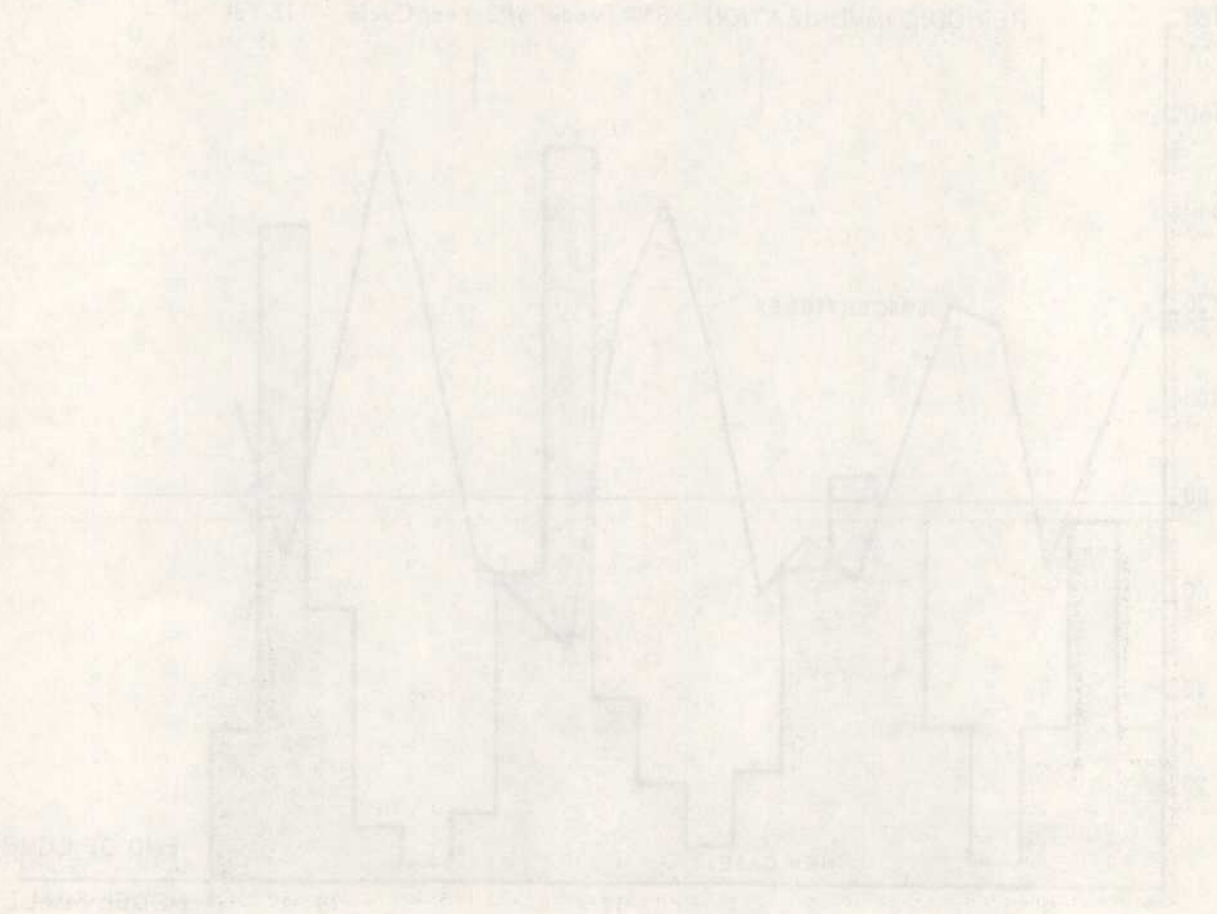


\*Macdonald, G., 1967.

\*\*Model Scale - 3 months equivalent to 18 months in reality.

THEORETICAL BACKGROUND

THEORETICAL BACKGROUND



THEORETICAL BACKGROUND

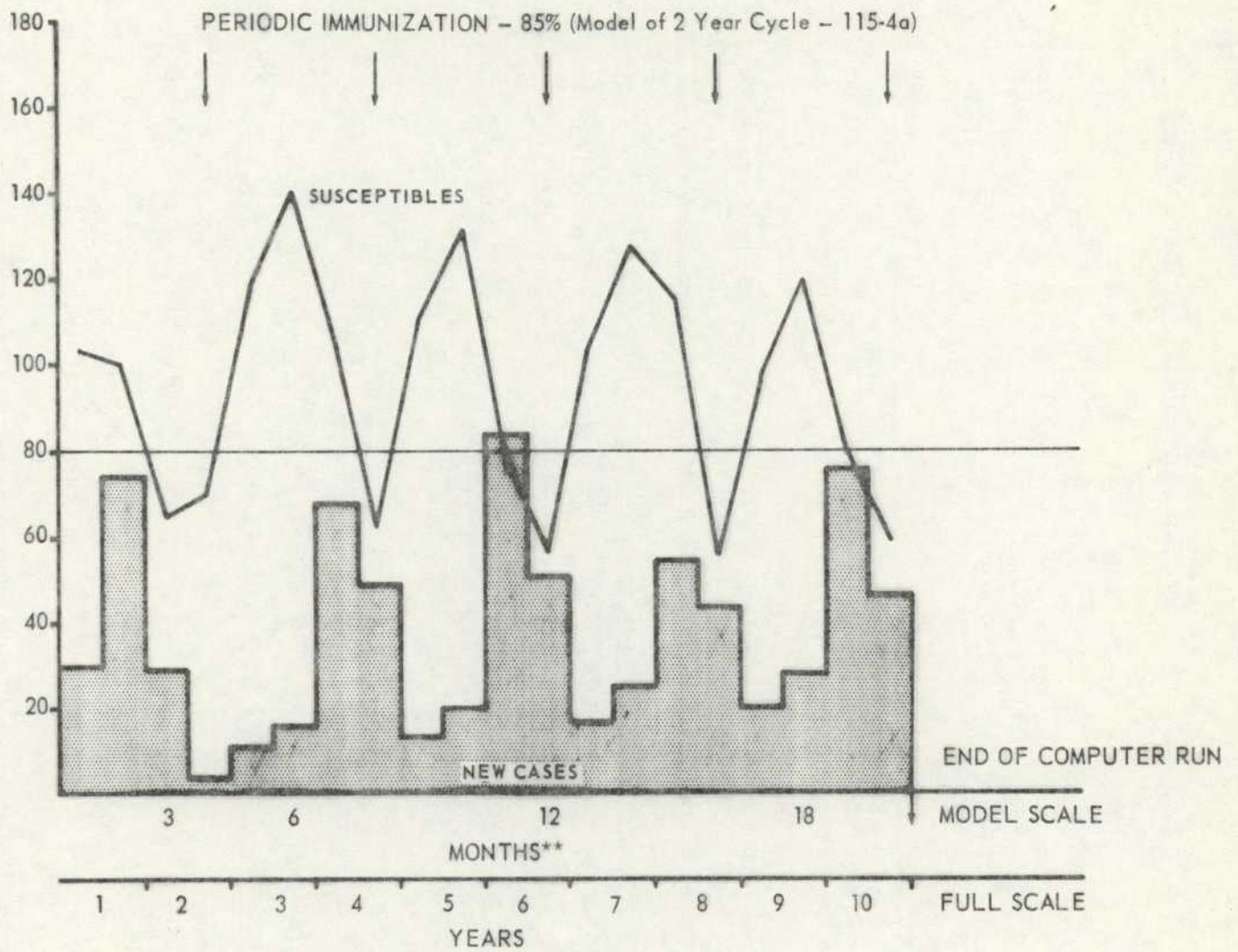
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FIGURE V  
THEORETICAL MEASLES MODEL\*



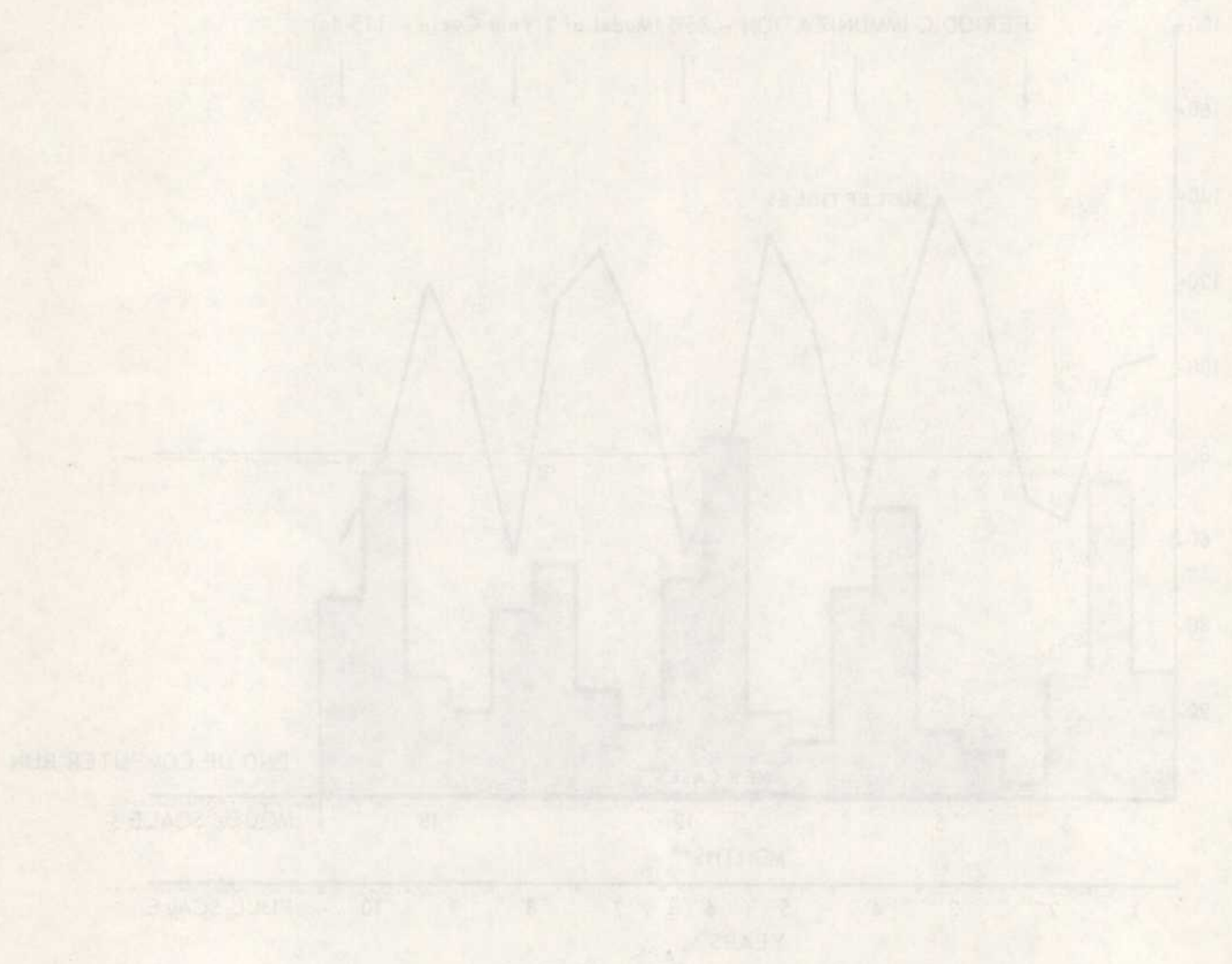
\*Macdonald, G., 1967.

\*\*Model Scale - 3 months equivalent to 18 months in reality.



THEORETICAL MODEL OF A MODEL

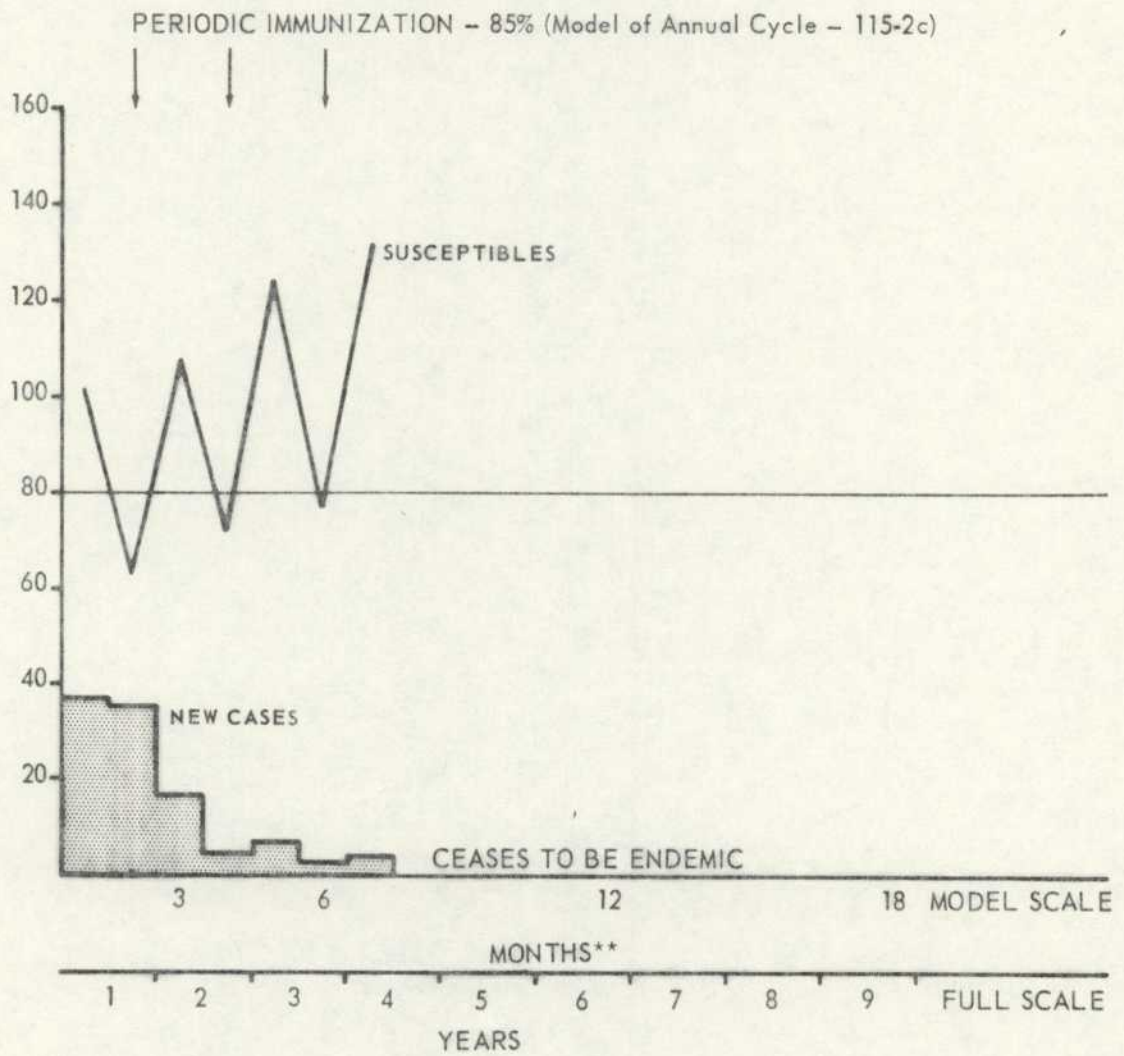
PERIODIC BOUNDARY VALUE PROBLEM



Model of a model - 2 months work, and 12 hours a day



FIGURE VI  
THEORETICAL MEASLES MODEL\*

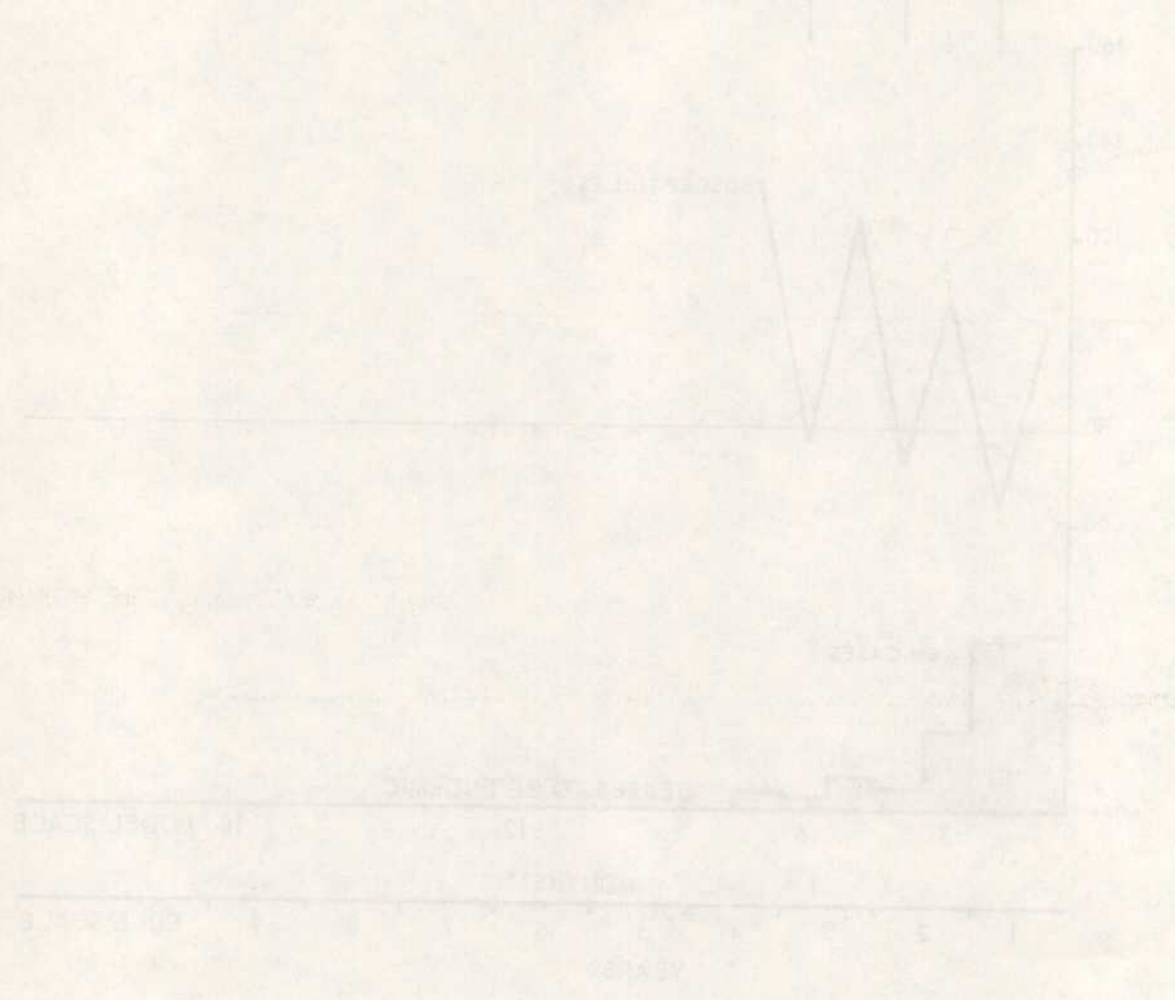


\*Macdonald, G., 1967.

\*\*Model Scale - 3 months equivalent to 18 months in reality.

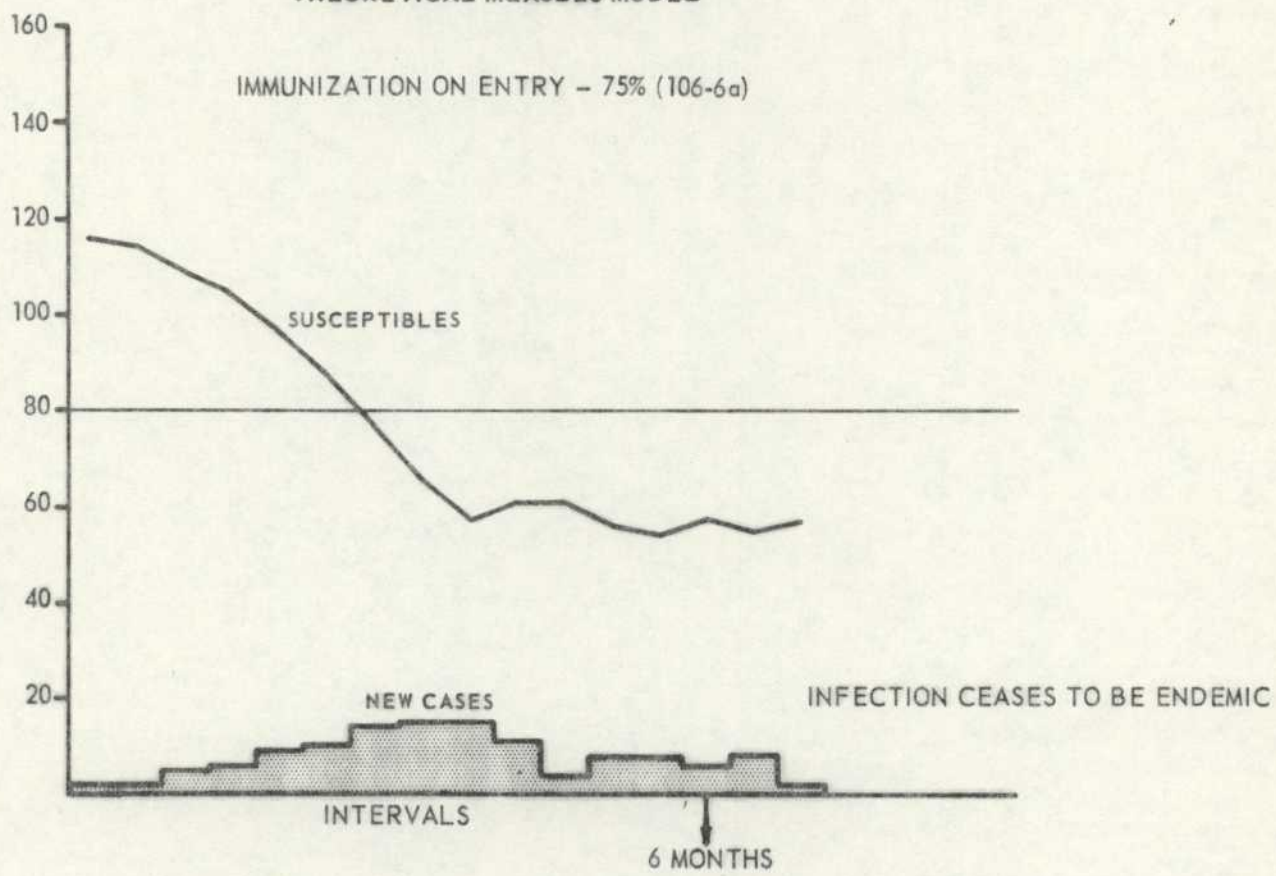
THEORETICAL - EXPERIMENTAL

EXPERIMENTAL - THEORETICAL



EXPERIMENTAL - THEORETICAL

FIGURE VII  
THEORETICAL MEASLES MODEL\*



\*Macdonald, G., 1967.

FIGURE 7  
THEORETICAL MODEL

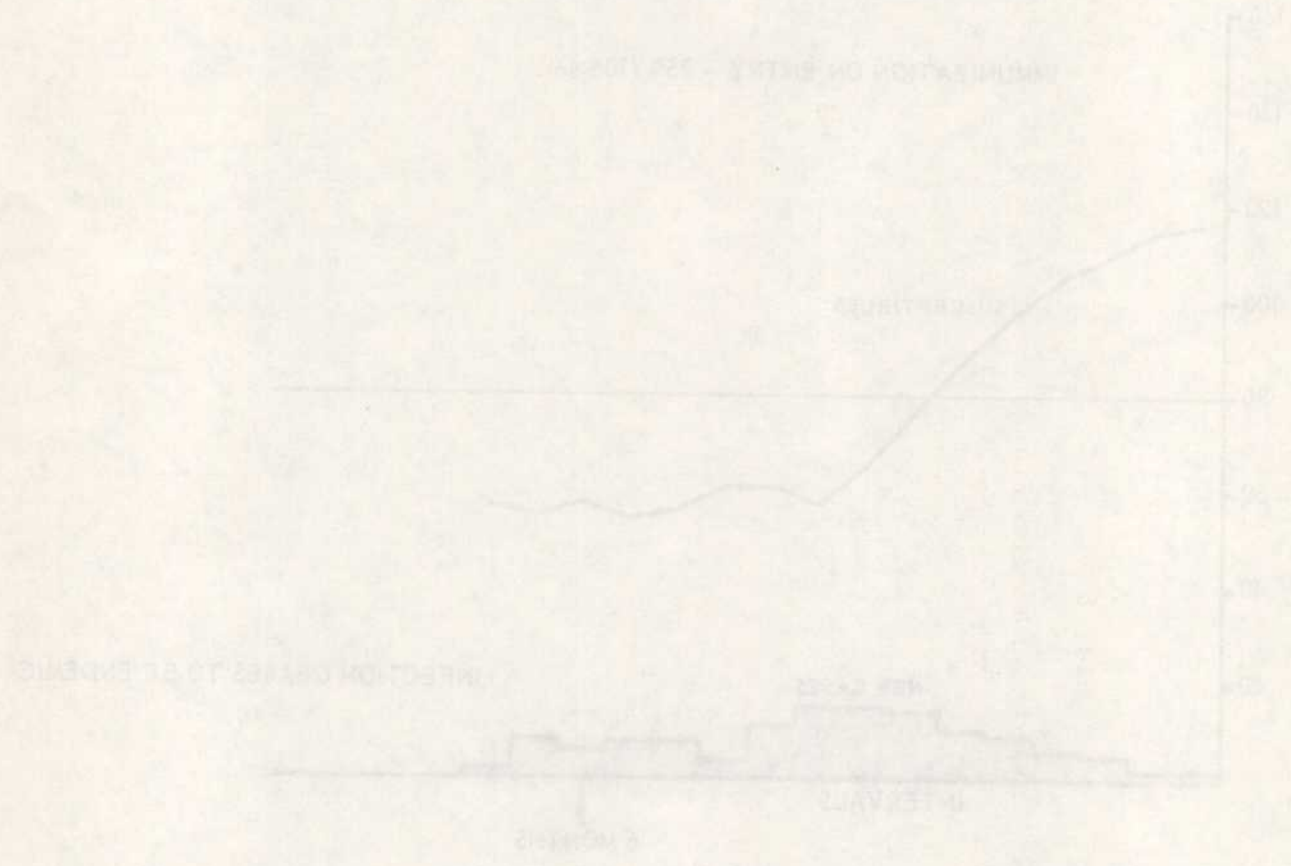




Table 6

Theoretical Measles Model  
Efficacy Various Periodic Mass Campaign Models in Interrupting  
Transmission in Three Vaccination Rounds or Less

<u>Method</u>	<u>Round Frequency</u>	<u>% Effectiveness</u>	<u>Duration 3 Rounds</u>	<u>No. Computer Runs</u>	<u>No. Interruptions</u>	<u>Percent</u>
A	3 yrs.	85	9 yrs.	5	2	40.0
B	2 yrs.	85	6 yrs.	5	1	20.0
C	18 mos.	85	4½ yrs.	5	4	80.0
D	1 yr.	85	3 yrs.	5	5	100.0

100%

300%

90%

100%

100%

100%

100%

100%

100%

100%

Industries 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

100%

Table 7

Theoretical Measles Model  
 Morbidity Reduction in Programs  
Not Interrupting Transmission\*

<u>Method</u>	<u>Round Frequency</u>	<u>Coverage</u>	<u>No. New Cases</u>
None	-	0.0	1193
A	3 yrs.	85.0	970
B	2 yrs.	85.0	762
C	18 mos.	85.0	511

\* Within 20 model months (120 full months)

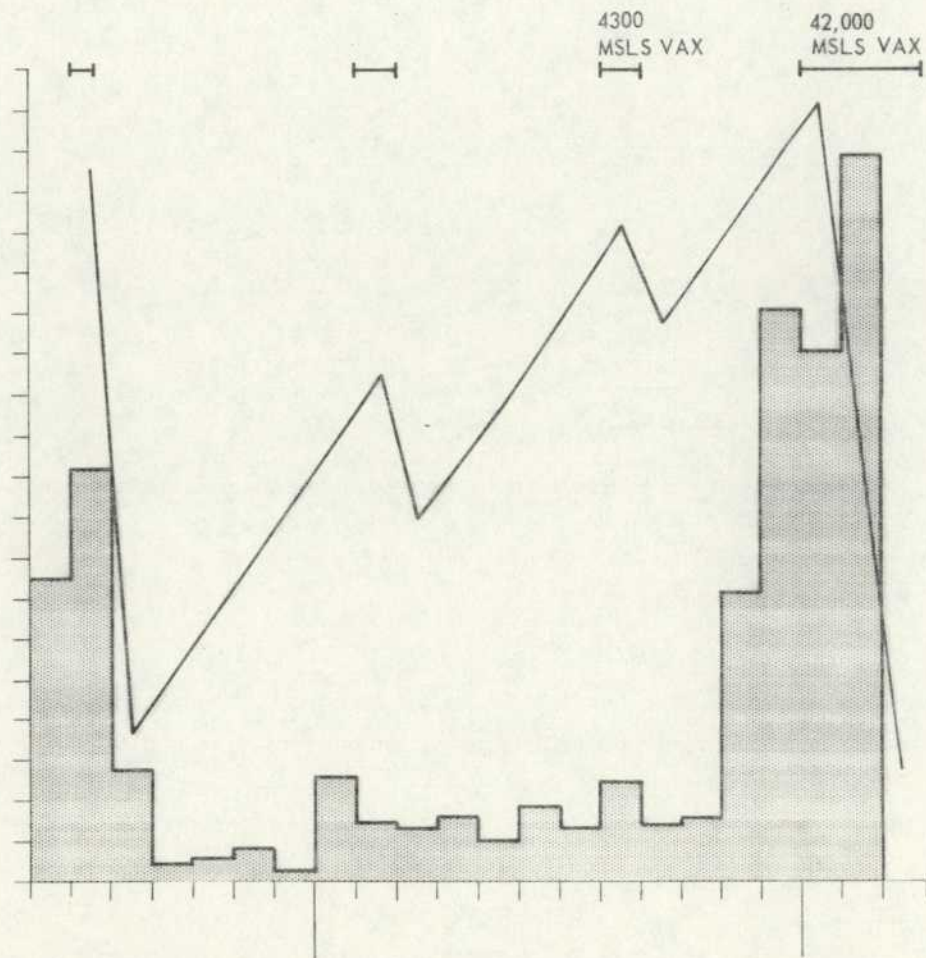
Table 1  
 The Effect of Temperature on the  
 Rate of Reaction of Hydrogen Peroxide  
 with Potassium Iodate

Temperature (°C)	Time (min)	Volume of Gas (ml)
20.0	1.0	1.0
25.0	1.0	1.5
30.0	1.0	2.0
35.0	1.0	2.5

\* Volume of gas evolved in 1.0 min at 20°C

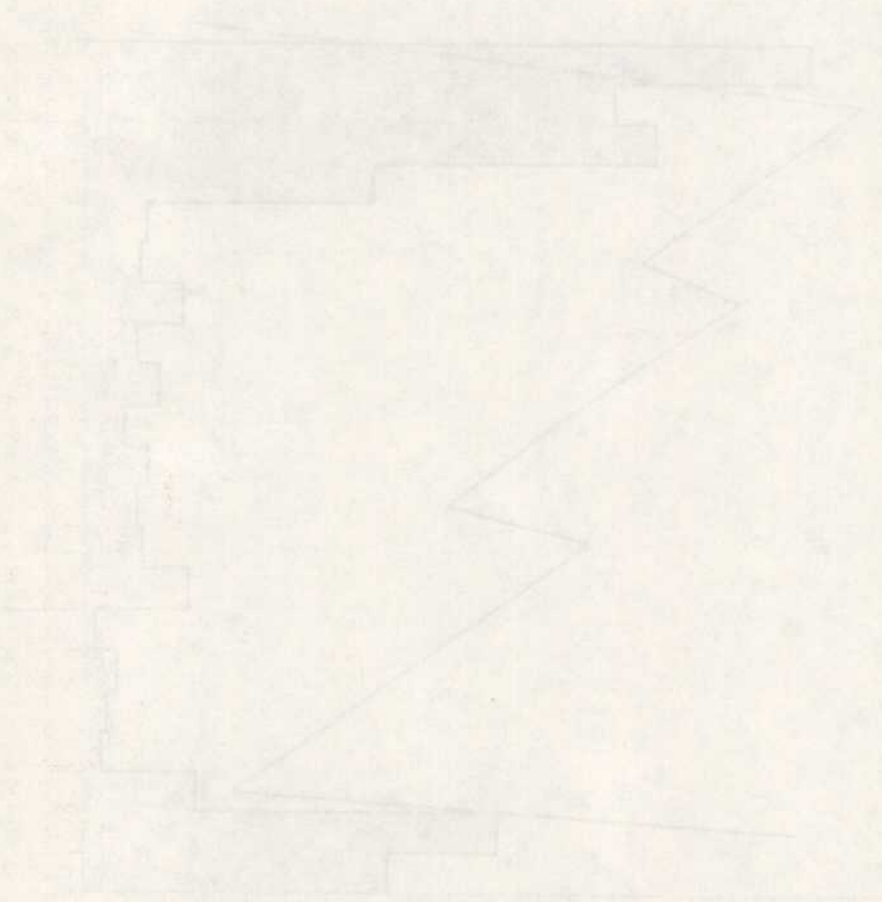


REPORTED CASES, ESTIMATED SUSCEPTIBLES, AND MAINTENANCE VACCINATIONS



\*Based on data presented by Grigsby, M., West African Regional Smallpox Eradication/Measles Control Program Annual Meeting, May 1968, Abidjan, Ivory Coast and MSLS Surveillance data, SEP, NCDC, Atlanta.

1. The first part of the document is a list of names and addresses of the members of the committee.

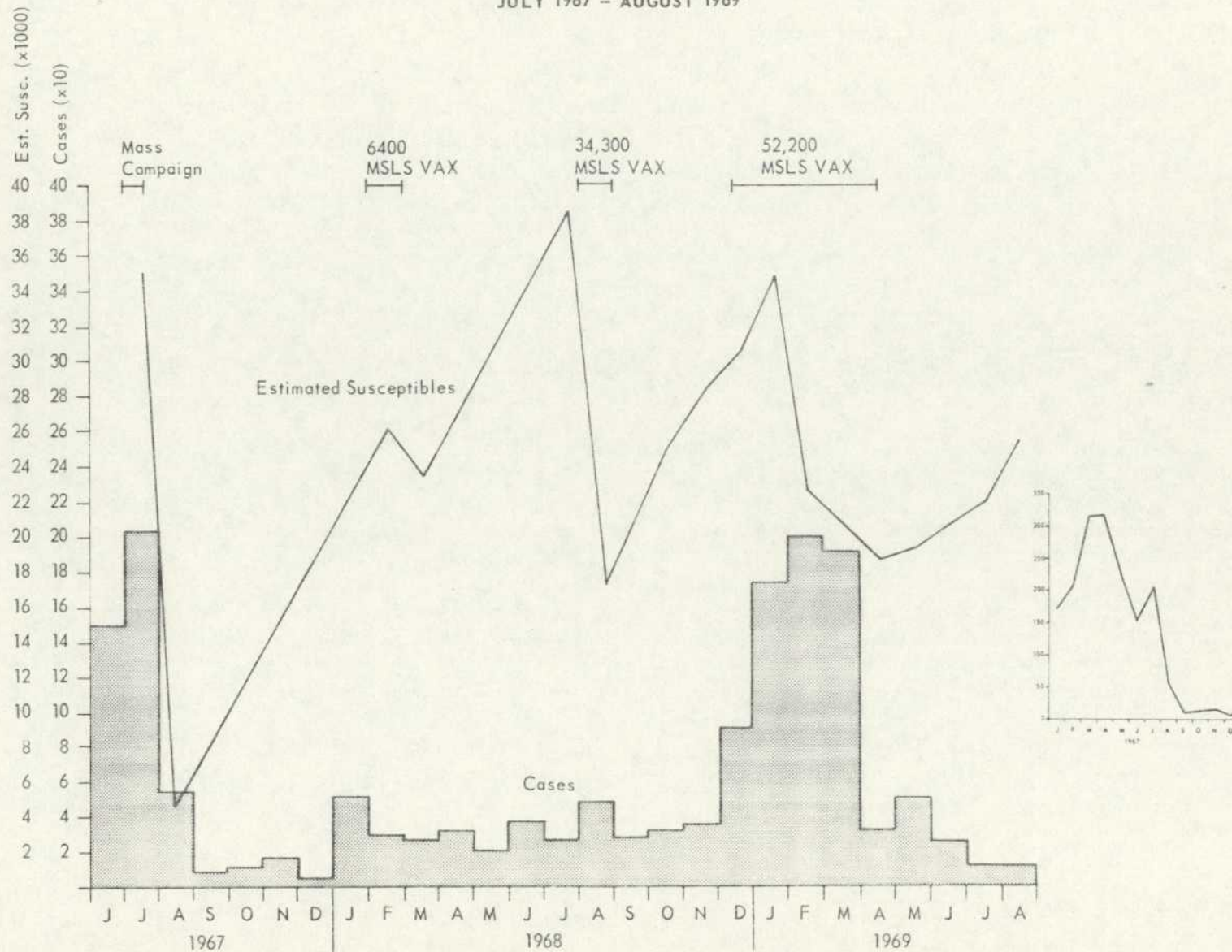


2. The second part of the document is a list of names and addresses of the members of the committee.

3. The third part of the document is a list of names and addresses of the members of the committee.

4. The fourth part of the document is a list of names and addresses of the members of the committee.

**FIGURE VIII**  
**MEASLES - IBADAN, W. NIGERIA**  
**HOSPITALIZED CASES, ESTIMATED SUSCEPTIBLES, AND MAINTENANCE VACCINATIONS**  
**JULY 1967 - AUGUST 1969\***



\*Based on data presented by Grigsby, M., West African Regional Smallpox Eradication/Measles Control Program Annual Meeting, May 1968, Abidjan, Ivory Coast and MSLS Surveillance data, SEP, NCDC, Atlanta



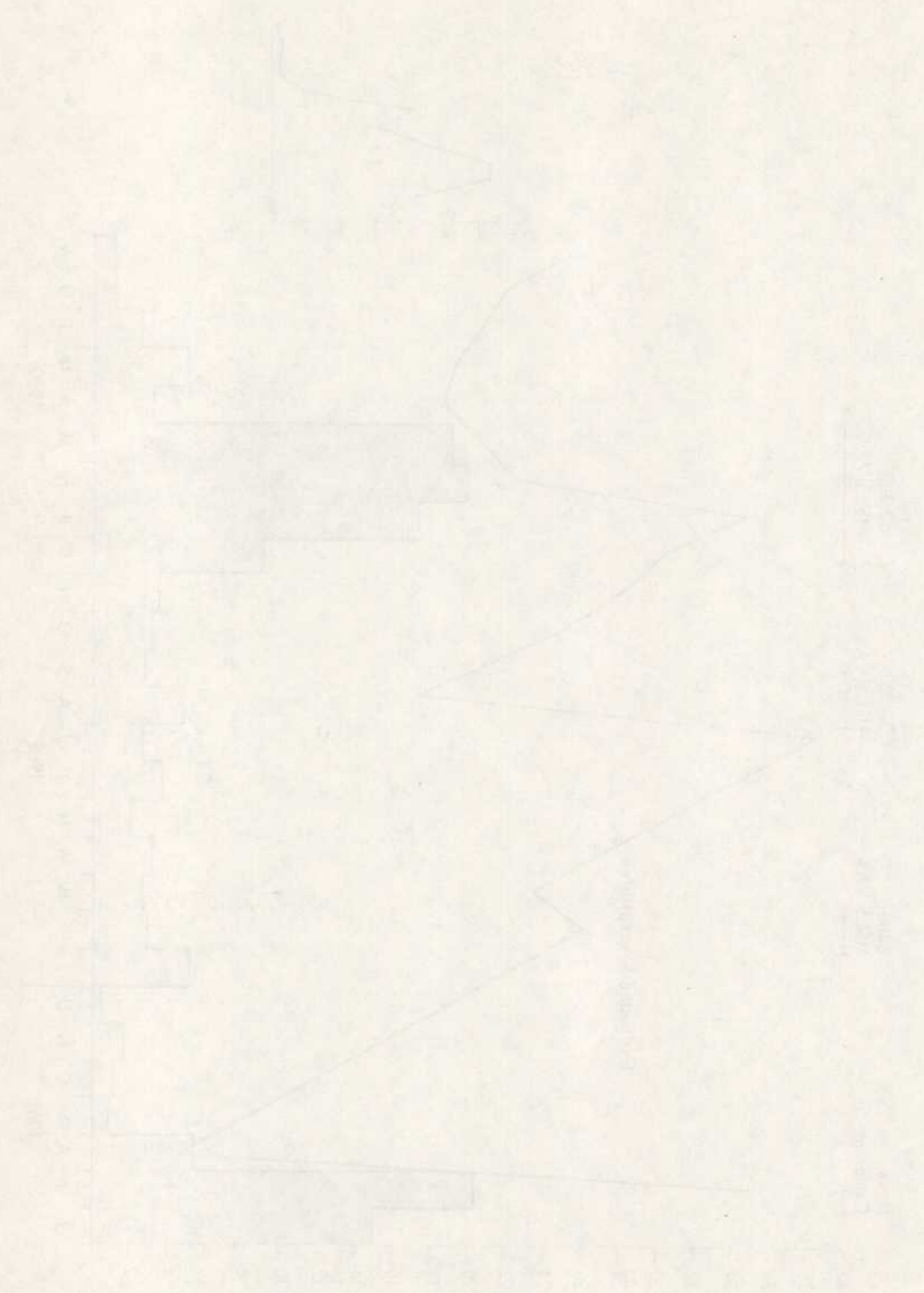




Table 8

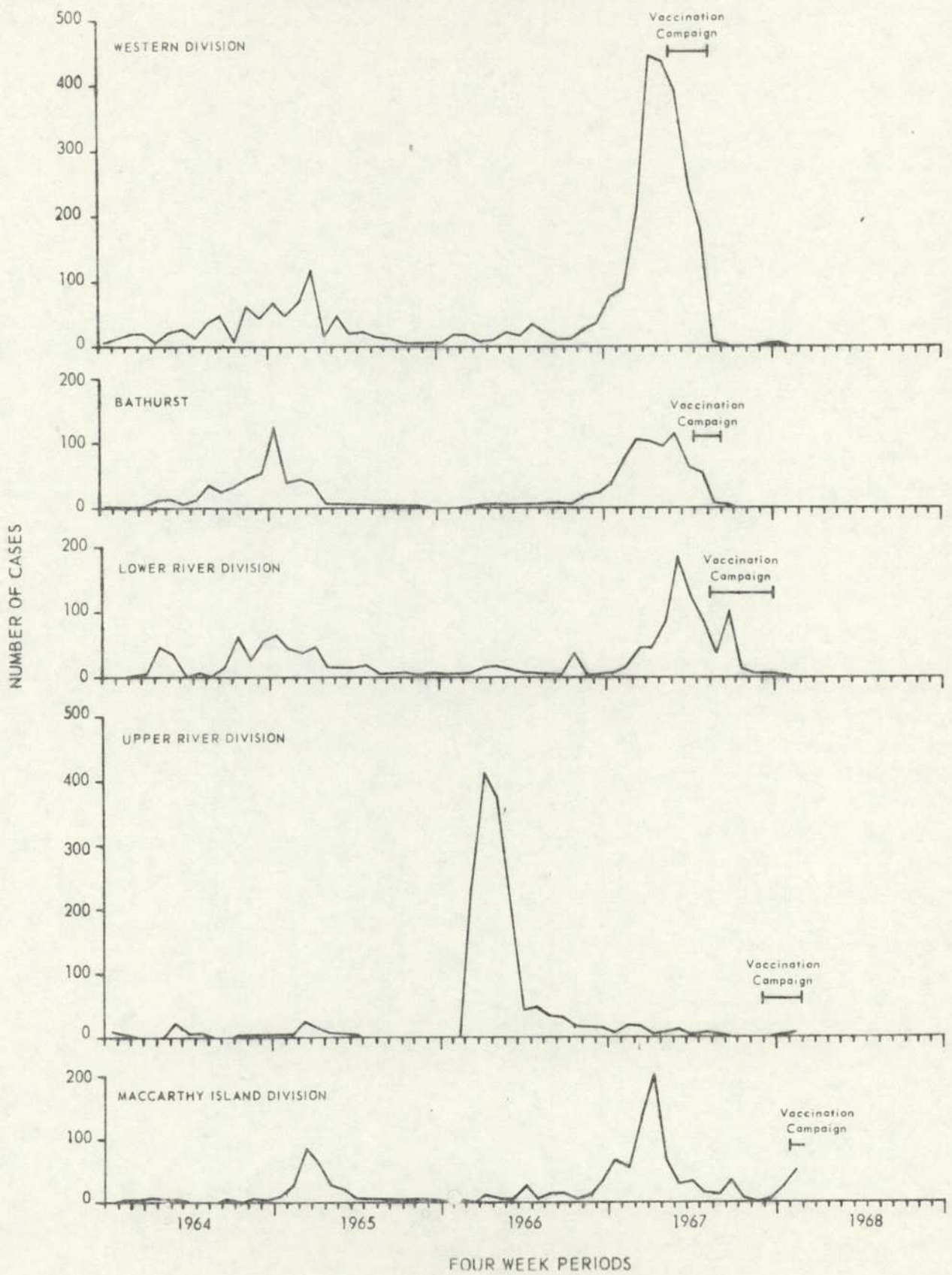
Measles, The Gambia (1967 and 1968)  
Reported Cases by Four-Week Periods\*

<u>Weeks</u>	<u>1967</u>	<u>1968</u>
1-4	184	27
5-8	247	54
9-12	509	43
13-16	699	10
17-20	721	7
21-24	777	4
25-28	472	9
29-32	390	5
33-36	63	2
37-40	137	4
41-44	20	11
45-48	2	0
49-52	7	0

\* Measles surveillance data, SEP, NCDC, Atlanta, Georgia.

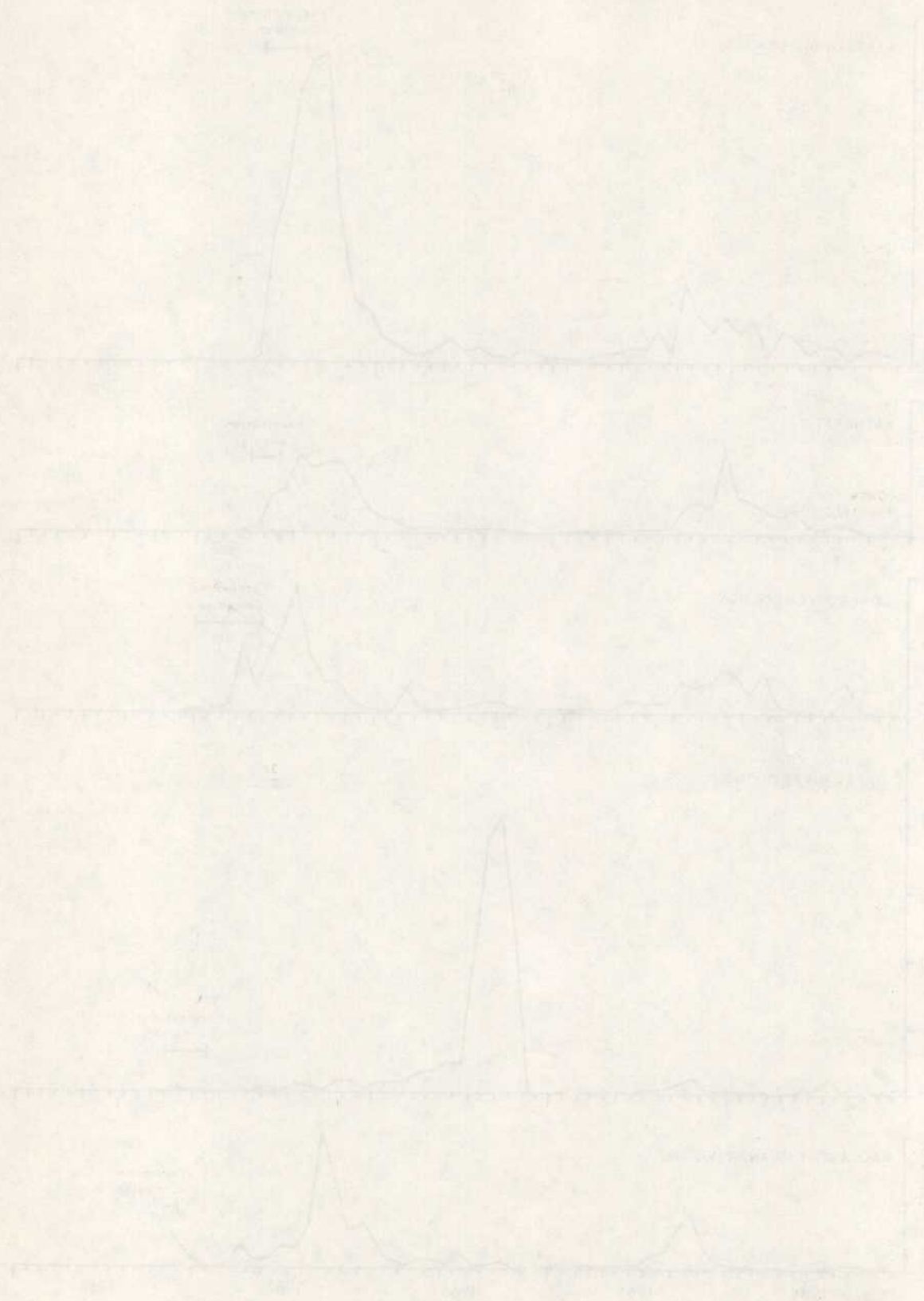
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FIGURE IX  
SEQUENCE OF VACCINATION CAMPAIGN - THE GAMBIA\*



\*Foege, William, "Evaluation of Smallpox Eradication/Measles Control Program - The Gambia," June 1968.

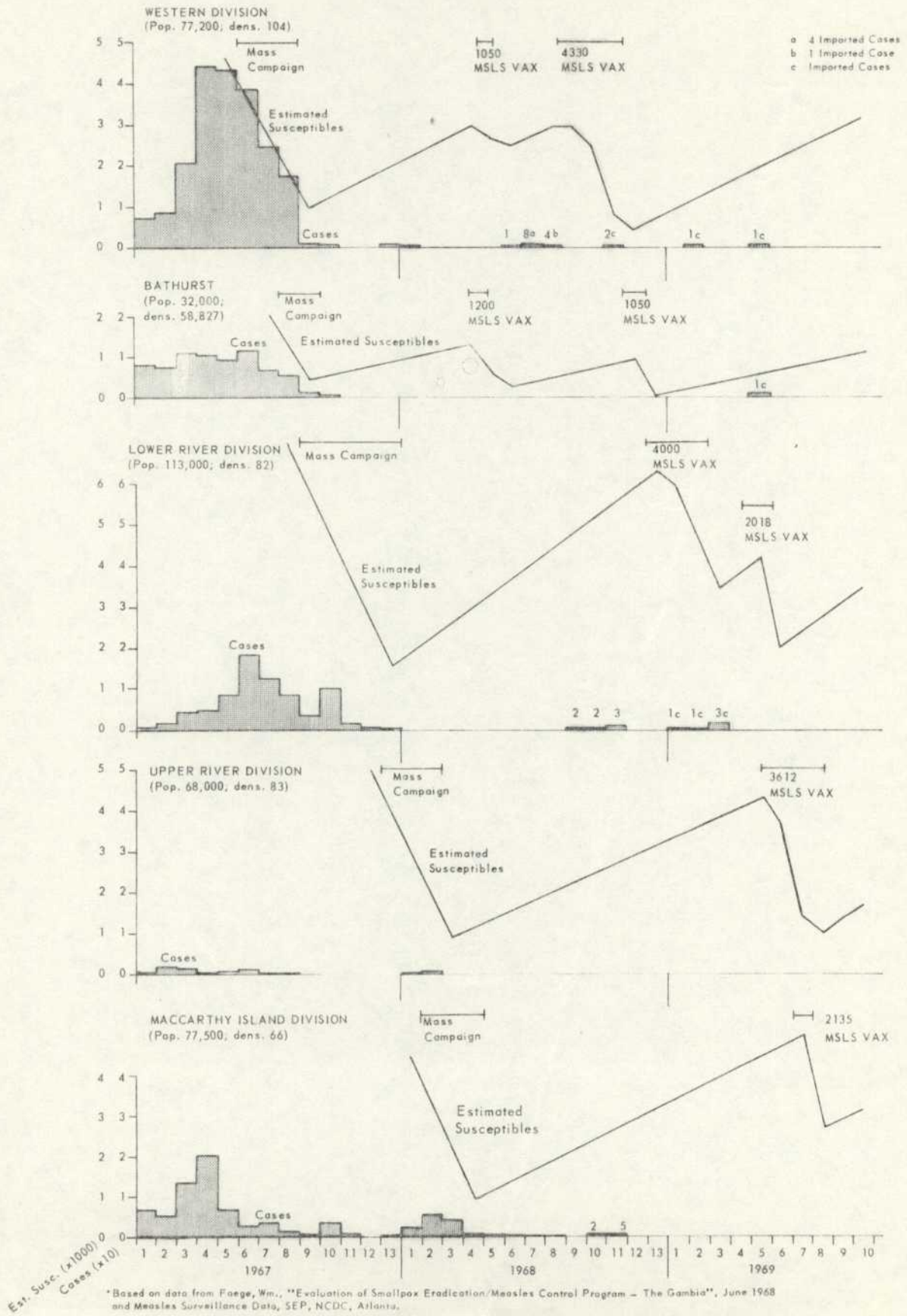
FIGURE 1  
STIMULATED SECRETION OF THE PANCREAS



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**FIGURE X**  
**MEASLES, THE GAMBIA (JANUARY 1967 - MARCH 1969)**  
**REPORTED CASES, ESTIMATED SUSCEPTIBLES, AND MAINTENANCE VACCINATIONS**  
**BY FOUR-WEEK PERIODS BY DIVISION\***



THE UNIVERSITY OF CHICAGO  
DEPARTMENT OF CHEMISTRY  
5408 SOUTH ELLIS AVENUE  
CHICAGO, ILLINOIS 60637

