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A NATIONAL EMERGENCY EXISTS [1]

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This twelfth annual meeting of the Western Branch, American Public Health Association, convenes amid shadows of war and rumors of war. We are meeting in one of the Nation's most active defense areas. The theme of our program is, "Public Health and National Defense." Regardless of our personal beliefs or political views, we must recognize the fact that the Nation is already launched on the greatest defense program in our history. Preparation for war is on a larger scale and may last for more years than we have ever before experienced. War is all but upon us. We face a serious and common danger.

This is not the time to proclaim the futility of war. If civilization is at fault the remedy must be applied in less troublous times. War may be a biological phenomenon as illogical as nature's waste of seed in procreation. It may be as uncivilized as a street brawl. To discuss these matters here is to waste valuable time on the regrets of yesterday. We are here today to apply the realism so characteristic of public health. Our immediate job is to prepare ourselves for the important work awaiting us now. What the distant future may hold, none can foretell, but war preparations impose some important responsibilities on the public health profession. I propose, therefore, in this brief discussion to suggest an orientation of public health in this chaos of world affairs, to point out certain national defense trends already apparent in public health, and to appraise certain of our present-day public health assets which we shall turn to good advantage in the present emergency.

THE MILITARY VS. CIVILIAN HEALTH

First we must realize that nothing, no matter how important it may seem to us, can interfere with or delay the organization, training, and equipping of the military. Everything that we hold dear may

[1] Read before the annual meeting of the Western Branch, American Public Health Association, San Diego, Calif., May 26, 1941.

depend upon our ability to organize quickly and efficiently a superior military machine. This may become our last and most essential defense for the democratic way of life, for our traditions, our homes, and our very existence. Without a winning army and navy we might lose all.

The military must be built up quickly and efficiently by those whose profession it is to do so. Health officers often resent interference from lay people when an emergency professional job is to be done. Let us remember that we civilians are the lay people in relation to the military. Military activity offers little place for that luxury of peace and democracy, "the discussion method." Let us give the military profession no slow or doubtful acquiescence, no interference, nothing but the fullest cooperation.

A healthy civilian population is the source of a healthy military. Strength and health at home are essential to a successful army and navy. Second only then to the prompt organization of an efficient military comes the preservation and improvement of the health of the civilian population. This is an obvious requisite if the Nation is to be successful in defending itself. This responsibility rests squarely on the shoulders of the public health and medical professions and on their colleagues, the teachers and welfare workers. Never does public health become more important than in preparation for war. Good public health work will furnish a continuing supply of able-bodied men to the armies and navies; it will provide a healthy and efficient army of industrial and agricultural workers to produce munitions and materiel; it will develop a healthy and courageous family at home to withstand the anxiety and danger which may be their lot. Poor public health work will diminish the supply of able-bodied soldiers and workers, will allow illness and physical defect to undermine the morale of those at home, and through them, of the Army. Next to military perfection, civilian health is the most important item in national defense.

Despite this importance we may have to expect certain difficulties in attaining our objectives. There are three reasons for this: First, the military comes before everything else; second, there is always some confusion of values when a great peaceful nation is forced to prepare for war; and third, taxation mounts to unprecedented heights.

Among these difficulties may be the necessity of doing more work with less personnel and perhaps with less money. The younger members of the profession, both men and women, will be called to the colors. This means that those who are left, together with what inexperienced new help they can find, must carry on. The burden will fall heaviest on the executives and administrators. They have no escape from meeting their full responsibility and upholding the best of public health standards. This means longer hours, harder

work. It is nothing new for the seasoned public health worker. The cause for which we labor has always justified our utmost efforts.

The necessity of doing more work with less money results from confusion of values and mounting taxes. This is also nothing new to the public health profession. It is an adversary with which we are accustomed to wrestle. During the recent depression we learned some new and effective holds. It simply means that we must be able to show the taxpayer a dollar's worth for every dollar spent. Experiments with new methods designed to cut costs and increase efficiency are especially appropriate. In times of curtailment we must stick to the items in our program which we know will produce results, the kind of results which are convincing to the taxpayer.

It seems clear then that we may expect the military to have first call on the Nation's energies and finances. Knowing our job as we do, we must then leave no stone unturned to teach the Nation that next to the military comes civilian health in national defense. Knowing our limitations as we do, we must be prepared to expect handicaps with which we are already familiar, more work to do, less personnel and less money to do it with. We have proved as recently as the late depression that these handicaps may be overcome.

SOME PUBLIC HEALTH NEEDS IN NATIONAL DEFENSE

Having oriented ourselves with respect to military preparedness, let us now turn to certain trends or changes in direction in our usual public health program which are already becoming apparent and urgent as contributions to national defense.

1. *Correction of physical defects.*—Medical rejection for military service of a large percentage of our young adults again focuses attention on the unmet need for medical care in our population. This is a public health problem of the first magnitude. It challenges the medical and public health professions alike.

It should be pointed out that we understand the reason for these rejections better than we did during the last war. Some would charge failure to medicine and public health for not producing in the past 25 years a higher percentage of physically fit young men. It should be borne in mind, however, that the most effective public health activities in the past have been aimed at reducing mortality, not at producing physical perfection. Our success with the infectious diseases has resulted in preserving a larger proportion of the population to the military age. It should also be kept in mind that Army physical standards, except for teeth, are higher than they were 25 years ago. Since the last war our methods of detecting physical defects have greatly improved. In the last war we were drafting men for combat. Now we are selecting men for defense. There is little basis for comparison in the standards of selection.

If our school health program has failed to correct a high proportion of remediable defects in children, it is largely due to our failure to persuade parents to seek competent medical care. We cannot overlook the fact, however, that our child health work has not produced all the results we expected. There is room for improvement in our methods of finding physical defects as well as in our method of obtaining correction. We have by no means exhausted the possibilities of preventing physical defects and illness through an effective technique of school health education which really produces improved health. Much of our child health program is pioneer work and its effectiveness will improve as we show our ability to get results. Like other pioneer work it has suffered from lack of personnel. Improvement will be noted when we are able to convince school boards that they need more and better school physicians and school nurses.

In any event serious study must be given to supplying the immediate medical needs of about one out of three men called by the Selective Service Boards and found unfit.

2. *Industrial hygiene.*—Thanks to vigorous national leadership in the Public Health Service and in the Army and Navy, we are at last on the verge of an awakening concerning the health of the worker. Men laboring in the essential industries are as important to national defense as are men in uniform. Some men in industry encounter more hazards to life and health than some men in uniform. Regardless of hazards or freedom from hazards, industry offers a fertile ground to apply the well-proved procedures of public health. They are the same as we apply to any population group in order to bring about reduction in preventable illness. These principles are of special value to industry since they mean reduction in lost time due to illness, and lost time means lost money and retarded production.

Responsibility for safeguarding the health of the worker is properly placed first on the State and local health or industrial authorities. It is more important than ever for each health officer to become familiar with the health aspects of working conditions in his locality and to include provision for reasonable health safeguards in his public health code.

3. *Disaster relief.*—One has but to examine the important work of health departments in the presence of local disasters such as flood, fire, and earthquake to appreciate its importance. Disaster may be mitigated by the alert health department to the point where the only lives lost are due to the accidental deaths arising directly from the disaster. On the other hand, disaster may bring a death toll many times greater than the original damage through epidemics or through the neglect of essential health safeguards. This depends almost solely on the efficiency of the local health department. Every city, county, and State health department should have its disaster relief

plans prepared, revised, and rehearsed periodically. Wartime disasters usually come without warning.

4. *Diseases of middle age.*—As the younger age groups depart for military training camps, more work and more economic importance devolves upon the older age groups. Moreover, the proportion of the population over 45 years of age in this country now increases each year. Our progress in prolonging life after age 45 has been slow, yet we know that much can be done to prevent or postpone death from cardiovascular disease, cancer, diabetes, and other so-called degenerative diseases. The techniques of the tuberculosis campaign applied to these increasing causes of death might yield large results under the competent leadership of the medical and public health professions. They assume enhanced importance in times of preparation for war.

5. *Health education.*—The success of the tuberculosis campaign in educating the public has pointed the way to better methods of educating the public in other health matters. This must be done in the schools through our colleagues, the teachers, as well as among the general public. There is still too great a lag between what we can do to prolong life and what we actually do. When the ingredients for good health, such as good medical care, good hospitals, clinics, and competent health departments, are lacking, health education is of little avail. When the ingredients for good health are at our fingertips and not used, it is usually for want of effective methods of health education.

Perhaps the best example of our weakness in health education is in the field of nutrition. In this land of plenty with an average standard of living far exceeding that of any other nation, it is little short of disgraceful that so large a proportion of our people should show evidence of malnutrition. There are groups in this country who lack the means to obtain an adequate and well-balanced diet. There is an appalling number, however, whom we have failed to educate to stir themselves to secure a proper diet. This is one of the most urgent challenges in public health education today. Its urgency is enhanced by the national defense program. We in public health and in teaching shall be found seriously wanting if we do not attack this problem with all the modern methods we possess and without further delay.

Venereal disease control is almost, though not quite, as completely a problem of health education. Its urgency is likewise increased by the need for national defense. It is not solely a problem of health education because it requires certain facilities such as diagnostic centers and treatment clinics before health education can be fully effective. Given these facilities, however, we are then faced with the fact that we fail to control these diseases through missing or faulty health education. The curtain of puritanical bigotry which prevented discussion of these diseases for so long has at last been lifted to admit

the light of scientific fact. No health department will be doing its share towards national defense today until it has employed every modern facility and educational device to combat this scourge of armies and of families.

Finally we must face with our teacher colleagues the fact that we need to help "toughen up America." The next few years may impose physical and nervous strains on our young and old such as we never dreamed human beings would be called upon to withstand. We must share with parents and teachers our scientific knowledge of the remarkable adaptability of the human mechanism. Especially must they know something of what we know concerning physiology and nature's defenses, the surprising reserve of the human mechanism, and its ability to function normally despite distressing external circumstances. We must bring into use our best knowledge of mental hygiene so that these inherent physiological reserves may not be hampered by psychological factors such as fear, insecurity, and frustration. Children of the present generation may have suffered from too much shielding from the unpleasant. Perhaps they needed more understanding and an opportunity to participate with the family group in facing common problems. As medical advisers to parents and teachers, we will be expected to prepare ourselves in this important field of child welfare so that we may render our maximum service to national defense.

So much for these special demands which we may expect the national defense program to present to us. Now let us turn our attention to some of the special and unique assets we in public health possess today with which we may meet these special demands.

PUBLIC HEALTH ADVANTAGES OF TODAY

Public health leadership in this country has always faced reality with an analytical, constructive, and courageous attitude. There is much in our situation today from which to take courage.

1. *National leadership.*—We are blessed to an even greater extent than ever before with strong and able leadership in Washington, D. C. We have in the Surgeon General of the United States Public Health Service and his staff, forceful, articulate, and professional representation. We have splendid leadership in the Children's Bureau. Other and newer Federal agencies show a health consciousness heretofore unparalleled. There is an excellent working relationship between the national official and the national voluntary health agencies. The importance of public health and our needs in all its subdivisions have never been more clearly presented to the Chief Executive and the Congress. The legislative response both nationally and in the States has never been more generous.

2. *Special attention to defense areas.*—Federal supervision of public health in defense areas, which might otherwise be neglected by local

health agencies, will be a stimulus to public health throughout the Nation. It will be a demonstration to local communities of the value of providing themselves with good public health departments. It will set high standards for other areas to follow. It is more than justified in view of the urgency of civilian health in national defense. Health officers of States and in contiguous cities and counties will do well to work closely with Public Health Service men recently assigned to these defense areas. They will thus prepare themselves to continue good work when decentralization takes place and jurisdiction is again returned to local communities. Furthermore, the local health officer is often able to render valuable assistance to Public Health Service and military medical officers. For example, health officers in the San Joaquin Valley are well aware of the dangers of "valley fever" when nonimmune troops are brought into known infected areas for the first time. The Sylvatic Plague Committee of the Western Branch has addressed all western State health officers on a series of conferences held with medical military officers on this distinctive western problem. Tularemia and Rocky Mountain spotted fever may prove troublesome to health authorities.

3. *Young and well-trained personnel.*—Thanks largely to Federal assistance, we have never before had so large a group of young men and women well trained in public health work. Besides good training they bring the vigor and enthusiasm of youth to our cause. Since they will be our mainstays in public health and national defense, it is to these future leaders of our profession that I would address my closing message.

4. *To our future leaders.*—Never lose faith in the cause of public health. It is the most tangible and the most effective of all the great movements for social betterment. It is "the flower, such as it is, of our civilization" with respect to sociological progress. Rooted in the firm ground of medical and sanitary science it meets definite needs in the public health field as well as in the related fields of education, sociology, political science, and statecraft.

The worthiness of this cause has commanded the lifetime energies and engaged the highest abilities of many of the world's greatest men. It has brought forth examples of devotion unsurpassed in other fields of human endeavor. And these examples have likewise come from a large and impressive group of those who were not called "great" in song or history. These are "the unsung great in public health." They comprise the State and local health officers and their loyal assistants of the passing generation. From the standpoint of service to mankind, their claim to greatness is as valid as that of any of their colleagues. Their devotion to the cause of public health is of the same stuff as was the devotion of Hippocrates, St. Francis, and Osler.

Yet their names will never be known to legend and history or perhaps even to science.

The last to covet fame, in fact often the first deliberately to avoid it, these men and women, your immediate predecessors, stuck to their faith in the cause of public health despite handicaps and hardships which you may never have to experience. They rarely had security in tenure of office, but were subject to removal with each political upheaval. They were woefully underpaid and cruelly overworked. They had neither funds nor time nor perhaps ability to seek the rewards of scientific research. They had so little to offer personnel in the way of salaries or security that they had often to be satisfied with men poorly equipped and usually had to do their own training. They were in constant political danger and often in physical danger which destroyed their health and sometimes claimed their lives.

But they never doubted that the game was worth the candle; they hung on because the cause for which they labored was a great cause and thereby they themselves became great, if unsung. Their reward was the abiding satisfaction of lowered death rates, of less illness, of increased life spans, and of greater health and happiness for their people. Are these rewards enough for us?

The urgent work of national defense will rest heavily on your younger and stronger shoulders. Your ability to preserve and protect the health of the civilian population may well be the deciding factor in this world struggle to preserve the freedom of mankind. You are better trained, better understood, better supported, and better led than your predecessors. With firm faith in the cause, you will bring us closer to the day when freedom of mankind also means freedom from preventable illness and premature death.

CONCLUSION

I have pointed out that we are in the throes of the greatest defense effort in terms of time, men, and money, that this Nation has ever put forth. Inherent in this effort is the fact that the military establishment of the Nation must have first claim to the Nation's resources, but a close second in immediate as well as in long-time importance is civilian health preservation. This is squarely our responsibility since we who are trained in the medical and public health professions have the knowledge and skill which qualify us to guide the health destinies of the Nation. We must be prepared to expect certain handicaps and difficulties none of which are new or insurmountable. I have presented briefly some of the new tasks already discernible in the national defense program which we may be expected to assume. Finally, we have reviewed some of the special advantages enjoyed by the present generation of public health workers which were unknown to their predecessors. The health of the Nation assumes greatly

increased importance in times of war and preparation for war. The public health profession will not be found wanting in ability to deal with the urgent and serious tasks of national defense before us if we continue to pursue our work with conviction, faith, devotion, and courage.

LEAD AND ARSENIC INGESTION AND EXCRETION IN MAN

By STEWART H. WEBSTER, *Biochemist, United States Public Health Service*

INTRODUCTION

The determination of the lead and arsenic content of biological specimens from a large number of individuals comprised a part of the chemical investigation of the lead arsenate spray residue study (*1*). Blood and urine samples were ordinarily secured at the time of the regular physical examinations and the analyses of these single specimens, therefore, represented only instantaneous pictures of concentration levels. Single fecal samples were secured from a group of about 48 persons at two different times of the year but the analytical values gave only qualitative comparisons of excreted lead and arsenic.

Since the investigation of Fairhall and Neal (*2*) on the absorption and excretion of lead arsenate in two individuals, it appeared desirable to extend this work to other persons having histories of extended exposure to lead arsenate and with potentially higher levels of intake of lead and arsenic during this time.

The purpose of the following investigation was to determine the maximal quantities of lead and arsenic excreted daily by orchardists consuming apples which had been sprayed with lead arsenate and to obtain an estimate of the quantities of these elements ingested with the fruit.

EXPERIMENTAL PROCEDURE

Nine healthy adult male orchardists who lived in the vicinity of Wenatchee, Washington, and all but one of whom had three routine physical examinations were selected as subjects for this experiment because of their typical exposure and customary habit of eating unwashed apples.[2] Four of the subjects received their examination 1 or 2 days before starting the experiment; for the other 5, the previous examination was made 3 to 5 months earlier. In 3 cases the final routine examination was made after the conclusion of the experiment, the time ranging from 1 day to nearly 3 months. None of these physical examinations revealed a combination of signs and symptoms indicative of lead arsenate intoxication. These men were

[1] From the Division of Industrial Hygiene, National Institute of Health.

[2] As used in this study, the term "washing" refers solely to the commercial washing treatment for apples and pears.

asked to eat as many average-sized unwashed lead arsenate sprayed apples during the 10–12-day experimental period as they ordinarily would eat during the peak apple consumption period, and to keep a record of the number eaten each day. Before starting the experiment each man reserved a separate lot of apples and confined his apple eating during the experimental period to his particular lot of fruit.

The total urinary and fecal output of each of the 9 orchardists during each 24-hour interval for the entire period was collected in lead- and arsenic-free containers in the manner previously described (*1*, *3*). A portion of each day's urine, a record of total daily volume, and the daily fecal output were sent to the National Institute of Health for analysis, together with a sample of the apples eaten by each individual during the test period. Information was secured in most cases regarding the condition of the apples, whether wiped or unwiped, before being consumed.

This experiment differed somewhat from the study undertaken earlier by Fairhall and Neal. In the former investigation 2 individuals having no appreciable lead or arsenic exposure previous to the experiment ingested 10 mg. of lead arsenate daily for 10 days; a fairly strict diet was provided, and a fore and after period observed, with a 4-day period of medication during the 13-day after period. In the present work 9 individuals who were orchardists and who therefore had had considerable previous exposure [3] to lead arsenate regulated the quantity of this substance ingested by the number of apples per day. Otherwise these men followed their usual work and continued on their customary diet; no fore or after period was observed, and no medication was administered at any time.

This study was not a balance experiment, in the usual sense of the term, since the intake could not be accurately controlled and volunteer subjects were not available for the extended time required for the usual fore, after, and experimental periods. From analyses of representative samples of the fruit eaten by each man it was hoped to estimate the quantities of lead and arsenic actually eaten. In any case such analyses would represent potential if not actual quantities consumed.

Each lot of fruit was treated in the following manner: Every apple was weighed and the average diameter was measured with a vernier caliper. After cutting out and throwing away that part of the skin adjacent to the stem and calyx which is not ordinarily eaten, the rest of the peeling and fruit were weighed separately. The peelings from a given lot of apples were combined and ashing was carried out in the customary way. No further use was made of the fruit portions of the apples. By ashing the edible peelings rather than the whole edible

[3] The length of time in orchard work ranged from 9 to 29 years and averaged 19 years; ages of subjects ranged from 34 to 53 and averaged 43 years.

portion [4] the amount of lead and arsenic commonly ingested was secured and the troublesome ashing of bulky apple residues was avoided.

Analyses were made for lead and arsenic on each lot of apples and on a sample of each day's urine and fecal specimen for each man as described elsewhere.[5] The weights of the daily individual output of feces (calculated on the dry basis) varied considerably and ranged from 6.1 to 63.6 gm., with an average of 35.3 gm. for 96 specimens. This is within the average range of 20 to 40 gm. per day given by Taylor (*4*).

EXPERIMENTAL RESULTS

The analytical findings are summarized in the following tables. Table 1 indicates the lead and arsenic content of representative samples of apples eaten by the 9 experimental subjects. In column 3 headed "condition" is recorded the treatment of the apples before being sent to the laboratory for analysis. No washed apples were eaten by any of the men. However, it was customary to wipe the fruit before eating it. It was found that, depending upon the thoroughness with which this was done, more or less lead and arsenic was removed in the process. Analyses of apples which were unwashed but which had been carefully wiped with cloths showed an average lead load, for the edible portion, of 4 mg. per apple. Likewise, analyses showed that the wiping of the apples removed only a part of the original arsenic. These experiments indicated that about a third of the residue was removed by the wiping process.

TABLE 1.—*Lead and arsenic content of samples of apples eaten by experimental subjects*

Experiment No.	Number of apples analyzed	Condition	Average weight, gm.	Average diameter, cm.	Total mg. of lead	Mg. of lead per apple	Total mg. of arsenic	Mg. of arsenic per apple	Consumption		Number of lead arsenate sprays
									Daily [1]	Annual	
1	14	W [2]	188.7	7.6	135.3	9.66	8.1	0.58	1.8 W	400B [4]	8
2	11	W	208.6	7.8	41.1	3.74	12.7	1.15	1.8 W	1,000 NW [5]	7
3	12	W	153.9	7.1	42.1	3.51	6.7	.56	1.9 W	50 B	6
4	12	UnW [3]	154.4	7.2	75.2	6.27	13.4	1.12	1.7 W	700 NW	7
5	10	W	155.5	7.2	34.3	3.43	9.0	.90	2.3 W	600 B	8
6	17	UnW	121.0	6.6	8.3	.49	15.9	.94	2.1 UnW	800 B	4
7	9	W	151.9	7.1	51.0	5.67	13.2	1.47	4.7 W	1,000 P [6]	8
8	15	(?)	153.7	7.1	35.1	2.34	8.0	.53	3.0 ?	1,000 B	6
9	10	(?)	135.2	6.7	12.8	1.28	8.3	.83	7.4 ?	800 NW	4
Total	110		Aver. 157.1	Aver. 7.1		Aver. 4.0		Aver. 0.89			

[1] Average during test period.
[2] W=wiped.
[3] UnW=unwiped.
[4] B=both washed and unwashed.
[5] NW=not washed.
[6] P=pared.

[4] By edible portion is meant the whole apple except the stem, portions around stem and calyx ends, and the core. This represents that part of the unpared apple which is ordinarily eaten.

[5] Lead in apple and fecal samples was determined by the chromate method (*1*), and in urine by a photometric dithizone method (*1, 3*). All arsenic analyses were made using the Gutzeit method (*1*).

One of the subjects, No. 6, claimed to have eaten unwiped apples during the experiment, one (No. 4) wiped the fruit before eating it but sent in unwiped apples, and for 2 (Nos. 8 and 9) the condition of the apples was not known so they were assumed to be unwiped as received.

Table 1 also shows that the lead and arsenic loads varied widely, ranging from about 0.5 to nearly 10 mg. of lead per apple, the average being nearly 4.0 mg. This is equivalent to 6.76 mg. of lead arsenate. The unpared apples varied in weight from 83.5 to 166.3 gm. and ranged in diameter from 5.7 to 8.7 cm., the corresponding averages being 157.1 gm. and 7.1 cm., respectively. The lead load on the ingested portion averaged 25.5 mg. per kg., which is equivalent to very nearly 10 times the tolerance of 0.018 grains of lead per pound (0.018 grains per lb. equals 2.57 mg. per kg.). If the lead present in the stem and calyx portions were added to the lead load as determined above, the values would be still higher.

In the columns headed "consumption" two figures are given for each individual; the first is the average daily consumption of apples during the test period, and the second, the annual consumption based upon the estimate of the subjects concerned. It will be noted that the condition of the fruit as well as the quantity consumed by these men varied considerably. The last column gives the number of lead arsenate sprays applied to the various lots of apples selected for this experiment.

TABLE 2.—*Estimated quantities of lead and arsenic on samples of apples consumed by experimental subjects*

Experiment No.	Total number of apples eaten in 10–12 days	Period of experimental apple consumption in days	Estimated total quantity on apples eaten by subjects	
			Mg. Pb	Mg. As
1	17.5	10	169.1	10.2
2	18	10	67.3	20.7
3	19	10	66.7	10.6
4	17	10	71.0	12.7
5	27	12	92.6	24.3
6	21	10	10.3	19.7
7	47	10	266.5	69.1
8	30	10	46.8	10.6
9	74	10	63.1	40.9
Total	270.5	92	853.4	218.8
Average per person for experimental period	30.1	10.2	94.8	24.3
Average per person per day	3.0		9.3	2.4

Table 2 shows the estimated intake of lead and arsenic for each person for the 10–12-day test period together with average values for the total time and also per day. The total quantity of lead ingested by each person was found by multiplying the average lead load per apple for his particular lot of fruit (see table 1) by the number of

apples eaten during the experimental period. The corresponding quantity of arsenic was calculated similarly. In 3 cases the lead and arsenic loads of the wiped fruit were calculated as two-thirds that of the unwiped fruit analyzed.

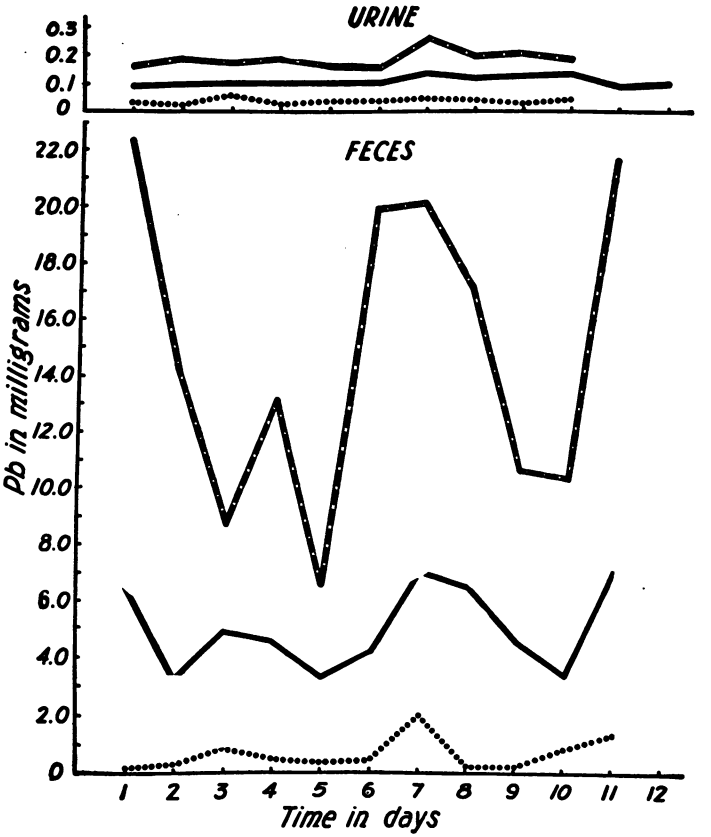

FIGURE 1.—Urinary and fecal lead outputs for a group of 9 experimental subjects. Daily maximum (- - - -), average (——), and minimum (. . . .).

Three hundred and seventy-six measurements were made in determining the individual daily outputs of urinary and fecal lead and arsenic. Figures 1 and 2 present in graphic form the minimum, maximum, and average values for *each* day, while the highest and lowest values for lead and arsenic excreted during any day of the experimental period are as follows:

	Output, mg. per day	
	Minimum	Maximum
Urinary lead	0.023	0.260
Fecal lead	.22	22.25
Urinary arsenic	.035	.637
Fecal arsenic	.008	2.04

The graphs show the wide range in daily variation as well as the relative magnitudes of the various measurements. The low and high values shown do not necessarily correspond to identical individuals from day to day. Especially noteworthy is the marked difference between fecal and urinary lead outputs.[6] To a lesser degree this difference is exhibited for arsenic also.

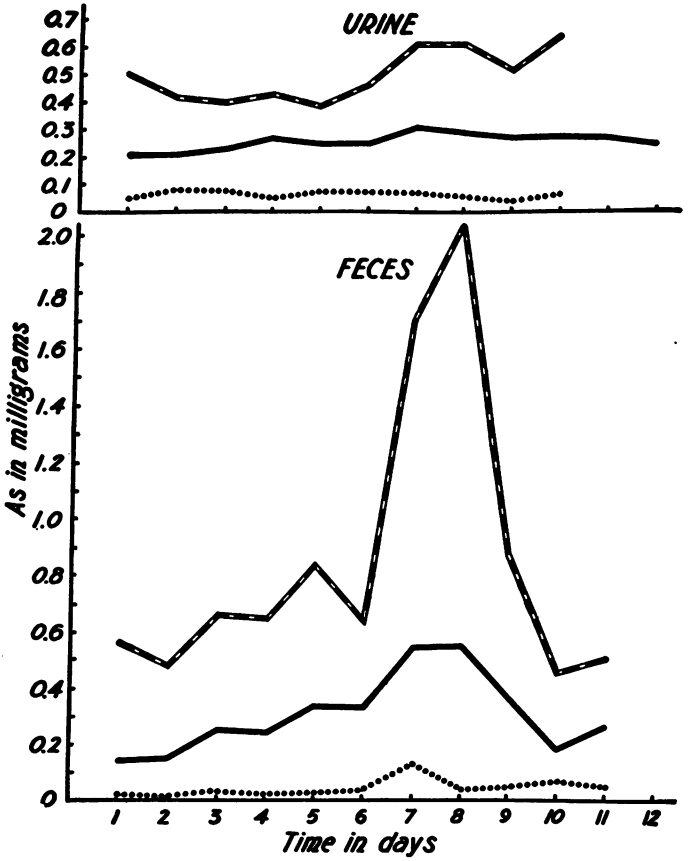

FIGURE 2.—Urinary and fecal arsenic outputs for a group of 9 experimental subjects. Daily maximum (----), average (——), and minimum (.....).

The small variation in the total daily urinary lead output for several of the individuals studied is rather remarkable. In fact, for any person, the urinary lead output varied much less from day to day than any of the other measurements. This is shown in table 3, giving the average daily deviation from the mean values for the 10–12-day period for the four types of determinations. Since the number of apples eaten by the subjects from day to day varied and therefore the amounts of lead and arsenic ingested were not constant, the great

[6] Fecal lead values have been plotted with a different scale for convenience in presenting the data.

TABLE 3.—*Variation in 24-hour lead and arsenic outputs in experimental subjects*

Experiment No.	Average deviation of daily output from the mean value for the 10-12-day period (all values in mg.)			
	Urinary Pb	Fecal Pb	Urinary As	Fecal As
1	0.009	4.16	0.046	0.181
2	.012	1.11	.033	.033
3	.042	2.95	.150	.134
4	.015	4.46	.066	.099
5	.041	6.12	.082	.477
6	.008	1.99	.012	.046
7	.020	2.23	.049	.234
8	.008	1.61	.013	.029
9	.027	.75	.068	.153
Average for all 9 persons	.019	2.86	.055	.154

uniformity of the urinary lead output for any one subject from day to day was all the more notable.

Table 4 gives the total quantities of the two constituents excreted by each person during the experimental period. The high average value of more than 5 mg. for the daily lead output is of considerable interest since the exposure of these experimental subjects is typical of a large group of orchardists. The average value of about 0.6 mg. of arsenic per day is low in comparison with the quantities of lead found and is difficult to explain.

TABLE 4.—*Lead and arsenic excreted in urine and feces of 9 subjects during the experimental period*

Experiment No.	Total urinary lead (mg.)	Total fecal lead (mg.)	Total urinary and fecal lead (mg.)	Total urinary arsenic (mg.)	Total fecal arsenic (mg.)	Total urinary and fecal arsenic (mg.)	Number of daily specimens	
							Urine	Feces
1	1.50	93.90	95.4	4.87	3.62	8.49	10	11
2	.871	20.50	21.37	.949	.686	1.64	10	11
3	1.550	59.45	61.00	3.74	3.00	6.74	10	11
4	.898	72.60	73.50	1.86	2.00	3.86	10	11
5	1.460	102.7	104.2	4.01	7.75	11.76	12	11
6	.416	31.25	31.67	.680	.878	1.56	10	11
7	1.733	52.37	54.10	4.03	4.03	8.06	10	10
8	.928	13.91	14.84	.857	.636	1.49	10	10
9	1.171	37.09	38.26	4.41	6.55	10.96	10	10
Total	10.53	483.8	494.3	25.41	29.15	54.56	92	96
Average per person for 10-12 days	1.17	53.8	54.9	2.82	3.24	6.09	10.2	10.6
Average per person per day	.11	5.04	5.15	.28	.30	.58	----	----

From the values given in this table it was found that the ratio of urinary to fecal lead averaged 2 percent with extremes of 1 to 7 percent. Also, the total fecal arsenic was about 15 percent greater than the total urinary arsenic. This was an unexpected result since, in the experiment of Fairhall and Neal, fecal arsenic amounted to mere traces in most samples and the total fecal arsenic was less than one-half percent of the quantity of urinary arsenic recovered.

It is probable that a considerable portion of the lead arsenate on the apple passed through the gastro-intestinal tract essentially unchanged. Analyses of fecal specimens from nearly 50 men examined at two periods of the year confirmed this view since 91 percent of the specimens showed fecal arsenic (*1*).

It is of interest to mention the recent work of St. John, McCulloch, Sotola, and Todhunter (*5*) who concluded that lead arsenate administered by capsules to sheep is more toxic than the same amount sprayed on vegetation and subsequently eaten by the sheep.

It is possible, therefore, that the pure lead arsenate and the weathered spray residue material may differ in both physical and chemical properties. Whether the observed difference in behavior of the arsenic portion of the molecule as studied in humans is due to the effect of chronic ingestion of lead and arsenic compounds or is due to differences in the properties of the ingested substances is not known.

In a number of cases high initial excretory values for the first day of the experiment were found but no regular correspondence between lead and arsenic measurements was observed. Whether these high initial values were due to previous exposure or resulted from the subjects eating large quantities of apples immediately before undertaking the experiment could not be ascertained. Two pertinent facts are known, however. First, this experiment was conducted during a time of year in which orchard activities involving high exposure to lead arsenate were at a minimum. Second, the normal apple consumption during this time of year was certainly below the average for the whole year.

Due to the experimental limitations already mentioned no balance could be accurately determined. In about half of the subjects there was fair agreement between the estimated intake and the measured output of lead and arsenic. It is evident, however, that in the remaining individuals the lead and arsenic were incompletely recovered although the exact differences could not be ascertained.

In the experiment of Fairhall and Neal a considerable fraction of these elements was not eliminated from the body during the 10-day period of ingestion, since lead and arsenic were still being excreted 13 days after the ingestion of lead arsenate had been stopped. The 2 subjects each ate an equivalent of 59.7 mg. of lead and 21.6 mg. of arsenic during the 10 days and the recoveries of these elements during that same time averaged 67 and 61 percent, respectively.

In the present study, the 9 subjects showed average recoveries for 10-day periods of 53 and 25 percent for lead and arsenic, respectively, based upon an estimated intake somewhat higher than in the former work.

The incomplete recovery of the lead and arsenic in the present study indicates either that equilibrium between intake and output

had not taken place, so that these elements were being stored, or that they were being eliminated through other channels. The presence of lead in the saliva and perspiration and the presence of arsenic in the hair (*6*) and nails and possibly in the perspiration has suggested other avenues of immobilization and excretion.

The systemic effects of this ingested spray residue material were not specifically investigated, since this question was considered in the lead arsenate spray residue study (*1*). Furthermore, it was not possible in this work to study a number of important problems related to this investigation, such as relative toxicities of pure lead arsenate and lead arsenate spray residue, relative rates of elimination of lead and arsenic, and relation of diet to the toxicity of lead arsenate. These problems are fundamental for an understanding of the toxicology of lead and arsenic and can be solved only by continued and intensive research.

SUMMARY AND CONCLUSIONS

Experiments were made with 9 healthy adult orchardists who ate lead arsenate sprayed apples during a period of 10 to 12 days. The daily consumption ranged from 0 to 10 and averaged 3.0 apples per person. Analyses of samples of the fruit eaten by the men showed a potential intake of from 1 to 26 mg. of lead and 0.34 to 6.8 mg. of arsenic per person per day.

Analyses of daily urine and fecal specimens from these subjects during the experimental period were made to measure the excretion of lead and arsenic during this time. The total 24-hour output of lead and arsenic per man amounted to as much as 22.3 mg. and 2.43 mg., respectively.

Wide variability in the quantities of urinary and fecal lead and arsenic excreted daily by different individuals was shown to be the rule. The 24-hour urinary lead output for a given individual was usually found to vary less from day to day than the other daily outputs (urinary arsenic and fecal lead and arsenic).

Comparison of the results of this investigation with those obtained earlier by Fairhall and Neal showed that in both experiments by far the largest part of the lead was eliminated in the feces. However, in the present study the fecal arsenic equalled or exceeded the urinary arsenic output in the majority of persons studied, while in the earlier experiment only traces of fecal arsenic were regularly found. Two explanations were offered for this difference. One suggested that the weathered spray residue may differ from pure lead arsenate in physical and chemical properties. The second postulated that individuals having chronic exposure to lead and arsenic compounds may differ from persons with only acute exposure in their utilization and ex-

cretion of arsenic. The experimental data were insufficient to decide this question.

The quantities of lead and arsenic excreted in the 10- to 12-day period generally were less than the amounts estimated to be ingested during that same time. Conditions did not permit the determination of the balance between intake and output. Several possible explanations for the apparent retention of these elements were suggested.

There has been indicated the need for further research on some of the unsolved fundamental problems relating to the toxicology of lead and arsenic.

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THE DENTAL STATUS AND DENTAL NEEDS OF YOUNG ADULT MALES, REJECTABLE, OR ACCEPTABLE FOR MILITARY SERVICE, ACCORDING TO SELECTIVE SERVICE DENTAL REQUIREMENTS [1] [2]

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INTRODUCTION

During the winter and spring of 1940–41 dental examinations were made of 947 young men enrolled in National Youth Administration projects located in Maryland and West Virginia, and of 451 men attending the National Defense Training School of Hagerstown, Md. Among approximately 1,400 individuals there were 642 within the age range 21 through 35 years. The dental examination record of each of these 642 men was reviewed with the purpose of finding those who would and those who would not meet the dental requirements set down by Selective Service for admittance to military duty. These requirements are given in the United States War Department Mobilization Regulations MR1–9, issued August 31, 1940, as follows:

Paragraph 31. Classes 1–A and 1–B.

a. *Class 1–A.*

(1) Normal teeth and gums.

(2) A minimum of three serviceable natural masticating teeth above and 3 below opposing and three serviceable natural incisors above and three below opposing. (Therefore, the minimum requirements consist of a total of 6 masticating teeth and of six incisor teeth.) All of these teeth must be so opposed as to serve the purpose of incision and mastication.

(3) *Definitions.*

(*a*) The term "masticating teeth" includes molar and bicuspid teeth, and the term "incisors" includes incisor and cuspid teeth.

(*b*) A natural tooth which is carious (one with a cavity), which can be restored by filling, is to be considered as a serviceable natural tooth.

(*c*) Teeth which have been restored by crowns or dummies attached to bridgework, if well placed, will be considered as serviceable natural teeth when the history and the appearance of these teeth are such as clearly to warrant such assumption.

(*d*) A tooth is not to be considered a serviceable natural tooth when it is involved with excessively deep pyorrhea pockets, or when its root end is involved with a known infection that has or has not an evacuating sinus discharging through the mucous membrane or skin.

b. *Class 1–B.*

Insufficient teeth to qualify for class 1–A, if corrected by suitable dentures.

Paragraph 32. Class 4.

a. Irremediable disease of the gums of such severity as to interfere seriously with useful vocation in civil life.

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[1] From the Division of Public Health Methods, National Institute of Health.

[2] Presented before the annual meeting (April 29, 1941) of the Milbank Memorial Fund, New York City, N. Y.

b. Serious disease of the jaw which is not easily remediable and which is likely to incapacitate the registrant for satisfactory performance of general or limited military service.

c. Extensive focal infection with multiple periapical abscess, the correction of which would require protracted hospitalization and incapacity.

d. Extensive irremediable caries.

For the purpose of the present report, the men who would meet the requirements for class 1–A are designated "acceptables" and those who would not meet class 1–A requirements are designated "rejectables." The age distributions of the two groups of men are given in table 1. A total of 545 men showed a dental status which would justify their being designated acceptable (dentally) for full military duty (class 1–A). The other 97 men, approximately 15 percent, fell into the rejectable group.[3] [4]

TABLE 1.—*Number of men examined and number found rejectable or acceptable and percentage found rejectable. Data arranged by single chronological ages and derived from examination of 642 men of West Virginia and Maryland*

Group examined	Chronological age (last birthday) in years															
	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	All ages
	Number examined															
Both	145	121	107	75	31	21	28	10	29	13	11	18	13	10	10	642
Rejectables	10	12	14	6	5	3	4	3	10	4	5	8	4	4	5	97
Acceptables	135	109	93	69	26	18	24	7	19	9	6	10	9	6	5	545
	Percentage rejectable															
	6.9	9.9	13.1	8.0	16.1	14.3	14.3	30.0	34.5	30.8	45.5	44.4	30.8	40.0	50.0	15.1

METHOD

The method used in the present analysis for describing dental status and dental needs is based upon considerations described fully in previous communications (*1*, *2*, *3*, *4*, *5*). This method has been adopted in part, or completely, by several investigators (*6*, *7*, *8*, *9*). Description of dental status is accomplished through measurement of (*a*) the tendency to be attacked by caries (the amount of caries experienced), (*b*) the volume of dental service received (the filled caries experience), and (*c*) the residuum of experience with caries which has not received

[3] The percentage of rejections obtained here is somewhat higher than that observed from actual Selective Service findings. The higher percentage found in the West Virginia and Maryland men is probably, in part, a resultant of a difference in age distribution. The actual selectees are probably somewhat younger than the men examined for the present study. Other factors probably also contribute to the high percentage of rejectables for dental conditions. Among these may be mentioned the socioeconomic status of the men examined and the possibility that some of them might be counted by Selective Service as rejectable for other than dental defects.

[4] The rejectables include some men who have insufficient teeth to qualify for class 1–A and who do not have their insufficient teeth "corrected by suitable dentures" (thus they do not qualify for class 1–B) and who obviously do not have enough irremediable dental disease to qualify them for class 4.

treatment by fillings (the unfilled caries experience). Dental needs (due to caries) are measured in terms of the three ingredients of the unfilled residuum of caries experience, namely, (*a*) the tooth surfaces carious and requiring fillings, (*b*) the teeth carious and indicated for extraction, and (*c*) the teeth already extracted presumably because of caries involvement. These two latter ingredients (*b* and *c*) together represent the need for prosthetic replacements.

Measurement of the tendency to experience caries is based on the fact that the stigmata of caries attack are essentially nonerasable. For example, a permanent tooth attacked by caries in a person 7 years of age will appear at a later chronological age as a carious tooth which should be filled, as a tooth which has been filled, as a tooth so extensively carious as to require extraction, or as a tooth already extracted. Teeth which fall into any of these four categories of caries experience are designated "DMF teeth" (decayed, missing, and filled)[5] (*1*). The summation of the numbers of permanent teeth representing these categories of caries experience, expressed on a per man basis, provides a broad measure of the tendency of a group to experience caries attack. A more detailed description of caries tendency is obtained by summation of the number of permanent tooth surfaces which fall into the several categories of caries experience. Such surfaces are termed "DMF surfaces"[6] (*1*).

In the present analysis, the tendency to experience caries is described in these terms for the rejectables and for the acceptables. The variation among the men of each group with respect to this tendency is described in terms of the number and percentage of men having particular numbers of DMF teeth and as the number and percentage of men having particular numbers of DMF surfaces.

A second component of dental status, that is, the filled caries experience, is measured broadly as the number of filled teeth per man, and the variation of this component is expressed as the number and percentage of men having particular numbers of filled permanent teeth. A more detailed insight into the volume of fillings received is obtained by determining the number of filled permanent tooth surfaces per man. The variation among the men with respect to this factor is expressed as the number and percentage of men showing particular numbers of filled surfaces.

The third component of dental status, the unfilled caries experience, is measured by adding together the teeth carious and in such condition as to warrant and require treatment by fillings, the teeth so extensively carious as to require extraction, and the teeth already extracted from

[5] The summation of these several categories has been designated by various symbols. The term "exteeth" is used by Salzmann (*10*) and the symbol "ABC teeth" by Sloman and Sharp (*11*). In the summations used in the present paper a tooth both carious and filled is counted as 1 DMF tooth.

[6] In this summation a surface both carious and filled is counted as 1 DMF surface. An extracted tooth is arbitrarily counted as 5 DMF surfaces.

the mouth presumably because of extensive damage by caries. A detailed quantification of unfilled caries experience is then obtained by totaling the number of tooth surfaces which are carious in teeth requiring fillings and in teeth requiring extraction, plus the surfaces which may be presumed to have been carious in teeth already extracted. Information on the three major components of dental status as observed in the rejectables and acceptables is given in tables 2 and 3.

TABLE 2.—*Status of permanent teeth of rejectables (R) and acceptables (A). Rates for specified components of dental status are expressed per man of specified chronological age group. Data derived from examination of 642 men of West Virginia and Maryland*

Components of dental status (teeth)	Group	Chronological age in years (last birthday)															
		21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	All ages
Carious, requiring fillings	R	4.9	5.4	6.9	7.0	5.2	4.6	5.3	4.7	5.3	5.3	5.2	7.9	3.0	3.5	2.4	5.4
	A	5.5	5.3	5.6	5.5	5.4	6.6	6.0	4.6	5.6	5.6	3.8	5.8	7.0	3.2	7.2	5.5
Extracted	R	10.1	9.4	10.6	11.3	14.0	10.0	11.5	12.7	14.2	15.3	22.8	11.4	14.5	20.3	20.8	13.0
	A	2.1	1.9	2.6	2.0	3.8	3.9	3.1	3.9	4.0	5.7	4.5	5.4	3.2	2.7	6.6	2.6
Carious, indicated for extraction	R	3.4	3.9	2.6	3.0	1.0	6.3	1.8	3.0	1.2	4.8	0	1.6	.5	1.5	.6	2.4
	A	.7	.5	.6	.3	.8	1.3	1.5	.7	1.5	.8	.7	1.4	1.6	.8	1.0	.7
Filled	R	1.0	2.2	2.6	3.5	1.0	0	1.3	2.7	3.0	1.5	1.8	2.6	2.0	1.0	2.0	2.1
	A	1.8	1.9	2.3	3.3	3.0	2.3	2.8	2.4	3.5	5.2	5.5	2.8	1.2	4.5	2.6	2.4
DMF	R	19.2	20.7	22.0	24.5	21.2	20.3	19.8	22.0	23.2	26.5	29.4	22.8	19.3	25.5	25.6	22.5
	A	9.8	9.4	10.9	10.8	12.8	13.7	13.4	11.0	14.3	16.4	13.8	15.3	12.9	10.8	17.2	11.0

TABLE 3.—*Status of permanent tooth surfaces of rejectables (R) and acceptables (A). Rates for specified components of dental status are expressed per man of specified chronological age group. Data derived from examination of 642 men of West Virginia and Maryland*

Components of dental status (surfaces)	Group	Chronological age in years (last birthday)															
		21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	All ages
Carious, requiring fillings	R	6.6	7.7	9.7	10.2	5.8	5.0	8.0	5.0	7.7	7.8	9.4	11.3	4.3	3.5	3.6	7.6
	A	7.2	6.7	7.1	7.1	7.0	8.1	7.4	6.3	6.7	7.0	4.2	8.4	8.9	4.2	8.8	7.1
Extracted	R	50.5	47.1	52.9	56.7	70.0	50.0	57.5	63.3	71.0	76.3	114.0	56.9	72.5	101.3	104.0	65.2
	A	10.3	9.4	13.1	10.1	18.8	19.4	15.4	19.3	20.0	28.3	22.5	27.0	16.1	13.3	33.0	13.1
Carious, indicated for extraction	R	14.6	15.8	11.9	13.0	4.4	31.7	8.8	10.0	4.5	17.3	0	5.8	1.8	4.8	2.4	9.9
	A	2.9	2.4	2.7	1.3	3.2	4.6	6.0	3.1	6.3	2.9	2.2	5.8	7.1	3.3	5.0	3.0
Filled	R	1.5	2.6	3.0	6.3	1.6	0	4.5	3.3	5.0	2.5	2.4	4.5	3.0	2.3	2.2	3.1
	A	2.9	2.8	3.5	5.8	4.9	3.4	4.9	3.3	6.1	10.2	8.8	5.0	1.8	9.3	3.8	4.0
DMF	R	73.2	73.0	77.4	86.2	81.8	86.7	78.8	80.7	88.0	103.8	125.8	78.1	80.8	111.5	112.0	85.7
	A	23.2	21.2	26.3	24.1	33.9	35.3	33.6	31.6	39.0	48.1	37.3	46.2	33.7	30.0	50.6	27.0

CARIES EXPERIENCE

At 21 years of age the rejectables have accumulated more than 19 DMF permanent teeth and more than 73 DMF surfaces per man. The acceptables of this age display a considerably lower caries tend-

ency. This is shown by the finding (tables 2 and 3) that they have accumulated up to 21 years of age less than 10 DMF teeth and fewer than 24 DMF surfaces per man. With advancing chronological age, teeth (and tooth surfaces) not previously attacked develop caries experience. This occurs in both groups, as shown in tables 2 and 3 and figure 1. For the entire age range, 21–35 years, the rejectables

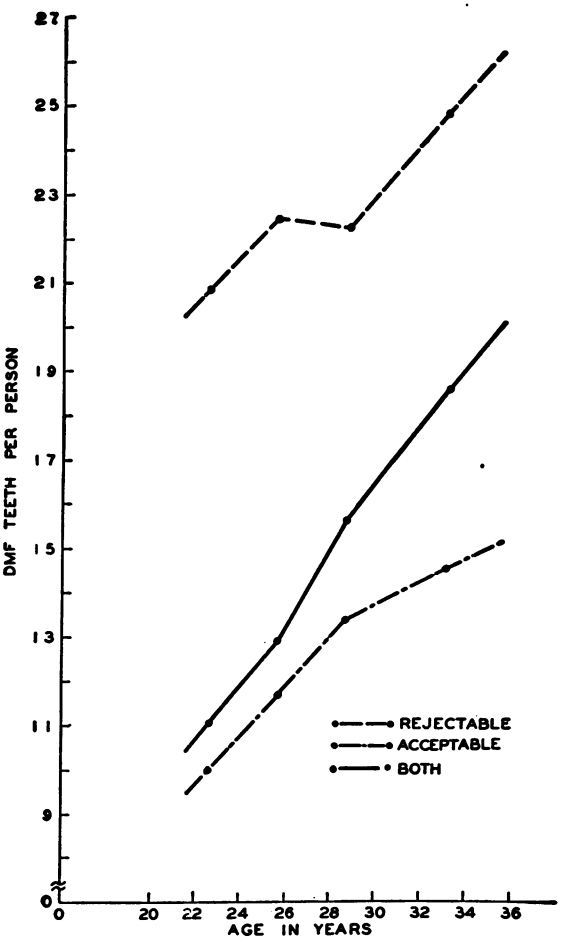

FIGURE 1.—Chronological age and the number of DMF teeth per person. The plotted points represent averages for the age groups 21–23, 24–26, 27–29, and 30–35 years.

show close to 23 DMF teeth and more than 85 DMF surfaces per man, while the acceptables show only approximately 11 DMF teeth and 27 DMF surfaces.

Further insight into the differences between the two groups in their respective tendencies to experience caries may be obtained through study of the number and percentage of men having particular numbers of DMF teeth. Table 4 gives such information. Close to

3 percent of the acceptables are free of DMF teeth while none of the rejectables have fewer than 7 DMF teeth. At the other end of the range, no acceptable has more than 28 DMF teeth, while more than 16 percent of the rejectables have 28 or more. Where half the rejectables (53.6 percent) have 22 or more DMF teeth, less than 5 percent (4.4 percent) of the acceptables have this many. Furthermore, where 100 percent of the rejectables have 7 or more DMF teeth, less than 75 percent (74.7) of the acceptables have this number.

TABLE 4.—*Number and accumulated percentage of men having specified numbers of DMF teeth and DMF surfaces. Data arranged by acceptable and rejectable groups for the chronological ages 21–35 years, inclusive, and derived from examinations of 642 men of West Virginia and Maryland*

Number of DMF teeth	Acceptables		Rejectables		Number of DMF surfaces	Acceptables		Rejectables	
	Number	Accumulated percentage	Number	Accumulated percentage		Number	Accumulated percentage	Number	Accumulated percentage
32			6	6.2	160			6	6.2
31			1	7.2	139–135			1	7.2
30			5	12.4	134–130			2	9.3
29			1	13.4	129–125			1	10.3
28	1	0.2	3	16.5	124–120			3	13.4
27	2	.6	6	22.7	119–115			3	16.5
26	3	1.1	7	29.9	114–110			1	17.5
25	4	1.8	7	37.1	109–105			3	20.6
24	3	2.4	3	40.2	104–100			4	24.7
23	6	3.5	5	45.4	99–95			6	30.9
22	5	4.4	8	53.6	94–90			7	38.1
21	9	6.1	8	61.9	89–85			3	41.2
20	16	9.0	11	73.2	84–80			7	48.5
19	16	11.9	3	76.3	79–75	1	0.2	8	56.7
18	19	15.4	10	86.6	74–70	8	1.7	10	67.0
17	21	19.2	5	91.8	69–65	6	2.8	14	81.4
16	28	24.4	2	93.8	64–60	14	5.3	6	87.6
15	25	29.0	1	94.8	59–55	22	9.4	2	89.7
14	32	34.8	1	95.9	54–50	19	12.8	4	93.8
13	29	40.2	1	96.9	49–45	24	17.2	3	96.9
12	25	44.8	0	96.9	44–40	37	24.0	2	99.0
11	32	50.6	2	99.0	39–35	39	31.2	0	99.0
10	33	56.7	0	99.0	34–30	51	40.6	0	99.0
9	37	63.5	0	99.0	29–25	54	50.5	0	99.0
8	32	69.4	0	99.0	24–20	55	60.6	0	99.0
7	29	74.7	1	100.0	19–15	55	70.6	*1	100.0
6	35	81.1			14–10	61	81.8		
5	20	84.8			9–5	48	90.6		
4	17	87.9			4–1	36	97.2		
3	21	91.7			0	15	100.0		
2	15	94.5							
1	15	97.2							
0	15	100.0							
All	545		97		All	545		97	

* 1 rejectable had 19 DMF surfaces.

Similar differences between the rejectables and acceptables appear when the number and percentage of men having particular numbers of DMF surfaces are studied. Thus, as shown by the data given in table 4, no rejectable has fewer than 19 DMF surfaces while 200 acceptables, or close to 37 percent, have fewer than 19 DMF surfaces, and 2.8 percent of the acceptables are free of such surfaces. On the other hand, 55 of the rejectables, or more than 56 percent, show 75 or more DMF surfaces.

These findings make it clear that the rejectable men show a strikingly higher tendency to be attacked by caries than the acceptables. It follows, therefore, that the rejectables display a significantly higher intrinsic or potential need for fillings than the acceptables.

FILLED CARIES EXPERIENCE

The number of filled teeth and filled surfaces found in the rejectables and in the acceptables are shown in tables 2 and 3. The rejectables aged 21 years show 1 filled tooth and 1.5 filled surfaces per man, while the acceptables of this age show 1.8 filled teeth and 2.9 filled surfaces.

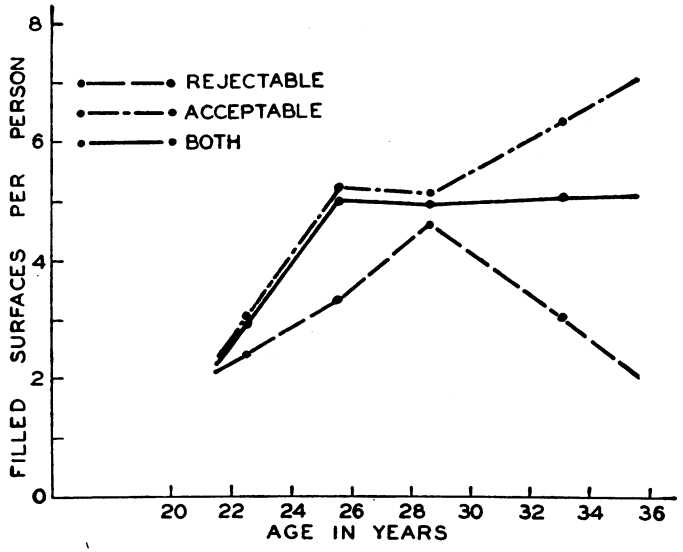

FIGURE 2.—Chronological age and the number of filled tooth surfaces per person. The plotted points represent averages for the age groups 21–23, 24–26, 27–29, and 30–35 years.

In general, over the interval from 21 through 35 years of age, there is only a slight increase in the number of filled teeth, as shown in figure 2.

The disparity between the rate of development of caries and the rate of supply of dental care in the form of fillings may be further appreciated by comparing the data on the potential need for fillings with that on the actual number of fillings found. This comparison can be made from the figures given in tables 2 and 3. Thus in 21-year-old rejectables only about one-twentieth of the teeth with caries experience show fillings (1 filled tooth of 19.2 DMF teeth) while in the acceptables of the same age about one-fifth of the teeth with caries experience show fillings (1.8 filled teeth of 9.8 DMF teeth). The disparity in each group is not reduced to any large extent during the interval between 21 and 35 years of age. For the ages 21–35 years, the rejectables show fillings in approximately one-tenth of their

DMF teeth and one twenty-seventh of their DMF surfaces, while the acceptables have received treatment by fillings for about one-fourth of their DMF teeth and approximately one-seventh of their DMF surfaces. Expressed in other terms, only a portion of the intrinsic need for fillings is supplied rejectables or acceptables. However, a higher proportion of the intrinsic need of the acceptables has been filled than in the case of the rejectables.

Although the acceptables receive, per tooth attacked by caries, more treatment by fillings than the rejectables, the acceptables receive per man about the same amount of fillings as the rejectables.[7] This finding, coupled with the observation that the rejectables have a considerably higher intrinsic need, leads to the view that the absolute number of fillings placed per man is not closely determined by the level of intrinsic need. Thus, men having high and men having relatively lower caries tendencies, both receive, on the average, about the same amount of dental care in the form of filled permanent tooth surfaces.

The similarities and the differences between the rejectables and acceptables with respect to the volume of treatment by fillings are shown in table 5. For example, no rejectable has more than 14 filled teeth while 3.9 percent of the acceptables have from 14 to 24 filled teeth. On the other hand, 54 percent of the rejectables and about the same percentage of the acceptables have no filled teeth in spite of the fact that, as shown earlier, 100 percent of the rejectables have 7 or more DMF teeth and 97 percent of the acceptables have one or more DMF teeth.

When the range of fillings supplied is obtained in terms of tooth surfaces, it is found that no rejectable has more than 26 filled surfaces and only about 2.5 percent of the acceptables have from 27 to 45 filled surfaces. The acceptables and rejectables are rather similar with regard to the percentage of men having no filled surfaces since 54 percent of the rejectables and about the same percentage of acceptables have no filled surfaces.

THE RESIDUUM OF UNFILLED CARIES EXPERIENCE

From the foregoing, it is apparent that the tendency to receive dental care in the form of fillings falls considerably below the tendency to experience caries, for both the rejectables and acceptables. The consequences of this disparity between the development of need for fillings and the receipt of fillings is reflected in a large residuum of current dental need, that is, carious teeth and tooth surfaces requiring fillings and carious teeth requiring extraction. These latter, together with carious teeth already extracted, produce the need for

[7] Obviously, fillings which may have been placed in teeth which later were removed from the mouth would not be counted among the filled teeth. However, it does not appear likely that more fillings would have been placed in the extracted teeth of the rejectables than in the teeth of the acceptables.

prosthetic replacements. Since both groups of men have roughly the same number of filled surfaces per man, the group having the higher caries tendency (the rejectables) would be expected to show a much larger residuum of unfilled caries experience.

TABLE 5.—*Number and accumulated percentage of men having specified numbers of filled teeth and filled surfaces. Data arranged by acceptable and rejectable groups for the chronological ages 21–35 years, inclusive, and derived from examination of 642 men of West Virginia and Maryland*

Number of filled teeth	Acceptables		Rejectables	
	Number	Accumulated percentage	Number	Accumulated percentage
32				
31				
30				
29				
28				
27				
26				
25				
24	1	0.2		
23	0	0.2		
22	0	0.2		
21	0	0.2		
20	0	0.2		
19	2	0.6		
18	1	0.7		
17	3	1.3		
16	5	2.2		
15	3	2.8		
14	6	3.9	1	1.0
13	4	4.6	0	1.0
12	8	6.1	1	2.1
11	7	7.3	0	2.1
10	9	9.0	1	3.1
9	6	10.1	2	5.2
8	9	11.7	3	8.2
7	12	13.9	1	9.3
6	12	16.1	2	11.3
5	20	19.8	8	19.6
4	18	23.1	7	26.8
3	29	28.4	6	33.0
2	45	36.7	5	38.1
1	42	44.4	7	45.4
0	303	100.0	53	100.0
All	545		97	

Number of filled surfaces	Acceptables		Rejectables	
	Number	Accumulated percentage	Number	Accumulated percentage
45	1	0.2		
44	0	.2		
43	0	.2		
42	0	.2		
41	0	.2		
40	0	.2		
39	1	.4		
38	0	.4		
37	1	.6		
36	1	.7		
35	0	.7		
34	0	.7		
33	1	.9		
32	3	1.5		
31	0	1.5		
30	2	1.8		
29	1	2.0		
28	1	2.2		
27	1	2.4		
26	2	2.8	1	1.0
25	3	3.3	0	1.0
24	3	3.9	0	1.0
23	4	4.6	1	2.1
22	2	5.0	0	2.1
21	4	5.7	0	2.1
20	2	6.1	0	2.1
19	3	6.6	0	2.1
18	5	7.5	0	2.1
17	7	8.8	0	2.1
16	4	9.5	0	2.1
15	2	9.9	2	4.1
14	1	10.1	0	4.1
13	3	10.6	1	5.2
12	4	11.4	0	5.2
11	4	12.1	2	7.2
10	7	13.4	3	10.3
9	12	15.6	2	12.4
8	12	17.8	0	12.4
7	10	19.6	4	16.5
6	12	21.8	9	25.8
5	16	24.8	3	28.9
4	25	29.4	5	34.0
3	22	33.4	4	38.1
2	37	40.2	4	42.3
1	23	44.4	3	45.4
0	303	100.0	53	100.0
All	545		97	

Carious teeth and tooth surfaces requiring fillings.—The numbers of teeth and tooth surfaces carious and requiring fillings are given in tables 2 and 3. At 21 years of age the rejectables show a current need of close to 5 teeth and more than 6 surfaces filled per man. At this age, the acceptables have a current need of more than 5 teeth and more than 7 surfaces filled per man. From study of the changes

with advancing age in the number of teeth and surfaces carious and requiring filling it may be noted (figure 3) that the numbers of these teeth and surfaces per man decrease more in the rejectable group than in the acceptables. This finding justifies some consideration.

It is clear that teeth, and particularly tooth surfaces, which are carious and require fillings represent the *current need for fillings* as observed on examination. The current need for fillings is obviously and basically determined by the intrinsic or potential need for fillings which has its basis in turn in the tendency to experience caries.

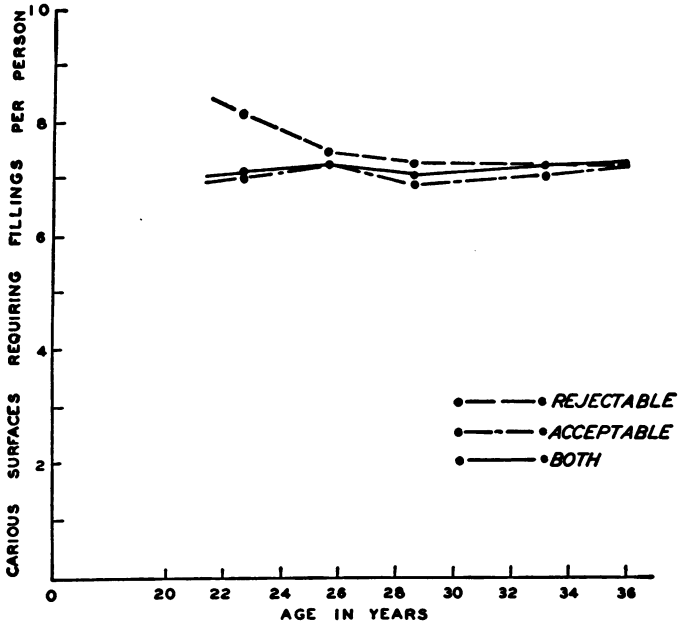

FIGURE 3.—Chronological age and the number of carious tooth surfaces requiring fillings per person. The plotted points represent averages for the age groups 21–23, 24–26, 27–29, and 30–35 years.

From the foregoing discussion it is clear that the current need for fillings represents that first part of the residuum of filled carious experience (DMF surfaces) which is still amenable to treatment by fillings.

From knowledge of present clinical practice it is clear that dental treatment for caries can take two main forms, (*a*) the filling of carious lesions and (*b*) the extraction of extensively carious teeth. Thus the current need for fillings may be reduced either by filling carious surfaces or by extracting carious teeth, or by both procedures. From the material presented in table 2, it becomes evident that there is a marked tendency among the rejectables to have teeth extracted. Thus the finding of a reduction in current need for fillings with advancing age

for the rejectables is explained in large part by a high tooth extraction rate.

As shown by the frequencies given in table 6, the acceptable group tends to have available greater numbers of surfaces requiring filling than is the case for the rejectables. For example, among the 545 acceptables, one man requires 42 surfaces filled and 3 men need fillings in 27 surfaces. Among the 97 rejectables, none of the men require more than 25 surfaces filled. However, the general similarity in the range of current need for fillings in both groups is indicated by the finding that approximately 52 percent of the acceptables need from 6 to 27 surfaces filled while about the same percentage of the rejectables (58.8 percent) need from 6 to 25 surfaces filled. Throughout the age interval 21–35 years, the rejectables and acceptables show, on the average, a similar current need for fillings—5 teeth and 7 surfaces requiring fillings per man for each group.

TABLE 6.—*Number and accumulated percentage of men having specified number of carious tooth surfaces requiring fillings. Data arranged by acceptable and rejectable groups for the chronological ages 21–35 years, inclusive, and derived from examination of 642 men of West Virginia and Maryland*

Number of surfaces carious, requiring fillings	Acceptables		Rejectables		Number of surfaces carious, requiring fillings	Acceptables		Rejectables	
	Number	Accumulated percentage	Number	Accumulated percentage		Number	Accumulated percentage	Number	Accumulated percentage
42	1	0.2			19	2	4.4	1	4.1
41	0	.2			18	7	5.7	1	5.2
40	0	.2			17	5	6.6	2	7.2
39	0	.2			16	12	8.8	2	9.3
38	0	.2			15	12	11.0	5	14.4
37	0	.2			14	17	14.1	5	19.6
36	0	.2			13	17	17.2	1	20.6
35	0	.2			12	12	19.4	3	23.7
34	0	.2			11	20	23.1	4	27.8
33	0	.2			10	17	26.2	6	34.0
32	0	.2			9	24	30.6	4	38.1
31	0	.2			8	33	36.7	7	45.4
30	0	.2			7	43	44.6	3	48.5
29	0	.2			6	42	52.3	10	58.8
28	0	.2			5	56	62.6	10	69.1
27	3	.7			4	34	68.8	6	75.3
26	3	1.3			3	46	77.2	4	79.4
25	0	1.3	1	1.0	2	44	85.3	5	84.5
24	3	1.8	0	1.0	1	36	91.9	3	87.6
23	1	2.0	0	1.0	0	44	100.0	12	100.0
22	6	3.1	1	2.1					
21	2	3.5	0	2.1	All	545		97	
20	3	4.0	1	3.1					

Carious teeth requiring extraction.—The status of the men with respect to this second ingredient for the residuum of unfilled caries experience is shown in tables 2 and 3. The rejectables at age 21 years have more than three teeth indicated for extraction. The acceptables of this age require the extraction of only a fraction of a tooth per man.

With advancing chronological age the rejectables tend to have fewer teeth requiring extraction than the acceptables. Through study of the tooth extraction data shown in table 2, the conclusion may be

reached that the reduction with age in need for extractions among the rejectables is explained by the fact that they have had a large number of teeth extracted.

That the range of this need is quite different for rejectables and acceptables is indicated in table 7. From these data it may be noted that 8.2 percent of the rejectables require extraction of from 10 to 19 carious teeth. Among the acceptables no man requires extraction of more than 9 carious teeth. More than 40 percent of the rejectables require the extraction of 1 or more carious teeth while about 30 percent of the acceptables show this need. Table 2 shows that throughout the age interval 21–35 years, the rejectables have more than 2 carious teeth requiring extraction, while the acceptables in this age range show less than 1 carious tooth requiring extraction.

TABLE 7.—*Number and accumulated percentage of men having specified numbers of teeth indicated for extraction. Data arranged by acceptable and rejectable groups for the chronological ages 21–35 years, inclusive, and derived from examination of 642 men of West Virginia and Maryland*

Number of teeth indicated for extraction	Acceptables		Rejectables		Number of teeth indicated for extraction	Acceptables		Rejectables	
	Number	Accumulated percentage	Number	Accumulated percentage		Number	Accumulated percentage	Number	Accumulated percentage
19			1	1.0	8		0.2	1	10.3
18			2	3.1	7	6	1.3	3	13.4
17			0	3.1	6	4	2.0	4	17.5
16			0	3.1	5	8	3.5	3	20.6
15			0	3.1	4	18	6.8	2	22.7
14			0	3.1	3	20	10.5	2	24.7
13			1	4.1	2	39	17.6	8	33.0
12			3	7.2	1	68	30.1	10	43.3
11			0	7.2	0	381	100.0	55	100.0
10			1	8.2					
9	1	0.2	1	9.3	All	545		97	

Extracted teeth.—The status of the men with respect to this third ingredient of the residuum of unfilled caries experience is shown in table 2. At 21 years of age the rejectables have had more than 10 teeth extracted per man, while the acceptables have had less than 3 extracted. With advancing chronological age both groups tend to have new increments of extracted teeth. For the ages 21–35 years, the rejectables have had 13 teeth extracted per man and the acceptables less than 3.

Current need for dentures and bridges.—When the extracted teeth are added to those indicated for extraction, the rejectables have 15 teeth extracted and indicated for extraction [8] which need to be replaced per man, while the acceptables have less than 4 such teeth per man.

In making the dental examinations on which the present report is based, no attempt was made to diagnose the particular type of prosthetic appliance best suited to particular individuals. The considera-

[8] The teeth extracted and indicated for extraction together are designated "missing teeth." These are represented by the "M" of the DMF symbol.

tions on which this decision was based are readily apparent. It is clear that a variety of prosthetic appliances may be recommended for a particular need. The choice of a particular type, whether bridge or partial denture, whether of precious or semiprecious metal, of vulcanite or the more modern plastics, is largely determined by the wishes of the patient, his capacity to purchase simple or expensive appliances, and by the opinion of the dentist concerned.

With the view of circumventing these more or less extrinsic variables which find an important place in determining the type and complexity of a particular appliance which might be recommended, the need for such appliances is deliberately not expressed in a direct form. Thus the information given in the present report provides rather data on the number of men having particular numbers of teeth needing replacement. From these data the need for prosthetic appliances may be interpreted. Obviously, men having 32 missing teeth would require full upper and lower dentures. Men who have fewer than 32 and more than 6 teeth extracted and indicated for extraction may be considered to require some type of partial denture or dentures. It is clear that the need for particular types of appliances is clearly not established by these data. On the other hand, it is reasonable to assume that men having as few as 1 to as many as 6 extracted teeth and indicated extractions require bridges rather than dentures and that men having more than 6 extractions and indicated extractions and fewer than 32 such teeth need partial dentures or their equivalents in bridges.

The status of the rejectables and acceptables with regard to the need for these various broadly classified types of prosthetic replacements may be interpreted from the data given in table 8. Extractions and indicated extractions are found in all rejectables, as would be expected on the basis of the criteria establishing rejectability. About half of the rejectables have from 3 to 13 teeth extracted and indicated for extraction and the remaining half of the rejectables have from 14 to 32 such teeth. It follows, therefore, that the rejectables all might be expected to require either full upper and lower dentures or partial dentures, or bridges. That a few of the rejectables have this need either completely or partially supplied will be shown later.

In contrast to these findings on the rejectables, approximately 18 percent of the acceptables have no missing teeth and no acceptable has more than 13 missing teeth. About half of the acceptables have from 3 to 13 teeth extracted and indicated for extraction, and of the remaining half about one-third have no tooth loss and two-thirds have only 1 or 2 missing teeth. Thus the prosthetic problem in the acceptables involves, in the main, bridges and partial dentures. The acceptables show no need for full dentures.

TABLE 8.—*Number and accumulated percentage of men having specified numbers of teeth extracted and indicated for extraction. Data arranged by acceptable and rejectable groups and derived from examination of 642 men of West Virginia and Maryland*

Number of teeth extracted and indicated for extraction	Acceptables		Rejectables		Number of teeth extracted and indicated for extraction	Acceptables		Rejectables	
	Number	Accumulated percentage	Number	Accumulated percentage		Number	Accumulated percentage	Number	Accumulated percentage
32			6	6.2	14			9	51.5
31			0	6.2	13	2	0.4	8	59.5
30			1	7.2	12	3	.9	12	72.2
29			0	7.2	11	6	2.0	5	77.3
28			0	7.2	10	12	4.2	12	89.7
27			0	7.2	9	16	7.2	4	93.8
26			0	7.2	8	16	10.1	4	97.9
25			3	10.3	7	28	15.2	0	97.9
24			0	10.3	6	37	22.0	1	99.0
23			2	12.4	5	43	29.9	0	99.0
22			2	14.4	4	58	40.6	0	99.0
21			2	16.5	3	62	51.9	1	100.0
20			3	19.6	2	82	66.9		
19			5	24.7	1	81	81.8		
18			3	27.8	0	99	100.0		
17			10	38.1					
16			2	40.2	All	545		97	
15			2	42.3					

The frequency distributions shown in table 8 give the status of tooth loss, actual and imminent, without providing information on the amount of prosthetic replacement which has already been supplied these men. In making the dental examinations, specific inquiries were made with regard to whether or not a man having missing teeth had had a prosthetic appliance already made. Among the 97 rejectables, all of whom show 3 or more missing teeth, 21 men had such replacements. Of these 21 men, there were 6 who had no natural teeth (32 missing), and of these 6 men, 5 had had full upper and lower dentures supplied, and 1 man had a full upper but was not supplied with a full lower. The remaining 15 men were partially edentulous. Thirteen of them wore full upper plates and needed partial lowers, or wore upper bridges and needed lower bridges. Two of these 15 men had had their need for partial upper and lower dentures completely supplied. Accordingly, of the 21 men having prosthetic appliances, only 7 men had had their need for full dentures or partial plates or bridges completely supplied. It follows, therefore, that of the 97 rejectables, of whom all show enough missing teeth to require appliances, 90 show an existing, incompletely supplied need for such appliances. Hence, of every 10 rejectables examined, 9 show a current unsupplied need for partial prosthetic replacement. It is of interest to note that men without any natural teeth tend to have their need for prosthesis supplied more readily than those men who have fewer than 32 missing teeth.

The data shown in table 8 reveal that close to 82 percent of the acceptables have enough missing teeth to justify having partial plates or bridges. Thus, of the 545 acceptables, 446 would be justified in

wearing partial plates or bridges. Of these 446 men, only 5 had been supplied with such appliances at the time of examination. Of these 5 men, only 1 had had his need completely serviced (an upper anterior two-tooth bridge). Three of these 5 men were wearing upper bridges and showed an unsupplied need for an appliance in the lower jaw. The remaining man had a partial upper plate and showed an unsupplied need for a partial lower denture. Thus of the 5 men having appliances, 4 remained incompletely serviced. It follows, therefore, that more than 9 out of every 10 acceptables show an incompletely supplied need for partial plates and bridges.

Dental rehabilitation of the rejectables.—From the findings given earlier it is clear that a group of men who would be accepted according to Selective Service dental criteria for full military duty (the acceptables) present a large current need for dental reparative services. Obviously, the dental needs shown by the men who would be rejected are larger than those displayed by the acceptables.

It would be interesting to know the number of rejectables who could be classed acceptable (1–A) and the number who could be classed 1–B if their missing dental structures were sufficiently reconstituted by prosthetic appliances to meet the minimal dental requirements for these classifications. A full consideration of this question cannot be given here since only 97 rejectables were encountered. Nevertheless, a statement with respect to the number of the rejectables who could be classed 1–A or 1–B would appear to be justified.

Study of the dental status of the 97 rejectables indicates that the placement of dental fixed bridgework in 49 of these men would probably justify their being placed in class 1–A. The remaining 48 men could be placed in class 1–B if partial and full dentures were supplied to them.

COMMENT

It is clear that the rejectable men have a more pronounced tendency to be attacked by caries than the acceptables. It may be noted, for example, that per man the rejectables have more missing teeth (extractions and indicated extractions) than the acceptables have teeth attacked by caries (DMF). Rejectables, as determined by Selective Service requirements, therefore tend to be those men who are high in caries susceptibility. On the other hand, the acceptables, although lower in susceptibility, have a considerable caries tendency. For example, it is clear that the acceptables have a caries susceptibility sufficient to render their current volume of carious surfaces needing fillings approximately equal in magnitude to that shown by the rejectables. Furthermore, the acceptables need a considerable amount of dental bridgework.

The present situation, that is, the existing profound loss of masticating function in the rejectables and the large volume of reparative services in the form of fillings, dentures, and bridges currently needed by both the rejectables and acceptables, arises in the main from a long-continued yearly accumulation of untreated carious teeth and tooth surfaces which have been piling up each year in the permanent teeth

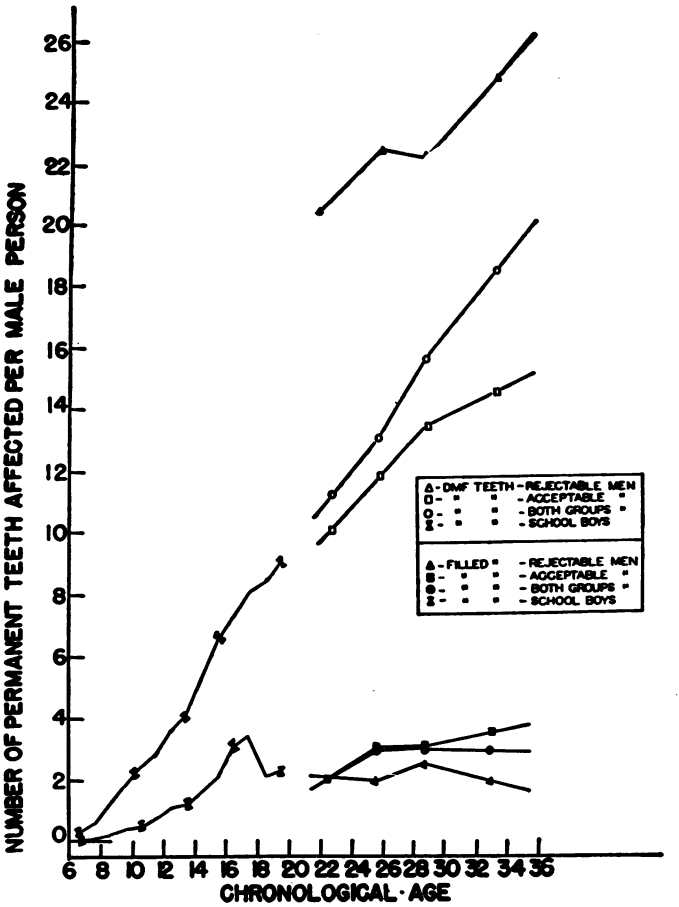

FIGURE 4.—Chronological age and the number of DMF permanent teeth and the number of filled permanent teeth per person. Data derived from examination of approximately 3,000 elementary and high school boys of Hagerstown, Md., and environs, and of approximately 640 youths aged 21–35 years in Maryland and West Virginia.

of the men since they were about 6 years of age. It is clear that a large disparity has long existed and still exists between the rate of development of carious lesions and the rate at which these lesions are serviced by fillings in both the acceptables and the rejectables. The character of this disparity is revealed graphically in figure 4, which shows the way in which teeth experiencing caries attack and teeth experiencing treatment by fillings accumulate in a population of

approximately 3,000 elementary and high schools boys of Hagerstown, Md. The rate of attack of the permanent teeth by caries may be seen to exceed by a large margin the rate at which the teeth are filled at the ages of 6 to 19 years, inclusive.

The manner in which teeth attacked by caries accumulate in the mouths of the 642 men whose dental findings are described in this report is shown by the trend line marked with small open circles in figure 4. In the lower right hand area of this figure are the trend lines which show the way in which filled teeth accumulate in the mouths of these men (the line shown with small closed circles). The tremendous disparity between the rate of provision of dental care in the form of fillings and the rate of attack by caries is clearly apparent from this graph. This figure also indicates that the disparity continues to widen with advancing chronological age. It is evident that, though a large disparity exists for the acceptable men, the disparity for the rejectables is almost twice that of the acceptables.

It is well known that the prompt placement of fillings during school attendance would have prevented a large share of the tooth loss observed in the men. Although knowledge is not sufficient for the prevention of initiation of caries, the procedures of dentistry are sufficient to prevent dental rejectability even in persons having marked caries susceptibility. If the prevention of dental rejectability be set up as an objective, it would be necessary to begin, at least at age 6, filling the teeth annually at a rate coincident with the rate at which carious lesions arise. To reiterate, it is necessary to recognize that a new crop of caries develops each year in the permanent teeth from about age 6 until practically all susceptible tooth surfaces have been attacked in late adult life. Thus the prevention of rejectability (as now defined) and the prevention of the excessive accumulation of need for fillings, and of dentures and bridges, in the rejectables and acceptables requires, until dental caries actually can be prevented, a systematic, perennial dental servicing problem, beginning in the first decade of life and continuing without interruption through the late adult ages.

SUMMARY

The dental status and dental needs arising from caries of a group of 97 men who would be rejectable for full military duty according to Selective Service requirements, and those of a group of 545 men who would be acceptable, are summarized graphically in figure 5.

Dental status.—Per rejectable man (aged 21–35 years) more than 22 permanent teeth have been attacked by caries (DMF). Of these 22 teeth showing evidence of caries experience, 13 are already extracted,

2 need to be extracted, 2 have been filled, and 5 are carious and justify treatment by fillings.

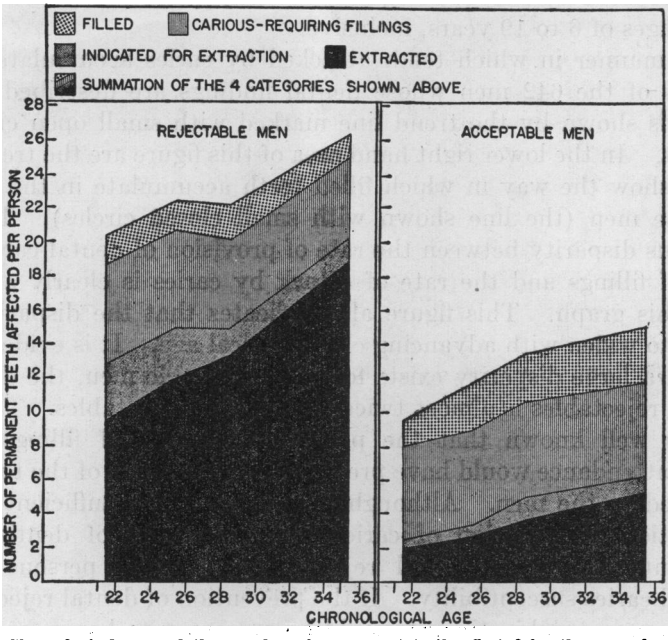

FIGURE 5.—Chronological age and the number of permanent teeth affected by the several categories of caries experience, per rejectable and per acceptable man. Data derived from examination of approximately 640 youths aged 21–35 years in Maryland and West Virginia.

Per acceptable man (aged 21–35 years) 11 permanent teeth have been attacked by caries (DMF). Of these 11 teeth showing evidence of caries experience, 3 teeth are already extracted, less than 1 tooth needs to be extracted, 2 have been filled, and more than 5 are carious and justify treatment by fillings.

Dental needs.—Per rejectable man (aged 21–35 years), 2.4 teeth are carious to such an extent as to require extraction, 7.6 tooth surfaces need to be filled, 13 teeth have been extracted, 2.4 teeth require extraction, and 9 out of every 10 of these rejectables need full or partial dentures.

Per acceptable man (aged 21–35 years), 0.7 of a tooth is carious to such an extent as to require extraction, 7.1 tooth surfaces need to be filled, about 2.5 teeth have been extracted, 0.7 of a tooth requires extraction, and 9 out of every 10 of the acceptables need partial dentures or bridges.

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PROTECTIVE ANTIBODIES AGAINST ST. LOUIS ENCEPHALITIS VIRUS IN THE SERUM OF HORSES AND MAN [1]

By CORNELIUS B. PHILIP, *Medical Entomologist*, and HERALD R. COX, *Principal Bacteriologist, United States Public Health Service*, and JOHN H. FOUNTAIN, *Weld County Health Office, Greeley, Colo.*

During the late summer and fall of 1940 an epidemic of encephalitis in man and horses occurred in Weld County, northern Colorado. Epidemiological considerations have been summarized by the authors.[2]

Since the onset of the human cases occurred during the summer months at a time when some 50 horses in the same community were afflicted, it was thought likely that equine encephalomyelitis (E. E.) virus was the causative agent, but preliminary tests carried out with a number of convalescent human serums suggested this was not the case. Moreover, on further test, a number of these serums showed protective antibodies against St. Louis encephalitis virus. In view of these findings a number of human and horse serums were tested for protective antibodies against both St. Louis encephalitis virus and the western type of E. E. virus. The object of this preliminary note is to report the results of the laboratory tests as carried out by one of us (H. R. C.) up to the present time.[3]

Serum-protection tests were carried out in mice (Swiss strain albinos) by the standard intracerebral technique. The serum-virus mixtures were held at 37° C. for 2 hours and then placed in the cold room at 4° C. overnight. In some of the preliminary tests 3 mice were injected with each serum-virus mixture; thereafter 4 mice were always used. The St. Louis encephalitis strain of virus was obtained from Dr. Charles Armstrong, of the National Institute of Health, while the W. E. E. strain was received from Dr. Carl Ten Broeck, of the Rockefeller Institute, Princeton, N. J. Known negative and positive serums were always included with each series of tests.[4] Those serums that showed protection or suggestive evidence of it were always retested at least once for purposes of confirmation; some were tested twice or 3 times. Only those serums that showed protection against at least 10 to 100 minimal lethal doses of virus were considered positive. A number of both human and horse serums showed protection against as many as 100 to 1,000 lethal doses.

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[1] Contribution from the Rocky Mountain Laboratory, Hamilton, Mont., Division of Infectious Diseases, National Institute of Health.

[2] C. B. Philip, H. R. Cox, and J. H. Fountain: J. Parasitol., 26 (Suppl.): 24 (December 1940).

[3] Due acknowledgments to those physicians, veterinarians, and others who so kindly cooperated in this study will be given in a later paper.

[4] We are indebted to Dr. C. G. Harford, Washington University, St. Louis, and Miss Beatrice Howitt, George Williams Hooper Foundation, University of California, San Francisco, for sending us immune rabbit serum specific for the St. Louis encephalitis and W. E. E. strain of viruses, respectively. No cross-immunity reactions occurred with these specific antiserums, thus confirming the earlier observations of Cox and Fite (Proc. Soc. Exp. Biol. and Med., 31: 499 (1934)) that there apparently is no immunological relationship between the St. Louis encephalitis and W. E. E. viruses.

Human serums from fourteen 1940, two 1939, and three 1938 cases diagnosed as encephalitis were tested, as were the following additional serums taken in the same area (all collected during the fall of 1940) from: (*a*) A 1938 human case diagnosed as poliomyelitis; (*b*) 5 members of families in which cases occurred during the 1940 outbreak (these are called family contacts; see table 1); (*c*) 3 physicians who treated patients during the 1940 epidemic and thus had contact exposure; (*d*) 6 veterinarians who treated and autopsied a number of horses supposedly affected with encephalomyelitis that occurred in 1938, 1939, and 1940; and (*e*) 7 horses that were afflicted during the 1940 epizootic. Table 1 summarizes the data concerning the serums tested.

TABLE 1.—*Protection tests on human and horse serums collected in Colorado*

Serums tested	Total number tested	Strain of virus				Number of serums positive for both viruses
		W. E. E.		St. Louis		
		Number serums positive	Number serums negative	Number serums positive	Number serums negative	
Human cases, 1940	14	1	13	7	7	1
Human cases, 1939	2	0	2	2	0	0
Human cases, 1938	3	[1] 1	2	2	[1] 1	0
1938 poliomyelitis case	1	0	1	0	1	0
Family contacts	5	0	5	1	4	0
Physicians	3	0	3	0	3	0
Veterinarians	6	0	6	4	2	0
Horses	7	5	2	7	0	5

[1] Serum tested from this patient in 1938 by Dr. Charles Armstrong, of the National Institute of Health, showed positive protection against W. E. E. virus. The serum tested here was taken in the fall of 1940.

Of the fourteen 1940 human cases tested, 7 showed protection against St. Louis virus. One of these 7 also gave equal protection against W. E. E. virus. Of the 5 encephalitic serums from persons ill in 1938 and 1939, 4 showed protection against St. Louis virus, the fifth against W. E. E. virus. This last case showed protection against the same virus in 1938 (see table 1). Serum taken from the poliomyelitis case of 1938 failed to neutralize either virus. One of the 5 family contacts showed protection against St. Louis virus alone. None of the 3 physicians showed protection against either virus although 2 were suspected of having had abortive cases of encephalitis. Four of the 6 veterinarians showed good protection against St. Louis virus, none against W. E. E. virus. Two of these were suspected of having had abortive (untreated) attacks of encephalitis. Five of the 7 horse serums protected equally against St. Louis and W. E. E. viruses. Two protected against St. Louis virus only. It may be of significance that veterinarians in the Colorado area frequently report "reinfections of encephalomyelitis" in horses in different seasons or years.

In view of these results, it was deemed necessary to test the serums of supposedly normal horses as well as the serums of horses recovered from attacks of encephalitis in parts of the country other than Colorado. Several such serums have been collected and tested with the results shown in table 2.

TABLE 2.—*Protection tests on horse serums collected in Montana and Washington*

Serums tested	Total number tested	Strain of virus				Number of serums positive for both viruses
		W. E. E.		St. Louis		
		Number serums positive	Number serums negative	Number serums positive	Number serums negative	
Montana horses with no previous history of encephalitis	5	2	3	2	3	2
Montana horses recovered from encephalitis	3	3	0	3	0	3
Washington horses recovered from encephalitis	3	3	0	3	0	3

Of 5 Montana horses with no previous history of encephalitis, 2 showed protection against both viruses while the remaining 3 showed no protection against either virus. All of the above horses were from the Bitterroot Valley in western Montana where epidemics of equine encephalomyelitis occurred in 1936 and 1937.[5] The 2 horses that showed protection were in the valley at the time of the above-mentioned epidemics and it is possible that they then suffered immunizing infections without showing frank clinical signs of disease. The 3 horses that failed to show protection were foaled from a year to 2 years after the above-mentioned outbreaks. The 3 Montana horses with definite histories of encephalitis were ill in September 1936, August 1937, and May 1940. All 3 showed protection against both viruses. The 3 Washington horses were from the vicinity of Ellensburg and Yakima, in which locality an epidemic of encephalitis affecting both man and horses occurred in the fall of 1940. All 3 were 1940 recoveries and all showed protection against both viruses.

The implications of the above findings are too far reaching to be discussed here. However, the above data definitely suggest that horses as well as man are susceptible to immunization by St. Louis encephalitis virus and that epidemics of encephalitis affecting both man and horses during the summer months [6] may be caused by this virus as well as by the known strains of E. E. virus.

Muckenfuss [7] reported tests of the susceptibility of "6 horses and mules" in which 2 of the latter animals developed febrile reactions,

[5] H. R. Cox, C. B. Philip, H. Marsh, and J. W. Kilpatrick: J. Am. Vet. Med. Assoc., 93: 225 (October 1938).

[6] One of the cases among horses in Colorado and one in Montana that showed protection occurred in May.

[7] Bull. N. Y. Acad. Med., 10: 451 (July 1934). See also Pub. Health Bull. No. 214, p. 33 (1935).

and 1 showed suggestive microscopic lesions in the brain. However, attempted passage to another animal was not successful.

Additional work is now in progress to determine whether horses are susceptible to St. Louis encephalitis virus under experimental conditions.

SUSCEPTIBILITY OF HORSES TO ST. LOUIS ENCEPHALITIS VIRUS [1]

By HERALD R. COX, *Principal Bacteriologist*, and CORNELIUS B. PHILIP, *Medical Entomologist, United States Public Health Service*, and J. W. KILPATRICK, *Deputy Veterinarian, Montana State Live Stock and Sanitary Board*, and *Special Consultant, United States Public Health Service*

The finding by Philip, Cox, and Fountain of the presence of antibodies for St. Louis encephalitis virus in the serums of horses and man suggested that this virus exists as a natural infection in horses and is partly responsible for epidemics of summer encephalitis affecting both man and horses.

Three horses were injected intracerebrally with St. Louis encephalitis virus representing 330,000 minimal lethal doses for mice. Blood samples taken prior to inoculation showed two of the horses to possess no antibodies for St. Louis virus while the third protected mice against 10 to 100 lethal doses. None showed antibodies against the western strain of equine encephalomyelitis virus.

Blood samples were taken daily and tested for virus content by injection into mice. Temperatures were taken three times daily. The horse showing natural antibodies remained afebrile during a 28-day observation period and never showed any indication of illness. The second horse showed a sharp temperature rise on the eighth day, accompanied by marked muscular tremors and incoordination. Fever and other signs of illness lasted six days and the horse recovered uneventfully. Blood samples taken after recovery showed neutralizing antibodies only for the St. Louis encephalitis virus. The third horse showed a sharp temperature rise on the ninth day, accompanied by marked symptoms of central nervous disturbance. This animal developed all the symptoms considered typical of equine encephalomyelitis in horses. It rapidly became worse and was sacrificed on the twelfth day. St. Louis encephalitis virus was recovered from the brain and upper cervical cord. No virus was recovered from the blood samples taken daily from the three horses, nor from the spinal fluid, heart, liver, kidneys, spleen, ileum, jejunum, colon, or feces of the sacrificed animal.

[1] From the Rocky Mountain Laboratory, Division of Infectious Diseases, National Institute of Health, Hamilton, Mont.

A suspension of the brain and upper cord of the third horse was injected intracerebrally into a fourth horse. Blood samples of the fourth taken prior to injection showed no antibodies to St. Louis virus but its serum protected mice against 1,000 to 10,000 lethal units of western equine encephalomyelitis virus. This horse showed a sharp temperature rise on the eleventh day, accompanied by signs of central nervous disturbance and remained febrile up to the time of complete prostration, which occurred on the twentieth day. During this interval it developed all the clinical symptoms typical of equine encephalomyelitis. This horse was sacrificed and tests are being conducted to determine the presence of virus in the various tissues. No virus was recovered from any of the daily blood samples, but St. Louis encephalitis virus was recovered from nasal washings made on the fifth day of fever.

These studies are being continued, but present data clearly demonstrate that horses are susceptible to St. Louis encephalitis virus, that this virus produces clinical symptoms in horses similar to western equine encephalomyelitis virus, that the virus may be recovered from the brain, spinal cord, and nasal washings of infected animals, and may be transmitted from one horse to another by intracerebral injection of infected brain tissue. Horses that show antibodies for western equine encephalomyelitis virus in high titer are susceptible to St. Louis encephalitis virus, while horses that have acquired St. Louis encephalitis antibodies by natural processes are apparently resistant to subsequent infection.

PREVALENCE OF COMMUNICABLE DISEASES IN THE UNITED STATES

May 18–June 14, 1941

The accompanying table summarizes the prevalence of nine important communicable diseases, based on weekly telegraphic reports from State health departments. The reports from each State are published in the Public Health Reports under the section "Prevalence of disease." The table gives the number of cases of these diseases for the 4-week period ended June 14, 1941, the number reported for the corresponding period in 1940, and the median number for the years 1936–40.

DISEASES ABOVE MEDIAN PREVALENCE

Influenza.—The incidence of influenza dropped about 75 percent during the 4-week period ended June 14. The number of cases (5,649) was still more than double the number occurring at this time in 1940, which figure also represents the 1936–40 median. The

excess was largely due to the relatively high incidence in the West South Central region, where the number of cases was almost 3 times the average incidence, and in the Pacific region, where the number of cases was more than 6 times the 1936–40 median figure; minor excesses were reported from the South Atlantic and Mountain regions. The increase in the Pacific region was due to the fact that for the week ended June 7 there were 1,203 cases reported, which were designated as "mostly delayed reports." In the North Atlantic, North Central, and East South Central regions the incidence was considerably below normal.

Measles.—The high incidence of measles since the beginning of the current year reached its peak during the month of April and has since declined in all sections of the country. However, the number of cases for the country as a whole is still the highest on record. For the 4 weeks ended June 14 there were 111,273 cases reported, as compared with approximately 42,000 and 48,000 cases in the years 1940 and 1939, respectively. In the New England and Pacific regions the incidence has dropped below the normal seasonal incidence, but in all other regions the excesses are still very significant. In 1934, 1935, and 1938 the cases for this period totaled approximately 90,000, 91,000, and 80,000, respectively.

Whooping cough.—The number of cases of whooping cough was considerably above the average seasonal incidence. In the Middle Atlantic and West South Central regions the incidence was relatively low, but all other regions reported a comparatively high incidence. For the country as a whole the number of cases (19,798) was the highest recorded for this period in the 4 years for which these data are available.

DISEASES BELOW MEDIAN PREVALENCE

Diphtheria.—For the 4 weeks ended June 14 there were 767 cases of diphtheria reported, as compared with 777, 1,022, and 1,260 cases for the corresponding period in 1940, 1939, and 1938, respectively. The current incidence approached the 1940 incidence very closely, but it was only about 60 percent of the 1936–40 median for this period, which is represented by the 1938 figure (1,260 cases). Increases over last year were reported from the West North Central, South Atlantic, West South Central, and Mountain regions, but only the Mountain region reported an excess over the average seasonal incidence.

Meningococcus meningitis.—The number of cases (152) of meningococcus meningitis was about 50 percent in excess of the number occurring at this time in 1940, but it was only about 70 percent of the 1936–40 median (220 cases) for this period. Each geographic region except the Mountain reported an increase over 1940, but only the New England and West South Central reported an increase over the preceding 5-year average incidence.

Number of reported cases of 9 communicable diseases in the United States during the 4-week period May 18–June 14, 1941, the number for the corresponding period in 1940, and the median number of cases reported for the corresponding period 1936–40

Division	Current period	1940	5-year median	Current period	1940	5-year median	Current period	1940	5-year median
	Diphtheria			Influenza [1]			Measles [2]		
United States	767	777	1,260	5,649	2,685	2,685	111,273	42,424	45,289
New England	13	22	29	6	10	10	6,472	7,291	7,291
Middle Atlantic	140	144	237	23	38	38	37,913	10,115	17,544
East North Central	143	153	239	197	258	304	29,395	7,686	7,686
West North Central	62	51	78	43	35	138	4,496	2,766	2,766
South Atlantic	140	119	173	972	977	517	17,982	2,456	4,157
East South Central	61	47	92	167	225	225	4,771	1,265	1,265
West South Central	86	99	165	1,830	674	705	4,554	4,314	1,738
Mountain	71	61	48	329	229	158	2,992	2,671	1,991
Pacific	51	81	132	2,082	239	309	2,698	3,860	3,860
	Meningococcus meningitis			Poliomyelitis			Scarlet fever		
United States	152	98	220	105	179	164	10,056	13,172	13,172
New England	14	6	10	3	2	2	905	719	1,130
Middle Atlantic	41	23	58	14	10	10	3,634	4,768	4,768
East North Central	21	19	31	12	9	12	3,041	5,109	5,109
West North Central	7	4	11	4	7	4	678	747	1,165
South Atlantic	25	17	36	27	7	12	552	529	518
East South Central	12	9	40	10	9	9	449	342	194
West South Central	19	14	14	10	6	10	153	172	267
Mountain	1	2	5	1	6	4	192	197	352
Pacific	12	4	18	24	123	24	452	589	800
	Smallpox			Typhoid and paratyphoid fever			Whooping cough [2]		
United States	144	243	839	513	572	804	19,798	14,203	[3] 14,203
New England	0	0	0	25	20	20	1,629	1,040	1,231
Middle Atlantic	0	0	0	90	68	71	3,011	2,585	3,502
East North Central	51	79	166	47	69	87	3,494	2,554	3,288
West North Central	43	90	412	31	49	45	1,379	655	655
South Atlantic	1	4	4	125	102	179	2,931	1,602	2,160
East South Central	20	23	23	47	69	87	789	632	632
West South Central	19	26	41	101	125	167	1,571	1,820	1,820
Mountain	4	17	109	15	25	29	1,400	1,186	839
Pacific	6	4	103	32	45	57	3,584	2,129	2,087

[1] Mississippi, New York, and Pennsylvania excluded; New York City included.
[2] Mississippi excluded.
[3] Three-year (1938–40) median.

Poliomyelitis.—For the current 4-week period, California reported 23 cases of poliomyelitis, Florida, 21 cases, and New York and Illinois, 7 cases each; more than 50 percent of the total of 105 cases reported occurred in those 4 States. The number of cases for the country as a whole was only about 65 percent of the normal seasonal expectancy. A marked increase of poliomyelitis usually occurs during this period of the year, but with the exception of the years 1936 and 1938, when approximately 90 cases were reported for this period in each year, the current incidence is the lowest recorded for this period in 8 years.

Scarlet fever.—A decrease in scarlet fever of approximately 3,800 cases occurred during the current 4-week period as compared with the preceding 4-week period. Comparison with recent years indicates that the incidence was considerably below the normal seasonal level.

For all regions the cases totaled 10,056, as compared with 13,172 cases for the corresponding period in 1940, which figure also represents the 1936–40 average incidence for this period.

Smallpox.—For smallpox the comparison with previous years was very favorable. The number of cases reported was 144, as compared with 243 for the corresponding period in 1940 and a 5-year median of 839 cases. Each region reported a comparatively low number of cases of this disease.

Typhoid fever.—The incidence of typhoid fever was also relatively low. The number of cases (513) reported amounted to about 90 percent of the number reported for this period in 1940 and it was only about 60 percent of the 1936–40 median incidence for the period. The North Atlantic regions reported a few more cases than might normally be expected, but in all other regions the incidence was comparatively low.

MORTALITY, ALL CAUSES

The average mortality rate from all causes in large cities for the 4 weeks ended June 14, based on data received from the Bureau of the Census, was 10.9 per 1,000 population (annual basis). The average rate for this period in the years 1938–40 was 11.1 per 1,000 population.

COURT DECISION ON PUBLIC HEALTH

City ordinance regulating hours for operation of barber shops held to delegate legislative power unlawfully.—(Pennsylvania Supreme Court; *Saccone et al.* v. *City of Scranton*, 20 A.2d 236; decided May 12, 1941.) A Pennsylvania statute authorized any municipality, by proper ordinance, to fix the days and hours during which barber shops could be open for business, with a proviso that in any such ordinance provision should be made that a designated local health or police official could, upon application of the proprietor of any barber shop and upon proof that barber service to the public so required, issue a permit effective for a limited time for the operation of a particular barber shop at such times outside of and beyond those fixed in the ordinance as was required by temporary public necessity, with the power to renew such permit upon further proof of public necessity. The city of Scranton, under such statutory authority, passed an ordinance making it unlawful to operate a barber shop, or any place where barbering was done, in the city except during the hours and on the days specified. One section of the ordinance granted power to the department of public safety of the city, upon application of a barber shop proprietor and upon proof that the barber service to the public so required, to issue a permit effective for a limited time, not exceeding thirty days, for the operation of a particular barber shop at such

times other than those fixed in the ordinance as was required by temporary public necessity, with the power to renew the said permit upon further proof of public necessity.

In a suit to restrain the enforcement of the ordinance, the Supreme Court of Pennsylvania passed upon that feature of it which involved an unlawful delegation of legislative power and regarding this said: "That the authority given to the department of public safety is an unlawful delegation of legislative power is clear under all the cases, because there is no standard set up for its guidance." In the course of the opinion the following statement also was made: "Parenthetically, we may observe that it is difficult to understand how the ordinance could be considered a health measure and as such a valid exercise of the police power."

DEATHS DURING WEEK ENDED JUNE 21, 1941

From the Weekly Mortality Index, Issued by the Bureau of the Census, Department of Commerce]

	Week ended June 21, 1941	Corresponding week, 1940
Data from 88 large cities of the United States:		
Total deaths	7,810	7,646
Average for 3 prior years	7,518	
Total deaths, first 25 weeks of year	222,371	223,854
Deaths per 1,000 population, first 25 weeks of year, annual rate	12.4	12.5
Deaths under 1 year of age	518	525
Average for 3 prior years	478	
Deaths under 1 year of age, first 25 weeks of year	13,127	12,740
Data from industrial insurance companies:		
Policies in force	64,428,322	65,214,936
Number of death claims	10,814	11,352
Death claims per 1,000 policies in force, annual rate	8.8	9.1
Death claims per 1,000 policies, first 25 weeks of year, annual rate	10.2	10.3

PREVALENCE OF DISEASE

No health department, State or local, can effectively prevent or control disease without knowledge of when, where, and under what conditions cases are occurring

UNITED STATES

REPORTS FROM STATES FOR WEEK ENDED JUNE 28, 1941

Summary

A total of 79 cases of poliomyelitis was reported for the current week as compared with 67 for the preceding week. The 5-year (1936–40) median expectancy for the week is 79 cases, the number reported for the corresponding week in 1940. The total reported to date this year (first 26 weeks) is 715 as compared with a 5-year cumulative median of 776. The States which have reported the largest numbers of cases to date this year are Florida (99), California (67), and Georgia (42).

For the current week, the number of cases declined in Florida from 15 to 10, but increased in Georgia from 9 to 23 and in Alabama from 8 to 10. California reported 7 cases, the same number as reported last week. For the preceding week, 13 of the 15 cases in Florida occurred in the Pensacola area. No cases have been reported in Miami since the week ended May 31.

Of the 9 important communicable diseases included in the following table, the total numbers of cases reported for the first half of 1941 are above the 5-year cumulative medians for only influenza, measles, and whooping cough.

Of 31 cases of endemic typhus fever, 10 cases occurred in Texas, 8 in Georgia, and 5 in Florida; and of 18 cases of Rocky Mountain spotted fever, 8 occurred in the Mountain States and the remainder east of the Rocky Mountains. Six cases of tularemia were reported in Utah and 3 cases in Mississippi.

One case of plague was reported in California.

The death rate for the current week in 87 major cities of the United States is 12.0 per 1,000 population, as compared with 10.9 for the preceding week and with a 3-year (1938–40) average of 10.5. This represents an increase in the urban mortality of 10 percent as compared with the preceding week and of 14 percent as compared with the 3-year average. The cumulative rate in these cities to date this year is 12.4, the same as for the corresponding period of 1940.

Telegraphic morbidity reports from State health officers for the week ended June 28, 1941, and comparison with corresponding week of 1940 and 5-year median

In these tables a zero indicates a definite report, while leaders imply that, although none were reported, cases may have occurred.

Division and State	Diphtheria			Influenza			Measles			Meningitis, meningococcus		
	Week ended		Median, 1936–40	Week ended		Median, 1936–40	Week ended		Median, 1936–40	Week ended		Median, 1936–40
	June 28, 1941	June 29, 1940		June 28, 1941	June 29, 1940		June 28, 1941	June 29, 1940		June 28, 1941	June 29, 1940	
NEW ENG.												
Maine	0	0	0	-------	-------	-------	82	157	81	0	0	0
New Hamsphire	0	0	0	-------	-------	-------	2	6	17	0	0	0
Vermont	0	0	0	-------	-------	-------	80	6	56	0	0	0
Massachusetts	5	1	4	-------	-------	-------	826	1,257	504	4	0	0
Rhode Island	1	0	1	-------	-------	-------	17	77	37	0	1	0
Connecticut [1]	0	0	0	-------	-------	1	317	15	45	1	0	0
MID. ATL.												
New York [2]	13	16	17	[3] 1	[3] 5	[3] 4	1,361	686	894	4	5	5
New Jersey [2]	3	9	7	3	6	2	784	714	364	3	0	0
Pennsylvania	12	0	19	-------	-------	-------	1,850	260	927	1	1	5
E. NO. CEN.												
Ohio	6	3	20	4	11	7	749	24	459	0	1	2
Indiana	5	0	6	6	3	3	114	14	14	0	0	1
Illinois [2]	15	12	21	11	18	8	428	185	182	0	0	1
Michigan [4]	5	1	9	-------	-------	-------	692	728	218	1	1	1
Wisconsin	1	0	2	7	45	14	1,049	793	313	0	1	1
W. NO. CEN.												
Minnesota	2	4	4	-------	1	1	14	61	103	0	0	0
Iowa	1	1	2	6	2	-------	92	61	61	0	0	2
Missouri [2]	1	3	6	-------	-------	-------	239	16	18	0	0	1
North Dakota	1	0	0	-------	-------	-------	20	4	6	0	0	0
South Dakota	3	0	0	-------	2	-------	6	3	0	0	0	0
Nebraska	5	1	1	-------	-------	-------	13	6	8	0	0	0
Kansas	5	3	2	-------	3	1	128	122	20	0	1	0
SO. ATL.												
Delaware [2]	0	0	0	-------	-------	-------	14	2	3	0	0	0
Maryland [4]	3	0	5	-------	1	-------	360	21	47	5	0	1
Dist. of Col	1	0	4	1	-------	-------	80	1	42	0	1	0
Virginia [2]	10	6	5	44	11	-------	526	136	115	4	3	4
West Virginia [4]	9	2	5	2	4	7	296	38	30	1	0	1
North Carolina	5	1	5	1	-------	-------	525	57	134	1	2	3
South Carolina	7	10	4	64	80	80	279	13	13	0	0	0
Georgia [1] [2]	3	2	4	4	-------	-------	228	21	0	0	0	0
Florida [1]	2	1	1	8	-------	-------	49	22	18	0	0	0
E. SO. CEN.												
Kentucky	1	4	3	2	5	5	96	77	71	1	3	3
Tennessee [2]	4	3	3	18	7	4	150	21	21	1	0	0
Alabama [1]	9	6	5	1	-------	5	94	62	47	2	0	2
Mississippi [1] [4]	3	0	4	-------	-------	-------	-------	-------	-------	0	1	0
W. SO. CEN.												
Arkansas	2	2	3	2	-------	3	114	17	8	0	0	0
Louisiana	1	5	5	-------	10	10	2	5	5	0	0	0
Oklahoma	2	0	4	9	7	8	63	16	23	0	1	1
Texas [1]	23	9	16	273	89	76	303	245	127	2	0	1
MOUNTAIN												
Montana [2]	0	0	1	-------	-------	-------	6	31	31	1	0	0
Idaho	0	0	0	4	-------	-------	23	10	10	0	0	0
Wyoming [2]	0	1	0	-------	-------	-------	5	6	2	0	0	0
Colorado	9	15	13	11	-------	-------	92	37	41	1	0	0
New Mexico	3	2	1	-------	1	1	52	46	23	0	0	0
Arizona	0	1	2	40	30	15	90	74	14	0	0	0
Utah [2] [4]	0	0	0	-------	-------	-------	17	126	58	0	0	0
Nevada	0	-------	-------	-------	-------	-------	1	-------	-------	0	-------	-------
PACIFIC												
Washington	4	0	0	-------	-------	-------	52	61	72	1	1	1
Oregon	4	8	4	6	3	10	34	75	40	1	0	0
California [1]	7	11	20	[5] 356	62	14	285	204	472	2	3	3
Total	196	143	247	884	406	406	12,699	6,619	6,619	37	26	41
26 weeks	6,591	7,772	11,649	595,363	166,672	149,475	801,124	207,940	253,856	1,209	983	1,898

See footnotes at end of table.

Telegraphic morbidity reports from State health officers for the week ended June 28, 1941, and comparison with corresponding week of 1940 and 5-year median—Con.

Division and State	Poliomyelitis			Scarlet fever			Smallpox			Typhoid and paratyphoid fever		
	Week ended—		Median 1936–40	Week ended—		Median 1936–40	Week ended—		Median 1936–40	Week ended—		Median 1936–40
	June 28, 1941	June 29, 1940		June 28, 1941	June 29, 1940		June 28, 1941	June 29, 1940		June 28, 1941	June 29, 1940	
NEW ENG.												
Maine	0	0	0	2	6	11	0	0	0	1	1	1
New Hampshire	0	0	0	0	1	1	0	0	0	0	0	0
Vermont	0	0	0	4	3	4	0	0	0	0	0	0
Massachusetts	0	0	0	147	76	122	0	0	0	1	5	2
Rhode Island	0	0	0	7	1	7	0	0	0	0	0	0
Connecticut [1]	0	0	0	23	38	24	0	0	0	0	0	2
MID. ATL.												
New York [2]	4	1	2	218	219	226	0	0	0	11	6	11
New Jersey [2]	0	0	0	82	108	58	0	0	0	3	4	4
Pennsylvania	1	0	0	138	133	223	0	0	0	8	13	13
E. NO. CEN.												
Ohio	0	1	1	75	82	121	0	0	1	8	15	8
Indiana	0	0	0	22	21	26	0	0	7	5	0	3
Illinois [2]	0	3	3	129	263	183	3	3	21	15	6	8
Michigan [4]	0	1	1	126	104	149	1	0	0	2	3	3
Wisconsin	0	5	0	53	60	60	2	4	2	0	1	1
W. NO. CEN.												
Minnesota	1	2	0	29	25	27	0	2	7	0	0	0
Iowa	0	4	0	15	13	17	0	8	12	0	3	3
Missouri [2]	0	0	0	37	20	27	0	5	11	5	5	13
North Dakota	0	0	0	0	6	5	0	0	3	0	1	0
South Dakota	0	0	0	4	2	11	15	1	4	0	0	0
Nebraska	0	1	0	8	8	8	1	0	1	0	2	0
Kansas	0	3	1	14	19	34	0	1	6	3	2	2
SO. ATL.												
Delaware [2]	0	0	0	2	4	3	0	0	0	0	1	2
Maryland [4]	0	0	0	12	11	14	0	0	0	0	1	2
Dist. of Col	0	1	0	3	11	6	0	0	0	0	0	0
Virginia [2]	2	1	1	12	7	4	0	0	0	3	5	7
West Virginia [4]	2	0	0	17	14	13	0	0	0	3	3	6
North Carolina	1	0	2	16	11	12	0	0	0	2	6	12
South Carolina	2	0	1	2	2	1	0	1	0	3	6	16
Georgia [1 2]	23	0	3	8	1	5	1	0	0	18	13	25
Florida [1]	10	0	0	3	1	1	0	0	0	1	2	2
E. SO. CEN.												
Kentucky	0	0	0	19	26	15	0	0	0	9	9	12
Tennessee [2]	1	0	1	19	18	6	0	1	1	11	13	15
Alabama [1]	10	0	2	4	11	7	0	4	0	3	4	10
Mississippi [1 4]	5	1	1	2	1	2	0	0	0	9	8	15
W. SO. CEN.												
Arkansas	0	0	0	1	5	2	0	1	1	12	10	13
Louisiana	3	0	1	5	5	5	0	0	0	24	15	20
Oklahoma	1	0	0	10	15	7	0	3	3	12	3	7
Texas [1]	2	3	3	14	11	32	0	0	1	12	15	21
MOUNTAIN												
Montana [2]	1	0	0	6	6	6	0	0	2	2	0	1
Idaho	0	2	0	4	2	2	0	0	3	1	1	3
Wyoming [2]	1	0	0	4	0	6	0	0	0	0	1	0
Colorado	1	0	0	15	13	13	0	4	0	3	1	2
New Mexico	1	1	0	2	7	7	0	0	1	4	0	7
Arizona	0	0	0	4	3	3	0	0	0	0	1	4
Utah [2 4]	0	1	0	5	0	6	0	0	0	0	0	0
Nevada	0	------	------	0	------	------	1	------	------	0	------	------
PACIFIC												
Washington	0	12	1	10	13	13	0	0	2	3	1	1
Oregon	0	0	0	8	2	12	5	0	2	2	5	4
California [1]	7	36	7	68	75	97	0	0	7	6	4	8
Total	79	79	79	1,408	1,483	1,617	29	38	151	205	195	310
26 weeks	715	776	776	86,857	112,937	130,360	1,113	1,763	7,370	2,454	2,646	3,791

See footnotes at end of table.

Telegraphic morbidity reports from State health officers for the week ended June 28, 1941, and comparison with corresponding week of 1940—Continued

Division and State	Whooping cough, week ended—	
	June 28, 1941	June 29, 1940
NEW ENG.		
Maine	15	25
New Hampshire	0	2
Vermont	8	23
Massachusetts	191	144
Rhode Island	13	6
Connecticut [1]	47	29
MID. ATL.		
New York [2]	270	262
New Jersey [3]	118	50
Pennsylvania	307	315
E. NO. CEN.		
Ohio	236	318
Indiana	16	20
Illinois [3]	117	79
Michigan [4]	282	197
Wisconsin	129	78
W. NO. CEN.		
Minnesota	79	30
Iowa	32	35
Missouri [3]	67	0
North Dakota	20	10
South Dakota	11	12
Nebraska	18	15
Kansas	152	44
SO. ATL.		
Delaware [3]	5	5
Maryland [4]	79	151
Dist. of Col	9	1
Virginia [3]	102	71
West Virginia [4]	55	100
North Carolina	330	112
South Carolina	160	24
SO. ATL.—continued		
Georgia [1 3]	17	13
Florida [1]	11	3
E. SO. CEN.		
Kentucky	69	61
Tennessee [2]	71	37
Alabama [1]	23	15
Mississippi [1 4]	----------	----------
W. SO. CEN.		
Arkansas	13	22
Louisiana	14	33
Oklahoma	50	42
Texas [1]	361	279
MOUNTAIN		
Montana [3]	27	1
Idaho	14	25
Wyoming [3]	5	5
Colorado	204	21
New Mexico	36	25
Arizona	12	34
Utah [3 4]	70	164
Nevada	0	----------
PACIFIC		
Washington	134	61
Oregon	23	25
California [1]	558	346
Total	4,580	3,370
26 weeks	119,698	83,686

[1] Typhus fever, week ended June 28, 1941, 31 cases, as follows: Connecticut, 1; Georgia, 8; Florida, 5; Alabama, 4; Mississippi, 2; Texas, 10; California, 1.
[2] Rocky Mountain spotted fever, week ended June 28, 1941, 18 cases, as follows: New York, 1; New Jersey, 1; Illinois, 1; Missouri, 3; Delaware, 1; Virginia, 1; Georgia, 1; Tennessee, 1; Montana, 1; Wyoming, 6; Utah, 1.
[3] New York City only.
[4] Period ended earlier than Saturday.
[5] Delayed reports.

HUMAN CASE OF PLAGUE IN SISKIYOU COUNTY, CALIF.

A fatal human case of plague has been reported in Siskiyou County, Calif., with onset on June 14, 1941, and death on June 26. The case occurred in a 10-year-old boy, residing near Montague. The diagnosis was confirmed bacteriologically. The source of the infection has not been determined, but it is believed to have been ground squirrels.

PLAGUE INFECTION IN KERN COUNTY, CALIF.

IN FLEAS FROM GROUND SQUIRRELS

Under date of June 18, 1941, Dr. N. E. Wayson, Medical Officer in Charge, Plague Suppressive Measures, San Francisco, Calif., reported plague infection proved, by animal inoculation and cultures, in a pool of 138 fleas from 8 ground squirrels, *C. beecheyi*, submitted to the laboratory on June 5, from a ranch 4 miles west and 5 miles south of Davis Ranger Station, Kern County, Calif.

IN A GROUND SQUIRREL

Under date of June 20, 1941, Dr. Bertram P. Brown, State Director of Public Health of California, reported plague infection proved, by animal inoculation and cultures, in organs from a ground squirrel, *C. beecheyi*, submitted to the laboratory on June 6 from a ranch 3 miles south of Davis Ranger Station, Kern County, Calif.

WEEKLY REPORTS FROM CITIES

City reports for week ended June 14, 1941

This table summarizes the reports received weekly from a selected list of 140 cities for the purpose of showing a cross section of the current urban incidence of the communicable diseases listed in the table.

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
Data for 90 cities:											
5-year average	105	35	18	3,279	335	1,072	12	362	33	1,201	----
Current week [1]	70	43	11	4,539	227	934	1	317	34	1,450	----
Maine:											
Portland	0	----	1	3	1	0	0	0	0	8	19
New Hampshire:											
Concord	0	----	0	0	0	0	0	1	0	0	8
Manchester	0	----	0	0	2	4	0	0	0	0	21
Nashua	0	----	0	0	1	0	0	0	0	7	5
Vermont:											
Barre	0	----	0	0	0	0	0	0	0	0	1
Burlington	1	----	0	2	0	0	0	0	0	0	8
Rutland	0	----	0	0	0	0	0	0	0	0	5
Massachusetts:											
Boston	3	----	1	190	6	58	0	4	1	66	194
Fall River	2	----	0	6	0	4	0	0	0	4	36
Springfield	0	----	0	72	0	7	0	1	0	2	35
Worcester	0	----	0	30	4	10	0	0	0	7	42
Rhode Island:											
Pawtucket	2	----	0	0	0	1	0	0	0	4	7
Providence	1	----	0	1	1	4	0	2	0	31	51
Connecticut:											
Bridgeport	0	----	0	24	2	2	0	1	0	5	44
Hartford	0	----	0	1	0	2	0	0	0	0	20
New Haven	0	----	0	7	0	13	0	0	0	3	38
New York:											
Buffalo	0	----	0	55	4	38	0	6	0	7	123
New York	13	2	1	541	44	181	0	71	9	88	1,357
Rochester	0	----	0	193	3	2	0	3	0	10	67
Syracuse	0	----	0	16	3	5	0	1	0	33	52
New Jersey:											
Camden	0	----	0	4	1	8	0	0	0	6	20
Newark	0	1	0	64	4	20	0	7	0	17	97
Trenton	0	----	0	41	2	5	0	1	1	0	34
Pennsylvania:											
Philadelphia	4	1	0	154	16	100	0	22	3	71	434
Pittsburgh	0	----	0	475	6	6	0	4	1	25	141
Reading	0	----	0	30	2	2	0	1	0	4	37
Scranton	0	----	----	20	----	0	0	----	0	0	----

[1] Figures for Terre Haute estimated; report not received.

City reports for week ended June 14, 1941—Continued

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
Ohio:											
Cincinnati	11		0	15	7	1	0	4	0	7	107
Cleveland	0	2	1	10	7	42	0	15	2	87	158
Columbus	0		0	40	1	12	0	3	0	15	84
Toledo	0		0	416	1	2	0	4	0	27	59
Indiana:											
Anderson	0		0	8	0	0	0	0	0	1	10
Fort Wayne	0		0	3	1	0	0	1	0	1	28
Indianapolis	5		0	193	8	7	0	2	0	20	88
Muncie	0		0	13	2	1	0	0	1	0	15
South Bend	0		0	11	0	0	0	0	0	0	17
Terre Haute											
Illinois:											
Chicago	11		1	110	14	98	0	35	0	40	652
Elgin	0		0	2	0	0	0	0	0	2	3
Moline	0		0	1	0	1	0	0	1	0	10
Springfield	0		0	40	0	1	0	0	0	1	21
Michigan:											
Detroit	0		0	295	10	128	0	9	1	117	257
Flint	0		0	28	1	2	0	0	0	2	20
Grand Rapids	0		0	60	0	5	0	2	0	3	23
Wisconsin:											
Kenosha	0		0	12	0	0	0	0	0	0	11
Madison	0		0	16	0	2	0	0	0	1	6
Milwaukee	0		0	476	2	21	0	1	0	45	77
Racine	0		0	23	0	2	0	0	0	5	10
Superior	0		0	0	0	1	0	0	0	12	12
Minnesota:											
Duluth	0		0	0	0	1	0	0	0	37	24
Minneapolis	1		0	11	0	16	0	1	4	16	89
St. Paul	0		0	1	3	6	0	0	0	12	60
Iowa:											
Cedar Rapids	0			1		2	0		0	2	
Davenport	0			2		0	0		0	0	
Des Moines	0			3		1	0		0	0	27
Sioux City	0			1		0	0		0	0	
Waterloo	0			19		1	0		0	6	
Missouri:											
Kansas City	0		0	67	4	5	0	7	0	8	83
St. Joseph	0		0	0	3	0	0	0	0	0	21
St. Louis	0		0	145	6	24	0	2	0	33	175
North Dakota:											
Fargo	0		0	2	0	0	0	0	0	14	1
Grand Forks	0			0		0	0		0	0	
Minot	0			15		0	0		0	1	8
South Dakota:											
Aberdeen	0			0		0	0		0	0	
Sioux Falls	0			0		0	0		0	0	9
Nebraska:											
Omaha	1		0	7	3	1	0	0	0	6	43
Kansas:											
Lawrence	0		0	0	2	0	0	0	0	3	5
Topeka	0		0	18	0	2	0	0	1	26	29
Wichita	0		0	3	3	2	0	0	0	6	22
Delaware:											
Wilmington	0		0	2	0	6	0	0	0	1	23
Maryland:											
Baltimore	1	1	0	353	7	16	0	8	0	64	207
Cumberland	0		0	3	0	2	0	0	0	0	15
Frederick	1		0	0	0	1	0	0	0	0	2
Dist. of Col.:											
Washington	2		0	184	3	5	0	10	0	16	166
Virginia:											
Lynchburg	0		0	29	0	0	0	0	0	4	14
Norfolk	2		0	3	1	0	0	1	0	2	17
Richmond	2		0	63	0	5	0	2	0	0	45
Roanoke	0		0	1	0	0	0	0	0	2	14
West Virginia:											
Charleston	0		0	2	0	0	0	0	0	0	18
Huntington	0			5		0	0		0	0	
Wheeling	0		0	54	1	0	0	0	0	7	19
North Carolina:											
Gastonia	0		0	7	1	0	0	0	0	2	
Raleigh	0		0	13	0	0	0	1	0	15	18
Wilmington	0		0	24	1	0	0	0	0	30	10
Winston-Salem	0	1	0	7	0	0	0	0	2	10	10

City reports for week ended June 14, 1941—Continued

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
South Carolina:											
Charleston	0	4	0	0	2	0	0	0	0	0	14
Florence	0	------	0	1	2	0	0	0	0	5	17
Greenville	0	------	0	2	0	0	0	0	0	1	10
Georgia:											
Atlanta	0	2	0	16	0	0	0	9	0	0	88
Brunswick	0	------	0	1	1	0	0	0	0	1	2
Savannah	1	------	0	9	1	3	0	3	0	0	34
Florida:											
Miami	0	2	0	1	0	0	0	5	1	9	43
St. Petersburg	0	------	0	5	2	0	0	0	0	0	16
Tampa	0	------	0	0	0	0	0	0	0	2	26
Kentucky:											
Ashland	0	------	0	3	0	0	0	1	0	0	8
Covington	0	------	0	0	2	3	2	1	0	0	9
Lexington	0	------	0	1	0	0	0	1	0	2	12
Tennessee:											
Knoxville	0	------	0	17	0	1	0	1	0	10	25
Memphis	1	5	1	65	1	2	1	5	1	16	81
Nashville	0	------	0	14	1	1	0	4	0	11	43
Alabama:											
Birmingham	0	2	0	8	3	4	0	4	0	3	62
Mobile	0	1	1	2	0	0	0	0	0	0	22
Montgomery	0	------	-------	2	-------	0	0	-------	0	2	--------
Arkansas:											
Fort Smith	0	------	-------	1	-------	0	0	-------	0	0	--------
Little Rock	0	------	0	3	0	0	0	1	0	0	20
Louisiana:											
New Orleans	0	2	2	5	5	1	0	14	0	0	141
Shreveport	0	------	0	0	4	0	0	2	0	0	37
Oklahoma:											
Oklahoma City	0	------	0	14	1	0	0	0	0	0	31
Tulsa	0	------	0	22	2	1	0	0	0	3	16
Texas:											
Dallas	0	------	0	-------	0	0	0	3	0	2	71
Fort Worth	0	------	0	0	1	0	0	0	3	5	32
Galveston	0	------	0	1	3	0	0	1	0	0	18
Houston	1	------	0	1	6	1	0	5	0	4	78
San Antonio	0	2	0	0	2	0	0	4	0	2	69
Montana:											
Billings	0	------	0	0	1	0	0	0	0	1	13
Great Falls	0	------	0	1	0	0	0	0	0	0	9
Helena	0	------	0	1	0	1	0	0	0	0	2
Missoula	0	------	0	0	0	0	0	0	0	0	3
Idaho:											
Boise	0	------	0	1	0	0	0	1	0	0	7
Colorado:											
Colorado Springs	0	------	0	3	4	3	0	0	0	0	13
Denver	6	9	0	99	2	3	0	3	2	100	79
Pueblo	1	------	0	7	0	0	0	0	0	15	6
New Mexico:											
Albuquerque	1	------	0	0	1	0	0	2	0	0	7
Arizona:											
Phoenix	0	20	--------	4	-------	0	0	-------	0	10	--------
Utah:											
Salt Lake City	0	------	1	3	0	1	0	0	0	14	43
Washington:											
Seattle	0	------	0	0	3	4	0	2	1	46	98
Spokane	0	------	0	2	0	1	0	0	0	6	23
Tacoma	0	------	0	3	2	1	0	0	0	23	40
Oregon:											
Portland	0	------	0	2	0	3	0	3	0	2	74
Salem	0	------	--------	1	-------	0	0	-------	0	0	--------
California:											
Los Angeles	0	8	0	57	2	27	0	16	4	64	306
Sacramento	1	------	0	4	0	2	0	2	0	31	34
San Francisco	1	------	0	9	2	3	0	10	0	66	160

City reports for week ended June 14, 1941—Continued

State and city	Meningitis, meningococcus		Poliomyelitis cases
	Cases	Deaths	
Massachusetts:			
Boston	1	0	0
New York:			
Buffalo	1	0	0
New York	3	1	1
New Jersey:			
Trenton	0	0	1
Pennsylvania:			
Philadelphia	1	0	0
Ohio:			
Cleveland	1	0	0
Maryland:			
Baltimore	2	0	0
Georgia:			
Atlanta	0	0	1
Florida:			
Miami	0	0	1
Tennessee:			
Memphis	0	0	1
Louisiana:			
Shreveport	0	1	0
California:			
Los Angeles	0	0	4

Encephalitis, epidemic or lethargic.—Cases: Trenton, 1; St. Paul, 2; Memphis, 1; Albuquerque, 1. Deaths: Trenton, 1; Memphis, 1.

Pellagra.—Cases: Charleston, S. C., 1; Savannah, 2; Tampa, 1;Memphis, 1; Montgomery, 1; New Orleans, 1; Houston, 1; San Francisco, 2.

Typhus fever.—Cases: Savannah, 2; Miami, 3; Houston, 2.

FOREIGN REPORTS

CANADA

Provinces—Communicable diseases—Week ended May 31, 1941.—During the week ended May 31, 1941, cases of certain communicable diseases were reported by the Department of Pensions and National Health of Canada as follows:

Disease	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Total
Cerebrospinal meningitis	4	4	2	2	10	-------	6	1	--------	29
Chickenpox	---------	15	1	170	216	87	41	33	44	607
Diphtheria	---------	15	--------	33	3	3	1	-------	--------	55
Dysentery	---------	---------	--------	10	-------	-------	-------	-------	--------	10
Influenza	---------	2	--------	-------	-------	-------	9	-------	178	189
Measles	---------	56	6	475	1,703	64	126	27	234	2,691
Mumps	---------	---------	--------	294	131	33	48	25	16	547
Pneumonia	---------	8	--------	-------	12	1	-------	-------	6	27
Scarlet fever	---------	19	13	90	171	6	22	6	16	343
Tuberculosis	3	1	7	84	40	1	1	-------	--------	137
Typhoid and paratyphoid fever	---------	---------	--------	25	7	-------	-------	1	--------	33
Whooping cough	---------	4	--------	59	164	1	4	3	29	264

Vital statistics—Fourth quarter 1940.—The Bureau of Statistics of Canada has published the following preliminary statistics for the fourth quarter of 1940. The rates are computed on an annual basis. There were 20.5 live births per 1,000 population during the fourth quarter of 1940 as compared with 18.6 for the fourth quarter of 1939. The death rate was 10.2 per 1,000 population for the fourth quarter of 1940 and 9.2 for the same quarter of 1939. The infant mortality rate was 62 per 1,000 live births in this quarter as compared with 59 for the corresponding quarter of 1939. The maternal death rate was 4.3 per 1,000 live births for the fourth quarter of 1940, and 4.2 for the same quarter of 1939.

The accompanying tables give the numbers of births, deaths, and marriages, by Provinces, for the fourth quarter of 1940, and deaths by causes in Canada for the fourth quarter of 1940 and the corresponding quarter of 1939.

Number of births, deaths, and marriages, fourth quarter, 1940

Province	Live births	Deaths (exclusive of still-births)	Deaths under 1 year of age	Maternal deaths	Marriages
Canada [1]	58,816	29,200	3,648	253	29,519
Prince Edward Island	464	297	35	2	221
Nova Scotia	3,023	1,716	216	13	1,676
New Brunswick	2,873	1,376	262	15	1,265
Quebec	20,223	8,505	1,496	103	6,525
Ontario	16,318	10,017	826	63	9,715
Manitoba	3,655	1,631	198	11	2,369
Saskatchewan	4,713	1,681	237	15	2,828
Alberta	4,168	1,666	220	16	2,585
British Columbia	3,379	2,311	158	15	2,335

[1] Exclusive of Yukon and the Northwest Territories.

Deaths, by cause, fourth quarter, 1940

Cause of death	Canada [1] (fourth quarter)		Province								
	1939	1940	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia
All causes	26,321	29,200	297	1,716	1,376	8,505	10,017	1,631	1,681	1,666	2,311
Automobile accidents	559	518	6	38	26	138	211	32	10	19	38
Cancer	3,131	3,381	37	178	140	932	1,198	213	187	198	298
Cerebral hemorrhage, cerebral embolism, and thrombosis	502	565	16	52	52	90	224	39	28	27	37
Diarrhea and enteritis	524	471	1	11	41	250	55	33	32	25	23
Diphtheria	100	87	------	19	3	46	4	3	7	5	------
Diseases of the arteries	2,728	3,111	23	171	129	574	1,539	179	156	114	226
Diseases of the heart	4,729	5,422	37	271	184	1,272	2,223	308	322	320	485
Homicides	31	28	------	2	------	4	9	1	1	5	6
Influenza	503	1,104	24	112	62	348	219	34	91	115	99
Measles	33	54	9	10	1	22	6	3	------	2	1
Nephritis	1,595	1,807	12	93	59	834	543	53	63	59	91
Pneumonia	1,539	1,808	27	118	133	542	575	79	109	102	123
Poliomyelitis	16	19	------	3	------	4	6	1	1	4	------
Puerperal causes	223	253	2	13	15	103	63	11	15	16	15
Scarlet fever	41	38	------	1	------	29	5	1	5	4	2
Suicides	237	199	1	13	7	36	68	12	14	13	35
Tuberculosis	1,321	1,298	11	105	65	555	225	77	53	74	133
Typhoid fever	47	69	------	------	5	40	9	6	4	1	4
Other violent deaths	1,072	1,135	8	59	43	244	450	69	59	73	130
Other specified causes	------	7,481	73	418	350	2,340	2,343	453	499	458	547
Unspecified or ill-defined causes	------	168	10	19	40	29	18	12	10	14	16
Whooping cough	170	184	------	10	21	82	24	12	15	18	2

[1] Exclusive of Yukon and the Northwest Territories.

Vital statistics—Year 1940—Comparative.—There were 21.4 live births per 1,000 population during the year 1940 as compared with 20.3 in 1939. The death rate was 9.7 per 1,000 population in 1940 and 9.6 in 1939. The infant mortality rate was 56 per 1,000 live births as compared with 61 for 1939. The maternal death rate was 4.0 per 1,000 live births during 1940 and 4.2 for 1939.

The accompanying tables give the numbers of births, deaths, and marriages, by Province, for 1940, and deaths by causes in Canada for 1940 and 1939.

Number of births, deaths, and marriages, year 1940

Province	Live births	Deaths (exclusive of still-births)	Deaths under 1 year of age	Maternal deaths	Marriages
Canada[1]	243,566	110,578	13,740	969	123,277
Prince Edward Island	2,047	1,057	135	6	702
Nova Scotia	12,677	6,123	788	46	6,390
New Brunswick	11,652	4,959	930	55	4,826
Quebec	83,857	32,799	5,856	377	35,071
Ontario	68,322	38,386	2,959	254	41,231
Manitoba	14,771	6,339	756	57	8,849
Saskatchewan	19,244	6,437	968	62	7,805
Alberta	17,272	6,194	830	69	8,778
British Columbia	13,724	8,284	518	43	9,625

[1] Exclusive of Yukon and the Northwest Territories.

Deaths by cause, year 1940, comparative

Cause of death	Canada[1]		Province								
	1939	1940	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia
All causes	108,951	110,578	1,057	6,123	4,959	32,799	38,386	6,339	6,437	6,194	8,284
Automobile accidents	1,584	1,711	10	105	81	434	746	87	59	73	116
Cancer	12,399	13,279	111	748	531	3,591	4,828	808	732	757	1,173
Cerebral hemorrhage, cerebral embolism, and thrombosis	2,060	2,287	50	207	183	448	901	127	119	116	136
Diarrhea and enteritis	2,375	1,883	16	38	159	1,050	257	98	121	89	55
Diphtheria	336	212		21	13	118	14	9	23	12	2
Diseases of the arteries	10,884	11,720	94	570	421	2,239	5,758	666	576	517	879
Diseases of the heart	18,562	20,243	159	973	719	4,749	8,529	1,193	1,110	1,088	1,723
Homicides	124	147	1	5		24	55	10	16	20	16
Influenza	3,955	2,769	40	249	105	955	605	140	246	254	175
Measles	197	167	9	14	1	71	31	18	14	6	3
Nephritis	6,538	6,821	53	319	211	3,225	1,951	212	282	217	351
Pneumonia	6,596	6,117	89	372	379	1,761	1,975	372	398	376	395
Poliomyelitis	56	48	1	3		17	14	5	2	4	2
Puerperal causes	967	969	6	46	55	377	254	57	62	69	43
Scarlet fever	167	125		2	1	66	31	5	9	9	2
Smallpox	1										
Suicides	978	944	5	28	28	156	336	61	94	96	140
Tuberculosis	5,977	5,771	56	409	295	2,503	1,008	369	241	322	568
Typhoid fever	180	225	1	2	19	130	27	18	17	3	8
Other violent deaths	4,487	4,563	33	260	175	1,023	1,753	246	274	318	481
Other specified causes		29,331	296	1,636	1,387	9,426	9,181	1,758	1,945	1,736	1,966
Unspecified or ill-defined causes		624	26	63	126	178	63	34	36	57	41
Whooping cough	541	622	1	53	70	258	69	46	61	55	9

[1] Exclusive of Yukon and the Northwest Territories.

CUBA

Provinces—Notifiable diseases—4 weeks ended May 24, 1941.—During the 4 weeks ended May 24, 1941, cases of certain notifiable diseases were reported in the Provinces of Cuba as follows:

Disease	Pinar del Rio	Habana[1]	Matanzas	Santa Clara	Camaguey	Oriente	Total
Cancer	4	2	1	6	1	7	21
Chickenpox	1	6	4	2	4	12	29
Diphtheria	1	19	2			3	25
Dysentery		1					1
Hookworm disease		21					21
Leprosy		1					1
Malaria	18	2		8	2	88	113
Measles		3	2		7	8	20
Poliomyelitis		1					1
Trachoma				3			3
Tuberculosis	19	19	18	45	20	32	153
Typhoid fever	19	47	13	47	13	33	172
Undulant fever					1		1
Whooping cough				9		1	10

[1] Includes the city of Habana.

OUTBREAK OF BUBONIC PLAGUE IN NEW CALEDONIA

According to information furnished the Public Health Service by Dr. R. R. Beard, of the Pan American Airways Co., an outbreak of bubonic plague occurred early this year at the village of Touaourou near Goro, on the island of New Caledonia. Goro is a seaport about 31 miles east of Noumea, the capital.

On February 24, 1941, five deaths from plague had occurred; and up to March 1, the date on which the last case was reported, there had been a total of nine cases with six deaths. Eight cases were stated to have occurred among young girls of a native school.

The diagnosis of plague was confirmed bacteriologically at the Gaston Bourret Institute at Noumea, where the plague bacillus was identified.

The source of the epidemic appears to have been native rats, commonly designated as "brush or coconut-tree rats." Prior to the outbreak, natives in the Goro region had found dead rats and others apparently sick. The disease is stated to be latently endemic in small areas of the colony. Of approximately 2,000 rats caught in Noumea, none was found to be infected.

Measures for control included isolation of the community, quarantine of vessels leaving it, extensive rat trapping, and vaccination of the entire population of the infected area. Anti-plague serum and sulfathiazole were used in treatment. The results of this joint treatment were reported as "very favorable," although no basis was given for the estimate of its efficacy.

New Caledonia is a mountainous, rocky island, 220 miles long and 25 to 30 miles wide, located among the Melanesian Islands of the South Pacific. The climate is warm and moderately moist. It has a population of about 50,000, one-half of which are Melanesians and Polynesians and one-third whites. Housing is stated to be generally of an unsubstantial nature, varying from wooden frame structures used by the whites to thatched huts occupied by the natives. Communication facilities, which are said to be poor, are provided principally by water routes.

Quarantine was discontinued the latter part of March, about 1 month after the last case of plague had been reported.

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