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THE EFFECT OF MORPHINE ADDICTION ON BLOOD, PLASMA, AND "EXTRA-CELLULAR" FLUID VOLUMES IN MAN[1]

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A number of authors have reported alterations in the water content of blood and tissue during morphine addiction or during withdrawal from morphine, and have postulated that changes in water economy might play a significant role in the development of physical dependence to morphine. The purpose of this paper is to present the results of a study of the effect of a cycle of morphine addiction on the blood, plasma, and "extra-cellular" fluid volumes (measured by the thiocyanate technique) of six human subjects who volunteered for the study.

Barbour, *et al.*, (*1*) found an increase in the water content of tissues in rats during morphine addiction and a further increase in the water content of tissue during the acute withdrawal period. Barbour, Hunter, and Richey (*2*) found similar changes in the water content of serum and tissues in dogs. Pierce and Plant (*3*) reported that the red cell counts and hemoglobin level of dog's blood remained unchanged from control levels during addiction, but that the red cell count and hemoglobin content fell sharply following abrupt withdrawal of morphine.

Adler (*4*) and Koh (*5*) attributed the abstinence syndrome to a retention of water and devised therapeutic regimes designed to dehydrate patients during the withdrawal period.

Karr, Light, and Torrance (*6*) found no changes outside the normal range in the concentration of the blood or plasma solids during maintained addiction in human subjects, but did note that their subjects showed a slight degree of anemia which the authors attributed to

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nutritional and hygienic factors. They found an increase of 9 percent in blood solids 48 hours after complete cessation of administration of morphine.

Williams (*7*) found that the mean hematocrit value was 42.7 vol. percent in addicted persons and 47.7 vol. percent in nonaddicts and in addicts who had received no morphine for 6 months. Blood water increased during addiction, but plasma water was unchanged. He found that, on the third day after abrupt discontinuance of injections of morphine, the mean hematocrit value had risen to 44.6 percent and the blood water content had fallen from 84.3 to 82.9 percent. Williams and Oberst (*8*) observed decreases in the hematocrit and hemoglobin values, increases in blood water, and increases in "extra-cellular" fluid volume during maintained addiction in two subjects. They thought that these findings implied an increased hydration of the body in general.

METHODS

Plasma volume was determined by the method of Gibson and Evelyn (*9*) as modified by Gregersen (*10*), using the Evelyn photoelectric colorimeter to measure the concentration of the dye. Hematocrit measurements were made according to the technique of Wintrobe (*11*). Total blood volume was calculated from the hematocrit and plasma volume figures. Blood cell mass was obtained by subtracting the plasma volume from the total blood volume. Thiocyanate fluid volume was determined simultaneously with the blood volume using the method of Crandall and Anderson (*12*) adapted to the photoelectric colorimeter.

"Extra-cellular" fluid volume was calculated by subtracting the total blood volume from the thiocyanate fluid volume. The water of serum and blood was determined by drying 1 cc. of blood and serum to constant weight at 105° C. Cell water was calculated from the serum and blood values and the hematocrit value. Red cell counts were done in duplicate on oxalated venous blood, using Bureau of Standards pipettes and hemacytometers. Hemoglobin was determined by the method of Evelyn and Malloy (*13*).

EXPERIMENTAL PROCEDURE

Six adult males, who had been addicted to morphine but who had been abstinent from the drug for at least 6 months, volunteered for the study. On physical examination, no significant defects were found in any of these men.

The determinations listed under METHODS were carried out on these men six times at intervals of 10 to 15 days prior to their readdiction to morphine. The determinations were made in the morning, with

the men under conditions similar to those used in carrying out basal metabolism tests. After the control determinations had been obtained, the men were readdicted to morphine. The drug was given intravenously in all cases. The dosages administered and the period over which the various dosages were given varied for each man (figs. 1 to 6). The determinations were repeated at intervals of 14 to 30 days throughout the addiction period.

Administration of morphine was stopped abruptly at the end of the addiction periods and determinations made 36 hours after the last injection of morphine had been given. All the subjects showed objective evidence of severe physical dependence to morphine at this time. The severity of the abstinence syndrome appeared to be approximately the same in all of the subjects. After the 36-hour determinations had been completed, the men were given morphine in gradually decreasing dosage over a period of 14 days. After they were no longer receiving morphine and had recovered sufficiently to carry on their usual work, the determinations were repeated one to three times at varying intervals, except for subject No. 676.

So far as possible, care was taken to avoid venous stasis in all experiments. Subject No. 684 had veins that were difficult to puncture, so that use of a tourniquet was frequently necessary. The data obtained on this subject, therefore, are not as reliable as those obtained on the other men.

RESULTS

The results are shown in figs. 1 to 6. A separate figure is shown for each subject. In these figures the preaddiction period represents the time during which the control determinations were obtained and the men were not receiving morphine. The addiction period represents the time during which the men were receiving morphine daily. The time between the addiction period and the abstinence period constitute the withdrawal period, during which the men were receiving decreasing dosages of morphine. It is not labeled in the figures. The abstinence period refers to the time following withdrawal, during which the men received no morphine, and is regarded as a recovery period.

Tables 1 and 2 present the mean values and standard deviations of the various measurements obtained during the control periods and the mean values and standard deviations found during the last 90 days of addiction. The column "p" represents the probability of the difference between the means occurring by chance, as calculated by the "t" test of Fisher (*14*). The last 90 days of the addiction period were chosen for comparison with the preaddiction period in order that there would be sufficient time for significant changes to develop.

TABLE 1.—*Effect of morphine addiction on the hematocrit, red-blood cell count, hemoglobin, and water of plasma, blood, and blood cells*

Subject	Period	Hematocrit	Red blood cell count millions	Hemoglobin (grams per 100 ml.)	Blood water (grams per 100 ml.)	Plasma water (grams per 100 ml.)	Cell water (grams per 100 ml.)
671	PA	50.9±1.6	5.29±0.05	15.0±0.3	82.06±0.45	92.52±0.4	72.1±1.2
	A	47.9±2.0	4.90±0.1	14.4±0.5	83.59±0.36	92.24±0.4	74.0±0.4
	p	0.05	0.01	0.8	0.01	0.5	0.01
676	PA	51.5±1.1	5.19±0.1	15.7±0.5	82.57±0.4	93.03±0.7	72.8±0.9
	A	46.5±0.9	4.82±0.3	15.0±0.5	84.00±0.17	93.81±0.9	73.4±0.6
	p	0.01	0.01	0.05	0.01	0.1	0.1
677	PA	50.8±0.6	5.32±0.05	15.4±0.1	82.46±0.4	93.15±0.15	72.1±0.7
	A	42.3±0.8	4.44±0.15	13.5±0.2	84.88±0.2	93.07±0.25	73.7±0.8
	p	0.01	0.01	0.01	0.01	0.5	0.01
684	PA	47.5±0.7	4.75±0.15	14.5±0.4	83.45±0.6	93.05±0.7	73.2±1.55
	A	46.5±1.5	4.76±0.15	14.3±0.4	83.53±0.8	92.75±1.01	72.9±1.42
	p	0.1	1.00	0.8	0.5	0.5	0.5
685	PA	49.7±0.8	5.32±0.1	15.4±0.5	82.78±0.8	92.75±0.44	73.8±1.74
	A	46.1±1.07	4.77±0.1	14.9±0.5	83.60±0.28	92.63±0.37	74.2±1.74
	p	0.01	0.01	0.05	0.05	0.5	0.5
686	PA	51.2±0.6	5.36±0.15	16.1±0.3	81.91±0.6	92.51±0.5	71.8±1.16
	A	47.4±0.6	5.05±0.1	14.9±0.15	83.21±0.7	92.38±0.3	72.6±1.9
	p	0.01	0.05	0.01	0.01	0.5	0.5

All figures represent means±standard deviations.
PA=values obtained in preaddiction period.
A=values obtained in last 90 days of addiction.
p=probability of difference between means occurring by chance. The level of significance is 0.05 or less.

TABLE 2.—*Effect of morphine addiction on total plasma, blood, thiocyanate, and "extra-cellular" fluid volumes*

Subject	Period	Plasma volume (in liters)	Blood volume (in liters)	Blood cell mass (in liters)	Thiocyanate fluid volume (in liters)	Extra-cellular fluid volume (in liters)
671	PA	2.69±0.26	5.47±0.42	2.78±0.18	18.0±0.7	12.5±0.95
	A	2.39±0.28	4.60±0.26	2.21±0.17	19.2±0.6	14.7±0.8
	p	0.1	0.01	0.01	0.02	0.02
676	PA	3.15±0.19	6.46±0.5	3.31±0.3	17.3±0.55	10.9±0.85
	A	2.81±0.18	5.24±0.11	2.43±0.13	19.1±1.02	13.9±1.6
	p	0.05	0.01	0.01	0.01	0.01
677	PA	3.15±0.19	6.41±0.12	3.25±0.21	18.1±1.55	11.8±1.2
	A	3.08±0.20	5.37±0.12	2.27±0.16	18.7±1.77	13.3±1.8
	p	0.5	0.01	0.01	0.5	0.07
684	PA	2.82±0.13	5.36±0.24	2.54±0.14	16.6±0.63	11.3±0.76
	A	2.68±0.19	4.87±0.24	2.26±0.05	17.6±1.1	12.6±0.95
	p	0.1	0.02	0.01	0.1	0.07
686	PA	2.69±0.22	5.50±0.12	2.80±0.22	16.6±0.55	11.3±0.8
	A	2.54±0.2	4.73±0.13	2.20±0.22	16.5±2.4	11.7±2.05
	p	0.1	0.02	0.01	0.5	0.5
686	PA	2.58±0.21	5.25±0.12	2.68±0.21	16.2±0.96	10.7±0.86
	A	2.71±0.14	5.16±0.23	2.45±0.095	18.4±1.55	13.2±1.56
	p	0.1	0.5	0.08	0.05	0.01

All figures represent means±standard deviations.
PA=values obtained in preaddiction period.
A=values obtained in last 90 days of addiction.
p=probability of difference between means occurring by chance. The level of significance is 0.05 or less.

CHANGES DURING THE ADDICTION PERIOD

Hematocrit.—The mean hematocrit value was significantly reduced during the addiction period in five of six instances. The extent of the reduction varied between 3.0 to 8.5 vol. percent. Although these changes are slight and the values are not reduced to points below the accepted normal range for males, the differences are highly significant statistically. No significant reduction was found in the hematocrit of subject No. 684 but, as mentioned previously, difficulty in performing venipuncture partially invalidates the data obtained on this man.

Red blood cell count and hemoglobin.—The changes noted paralleled those seen in the hematocrit. Statistically significant reductions varying between 0.31 to 0.88 million cells per cubic millimeter and 0.5 to 1.9 gm. of hemoglobin per 100 cc. of blood were found. The hemoglobin values were more variable than either the hematocrits or red cell counts. No changes were noted in the red cell counts or hemoglobin concentration of the blood of subject No. 684.

Blood water.—The water content of whole blood was increased significantly in five of six instances. The change varied between 0.82 to 2.42 gm. per 100 cc. of whole blood. No change was found in the blood water of subject No. 684.

Plasma water.—No statistically significant changes developed in the water content of plasma in any of the six men.

Blood cell water.—No significant change was found in the water content of the cells in four of six subjects. The cell water apparently increased 1.9 and 1.6 gm. per 100 cc. in subjects No. 671 and No. 677. The significance of the increases in these two cases is doubtful since the value for cell water is obtained indirectly and would be greatly affected by small errors in the hematocrit readings.

Plasma volume.—Mean plasma volume was slightly reduced in five of six subjects, but the reductions were not statistically significant, except in the case of subject No. 676, who lost 0.34 liters of plasma. Subject No. 686 showed a small increase in plasma volume which was not statistically significant.

Blood volume.—Total blood volume was significantly reduced in five of six subjects. The reductions varied from 0.49 to 1.22 liters.

Blood cell mass.—Statistically significant reductions varying between 0.28 to 0.98 liters were found in the blood cell masses of five of six subjects. The mean blood cell mass of subject No. 686 fell 0.23 liters in the addiction period, but the change was too small to reach the level of statistical significance. The diminutions in the blood cell masses account for the largest part of the decreases in blood volume.

Thiocyanate fluid volume.—Five of the six subjects showed increases in the mean thiocyanate fluid volumes, but the changes were statis-

tically significant in only three cases (subjects No. 671, No. 676, and No. 686). The increments varied from 0.6 to 2.2 liters. No change was noted in subject No. 685. Inspection of the charts reveals that the increases appeared in all subjects only after the daily dosage of morphine had been raised to 500 mg. or more and also that elevations were more likely to be found when the determinations were made during a period in which the dosage was being elevated, or shortly after a dosage plateau had been reached. Changes in the thiocyanate fluid volumes were not accompanied by parallel changes in body weight.

"Extra-cellular" fluid volume.—"Extra-cellular" fluid volume was increased in all cases. The increases varied from 0.4 to 3.0 liters, but were statistically significant in only three cases (subjects No. 671, No. 676, and No. 686).

Expression of the data for plasma, blood, thiocyanate and "extra-cellular" fluid volumes on the basis of milliliters per kilogram of body weight did not alter the trend of the results; interpretation on this basis was complicated by the fact that the men lost weight in the first part of the addiction period and gained weight toward the end of this period. None of the subjects showed significant changes in plasma volume expressed as milliliters per kilogram of body weight; four of the six showed significant reductions in total blood volume; five of six exhibited significant reductions in circulating cell mass. Four of the six subjects showed significant elevations in thiocyanate fluid volume, and four of six showed significant elevations in "extra-cellular" fluid volume.

CHANGES IN WITHDRAWAL PERIOD

Since only one set of determinations could be carried out in the withdrawal period, the data obtained cannot be analyzed statistically. Furthermore, restlessness, muscle twitching, and fever associated with the abstinence syndrome make it impossible to carry out the procedures under basal conditions, so that the results obtained cannot be strictly compared with those found during the control and addiction periods.

If the withdrawal values are compared to the last value (figs. 1 to 6) obtained in the addiction period, increases in the hematocrit readings, red cell counts and hemoglobin were seen in five of six subjects. Blood water decreased in four out of six cases. Plasma water decreased in three cases, was unchanged in one, and increased in two. Blood cell water decreased in four cases, increased in one, and was unchanged in another. Plasma volume increased in three out of six cases, decreased in two, and was unchanged in one. Blood volume was increased in three cases, decreased in two, and was unchanged in one. Red cell mass was elevated in four cases, was unchanged in one, and

decreased in one. Thiocyanate fluid volume was decreased in three cases, increased in one, and was unchanged in two.

The changes noted fall within the limits of the variations found in the last 90 days of addiction, except in the case of values found for plasma volume, blood volume, and circulating cell mass on subject No. 684.

CHANGES IN THE ABSTINENCE (RECOVERY) PERIOD

The number of determinations obtained on any given individual in this period was too small for statistical analysis. Inspection of the figures show that the hematocrit, blood volume, and circulating cell mass of subjects No. 671 and No. 677 were not restored to their original preaddiction levels for 60 to 90 days.

DISCUSSION

All of the changes in the blood in the addiction period can be explained on the basis of the development of a very mild anemia. The total blood volume, circulating cell mass, hematocrit, hemoglobin, and red cell count were decreased in most cases, whereas the total plasma volume decreased only slightly. Total blood water increased, while plasma water and cell water remained constant.

These facts indicate that the increase in blood water noted by Williams (*7*) and by Karr, Light, and Torrance (*6*) is not related to any real "hydration" (increase in the water content of cells or plasma) of the blood, but is a function of the increased proportion of plasma to cells in the circulating blood. Calculations show that the increase in the water content of blood during addiction, which was noted by Williams (*7*), is exactly accounted for by the decrease in the hematocrit values.

The degree of the anemia developed in these subjects, although highly significant statistically, was small. Red cell counts and hemoglobin values did not fall outside the accepted normal range except in subject No. 677. Karr, Light, and Torrance (*6*) found a mild anemia in their subjects but attributed it to poor personal hygiene and nutrition. These factors appear to be excluded in our study since the men lived under excellent hygienic circumstances, and the anemia persisted after they had regained their appetites and increased their food intakes to the preaddiction level.

Individual factors apparently influenced the speed of development of the anemia as well as its degree. Subject No. 677 developed a definite anemia after 3 weeks' addiction, while Nos. 671, 676, 685, and 686 showed no significant changes in the first 60 to 90 days of the addiction period. Subject No. 684 never developed an anemia. It seems unlikely that such a mild anemia could play any significant role in the development of physical dependence to morphine.

Changes in the thiocyanate and "extra-cellular" fluid volumes are more difficult to interpret. Three of the men showed significant increases in these measures during the addiction period, and three did not. The abstinence syndrome was no more severe in the men who had significantly increased thiocyanate and "extra-cellular" fluid volumes than in the men whose thiocyanate and "extra-cellular" fluid volumes were not significantly elevated. The increases in the thiocyanate and "extra-cellular" fluid volume did not occur in any of the men until the daily dosage of morphine had been elevated to 500 mg. or more; yet it is certain from past experience that the subjects had developed strong physical dependence to morphine long before they attained the 500-mg.-dosage level.

These findings indicate that elevations of thiocyanate fluid volume play little part in the production of physical dependence to morphine. This interpretation is supported by results obtained by Wikler (*14*) in experiments designed to study the effects of water intoxication on the electroencephalogram. In these experiments, healthy adult men were hydrated by the administration of 3 to 5 liters of 5-percent glucose intravenously, while diuresis was suppressed by the administration of pitressin. Although the subjects developed definite acute water intoxication, the clinical picture was very different from that observed in the morphine abstinence syndrome. The water intoxication syndrome was characterized by severe headache, muscle cramps, vomiting, diarrhea, and ataxia. None of the signs of disturbances in function of the autonomic nervous system which are so characteristic of the abstinence syndrome (dilatation of the pupils, gooseflesh, rhinorrhea) were observed. No signs suggestive of the abstinence syndrome were seen in these men during the period of diuresis following the discontinuance of the pitressin.

The determinations made during the withdrawal period lend no support to the thesis that an increased retention of water occurs in this period. Such changes as did occur were more compatible with loss of body water rather than an increase.

SUMMARY

Hematocrit readings, red cell count, and hemoglobin values of the blood of men are reduced during addiction to morphine. The diminution in these measurements, although small, is statistically significant.

The water content of plasma and cells is unchanged in morphine addiction. The water content of whole blood is increased. The increase in blood water is due to the increased proportion of plasma to cells and not to an increase in the water content of cells or plasma.

Plasma volume is not altered in the course of morphine addiction; total blood volume and blood cell mass are reduced.

The anemia, which develops during morphine addiction, is slight and probably has no significance in the production of physical dependence.

Thiocyanate and "extra-cellular" fluid volume tended to be increased in addiction when the daily dosage of morphine exceeded 500 mg. per day.

CONCLUSION

It is unlikely that excessive body hydration plays a significant role in the production of physical dependence to morphine in man.

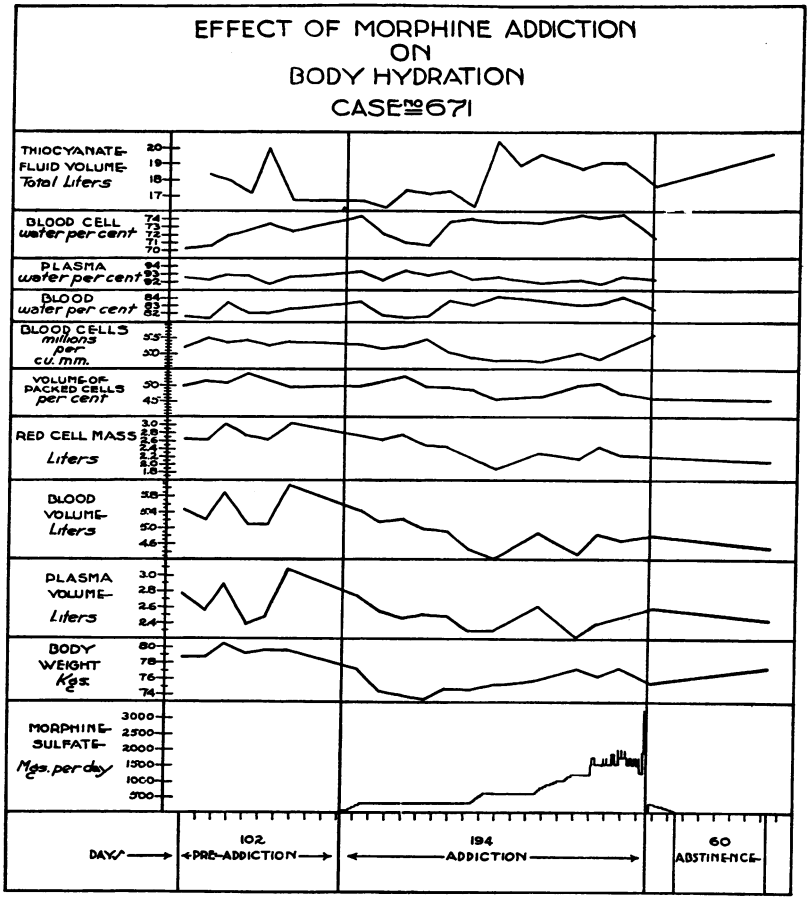

FIGURE 1

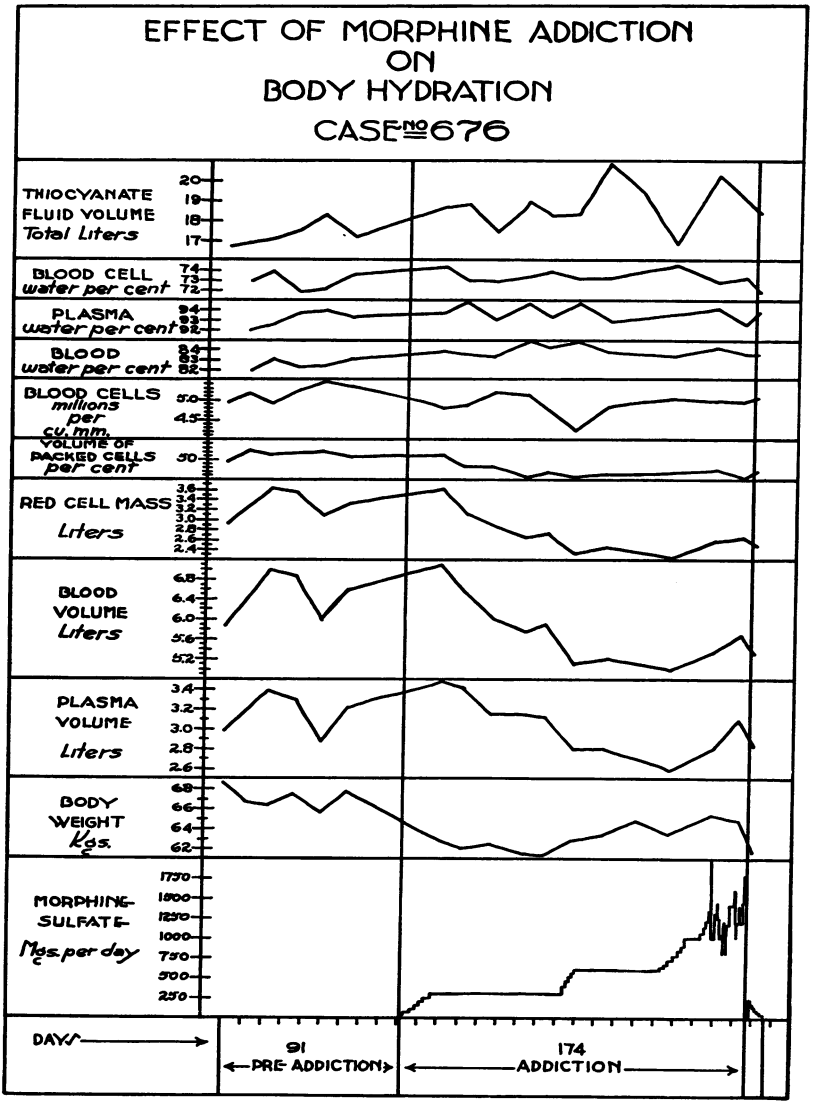
EFFECT OF MORPHINE ADDICTION
ON
BODY HYDRATION
CASE NO 676
THIOCYANATE FLUID VOLUME Total Liters
20
19
18
17
BLOOD CELL water per cent
74
73
72
PLASMA water per cent
94
93
92
BLOOD water per cent
84
83
82
BLOOD CELLS millions per cu. mm.
5.0
4.5
VOLUME OF PACKED CELLS per cent
50
RED CELL MASS Liters
3.6
3.4
3.2
3.0
2.8
2.6
2.4
BLOOD VOLUME Liters
6.8
6.4
6.0
5.6
5.2
PLASMA VOLUME Liters
3.4
3.2
3.0
2.8
2.6
BODY WEIGHT Kgs.
68
66
64
62
MORPHINE-SULFATE- Mgs. per day
1750
1500
1250
1000
750
500
250
DAYS
91
PRE-ADDICTION
174
ADDICTION

FIGURE 2

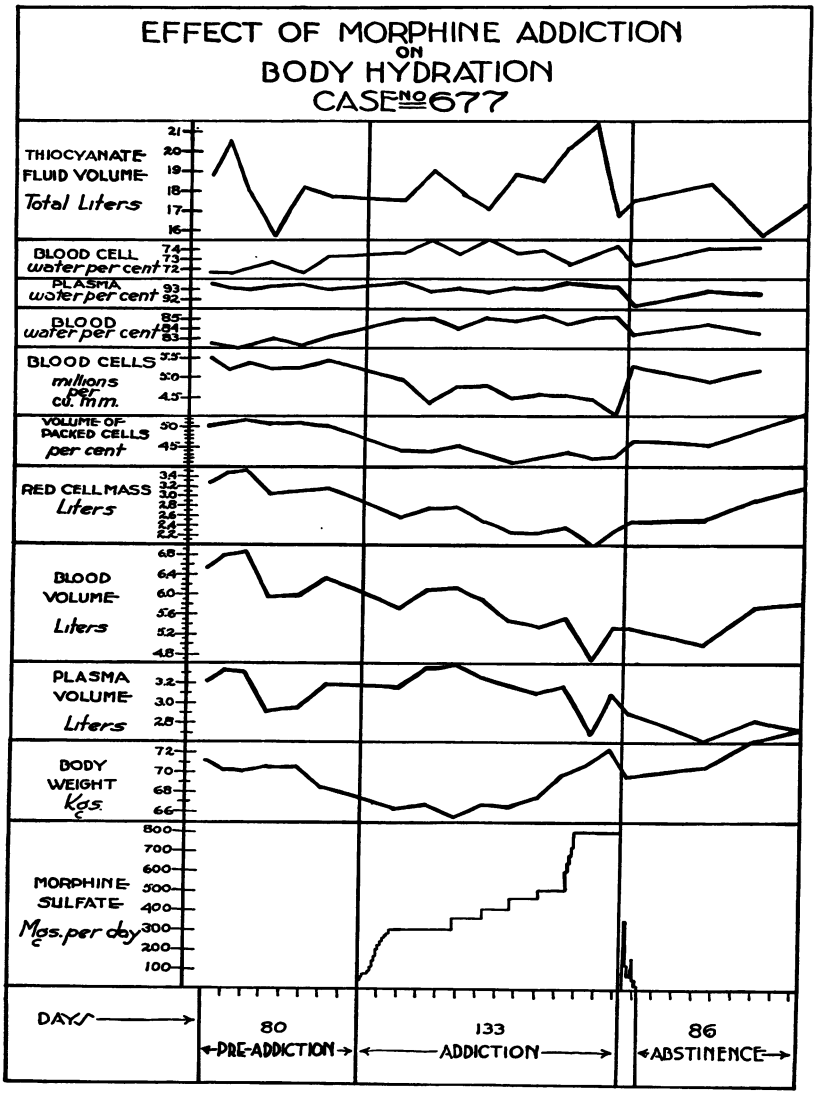
EFFECT OF MORPHINE ADDICTION
ON
BODY HYDRATION
CASE NO 677
THIOCYANATE FLUID VOLUME Total Liters
21
20
19
18
17
16
BLOOD CELL water per cent
74
73
72
PLASMA water per cent
93
92
BLOOD water per cent
85
84
83
BLOOD CELLS millions per cu. mm.
5.5
5.0
4.5
VOLUME OF PACKED CELLS per cent
50
45
RED CELL MASS Liters
3.4
3.2
3.0
2.8
2.6
2.4
2.2
BLOOD VOLUME Liters
6.8
6.4
6.0
5.6
5.2
4.8
PLASMA VOLUME Liters
3.2
3.0
2.8
BODY WEIGHT Kgs.
72
70
68
66
MORPHINE SULFATE Mgs. per day
800
700
600
500
400
300
200
100
DAYS
80
PRE-ADDICTION
133
ADDICTION
86
ABSTINENCE

FIGURE 3

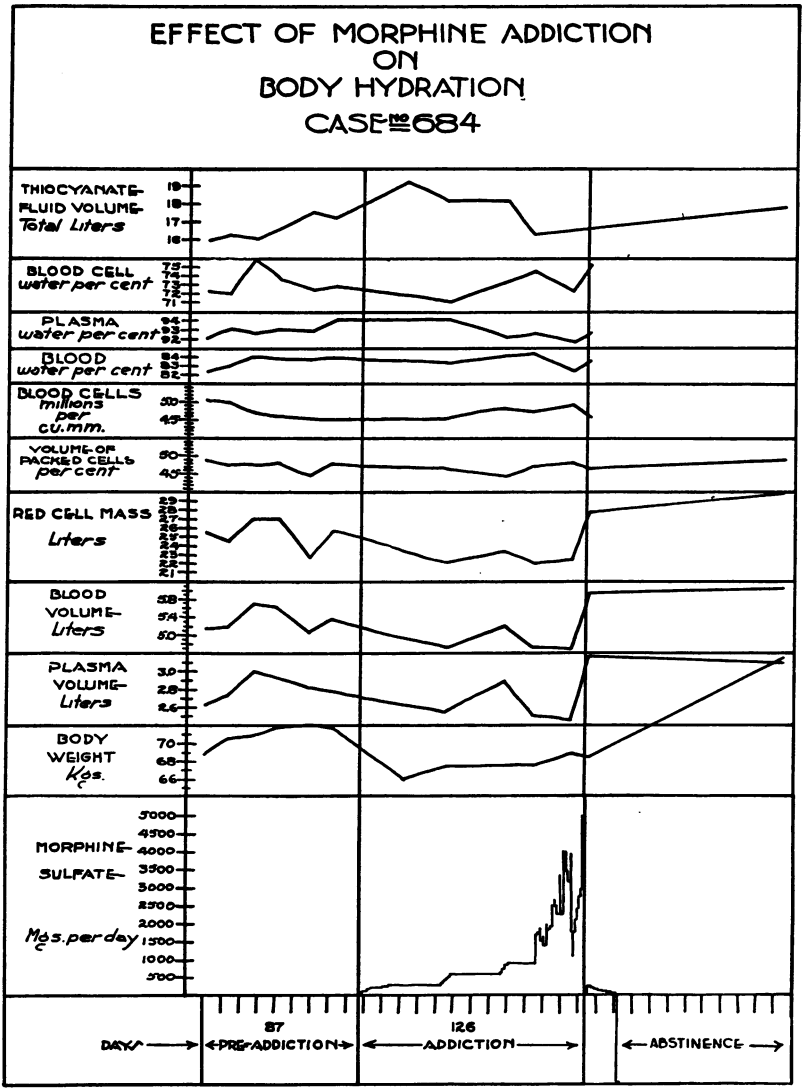
EFFECT OF MORPHINE ADDICTION
ON
BODY HYDRATION
CASE No 684
THIOCYANATE FLUID VOLUME Total Liters
BLOOD CELL water per cent
PLASMA water per cent
BLOOD water per cent
BLOOD CELLS millions per cu.mm.
VOLUME OF PACKED CELLS per cent
RED CELL MASS Liters
BLOOD VOLUME Liters
PLASMA VOLUME Liters
BODY WEIGHT Kgs.
MORPHINE SULFATE Mgs. per day
DAYS
87
PRE-ADDICTION
126
ADDICTION
ABSTINENCE

FIGURE 4

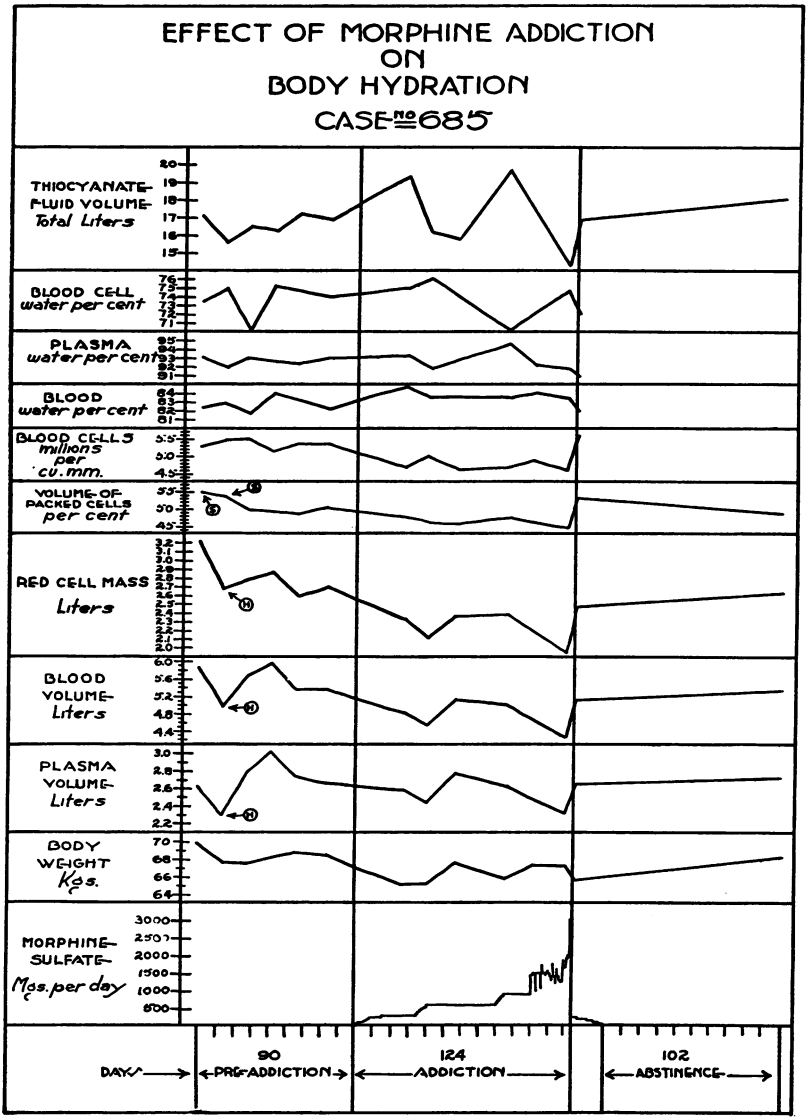

FIGURE 5

Ⓗ indicates hemolysis in dyed serum.
Ⓢ indicates stasis in drawing blood.

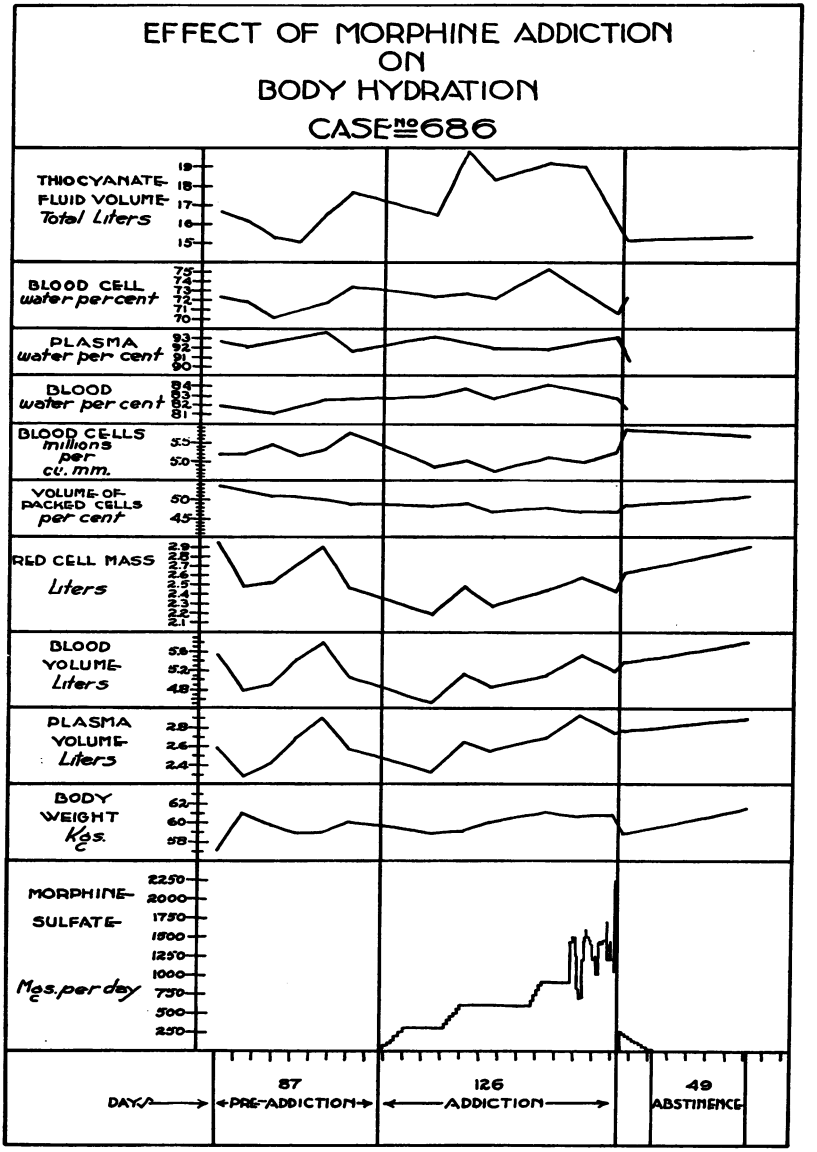

FIGURE 6

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ELECTRON MICROSCOPY OF TOOTH STRUCTURE BY THE SHADOWED COLLODION REPLICA METHOD[1]

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In previous papers (*1*, *2*, *3*) it has been shown that the fine structure of dental tissues can be instructively examined under the optical microscope by means of metal-shadowed collodion replicas. Since replicas of this sort can be taken from intact tooth surfaces, as well as from polished and etched sections, this is a procedure that can be applied to living as well as extracted teeth. The present paper describes the modifications in the technique that are needed to permit examination of tooth structures under the electron microscope.

Dental tissues have already been studied under the electron microscope by Richards and Thomassen (*4*), and Gerould (*5*, *6*), through the agency of polystyrene-silica replicas. This method involves taking an impression of a tooth slab, untreated or etched, by pressing the slab into a block of polystyrene under pressure approaching 3,000 pounds per square inch and a temperature of about 160° C. After the

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tooth slab has been removed from the plastic block, a very thin layer of silica is evaporated vertically onto the surface of the impression. The silica reproduces the detail of the impression surface in a thin film which can be freed for examination under the electron microscope by dissolving the polystyrene block. When this method was tried in this laboratory, it became evident that many of the details which had previously been seen on metal-shadowed collodion replicas of lightly etched ground sections under the optical microscope (*3*) were not reproduced in the silica replicas. It is reasonable to ascribe the diminished detail on such replicas in part, at least, to destruction of delicate structures by the high pressures used. Heating also modifies the dental structures, as can readily be demonstrated by the separation that commonly occurs between enamel and dentin. This often takes place with such explosive force as to blow the enamel completely free of the dentin.

The modification of this method (*7*) in which the impression is made on a thin sheet of polystyrene under only a kilogram weight gave similar results. Evidently even this slight pressure is sufficient, at elevated temperature, to damage severely the structural detail originally present on the lightly etched tooth slab. It is also possible that some damage results from the large amount of radiant heat reaching the polystyrene impression during the evaporation of silica. This heat is often sufficient to warp the polystyrene sheet.

The procedures described below for preparation of metal-shadowed collodion replicas of the surfaces of ground sections were developed to prevent such damage to fine structural detail and to improve the visibility of existing structures by shadow-casting. The steps in the preparation of these replicas are outlined graphically in figure 1. To begin with, a tooth is ground in the desired plane to the level of choice with various abrasive wheels under running water. The ground surface is then highly polished on metallographic emery papers, through grade 4–0. Next, a slab a millimeter thick is cut, either by grinding away the excess tooth structure with abrasive wheels, or by using the slicing attachment of a standard tooth-sectioning machine. One face of the slab is the highly polished surface. Several slabs can, if desired, be made from a tooth. The average time needed to complete a slab is less than 30 minutes.

Structural detail is next brought out on the polished section by immersing the entire slab for a few seconds in dilute acids. It has been demonstrated that in making replicas for optical examination, various concentrations and types of acids bring out different structures to the best advantage (*3*). This is also the case when preparing replicas for electron microscopy. For the general observation of enamel, a 5-

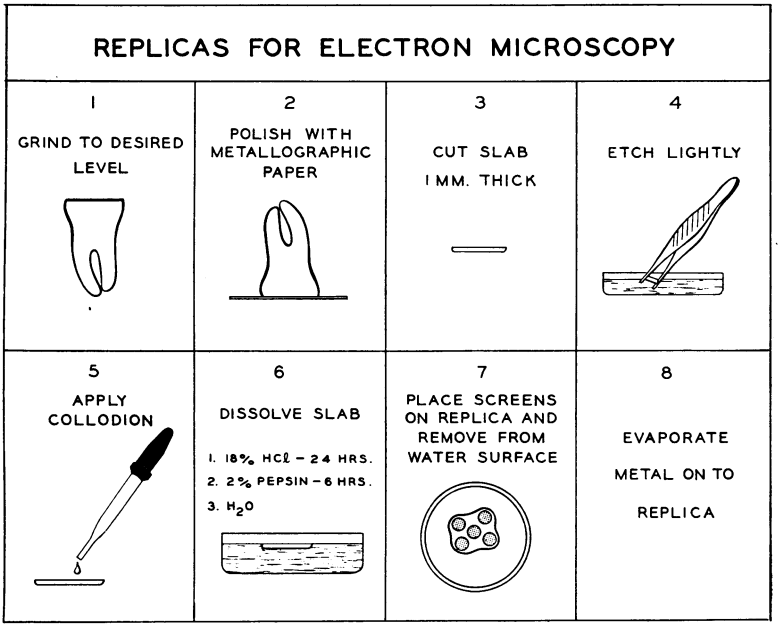

FIGURE 1.

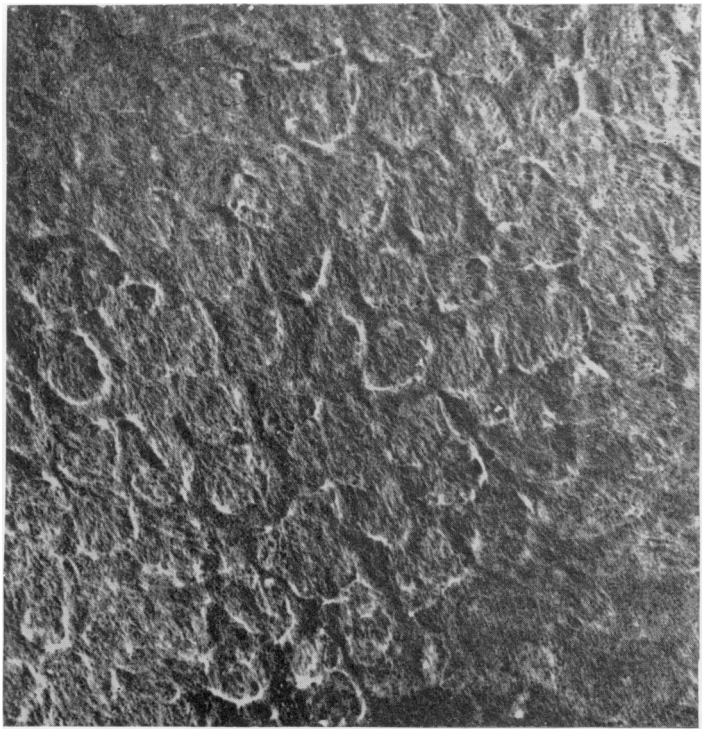

FIGURE 2.—Cross-section through enamel (× 1,600).

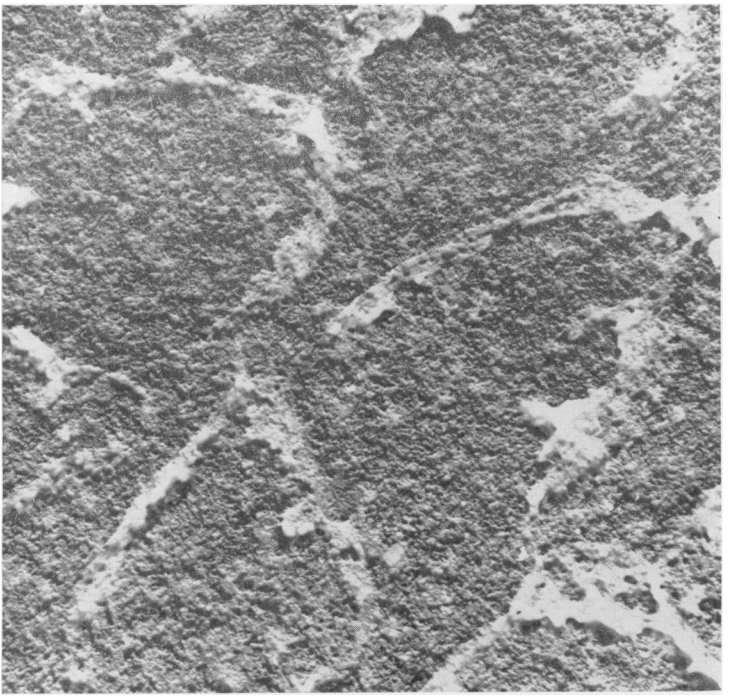

FIGURE 3.—Cross-section through enamel (× 9,500).

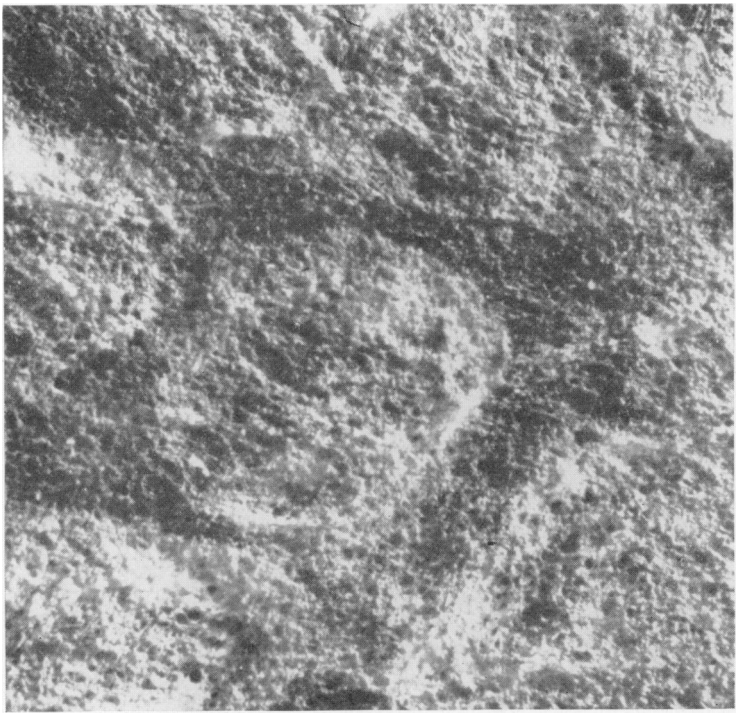

FIGURE 4.—Cross-section through enamel (× 9,500).

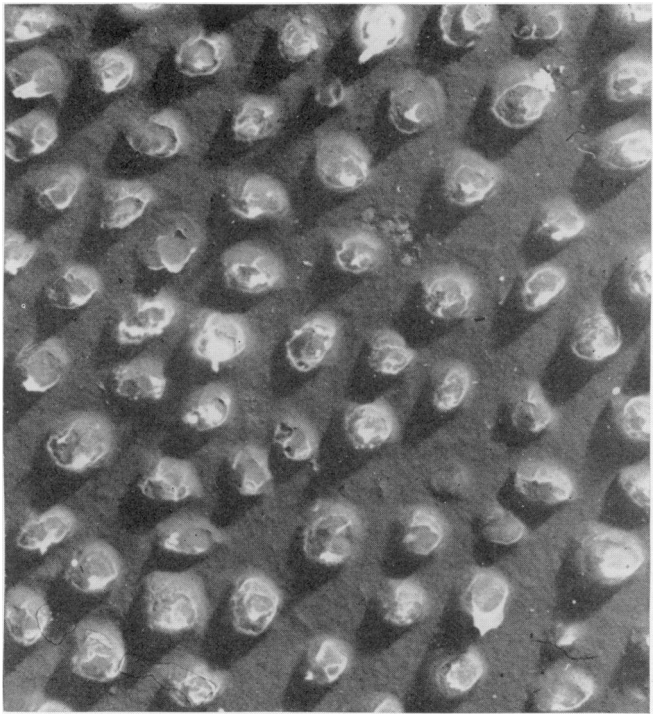

FIGURE 5.—Cross-section through dentin (× 2,000).

FIGURE 6.—Cross-section through dentin (× 9,500).

FIGURE 7.—Cross-section through a single dentinal tubule (× 13,500).

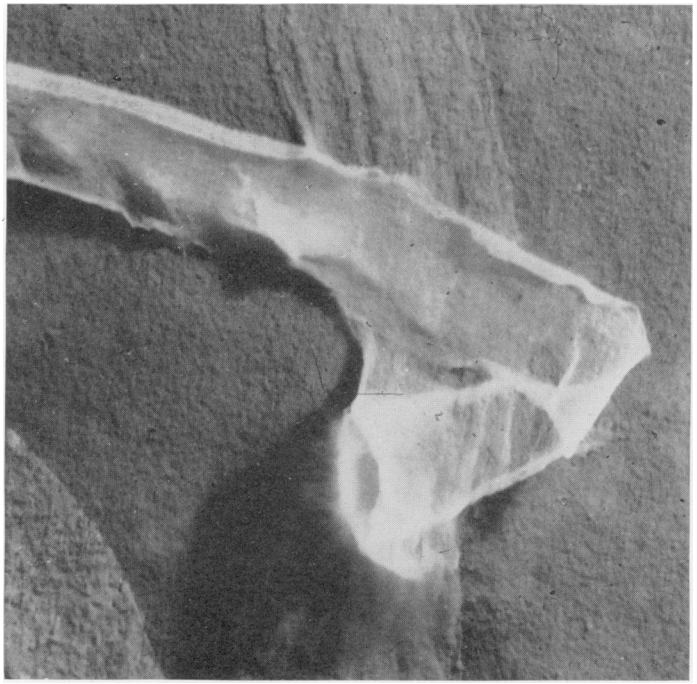

FIGURE 8.—Cross-section through dentin, showing isolated dentinal fiber (× 12,000).

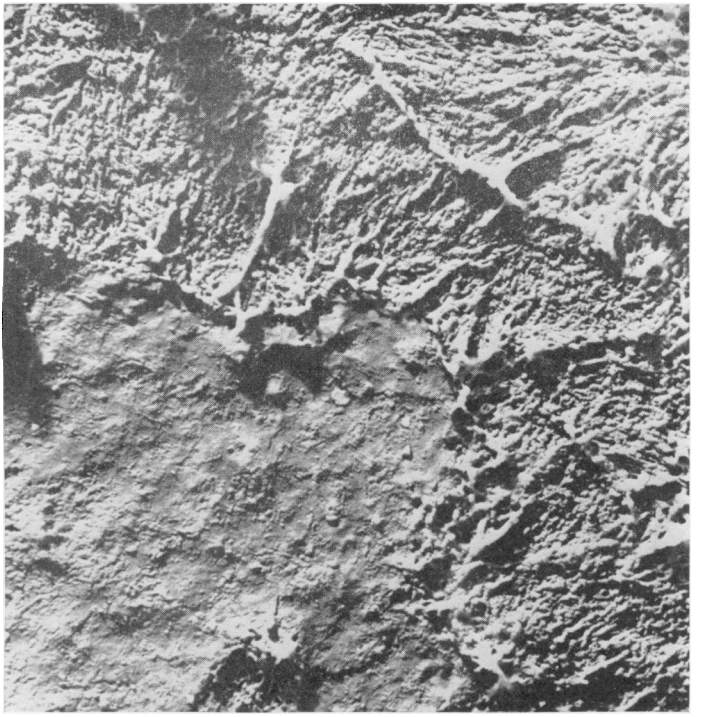

FIGURE 9.—Cross-section through the dentino-enamel junction (× 9,500).

second exposure to 0.1N HCl has been found satisfactory; for dentin a 5-second exposure to 0.05N HCl or to 0.8N citric acid is optimal.

After the polished surface of the slab has been etched and washed a few drops of collodion, U. S. P., diluted 1:6 with ether, are applied, the excess liquid drained, and the film allowed to dry thoroughly. The slab is then floated, collodion side up, on the surface of 18 percent HCl for at least 24 hours. The greater portion of the slab dissolves and only a slight residue of debris and organic matter remains attached to the floating collodion. The replica is then picked up by introducing a glass slide under it and lifting the two together from the acid, and the collodion film is refloated on clean distilled water. Next, the replica is transferred in the same way to 1 percent pepsin solution, pH 1.8, and incubated at 37° C. for 8 hours to effect its thorough cleansing. Final washing is made through one or more transfers to the surface of distilled water.

Up to this point, the replica has been floating face down on the liquid surface. Next the metal specimen screens used for electron microscopy are placed on the replica, and screens and replica together are picked from the water surface with a piece of blotting paper. After the replica has dried, it is metal-shadowed by the oblique evaporation of 30 mg. of chromium onto its surface, according to procedures already described (*8*). For the evaporation, the tungsten filament is placed 18 cm. behind and 6 cm. above the specimen in order to produce shadows approximately three times the height of the details responsible for them.

Shadowed replicas, prepared by the foregoing technique, have been examined with both the RCA 50 KV type EMU microscope and the RCA 30 KV console-type (EMC) instrument. The console microscope has proved especially useful in giving preliminary surveys of a replica at its low magnification (500×), this survey being followed with more detailed study of selected fields at the higher magnifications afforded by the larger instrument.

The series of electron micrographs that follow have been chosen to illustrate, for comparison with the optical photomicrographs previously published, typical tooth structures as reproduced by collodion replicas of the sort just described. Figures 2, 3, and 4 show the characteristic appearance of enamel. The first of these, made at 500× with the console microscope, includes a field in which enamel-rod axes are nearly normal to the plane of the section. Figures 3 and 4, photographed at 3,800× with the EMU microscope, illustrate detail in and about individual rods. The enamel in all three instances was etched for 5 seconds with 0.1N HCl. The microscopic pitting which results from such an etch is clearly evident. The next four figures (5–8) are micrographs of dentin etched for 5 seconds with

0.05N HCl. The first and last of these were made with the console microscope at 500× and 5,000× respectively, the others with the EMU at 3,800×. Figure 5 shows how individual dentinal tubules stand out even at low magnification in replicas prepared for electron microscopy. At the higher magnifications of figures 6 and 7, one can readily see the central fiber, a distinct structure at the periphery of the tubules, and the homogeneous nature of the matrix between the tubules. In figure 8 a dentinal fiber can be seen which apparently was trapped on the surface of the replica and not dissolved through action of the pepsin. It appears as a thin-walled tube, in this case with part of the wall torn away. The dentino-enamel junction is reproduced in the electron micrograph of figure 9, taken at 3,800× on the EMU. The specimen was etched for 5 seconds with 0.1N HCl. The sharpness of transition between the relatively structureless dentinal matrix and the extremely rough enamel is brought out clearly.

Besides giving fundamental information about structures too fine to be visible under the optical microscope, this technique for electron microscopy can be used in many other kinds of dental problems. Thus the effects of chemical agents, such as fluorides, upon tooth surfaces and sections can be determined, as well as the resistance of chemically treated structures to subsequent etchings by various acids. Such studies are now in progress.

SUMMARY

Metal-shadowed collodion replicas reproduce fine detail that is lost under the action of the elevated temperatures and pressures required to make the impressions involved in previous techniques for electron microscopic examination of tooth structures. The method of making such replicas is described and typical electron micrographs are presented.

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INCIDENCE 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 SEPTEMBER 27, 1947

Summary

For the second consecutive week the incidence of poliomyelitis declined. A total of 801 cases was reported, as compared with 881 last week, a decline of 9 percent, approximately the same rate as for the same week last year—1,425 to 1,296. Decreases are reported currently in all geographic divisions except the South Central and Mountain areas. Only 14 States reported more than 12 cases—8 showing increases. These States are as follows (last week's figures in parentheses): *Increases*—Massachusetts 30 (28), New Jersey 34 (28), Ohio 176 (146), Indiana 18 (17) Michigan 79 (77), Iowa 13 (5), Virginia 23 (10), Idaho 26 (9); *decreases*—New York 117 (158), Pennsylvania 31 (40), Illinois 50 (89), Wisconsin 25 (27), North Carolina 18 (27), California 28 (32). The total number of cases reported since March 15 (the approximate average date of seasonal low incidence) is 6,686, as compared with 18,035 for the same period last year and a 5-year median for the period of 9,260.

Of the total of 33 cases of infectious encephalitis (last week 21, 5-year median 17), Colorado reported 6, Minnesota 5, Iowa and California 4 each, and Illinois and Montana 3 each. Of 173 cases of undulant fever (last week 125, 2-year average 82), 49 occurred in Iowa, 19 in Illinois, 16 in Minnesota, 9 in Wisconsin, 8 in Connecticut, and 6 each in Kansas, Oklahoma, and Texas. The total cases for the year to date of tularemia is 1,140, as compared with 717 for the same period last year and a 5-year median of 660.

Deaths recorded for the week in 93 large cities of the United States totaled 8,173, as compared with 8,269 last week, 8,186 and 8,378 for the corresponding weeks of 1946 and 1945, and a 3-year (1944–46) median of 8,186. The total to date is 359,238, as compared with 354,019 for the same period last year. Deaths under 1 year in the same cities totaled 646, as compared with 743 last week and a 3-year median of 649. The total for the year to date is 28,986, as compared with 25,115 for the corresponding period last year.

Telegraphic morbidity reports from State health officers for the week ended Sept. 27, 1947, and comparison with corresponding week of 1946 and 5-year median

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

Division and State	Diphtheria			Influenza			Measles			Meningitis, meningococcus		
	Week ended—		Median 1942–46	Week ended—		Median 1942–46	Week ended—		Median 1942–46	Week ended—		Median 1942–46
	Sept. 27, 1947	Sept. 28, 1946		Sept. 27, 1947	Sept. 28, 1946		Sept. 27, 1947	Sept. 28, 1946		Sept. 27, 1947	Sept. 28, 1946	
NEW ENGLAND												
Maine	0	0	0	------	------	------	1	13	------	0	0	0
New Hampshire	0	0	0	------	1	------	------	3	------	0	0	0
Vermont	0	1	0	------	1	------	------	33	4	0	0	0
Massachusetts	1	24	7	------	------	------	21	71	40	1	1	3
Rhode Island	1	2	0	2	------	------	------	3	3	0	1	1
Connecticut	1	0	1	1	1	1	14	9	6	1	2	2
MIDDLE ATLANTIC												
New York	3	18	12	[1] 1	[1] 4	[1] 4	49	46	42	2	5	12
New Jersey	2	3	3	4	2	2	28	12	12	1	2	3
Pennsylvania	8	16	9	(2)	(2)	(2)	26	69	51	6	5	10
EAST NORTH CENTRAL												
Ohio	9	16	11	1	1	5	13	14	14	1	5	5
Indiana	5	6	7	12	2	3	2	4	4	1	1	1
Illinois	2	13	7	2	1	1	38	15	15	0	5	5
Michigan [3]	2	4	5	------	3	------	39	15	21	3	1	3
Wisconsin	1	15	2	18	18	14	28	22	40	0	2	2
WEST NORTH CENTRAL												
Minnesota	10	4	6	1	------	------	35	2	3	0	0	0
Iowa	14	3	6	------	------	------	6	6	2	2	1	0
Missouri	1	3	3	1	2	1	4	2	2	1	0	2
North Dakota	0	1	1	------	4	3	6	------	------	0	0	0
South Dakota	0	2	3	------	------	------	4	1	1	0	0	0
Nebraska	0	2	2	------	3	------	1	2	4	0	1	0
Kansas	6	2	4	------	4	4	2	2	5	2	1	1
SOUTH ATLANTIC												
Delaware	1	0	0	------	------	------	------	------	------	0	0	0
Maryland [3]	8	6	5	------	------	------	5	9	7	1	0	2
District of Columbia	1	0	0	------	------	------	2	4	1	0	0	0
Virginia	4	27	16	232	161	111	17	12	7	1	4	4
West Virginia	4	2	6	15	------	------	80	------	------	0	3	1
North Carolina	49	12	38	------	------	------	3	8	6	0	1	1
South Carolina	15	1	20	230	30	166	2	3	8	0	0	1
Georgia	7	10	24	5	2	6	1	7	4	0	0	0
Florida	6	11	7	6	5	4	2	1	1	0	2	2
EAST SOUTH CENTRAL												
Kentucky	11	26	15	------	------	2	2	------	1	3	2	2
Tennessee	10	6	23	12	4	7	6	1	5	2	0	1
Alabama	7	11	25	14	28	19	2	5	5	2	2	2
Mississippi [3]	19	10	10	1	------	------	1	------	------	0	1	0
WEST SOUTH CENTRAL												
Arkansas	5	8	8	------	------	10	3	2	3	0	1	0
Louisiana	7	3	6	------	------	2	1	5	1	1	0	1
Oklahoma	2	1	4	42	17	17	1	4	2	0	0	0
Texas	29	15	46	472	624	456	109	39	24	3	3	3
MOUNTAIN												
Montana	5	0	0	2	3	2	16	3	3	0	1	0
Idaho	0	0	0	20	6	------	1	4	6	0	0	0
Wyoming	1	0	0	------	1	1	1	------	1	1	0	0
Colorado	5	2	6	3	32	16	8	5	5	0	1	1
New Mexico	0	1	3	------	2	2	1	7	2	0	0	0
Arizona	7	2	2	6	22	22	2	3	3	0	1	0
Utah [3]	4	0	0	------	1	------	2	2	3	0	1	0
Nevada	0	0	0	------	------	------	------	------	------	0	0	0
PACIFIC												
Washington	0	5	6	------	------	------	11	5	16	1	0	3
Oregon	4	2	1	7	1	1	7	11	22	0	2	2
California	12	17	19	1	5	12	68	43	92	5	6	7
Total	289	313	425	1,111	991	959	671	527	612	41	64	101
39 weeks	8,230	11,436	9,374	306,917	195,844	85,825	187,822	642,181	542,892	2,727	4,799	6,679
Seasonal low week [4]	(27th) July 5–11			(30th) July 26–Aug. 1			(35th) Aug. 30–Sept. 5			(37th) Sept. 13–19		
Total since low	1,933	2,808	2,808	5,404	5,647	5,647	2,320	2,096	2,178	86	133	184

[1] New York City only.
[2] Philadelphia only.
[3] Period ended earlier than Saturday.
[4] Dates between which the approximate low week ends. The specific date will vary from year to year.

Telegraphic morbidity reports from State health officers for the week ended Sept. 27, 1947, and comparison with corresponding week of 1946 and 5-year median—Con.

Division and State	Poliomyelitis			Scarlet fever			Smallpox			Typhoid and paratyphoid fever		
	Week ended—		Median 1942–46	Week ended—		Median 1942–46	Week ended—		Median 1942–46	Week ended—		Median 1942–46
	Sept. 27, 1947	Sept. 28, 1946		Sept. 27, 1947	Sept. 28, 1946		Sept. 27, 1947	Sept. 28, 1946		Sept. 27, 1947 [5]	Sept. 28, 1946	
NEW ENGLAND												
Maine	5	2	2	8	22	14	0	0	0	1	0	0
New Hampshire	1	10	2	7	5	4	0	0	0	0	0	0
Vermont	3	7	2	0	0	2	0	0	0	1	0	0
Massachusetts	30	28	28	30	30	64	0	0	0	9	9	7
Rhode Island	8	13	3	1	3	3	0	0	0	0	0	0
Connecticut	2	5	10	4	10	11	0	0	0	1	0	1
MIDDLE ATLANTIC												
New York	117	117	108	50	89	99	0	0	0	5	8	11
New Jersey	34	10	10	10	23	23	0	0	0	1	6	2
Pennsylvania	31	19	19	52	54	80	0	0	0	3	8	10
EAST NORTH CENTRAL												
Ohio	176	52	36	37	93	99	0	0	0	7	6	7
Indiana	18	27	8	20	26	26	0	0	0	4	2	2
Illinois	50	131	71	19	41	76	0	0	0	1	5	4
Michigan [3]	79	60	19	31	43	59	0	0	0	8	3	3
Wisconsin	25	95	19	8	30	43	0	0	0	2	0	1
WEST NORTH CENTRAL												
Minnesota	11	96	26	15	15	28	0	0	0	0	1	0
Iowa	13	31	16	3	17	20	0	0	0	1	0	0
Missouri	4	90	19	4	18	32	0	1	0	2	4	4
North Dakota	1	25	1	5	0	3	0	0	0	0	0	0
South Dakota	0	6	1	3	1	5	0	0	0	1	0	0
Nebraska	8	34	8	3	10	10	0	0	0	0	0	0
Kansas	7	66	9	8	11	30	0	0	0	0	1	1
SOUTH ATLANTIC												
Delaware	2	6	2	0	4	3	0	0	0	0	0	1
Maryland [3]	8	5	5	8	13	18	0	0	0	1	2	3
District of Columbia	0	2	2	2	4	9	0	0	0	1	1	1
Virginia	23	3	8	22	27	41	0	0	0	8	1	6
West Virginia	7	1	4	15	26	58	0	0	0	2	1	2
North Carolina	18	10	8	14	33	55	0	0	0	3	1	2
South Carolina	0	1	2	4	1	12	0	0	0	4	2	3
Georgia	5	3	2	5	10	16	0	0	0	3	3	3
Florida	3	7	4	7	6	5	0	0	0	1	3	3
EAST SOUTH CENTRAL												
Kentucky	11	4	4	9	26	29	0	0	0	11	2	3
Tennessee	12	5	6	38	27	42	0	0	0	3	3	5
Alabama	2	4	4	4	11	17	0	0	0	1	2	4
Mississippi [3]	1	11	4	7	16	8	0	0	0	1	0	2
WEST SOUTH CENTRAL												
Arkansas	4	26	3	1	6	6	0	0	0	2	4	5
Louisiana	1	5	2	1	1	6	0	0	0	5	1	3
Oklahoma	0	12	6	2	3	10	0	0	0	3	1	3
Texas	9	28	26	22	18	32	0	0	0	5	14	13
MOUNTAIN												
Montana	3	9	5	8	2	8	0	0	0	1	1	1
Idaho	26	2	0	7	10	10	0	0	0	0	2	2
Wyoming	0	7	2	2	3	2	0	0	0	0	0	0
Colorado	2	41	4	10	6	10	0	0	0	2	1	1
New Mexico	2	8	1	4	0	3	0	0	0	2	3	6
Arizona	0	2	2	3	8	5	0	0	0	0	1	1
Utah [3]	1	10	10	4	2	11	0	0	0	0	1	0
Nevada	0	0	0	0	3	0	0	0	0	0	0	0
PACIFIC												
Washington	5	27	13	14	17	22	0	0	0	1	0	2
Oregon	5	4	5	10	11	11	0	0	0	1	1	1
California	28	129	52	43	77	96	0	0	0	6	7	6
Total	801	1,296	774	584	912	1,385	0	1	3	114	111	155
39 weeks	7,298	18,502	9,657	65,151	90,904	104,359	149	293	320	2,963	3,225	4,335
Seasonal low week [4]	(11th) Mar. 15–21			(32d) Aug. 9–15			(35th) Aug. 30–Sept. 5			(11th) Mar. 15–21		
Total since low	6,686	18,035	9,260	3,048	4,609	6,184	2	14	14	2,478	2,750	3,519

[3] Period ended earlier than Saturday.

[4] Dates between which the approximate low week ends. The specific date will vary from year to year.

[5] Including paratyphoid fever reported separately as follows: Massachusetts 9 (salmonella infection); Connecticut 1; Virginia 1; North Carolina 2; Tennessee 2; New Mexico 1; California 5.

Telegraphic morbidity reports from State health officers for the week ended Sept. 27, 1947, and comparison with corresponding week of 1946 and 5-year median—Con.

Division and State	Whooping cough			Week ended Sept. 27, 1947								
	Week ended—		Median 1942–46	Dysentery			Encephalitis, infectious	Rocky Mt. spotted fever	Tularemia	Typhus fever, endemic	Undulant fever
	Sept. 27, 1947	Sept. 28, 1946		Amebic	Bacillary	Unspecified					
NEW ENGLAND											
Maine	39	21	21								2
New Hampshire	1	4	4								1
Vermont	20	13	12								3
Massachusetts	143	110	110		6						2
Rhode Island	16	30	26								1
Connecticut	68	20	22								8
MIDDLE ATLANTIC											
New York	206	132	197	6							1
New Jersey	132	128	128	2				1			1
Pennsylvania	257	115	136								1
EAST NORTH CENTRAL											
Ohio	239	96	107	2							2
Indiana	30	20	20		1	3	1	1			
Illinois	128	102	102	7			3	1	1		19
Michigan [3]	216	161	161							1	5
Wisconsin	132	211	187								9
WEST NORTH CENTRAL											
Minnesota	69	12	34				5				16
Iowa	9	27	23				4				49
Missouri	14	19	23						3		3
North Dakota	3	2	5								
South Dakota	5		4								1
Nebraska		1	4								2
Kansas	56	7	22				1		1	1	6
SOUTH ATLANTIC											
Delaware	2	3	3								1
Maryland [3]	83	27	52					1			
District of Columbia	16	3	6								
Virginia	98	44	41			255					2
West Virginia		11	10								
North Carolina	34	38	54					2		1	
South Carolina	86	3	39	2	10		2	1		1	1
Georgia	25	1	6	2	7	2		1		4	1
Florida	9	11	3	1						3	2
EAST SOUTH CENTRAL											
Kentucky	29	20	26								
Tennessee	37	22	21	1		3			1	1	
Alabama	17	4	11	1			1			5	2
Mississippi [3]	3			1			1				1
WEST SOUTH CENTRAL											
Arkansas	37	9	15	1				1	2		1
Louisiana	4		3	2			2		1	3	2
Oklahoma	10		3	5				1	1		6
Texas	174	135	124	8	206	30				19	6
MOUNTAIN											
Montana	18		10		3		3				
Idaho	6	7	2		1						2
Wyoming		5	5						1		1
Colorado	65	15	19				6				3
New Mexico	13	5	5			4					
Arizona	19	3	3			5					
Utah [3]	18	14	21						1		1
Nevada											
PACIFIC											
Washington	29	35	18								4
Oregon	6	7	7								
California	152	75	141	2	2		4				5
Total	2,773	1,728	1,950	43	236	302	33	10	12	39	173
Same week, 1946	1,728			97	228	110	17	14	20	88	78
Median, 1942–46	1,950			49	461	203	17	7	13	130	[6] 82
39 weeks: 1947	121,929			2,231	12,110	7,810	461	505	1,140	1,578	4,691
1946	75,875			1,845	12,942	5,180	497	529	717	2,676	3,832
Median, 1942–46	97,536			1,432	12,942	6,238	497	434	660	3,076	[6] 3,720

[3] Period ended earlier than Saturday.

[6] 2-year average, 1945–46.

Alaska, week ended September 13, 1947, no cases reported. Week ended September 20: Chickenpox 1, influenza 46, pneumonia 11, septic sore throat 9.

Territory of Hawaii, week ended September 27: Diphtheria 1, bacillary dysentery 6, poliomyelitis 3, endemic typhus fever 1, whooping cough 55.

WEEKLY REPORTS FROM CITIES *

City reports for week ended September 20, 1947

This table lists the reports from 88 cities of more than 10,000 population distributed throughout the United States, and represents a cross section of the current urban incidence of the diseases included in the table.

Division, State, and City	Diphtheria cases	Encephalitis, infectious, cases	Influenza		Measles cases	Meningitis, meningococcus, cases	Pneumonia deaths	Poliomyelitis cases	Scarlet fever cases	Smallpox cases	Typhoid and paratyphoid fever cases	Whooping cough cases
			Cases	Deaths								
NEW ENGLAND												
Maine:												
Portland	0	0	------	0	-------	0	0	0	0	0	0	3
New Hampshire:												
Concord	0	0	------	0	-------	0	0	0	0	0	0	------
Vermont:												
Barre	0	0	------	0	1	0	0	0	0	0	0	------
Massachusetts:												
Boston	1	0	------	0	7	0	9	15	3	0	0	25
Fall River	0	0	------	0	-------	0	1	0	0	0	0	11
Springfield	0	0	------	0	-------	0	0	2	1	0	0	9
Worcester	0	0	------	0	-------	0	4	1	1	0	0	7
Rhode Island:												
Providence	0	0	1	1	2	0	1	2	0	0	0	20
Connecticut:												
Bridgeport	0	0	------	0	-------	0	0	0	0	0	0	1
Hartford	0	0	------	1	-------	0	0	0	0	0	0	11
New Haven	0	0	------	0	-------	0	0	3	0	0	0	42
MIDDLE ATLANTIC												
New York:												
Buffalo	0	0	------	0	-------	0	2	12	2	0	0	10
New York	9	0	------	0	22	3	39	25	13	0	3	83
Rochester	0	0	------	0	2	0	2	19	1	0	1	15
Syracuse	0	0	------	0	-------	0	2	9	2	0	0	25
New Jersey:												
Camden	1	0	------	0	2	0	0	2	1	0	0	3
Newark	0	0	------	0	5	0	5	3	2	0	0	35
Trenton	0	0	------	0	-------	0	0	2	0	0	0	2
Pennsylvania:												
Philadelphia	1	0	------	0	4	0	14	3	5	0	0	93
Pittsburgh	1	0	------	0	1	0	5	10	2	0	0	51
Reading	0	0	------	0	1	0	2	0	1	0	0	6
EAST NORTH CENTRAL												
Ohio:												
Cincinnati	1	0	------	0	-------	0	1	20	2	0	1	3
Cleveland	2	0	------	0	1	1	2	28	5	0	0	95
Columbus	1	0	------	0	1	0	1	11	2	0	1	14
Indiana:												
Fort Wayne	0	0	------	0	-------	0	2	0	0	0	0	------
Indianapolis	2	0	------	0	1	0	1	2	3	0	1	18
South Bend	0	0	------	0	-------	0	0	0	0	0	0	------
Terre Haute	0	0	------	0	-------	0	2	0	0	0	2	------
Illinois:												
Chicago	0	0	------	0	12	1	21	38	7	0	0	46
Michigan:												
Detroit	0	0	------	1	6	1	3	33	16	0	1	68
Flint	0	0	------	0	1	1	0	8	2	0	0	3
Grand Rapids	0	0	------	0	8	0	1	1	1	0	0	25
Wisconsin:												
Kenosha	0	0	------	0	-------	0	0	0	0	0	0	5
Milwaukee	0	0	------	0	9	1	0	10	1	0	0	18
Racine	0	0	------	0	1	0	0	0	0	0	0	4
Superior	0	0	------	0	-------	0	0	0	0	0	0	1
WEST NORTH CENTRAL												
Minnesota:												
Duluth	0	0	------	0	-------	0	0	0	1	0	0	33
Minneapolis	1	0	------	0	16	2	3	1	4	0	0	23
St. Paul	0	0	------	0	2	0	3	2	1	0	0	33
Missouri:												
Kansas City	0	0	------	0	-------	0	6	4	3	0	0	6
St. Joseph	0	0	------	0	-------	0	0	0	0	0	0	------
St. Louis	0	5	1	0	-------	0	4	1	0	0	1	10

* In some instances the figures include nonresident cases

City reports for week ended September 20, 1947—Continued

Division, State, and City	Diphtheria cases	Encephalitis, infectious, cases	Influenza		Measles cases	Meningitis, meningococcus, cases	Pneumonia deaths	Poliomyelitis cases	Scarlet fever cases	Smallpox cases	Typhoid and paratyphoid fever cases	Whooping cough cases
			Cases	Deaths								
WEST NORTH CENTRAL—continued												
North Dakota:												
Fargo	0	1		0	2	0	1	1	0	0	0	4
Nebraska:												
Omaha	0	0		0		0	1	2	0	0	0	1
Kansas:												
Topeka	1	0		0		0	0	0	0	0	0	8
Wichita	0	0		0	1	0	1	0	0	0	0	3
SOUTH ATLANTIC												
Delaware:												
Wilmington	0	0		0	1	0	0	3	0	0	0	1
Maryland:												
Baltimore	5	0		0	1	0	5	2	2	0	0	72
Cumberland	0	0		0		0	0	0	0	0	0	
Frederick	0	0		0		0	1	0	0	0	0	
District of Columbia:												
Washington	0	0		0	1	1	3	3	7	0	0	19
Virginia:												
Richmond	0	0		0	1	0	3	2	4	0	0	
Roanoke	0	0		0		0	0	0	0	0	0	
West Virginia:												
Charleston	0	0		0		0	0	0	0	0	0	
Wheeling	0	0		0		0	2	0	0	0	0	
North Carolina:												
Raleigh	0	0		0		0	1	3	0	0	0	
Wilmington	1	0		0		0	0	0	0	0	0	2
Winston-Salem	0	0		0		0	0	0	0	0	0	6
South Carolina:												
Charleston	4	0	2	0		0	0	0	0	0	0	2
Georgia:												
Atlanta	1	0		0		0	2	0	3	0	1	2
Brunswick	0	0		0		0	0	0	0	0	0	
Savannah	0	0		0		0	0	0	0	0	0	6
Florida:												
Tampa	0	0		0	1	0	0	0	0	0	0	5
EAST SOUTH CENTRAL												
Tennessee:												
Memphis	1	0		1	1	0	4	2	0	0	1	6
Nashville	0	0		0	1	0	0	0	0	0	0	5
Alabama:												
Birmingham	0	0		0	2	0	6	1	1	0	0	
Mobile	1	0		0		1	1	0	0	0	0	
WEST SOUTH CENTRAL												
Arkansas:												
Little Rock	0	0		0		0	1	0	0	0	0	5
Louisiana:												
New Orleans	2	1	1	0	1	1	4	0	0	0	1	4
Shreveport	0	0		0		0	3	0	0	0	1	
Oklahoma:												
Oklahoma City	0			0		0	6	0	0	0	0	
Texas:												
Dallas	1	0		0		0	1	0	1	0	0	9
Galveston	0	0		1		0	0	0	1	0	0	
Houston	0	0	2	0		0	0	0	0	0	2	
San Antonio	2	0		0		0	4	0	1	0	0	
MOUNTAIN												
Montana:												
Billings	0	0		0		0	2	0	1	0	0	1
Great Falls	0	0		0	1	0	1	0	0	0	0	2
Helena	0	0		0		0	0	0	0	0	0	4
Missoula	0			0		0	1	0	0	0	0	3
Colorado:												
Denver	3	0		0	1	0	9	1	0	0	0	16
Pueblo	0	0		0		0	0	0	0	0	0	13
Utah:												
Salt Lake City	0	0		0	2	0	0	0	1	0	0	1

City reports for week ended September 20, 1947—Continued

Division, State, and City	Diphtheria cases	Encephalitis, infectious, cases	Influenza cases	Influenza deaths	Measles cases	Meningitis, meningococcus, cases	Pneumonia deaths	Poliomyelitis cases	Scarlet fever cases	Smallpox cases	Typhoid and paratyphoid fever cases	Whooping cough cases
PACIFIC												
Washington:												
Seattle	0	0	------	0	5	0	4	0	1	0	0	9
Spokane	1	0	------	0	3	0	3	2	1	0	0	1
Tacoma	0	0	------	0	-------	0	0	1	0	0	0	1
California:												
Los Angeles	2	0	------	0	9	0	1	8	7	0	0	29
Sacramento	1	0	------	0	-------	0	0	0	3	0	0	2
San Francisco	1	0	2	0	10	0	5	0	1	0	1	5
Total	47	7	9	5	149	13	212	298	117	0	18	1,104
Corresponding week, 1946 [1]	50	------	36	6	88	------	222	------	190	0	7	663
Average 1942–46 [1]	59	------	31	[2] 7	[3] 148	------	[2] 224	------	277	0	24	735

[1] Exclusive of Oklahoma City. [2] 3-year average, 1944–46. [3] 5-year median, 1942–46.

Dysentery, amebic.—Cases: New York, 2; Chicago, 1; Dallas, 4; Los Angeles, 1.
Dysentery, bacillary.—Cases: Chicago, 8; Charleston, S. C., 3; Memphis, 1; Los Angeles, 4.
Dysentery, unspecified.—Cases: San Antonio, 1.
Tularemia.—Cases: New Orleans, 1.
Typhus fever, endemic.—Cases: Charleston, S. C., 1; Tampa, 2; New Orleans, 1.

Rates (annual basis) per 100,000 population, by geographic groups, for the 88 cities in the preceding table (latest available estimated population, 34,493,700)

	Diphtheria case rates	Encephalitis, infectious, case rates	Influenza case rates	Influenza death rates	Measles case rates	Meningitis, meningococcus, case rates	Pneumonia death rates	Poliomyelitis case rates	Scarlet fever case rates	Smallpox case rates	Typhoid and paratyphoid fever case rates	Whooping cough case rates
New England	2.6	0.0	2.6	5.2	26	0.0	39.2	60.1	13	0.0	0.0	337
Middle Atlantic	5.6	0.0	0.0	0.0	17	1.4	32.9	39.3	13	0.0	1.9	149
East North Central	3.7	0.0	0.0	0.6	25	3.1	20.9	92.6	24	0.0	3.7	184
West North Central	4.0	11.9	2.0	0.0	42	4.0	37.8	21.9	18	0.0	2.0	241
South Atlantic	18.2	0.0	3.3	0.0	8	1.7	28.1	21.5	26	0.0	1.7	190
East South Central	11.8	0.0	0.0	5.9	24	5.9	64.9	17.7	6	0.0	5.9	65
West South Central	12.7	2.5	7.6	2.5	3	2.5	48.3	0.0	8	0.0	10.2	46
Mountain	24.8	0.0	0.0	0.0	33	0.0	107.4	8.3	17	0.0	0.0	330
Pacific	7.9	0.0	3.2	0.0	43	0.0	20.6	17.4	21	0.0	1.6	74
Total	7.1	1.1	1.4	0.8	23	2.0	32.1	45.2	18	0.0	2.7	167

DEATHS DURING WEEK ENDED SEPT. 20, 1947

[From the Weekly Mortality Index, issued by the National Office of Vital Statistics]

	Week ended Sept. 20, 1947	Corresponding week, 1946
Data for 93 large cities of the United States:		
Total deaths	8,269	8,246
Median for 3 prior years	8,205	----------
Total deaths, first 38 weeks of year	351,065	345,833
Deaths under 1 year of age	743	701
Median for 3 prior years	607	----------
Deaths under 1 year of age, first 38 weeks of year	28,340	24,378
Data from industrial insurance companies:		
Policies in force	67,141,685	67,286,004
Number of death claims	10,939	10,914
Death claims per 1,000 policies in force, annual rate	8.5	8.5
Death claims per 1,000 policies, first 38 weeks of year, annual rate	9.3	9.6

PLAGUE INFECTION IN EL DORADO, KERN AND SISKIYOU COUNTIES, CALIFORNIA

Plague infection has been reported proved in pools of fleas and tissue from rodents collected in California, as follows:

El Dorado County.—Proved positive on September 12, organs from 1 ground squirrel, *Citellus beecheyi*, taken in Fallen Leaf Lake area, Lake Tahoe; and proved positive on September 15, a pool of tissue from 3 Tamarack squirrels, *Sciurus douglasii albolimbatus*, taken 1 mile east of Tahoe Valley post office.

Kern County.—Proved positive on September 19, a pool of 12 fleas from 6 ground squirrels, *C. beecheyi*, taken at the Girl Scout Camp 12 miles west of Lebec.

Siskiyou County.—Proved positive on September 22, a pool of 200 fleas from 17 ground squirrels, *C. douglassii*, taken on a ranch 2½ miles north and 2 miles west of Yreka.

FOREIGN REPORTS

CANADA

Provinces—Communicable diseases—Week ended September 6, 1947.—During the week ended September 6, 1947, cases of certain communicable diseases were reported by the Dominion Bureau of Statistics of Canada as follows:

Disease	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Total
Chickenpox		5	1	8	23	4	9	10	12	72
Diphtheria		1		20	2	2				25
Dysentery, bacillary				4					1	5
Encephalitis, infectious						12	3			15
German measles				2	3			1	2	8
Influenza		17			13	2				32
Measles		1		60	62	24	1	17	18	183
Meningitis, meningococcus				1	3					4
Mumps		5		3	71	1	8	12	4	105
Poliomyelitis		8	1	16	99	58	14	5	23	224
Scarlet fever			5	15	16	1		1		38
Tuberculosis (all forms)		2	19	176	19	61	3		36	316
Typhoid and paratyphoid fever		1		10	3				6	20
Undulant fever				2		1				3
Venereal diseases:										
Gonorrhea		10	13	132	102	47	23	37	52	416
Syphilis	1	12	5	92	50	7	5	11	13	196
Whooping cough				39	112	21	9	23	21	225

CUBA

Habana—Communicable diseases—4 weeks ended August 30, 1947.—During the 4 weeks ended August 30, 1947, certain communicable diseases were reported in Habana, Cuba, as follows:

Disease	Cases	Deaths	Disease	Cases	Deaths
Diphtheria	23	1	Tuberculosis	5	
Malaria	1	1	Typhoid fever	12	1
Measles	2		Typhus fever (murine)	1	
Poliomyelitis	1				

Provinces—Notifiable diseases—4 weeks ended August 30, 1947.—During the 4 weeks ended August 30, 1947, 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	3	9	14	18	3	21	68
Cerebrospinal meningitis						1	1
Diphtheria	3	27	1		3	4	38
Leprosy		7				1	8
Malaria	6	3	1		3	191	204
Measles		2		1	3		6
Poliomyelitis	1	2				3	6
Tuberculosis, pulmonary	23	45	21	57	8	38	192
Typhoid fever	16	23	12	29	9	92	181
Typhus fever (murine)		1					1
Whooping cough		18				1	19

[1] Includes the city of Habana.

GREAT BRITAIN

England and Wales—Poliomyelitis.—For the week ended September 13, 1947, 614 cases of poliomyelitis (including polioencephalitis) were reported in England and Wales, a decrease from the number of cases reported for the preceding week. The total to date is 5,598 cases.

SWITZERLAND

Notifiable diseases—April–June 1947.—During the months of April, May, and June 1947, cases of certain notifiable diseases were reported in Switzerland as follows:

Disease	April	May	June	Disease	April	May	June
Cerebrospinal meningitis	6	3	10	Mumps	179	95	101
Chickenpox	173	117	238	Paratyphoid fever	3	2	4
Diphtheria	344	261	233	Poliomyelitis	7	9	58
Dysentery, unspecified	10	5	16	Scarlet fever	424	347	276
Encephalitis, infectious			1	Tuberculosis	413	338	368
Hepatitis, epidemic	29	34	33	Typhoid fever	6	7	10
Influenza	108	9	12	Undulant fever	11	23	11
Measles	1,480	1,227	823	Whooping cough	411	348	383

REPORTS OF CHOLERA, SMALLPOX, AND TYPHUS FEVER RECEIVED DURING THE CURRENT WEEK

NOTE.—Except in cases of unusual incidence, only those places are included which had not previously reported any of the above-named diseases, except yellow fever, during recent months. All reports of yellow fever are published currently.

A table showing the accumulated figures for these diseases for the year to date is published in the PUBLIC HEALTH REPORTS for the last Friday of each month.

Cholera

China—Kiangsu Province.—Cholera has been reported in Kiangsu Province, China, as follows: August 11–20, 1947, 92 cases, 3 deaths; August 21–31, 1947, 203 cases, 6 deaths.

Egypt.—Under date of September 25, 1947, cholera was reported in 3 provinces east of the Rosetta branch of the Nile, north of Cairo but not including the canal area. Ten deaths had occurred.

On September 30, 1947, 9 cases of suspected cholera with 1 death were reported in Alexandria.

According to an unofficial report dated September 26, 1947, at least 142 cases of cholera with 32 deaths had occurred with infected areas given as Cairo and the provinces of Sharkiya and Kalyubiya. An unofficial report dated September 29, 1947, stated that 12 deaths from cholera had occurred in Cairo during the preceding 24 hours, raising the officially announced deaths to 93.

India.—For the week ended September 6, 1947, 109 cases of cholera were reported in Lahore, Punjab province, India. For the week ended September 20, 1947, 3,400 cases of cholera with 1,100 deaths were reported in Punjab province, including about 300 deaths from cholera in Lahore.

Indochina (French)—Annam.—For the month of July 1947, 20 cases of cholera with 16 deaths were reported in Annam, French Indochina.

Smallpox

Belgian Congo.—For the week ended August 30, 1947, 448 cases of smallpox with 2 deaths were reported in Belgian Congo.

Colombia—For the month of August 1947, 304 cases of smallpox with 7 deaths were reported in Colombia.

Ecuador.—Smallpox has been reported in Ecuador as follows: For the month of August 1947, 348 cases of smallpox with 1 death were reported in all of Ecuador. For the week ended September 6, 1947, 4 cases were reported in Bahia. For the week ended September 13, 1947, 45 cases of smallpox (alastrim) were reported in Guayaquil.

Typhus Fever

Eritrea.—For the week ended September 6, 1947, 72 cases of typhus fever with 8 deaths were reported in Eritrea.

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