

# ACUTE PNEUMONITIS

## REPORT OF AN EPIDEMIC\*

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During the past seven years several reports of an acute type of pulmonary infection, characterized by an onset with headache, malaise, and mild cough and by a febrile course of about a week's duration, with a minimum of adventitious signs on examination of the chest, little or no leukocytosis or sputum, and x-ray signs of evidence of pulmonary infection far out of proportion to the patient's clinical signs or appearance, have appeared in the literature. Recent reports by Weir and Horsfall<sup>10</sup> and by Gallagher<sup>3</sup> have referred to this disease as "acute pneumonitis," and that designation would seem to be satisfactory and to eliminate some of the confusion which results when many different names are used for what appears to be the same clinical entity. Other reports by Murray,<sup>7</sup> Smiley, Showacre, Lee, and Ferris,<sup>9</sup> Reiman,<sup>8</sup> Kneeland and Smetana,<sup>5</sup> and Longcope,<sup>6</sup> have discussed the epidemic features of this disease, but only Hornibrook and Nelson<sup>4</sup> have described an epidemic in detail; their report concerns 15 cases of acute pneumonitis occurring during the spring of 1940 among 153 employees in one building of the National Institute of Health.

In the fall of 1939 an outbreak of 35 cases of acute pneumonitis developed at a Massachusetts boys' preparatory school with a population of 650 boarding students; this disease, in sporadic form, had been noted at two schools during the six preceding years, but a glance at Table 1 will show that the disease had not previously assumed such proportions.

TABLE 1

	<i>Sept.</i>	<i>Oct.</i>	<i>Nov.</i>	<i>Dec.</i>	<i>Jan.</i>	<i>Feb.</i>	<i>Mar.</i>	<i>Apr.</i>	<i>May</i>	<i>June</i>	<i>Total</i>
1932-33*	0	1	0	0	1	1	2	1	3	0	9
1933-34*	0	0	1	0	3	2	1	0	0	0	7
1935-36	0	0	2	1	1	2	0	0	0	0	6
1936-37	0	1	6	1	2	3	2	1	0	0	16
1937-38	2	1	1	0	0	0	0	0	0	0	4
1938-39	1	2	0	0	1	4	0	0	0	0	8
1939-40	0	16	15	4	0	1	0	0	0	1	37

\* These cases were from another school whose student population was approximately 350.

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## CLINICAL DATA

The clinical and laboratory findings in the cases occurring in October, November, and December of 1939 seemed similar to those of cases seen during the previous four years at that institution, and to those of cases reported from a boarding school in Pennsylvania, but in order to determine what differences, if any, existed between those cases, the following table has been prepared. In comparing the columns of Tables 2 and 3 it is necessary to remember that a group of 35 cases is being compared with one of 52 cases.

TABLE 2  
COMPARISON OF ADMISSION SYMPTOMS AND SIGNS

	<i>Epidemic group 35 cases</i>	<i>Other group 52 cases</i>
Age, range .....	14-19	13-19
Illness before onset		
Without previous "cold" or "sore throat" .....	14	25
Preceded by "cold" or "sore throat" .....	21	27
Symptoms		
Slight cough .....	22	23
Moderate or severe cough .....	12	9
Mild malaise .....	9	37
Moderate to marked malaise .....	25	9
Headache .....	32	36
Chilliness .....	13	7
Chest pain .....	6	5
Abdominal pain .....	0	2
Nausea .....	3	2
Pharyngitis with dysphagia .....	6	1
Sputum (on first or second day) .....	6	8
Nosebleed .....	1	0
Earache .....	0	1
Meningismus .....	1	0
Signs		
Temperature, range (at admission) .....	98-103	98.4-103.6
Leukocyte count, range .....	6,800-14,700	5,200-18,000
Leukocyte count, average .....	8,500	9,000
Râles or dulness detected on first or second day .....	10	16

It will be seen that there is little difference in the incidence of previous upper respiratory tract infection in the two groups, little difference in initial leukocyte count and temperature, but a definite

difference in the degree of such symptoms as malaise, headache, chilliness, and cough at the time of admission. This difference in severity of initial symptoms was more noticeable in the early cases in the epidemic than in the later ones. Every case in each group had x-ray evidence of pulmonary infection and in no instance was this infection similar to the usual types of bronchopneumonia or pneumococcal lobar pneumonia. However, we will mention later in this report 11 cases diagnosed as "pyrexia of unknown etiology" which probably represent a non-pulmonary form of this disease.

TABLE 3  
COMPARISON OF CLINICAL DATA DURING COURSE

	<i>Epidemic group 35 cases</i>	<i>Other group 52 cases</i>
Days of malaise, range .....	1-8	1-14
average .....	4	5
Cough, slight .....	14	13
moderate or severe .....	21	29
Sputum, day appeared, range .....	1-7	1-8
day appeared, average .....	4	4
amount, absent .....	14	26
slight .....	14	11
medium or copious .....	6	16
Temperature (maximum), range .....	101-105.2	101.5-105
duration, range .....	2-14	2-18
average .....	7	7
daily swing, present .....	23	42
Respirations (maximum), range .....	20-32	20-38
Pulse (maximum), range .....	90-124	90-136
Day râles or dulness detected, range .....	1-5	1-12
average .....	3	3
Adventitious physical signs, not elicited .....	7	8
relatively obscure .....	15	21
obvious .....	13	33
Signs of consolidation, present .....	3	9
day appeared, range .....	6-10	3-10
average .....	7	5
Leukocyte count, range .....	6,200-16,100	6,000-23,400

A comparison of data applying to the course of the illness shows little difference between the two groups, and certainly no more than exists between individuals in each group. Kneeland and Smetana<sup>5</sup>

have separated these cases into three groups on the basis of severity, and it should be pointed out that the differences between these two groups were not as great as were the differences between each of their groups, and in no instance did a patient fall into their Group 2 classification. There seems to be no reasonable doubt that the 35 cases occurring in the latter part of 1939 were the same clinical entity as the other 52 cases.

### *Case reports*

Two brief case reports will serve to emphasize the clinical features of this disease and show the similarity between cases in this series and those reported by others.

Case I. T. S., age 16, was admitted on October 15, 1939, complaining of malaise, chilliness, backache, and occasional non-productive cough. At admission the physical examination was negative, the leukocyte count 8,600; no sputum was ever obtained. On the fifth day râles were heard at the right lower lobe. At no time did the patient appear particularly ill. His x-rays and clinical chart are reproduced.

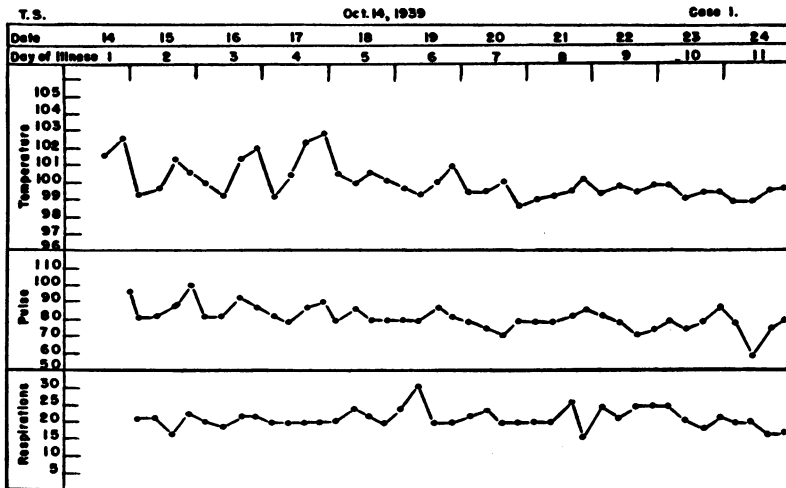


CHART I (Case I). Age 16. Temperature, pulse, and respiration chart during the febrile period.

Case II. W. McG., age 15, was admitted on November 10, 1939, complaining of malaise, chilliness, headache, and occasional non-productive cough. His physical examination was negative, the leukocyte count 8,000. On the

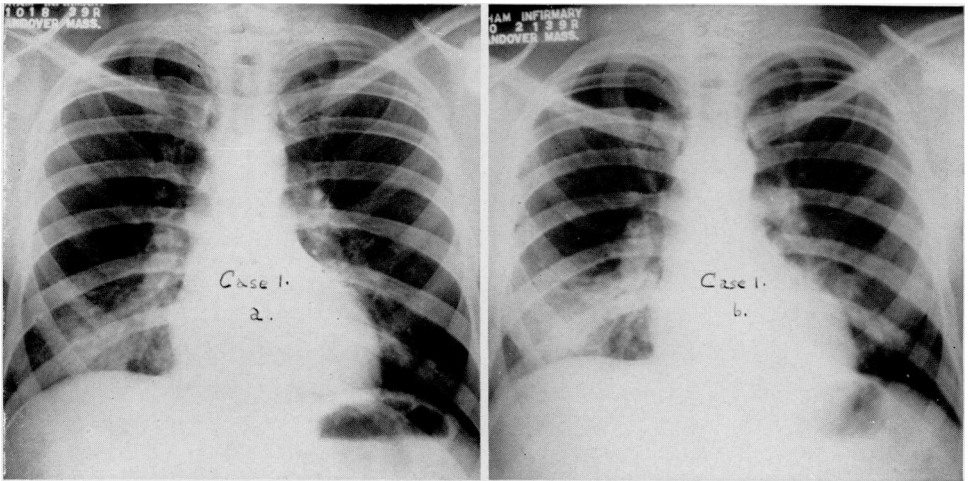


FIG. 1 (Case I). X-rays taken on the fifth day of disease (a) and on the eighth day (b), showing the development of a lesion at the base.

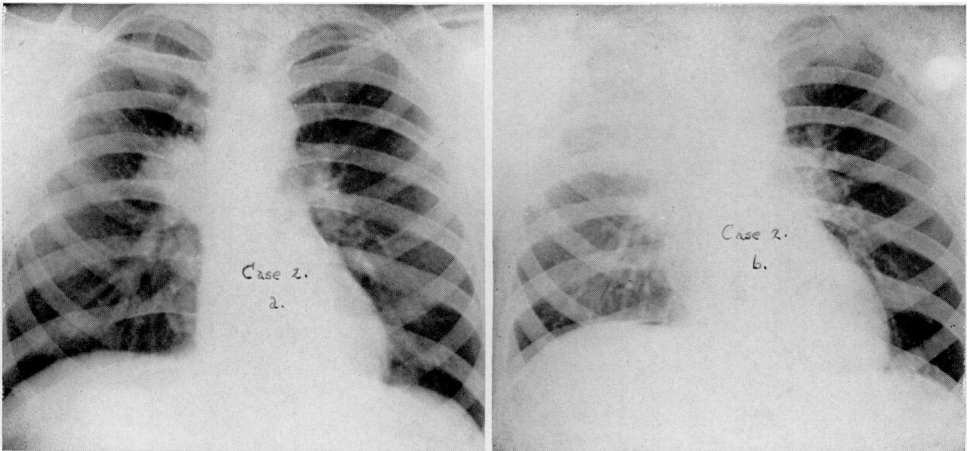


FIG. 2 (Case II). X-rays taken on the fourth day of disease (a) and on the seventh day (b), showing the development of a lesion at the apex.

third day râles were heard, after cough, at the inferior angle of the right scapula. Fever persisted for 11 days, the cough was always non-productive, and by the eighth day the patient looked and felt quite well. On the eleventh day egophony and tubular breath sounds were made out in the right axilla. The x-rays and clinical chart are reproduced.

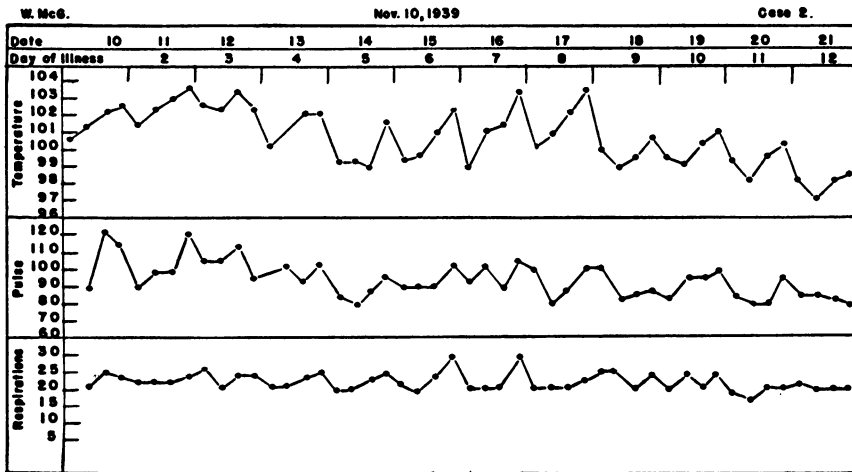


CHART II (Case II). Age 15. Temperature, pulse and respiration chart during the febrile period.

#### EPIDEMIOLOGICAL DATA

In an effort to determine the mode of spread of this disease, as well as to estimate its incubation period, various data have been collected. The difficulties usually encountered in tracing infections in a group of boarding-school boys, who are nothing if not ubiquitous, will be only too obvious in this discussion.

#### *Community distribution*

In Table 4 are listed the attack rates for various parts of this community; the student population has been broken up into its four classes and these in turn have been separated into those students who had previously attended this school and those who entered the school in September, 1936. The day students, who attend classes at the school but live at home, are separated from the boarding students. Janitors have been chosen as the type of school employee most likely to come in contact with students, since their duties in making beds

and cleaning dormitory rooms bring them in close association with students. However, there were no cases of this illness among the janitors or in the, approximately, 170 other employees who work as food handlers in the dining hall, groundsmen, janitors in other buildings, electricians, etc.

It will be seen that the attack rate was much higher among students who had not been at the school during previous years, and that this difference was not entirely due to the relatively high incidence among the members of the Junior Class. The absence of illness among day students and faculty and among the town high-school students is striking, and makes one suspect that residence in this community over a period of years provides a degree of immunity to this infection.

TABLE 4  
DISTRIBUTION OF CASES IN VARIOUS PARTS OF THE COMMUNITY

<i>Designation</i>	<i>Number</i>	<i>Cases</i>	<i>Attack rate</i>
Seniors, old boarders .....	151	2	.013
new boarders .....	47	7	.150
day students .....	17	0	.000
Upper Middlers, old boarders .....	142	5	.035
new boarders .....	42	2	.047
day students .....	14	0	.000
Lower Middlers, old boarders .....	95	5	.052
new boarders .....	70	4	.056
day students .....	18	0	.000
Juniors, new boarders .....	100	10	.100
day students .....	26	0	.000
All old boarders .....	388	12	.030
All new boarders .....	259	23	.086
All day students .....	75	0	.000
Infirmiry nurses .....	7	1	.142
Dormitory janitors .....	23	0	.000
Faculty .....	78	0	.000
Other employees .....	120	0	.000
Town high-school students* .....	400	0?	.000?

\* The data on the high-school students in the town is believed reliable; no cases of this illness were known to occur and the attendance figures for the fall of 1939 of that institution show no significant variation from those of other years. (See Table 5.) This would indicate that the outbreak was strictly a local one, and not widespread over this area.

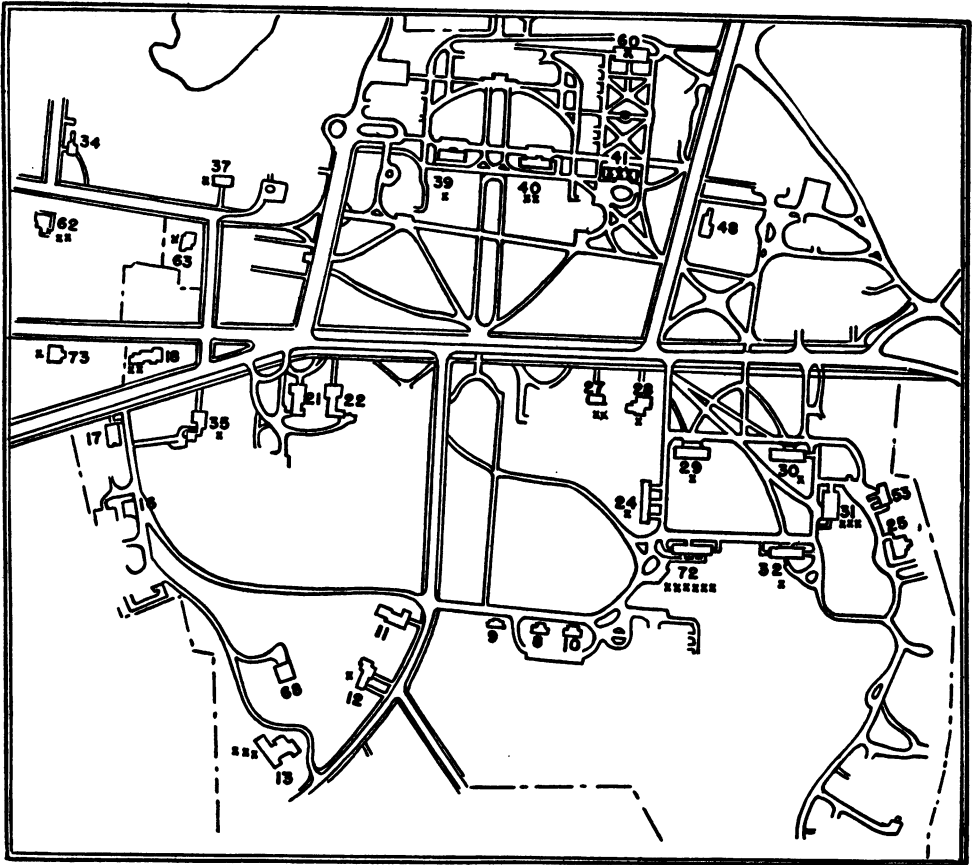
TABLE 5

ATTENDANCE RECORD AT THE TOWN HIGH SCHOOL FOR A THREE-YEAR PERIOD  
(PER CENT OF ATTENDANCE)

	Sept.	Oct.	Nov.	Dec.
1938 .....	96.3	95.5	95.6	93.4
1939 .....	98.2	95.0	94.2	93.8
1940 .....	96.2	92.5	95.4	88.5

*Place infection*

Hornibrook and Nelson<sup>4</sup> have commented on the development of pneumonitis in 15 persons employed in one building and on the



A map of the community showing the cases (x) which developed in each dormitory. The dormitories listed in Table 9 are numbered: Taylor, 31; Rockwell, 72; Day, 41; Williams, 13; Salisbury, 62; Clement, 35; Pease, 27; Bartlet, 40.



failure of the disease to appear among another group working in a nearby building at similar duties. They also noted the fact that no secondary cases developed in the families of those who had the disease. These observations raise the question of place infection rather than contact infection. The map shows the distribution of our cases in the dormitories of the institution, the crosses near the outlines of each dormitory indicating the number of cases. It is evident from the map that the cases were widely distributed over all parts of the campus. A relatively large number of cases, however, occurred in a few buildings, and in Table 9 additional data are given on those cases. Place infections, other than the dormitory one and the dining hall, are difficult to trace in this community. In Table 6 the distribution by dining halls is given; it will be noticed that the distribution is quite even except that the incidence in the Lower Hall, where the proportion of new students is large, is greater than elsewhere.

TABLE 6

<i>Place</i>	<i>Number attending</i>	<i>Cases</i>	<i>Attack rate</i>
Senior Hall .....	160*	8	.050
Upper Hall .....	155*	8	.051
Lower Hall** .....	150*	16	.106
Williams Hall (Juniors) .....	48*	3-	.062

\* Average attendance.

\*\* About half the Junior Class eat here with Lower Middlers.

### *Contact infection*

The possibilities of contact infection are practically unlimited, but data of some degree of reliability can be obtained from such material as the distribution within dormitories, roommate infection, infirmary cross-infection, and class-room contact. In Table 9 data concerning students living in the same dormitory are given; other dormitory cases were distributed so that only one student in a dormitory became ill. The proportion of students in this table having roommates is comparatively small, 8 out of 23, but the possibility of cross-infection between K. K. and T. W. S. is significant, and the illness of T. S.'s roommate, will be discussed later. Of the cases not included in Table 9, 6 had roommates, none of whom became ill.

### *Infirmary cross-infection*

Despite reasonable precautions cross-infections in a hospital may occasionally be expected and the possibility of any of these cases having had a hospital admission prior to their admission with pneumonitis has been considered. Only five individuals in this series had

hospital admissions between September 11, 1939, and their admission with pneumonitis.

TABLE 7

DATA ON PATIENTS HAVING A HOSPITAL ADMISSION PRIOR TO ONSET OF PNEUMONITIS

<i>Name</i>	<i>Adm. date</i>	<i>Discharge date</i>	<i>Diagnosis</i>	<i>Admission date (Pneumonitis)</i>
F. P.	Sept. 11	Sept 12	Gastroenteritis	Nov. 29
R. D.	Sept. 19	Sept. 20	Gastroenteritis	Nov. 12
T. H.	Sept. 22	Sept. 24	Head injury	Nov. 13
M. H.	Oct. 14	Oct. 15	Ivy poisoning	
	Oct. 18	Oct. 21	Ivy poisoning	Dec. 4
K. S.	Nov. 1	Nov. 3	Acute appendicitis(?)	Nov. 6

It is possible that K. S. became infected while at the infirmary from November 1 to 3, but in view of the brevity of the incubation period which that postulates and the other sources of infection to which he was exposed (see below), that possibility seems unlikely. The intervals between the admissions of the other individuals seem too long to make infection at the time of the first admission a likely one. There was, however, a probable cross-infection occurring in one of the nurses caring for these patients; she became ill on November 13, and ran a typical course. No other nurse developed the disease. It is impossible to determine which patient was the source of her infection.

#### *Class-room infection*

The possibility of contact between students who attend the same recitations is sufficiently great to warrant investigation. In Table 8 these relationships are listed. The most reliable close contacts are listed, and the probable incubation period is indicated.

TABLE 8

DATA CONCERNING CLASS-ROOM CONTACTS

<i>Source</i>	<i>Date admitted</i>	<i>Class-room contact</i>	<i>Date admitted</i>	<i>Interval (days)</i>
R. G.	Oct. 24	R. McC.	Nov. 1	8
		K. S.	Nov. 6	13
D. D.	Oct. 27	R. O'B.	Nov. 7	10
		A. McG.	Nov. 10	14
P. D.	Oct. 30	R. O'L.	Nov. 7	8
		R. D.	Nov. 12	13
H. H.	Oct. 30	R. D.	Nov. 12	13

*The incubation period*

If it can be assumed that this disease is spread by contact and is not a place infection, it should be possible to arrive at some fairly definite estimation of the incubation period. Murray<sup>7</sup> has suggested an incubation period of from 7 to 11 days; Kneeland and Smetana<sup>5</sup> believe it to be from 2 to 3 weeks; Hornibrook and Nelson<sup>4</sup> believe that if the disease is spread by contact the incubation period is long. In a report<sup>3</sup> which considered the incubation period of some 52 cases of acute pneumonitis, and 11 cases of a similar illness in which pulmonary lesions could not be demonstrated, the incubation period ranged from 7 to 23 days. Of these 63 cases the evidence of cross-infection was quite reliable in 6 instances; in two of these the interval between admissions was 7 days, in two others it was 9 days, in one it was 11, and in another it was 18 days.

TABLE 9

ADDITIONAL DATA CONCERNING CASES OF STUDENTS LIVING IN THE SAME DORMITORY

<i>Name</i>	<i>Dormitory</i>	<i>Class</i>	<i>Date admitted</i>
R. G.	Taylor	Upper Middler	10.14
T. S.	Taylor	Upper Middler	10.14
H. E.	Taylor	Upper Middler	11.14
S. B.	Rockwell	Junior	10.16
D. D.	Rockwell	Junior	10.27
R. O'B.	Rockwell	Junior	11.7
A. M'G.	Rockwell	Junior	11.10
R. D.	Rockwell	Junior	11.12
T. H.	Rockwell	Junior	11.13
H. M.	Day	Senior	10.19
C. S.	Day	Senior	10.22
R. G.	Day	Senior	10.24
H. H.	Williams	Junior	10.30
P. D.	Williams	Junior	10.30
C. G.	Williams	Junior	12.1
W. H.	Salisbury	Lower Middler	10.16
R. McC.	Salisbury	Lower Middler	11.1
J. C.	Clement	Lower Middler	10.23
J. P.	Clement	Lower Middler	11.29
K. K.	Pease	Upper Middler	11.21
T. W. S.	Pease	Upper Middler	12.2
E. M.	Bartlet	Senior	10.30
R. R.	Bartlet	Senior	11.8

A study of Table 9 yields some reliable data. The cases developing in R. G. and T. S. living in Taylor and members of the Upper Middler class were among the first in this series. The next member of their class to develop pneumonitis was B. M., who lived in a nearby dormitory and ate in the same dining hall; he was admitted on October 23. On that same day the roommate of T. S. was admitted with what we shall refer to as the non-pulmonary form of this disease. In each of those instances the interval between admission was 9 days, and no other likely source of infection is evident.

The first member of the Junior Class to become ill was S. B., who was admitted on October 16. No cases of the non-pulmonary type developed in this dormitory, and the next case of pneumonitis from dormitory Rockwell and from the Junior Class was D. D., admitted on October 27. D. D. did not live on the same floor as S. B., but students in that dormitory share a common meeting room and live in intimate contact. His admission was 11 days after that of S. B.

D. D., A. M'G., and T. H. all lived on the same floor of Rockwell in rooms diagonally opposite, and all used the same bath. A. M'G. was admitted on November 10, 13 days after D. D., and T. H. was admitted on November 13, 15 days after D. D. A. M'G. had spent a considerable amount of time with D. D. on the day before the latter's admission. D. D. also appears to have been the most likely source of R. O'B's infection; they lived in widely separated parts of the same dormitory, but they were in the same classrooms, dining hall, and meeting room. Their admissions were 10 days apart.

The origin of the cases among Seniors in dormitory Day is difficult to explain unless one postulates that J. W., who had the non-pulmonary form of the disease, was the source of the infection. J. W. was in the same dormitory as R. G., H. M., and C. S., and in classes with R. G. The intervals between the admissions of J. W. and those three patients were 9, 12, and 14 days respectively. It is possible that C. S., who spent considerable time with E. M., was the source of the latter's infection; it will be noted that there were no intervening cases in the senior class and that the interval between the admissions was 8 days. The senior who developed pneumonitis following E. M. was R. R., who lived in the same dormitory as E. M.; the interval between their admissions was 8 days.

The only roommates to develop pneumonitis were K. K. and T. W., who were admitted on November 21 and December 2 respectively, at an interval of 12 days.

One may take the gaps which occur when the cases are arranged chronologically as further evidence that the incubation period of this illness is not short. No cases were admitted between November 1 and November 6; none between November 14 and 21; none between November 21 and November 29. From 11 cases in which the evidence of contact is reasonably reliable, the incubation period appears to range from 9 to 15 days, the average being 11 days. These figures are very similar to those obtained from the data on class-room contact listed in Table 8 and to those cited in another report<sup>3</sup> on the incubation period between cases of the pulmonary and non-pulmonary form. Evidence in other reports<sup>3, 5, 7</sup> indicates that the incubation period may be as long as 20 days, and a period of that length should perhaps be considered unusual but not unlikely.

### *Immunity*

In our experience of seven years with this disease we have never seen a second attack develop in the same individual. In this series B. U. developed a pneumococcal (Type 18) lobar pneumonia two months after his acute pneumonitis. The proportion of cases developing in students new to this environment and the absence of cases among faculty and employees suggest that a specific immunity to this disease may develop. The absence of cases in the local high-school group may be an indication that these students had no contact with the infection or it may mean that that group had a high degree of immunity. Our data indicate that it would be valuable in the future to apply the technic of Dyer, Topping, and Bengston<sup>1</sup> and to attempt to determine the presence of protective antibodies in the sera of known contacts who do not develop the disease.

### SUMMARY

1. Clinical data have been presented on 35 cases of acute pneumonitis which occurred in a student population of 722 adolescents within a period of 7 weeks. These data indicate that the cases recorded were similar to cases described in other reports of this disease, although in most other instances the attack rate did not reach epidemic proportions.

2. The higher incidence of this disease among newcomers to this community suggests that residence in this region may, through the same or a related illness, produce immunity to this infection.

3. The distribution of cases throughout various buildings in the community leads one to believe that this disease is spread by contact and is not a place infection.

4. The data suggest that an incubation period of from 9 to 15 days is most likely, but the probability of a longer interval in occasional cases is noted.

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