Public Health Reports

Vol. 63 • SEPTEMBER 17, 1948 • *No. 38*

Effect of Topically Applied Fluoride on Dental Caries Experience [1]

VI. Experiments with sodium fluoride and calcium chloride . . . Widely spaced applications . . . Use of different solution concentrations

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Previous reports in this series (*1, 2, 3, 4, 5*) on the effects of topically applied fluoride on dental caries experience indicate that under the conditions of the application technique employed: (1) A series of four topical applications of a 2 percent solution of sodium fluoride, preceded by a single dental cleansing, effects a 40 percent reduction in dental caries incidence. More than four applications do not increase the caries-prophylactic effect. (2) The caries-inhibiting value of topically applied sodium fluoride is not appreciably decreased during a 3-year period following treatment. (3) The omission of dental cleansing prior to a series of applications reduces the effectiveness of topically applied sodium fluoride solution by approximately half. (4) Application of a saturated solution of lead fluoride (0.06 percent), using the same application technique as for solutions of sodium fluoride, is not associated with a significant reduction in the incidence of dental decay.

This report presents the results of seven additional studies designed to investigate the possibility of increasing the caries-inhibiting effect of topically applied fluoride solutions. Briefly, the results of these studies indicate: (1) The application of a 2 percent solution of sodium fluoride to the teeth, followed immediately by a 5 percent solution of calcium chloride, does not increase the caries-prophylactic effect over that accomplished by the use of a solution of sodium fluoride alone. (2) An increase in the time interval between applications of the fluoride solution in a given series of applications from one or two a week to one each 3 or 6 months decreases the caries-prophy-

[1] From the Dental Public Health Section, States Relations Division, Public Health Service, Washington, D. C., in cooperation with the Division of Dental Hygiene, Ohio State Department of Health, and the Troy-Miami County Department of Health.

lactic effect observed. (3) A concentration of 1 percent solution of sodium fluoride appears to be equally as effective in inhibiting new dental decay as a 2 percent sodium fluoride solution.

Materials and Methods

During the period from May to December 1946, groups of school children in Bradford, Tipp City, Newton, and Piqua, Ohio—all in Miami County—were given applications to the teeth in half the mouth, as follows:

Group 1. Two applications of a 2 percent solution of sodium fluoride followed by the application of a 5 percent solution of calcium chloride, using cotton applicator, and given at the rate of one or two treatments a week, without initial cleansing of the teeth.

Group 2. Two applications of a 2 percent solution of sodium fluoride followed by the application of a 5 percent solution of calcium chloride, using cotton applicator, and given at the rate of one or two treatments a week, with initial cleansing of the teeth.

Group 3. Four applications of a 2 percent solution of sodium fluoride followed by the application of a 5 percent solution of calcium chloride, using cotton applicator, and given at the rate of one or two treatments a week, with initial cleansing of the teeth.

Group 4. Three applications of a 2 percent solution of sodium fluoride, using cotton applicator, and given at the rate of one treatment each 3 months, cleansing of the teeth preceding each application.

Group 5. Two applications of a 2 percent solution of sodium fluoride, using cotton applicator, and given at the rate of one treatment each 6 months, cleansing of the teeth preceding each application.

Group 6. Two applications of a 1 percent solution of sodium fluoride, using spray bottle, and given at the rate of one or two treatments a week, with initial cleansing of the teeth.

Group 7. Four applications of a 1 percent solution of sodium fluoride, using spray bottle, and given at the rate of one or two treatments a week, with initial cleansing of the teeth.

In approximately half the children in each group, teeth in upper and lower right mouth quadrants were treated; in the other half of the children, teeth in left mouth quadrants were treated. Teeth in untreated mouth quadrants served as controls. Fine pumice paste and motor driven rubber cup were used for cleansing the teeth. A detailed dental examination was made and the findings recorded for each of the children before treatment was begun.

The examinations were made with a No. 4 plane mouth mirror and a double end No. 5 explorer, under artificial light and with compressed air available for use at the discretion of the examiner. The treatment consisted of isolating the teeth of the treated side with cotton rolls, drying with compressed air and wetting the crown surfaces with the treatment solution by using either cotton applicator or

a fine spray. The applied solution was allowed to dry in air for from 3 to 4 minutes and then the cotton rolls were removed and the child dismissed.

In the case of the first three study groups, the crown surfaces of the teeth were wet with a 5 percent solution of calcium chloride after the solution of sodium fluoride had dried. The calcium chloride solution was also permitted to dry in air.

One year after the series of applications were begun, the children were reexamined. Analysis of the data on caries experience is confined to the erupted permanent teeth present at the time of the initial examination.

The age classification of the children in each of the seven study groups reported is shown in table 1. The number of males and females in each group is approximately equal.

TABLE 1. *Age distribution of Miami County, Ohio, school children examined at the end of a one-year study period*

Study groups	All ages	Children by age at time of treatment										
		6	7	8	9	10	11	12	13	14	15	16
Group 1	208	------	17	30	25	36	30	24	18	22	6	------
Group 2	371	------	33	49	47	34	58	46	44	45	15	------
Group 3	272	------	33	45	33	42	27	33	28	26	5	------
Group 4	304	7	29	31	26	33	29	48	51	31	17	2
Group 5	362	8	47	45	47	49	48	56	48	12	1	1
Group 6	335	------	59	85	69	43	46	21	4	6	2	------
Group 7	276	16	30	46	33	28	46	32	29	13	3	------

Findings

The caries experience during the study year in treated and untreated teeth of children included in each of the seven study groups is shown in tables 2 and 3.

Application of Sodium Fluoride and Calcium Chloride Solutions

The first three studies are concerned with the application of 2 percent solution of sodium fluoride and 5 percent solution of calcium chloride under various treatment combinations. These studies were conducted on the basis of the assumption that when the sodium fluoride solution is applied to the tooth enamel, the uncombined or excess fluoride ions might be used to protect the enamel further against the forces of dental caries by facilitating a surface deposition of calcium fluoride, particularly in the orifices of the enamel lamellae (*6*).

The children whose teeth had been given two applications of a 2 percent solution of sodium fluoride and a 5 percent solution of calcium chloride, without prior dental cleansing, were found to have 86 new carious teeth in treated quadrants and 78 in untreated quadrants at the end of the first study year. This negative result is within the

TABLE 2. *Dental caries experience during the 1-year period ending December 1947, in treated and untreated permanent teeth of Miami County, Ohio, school children*

Treatment groups by treated and untreated quadrants	Number of noncarious teeth (Dec. 1946)	New DF[1] teeth (Dec. 1947)	DF surfaces in new DF teeth	New DF surfaces in previously carious teeth	Total new DF surfaces
2% NaF—5% $CaCl_2$					
2 applications—no cleansing:					
Treated quadrant	1,489	86	90	59	149
Untreated quadrant	1,486	78	83	53	136
2 applications—prior cleansing:					
Treated quadrant	2,706	216	233	138	371
Untreated quadrant	2,736	271	301	127	428
4 applications—prior cleansing:					
Treated quadrant	1,927	140	155	86	241
Untreated quadrant	1,926	207	224	106	330
2% NaF, applications spaced, cleansing prior to each application:					
3 applications—one each 3 months:					
Treated quadrant	2,155	159	169	134	303
Untreated quadrant	2,192	217	240	159	399
2 applications—one each 6 months:					
Treated quadrant	2,376	193	211	167	378
Untreated quadrant	2,347	226	255	180	435
1% NaF, prior cleansing:					
2 applications:					
Treated quadrant	1,769	139	156	114	270
Untreated quadrant	1,772	163	182	125	307
4 applications:					
Treated quadrant	1,674	101	110	96	206
Untreated quadrant	1,680	166	185	118	303

[1] DF means carious (decayed or filled).

range of variability that might be anticipated from only two applications not preceded by tooth cleansing.

When the teeth were cleansed prior to being wet with two applications of these solutions, there were, at the end of the study year, 216 new decayed teeth in treated quadrants as compared with 271 in untreated quadrants, or a reduction in new decay of 20.3 percent. After four applications of the two solutions, preceded by dental cleansing, 140 new carious teeth were observed in treated mouth quadrants as compared with 207 in untreated mouth quadrants—a reduction in new dental caries of 32.4 percent.

TABLE 3. *Percentage reduction in new caries experience during the 1-year period ending December 1947, in the permanent, treated teeth of a group of Miami County, Ohio school children*

Treatment groups	Percentage reduction in newly carious teeth
2% NaF—5% $CaCl_2$:	
2 applications—no cleansing	−10.3
2 applications—prior cleansing	20.3
4 applications—prior cleansing	32.4
2% NaF, applications spaced, cleansing prior to each application:	
3 applications—one each 3 mos	26.7
2 applications—one each 6 mos	14.6
1% NaF:	
2 applications—prior cleansing	14.7
4 applications—prior cleansing	39.2

The caries-prophylactic effect of two applications, preceded by tooth cleansing, is equal to that observed after two applications of a 2-percent solution of sodium fluoride alone, using the same treatment technique. The reduction in new dental decay resulting from four applications of the combined solutions, preceded by tooth cleansing, is a little less than that resulting from four applications of a 2-percent solution of sodium fluoride alone (*5*).

Spacing of Applications

The treatment procedure used in applying topical fluorides has varied with investigators. In previous studies reported in this series, all applications were made within a period of several weeks at the beginning of the study at the rate of one or two treatments a week, preceded by a single dental cleansing. Other investigators (*7*, *8*) have administered topical fluoride applications at the rate of one every 3 or 4 months, to a total of three or four applications in the series during a study year, and each application was preceded by dental prophylaxis.

Inasmuch as the number of topical fluoride applications, up to four, seems to be a basic consideration in the caries reduction observed, it might be assumed that the complete effectiveness of the treatment procedure would be postponed until four applications had been given. To determine the validity of this assumption, two studies were undertaken in which the series of applications were spaced at 3- and at 6-month intervals of time.

In the first of these (group 4) a total of three applications of a 2 percent solution of sodium fluoride was applied, one each 3 months, each application preceded by tooth cleansing. At the end of the study year 159 new carious teeth were found in treated mouth quadrants, and 217 in untreated quadrants—a reduction in new dental decay of 26.7 percent.

In the second of the two studies conducted to determine the effect of wide spacing of applications (group 5), two applications of a 2 percent solution of sodium fluoride were applied, one at the beginning of the study and one 6 months later. The teeth were cleansed prior to each application. After one year, 193 sound teeth had become carious in treated, and 226 in untreated mouth quadrants—a reduction of 14.6 percent in new dental decay.

Concentration of Solution

In this series of studies, all solutions of sodium fluoride tested have been of 2 percent concentration. In study groups 6 and 7 the relative efficacy of a 1.0 percent solution has been explored. The treatment procedure was varied to include the use of a spray for application of the fluoride solution in place of the cotton applicator.

Two applications of a 1 percent solution were made within a week or two after dental cleansing, and after one year, 139 new carious teeth were observed in treated mouth quadrants, and 163 in untreated quadrants—a percentage reduction of 14.7 in new dental caries. Four applications of a 1 percent solution of sodium fluoride effected a reduction of 39.2 percent in new decay, with 101 new decayed teeth among those treated and 166 among teeth untreated.

Summary

A study of the incidence of new dental decay in seven groups of Miami County, Ohio, children who received topical fluoride applications on the teeth in half the mouth has been presented and analyzed. The seven separate studies may be divided into three general groups:

1. Children whose teeth were given applications of 2 percent solution of sodium fluoride and 5 percent solution of calcium chloride, one group receiving two applications without prior tooth cleansing; another group, two applications with prior tooth cleansing, and the third group four applications with prior tooth cleansing. All applications were given at the rate of one or two a week at the beginning of the treatment period.

2. Children whose teeth were given two and three applications of 2 percent solution of sodium fluoride spaced intermittently over the first study year, each application preceded by a dental cleansing.

3. Children whose teeth were given by the spray method two and four applications of 1 percent solution of sodium fluoride, with prior tooth cleansing, all applications being given at the rate of one or two a week at the beginning of the treatment period.

Analysis of the data for the first study year indicates:

1. The use of calcium chloride as a supplemental treatment to applications with a 2 percent solution of sodium fluoride does not enhance the caries-inhibitive action of sodium fluoride alone.

2. An increase in the spacing between applications of a 2 percent solution of sodium fluoride from one or two weekly, to 3-month or to 6-month time intervals, decreases the observed caries-inhibiting action and apparently postpones the time when the full effectiveness of four applications is operative.

3. Apparently a 1 percent solution of sodium fluoride is as effective as a 2 percent solution. However, clinical experience with the caries-prophylactic effect of a 2 percent solution is at present far more extensive than with solutions of lower concentration.

4. Application of the fluoride solution to the teeth by means of a spray appears to be as effective as when application is made by cotton applicator.

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Dentist-time for Children's Services[1]

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The data presented in this paper on time per dental service were obtained in studies made by the Public Health Service in cooperation with the Children's Fund of Michigan at four of the clinics sponsored by the Fund. Results of similar time studies made in the clinics of the Philadelphia Mouth Hygiene Association have been reported in an earlier paper (*1*). The average time intervals determined for specific individual operations in the routine and most frequently occurring dental services given to preschool and school children in the Children's Fund clinics reflect a program somewhat different in its policies and procedures.

Information on the time required for basic services furnished under different methods of operation and routines is of interest since the time element is an important factor in the choice of treatment that will produce a maximum amount of care for the child population of a community. The data presented here bring together actual experiences observed in established programs which have pioneered in dental care for large groups of children. These data for specified routines are of value particularly in view of the continued emphasis

[1] From the Division of Public Health Methods.

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on services to insure and maintain the dental health of children. It is generally accepted that the effort to meet their needs has priority in attacking the country's dental problem.

Dental Program of the Children's Fund of Michigan

The Children's Fund of Michigan was created in 1929 by the late Senator James Couzens, "To promote the health, welfare, happiness, and development of the children of the State of Michigan primarily, and elsewhere in the world." In line with this objective there has been in existence since 1929 a dental program which provides treatment for indigent children throughout a good part of Michigan.

Personnel—Generally a full-time staff of 20 to 30 dentists is assigned to the clinics. In some of the sparser areas, several clinics may be manned by the same dentist, who spends a part of the year in each. In each clinic visited there was a dental assistant who set up the trays, sterilized the instruments, took care of the record files, recorded the examination findings, and charted the work done.

Eligibility—Eligibility for dental services is based on a means test and is limited by age and school status. A child on reaching his sixteenth birthday or graduating from the eighth grade, whichever occurs first, is no longer eligible. Preschool children are treated if the family is eligible for care. No charge is made for any of the Fund's dental services.

Procedures—Examinations, with mirror and explorer only, are made at the first of each new series of visits. All fillings and extractions are done under a local anesthetic, except that loose deciduous teeth may be extracted without anesthesia. The anesthetic is administered to three or four patients in succession and then work is begun on the first patient injected. Complicated extractions are not handled, but patients may be referred to private specialists at the expense of the Fund. It is required that a cement base be placed in all cavities, and pulp cappings are employed wherever necessary. Prophylaxes are done by the dentist only when considered necessary and subsequent to all other treatment.

Material and Method of the Study

Clinics studied—The four dental clinics studied were the clinic in Hamtramck; the Oakland County clinic, located just outside Royal Oak; the Bay County clinic in Bay City; and the Sanilac County dental unit while operating in Sandusky. The first two clinics serve urban areas, the third, a mixed rural and urban area, and the fourth, a predominantly agricultural area. The Oakland County clinic also serves as a training center for newly employed dentists.

Method of recording time per service—The clock hour and minutes were called out to the assistant by the dentist at the beginning of an operation and again when it was completed. These time records were accumulated over an average period of 10 weeks per clinic. Time for fillings was tabulated only where the treatment indicated for a tooth had been completed, whether one surface or more than one surface was filled.

Number of observations—The total number of children on whom observations were made was 1,632—815 boys and 817 girls. Although the children ranged in age from 3 to 16 years, only 11 were under 5 years (table 1). The average age was 10.6 years. No special selection of patients was made; all patient records on which time recordings

TABLE 1. *Number of children, by sex and age groups, for whom length of time of operation was recorded. Children's Fund of Michigan Dental Program, 1947.*

Sex	Average age (years) ±1 standard deviation	All ages	Age in years [1]											
			Under 5	5–6	6–7	7–8	8–9	9–10	10–11	11–12	12–13	13–14	14–15	15–16
All children	10.6±2.6	1,632	11	58	113	131	169	187	186	236	196	191	98	56
Boys	10.6±2.7	815	6	32	62	60	75	95	85	122	98	95	50	35
Girls	10.5±2.6	817	5	26	51	71	94	92	101	114	98	96	48	21

[1] These ages were obtained by subtracting year of birth from 1947. Since the observations were made about January 1, 1947, the age refers generally to the interval between two successive birthdays. For example, "6–7" designates children who have attained their sixth but not yet their seventh birthday.

were entered were included except a small number which could not be used. The number of nonwhite children in this group could not be determined since color is not noted on the case record.

The age distribution of the observed population differs from that of the child population of the country. While the latter follows a fairly rectangular pattern, the former shows a concentration around age 11. However, as will be seen later, age has little effect upon time per operation. When average time per filling, which showed the greatest variation with age, was adjusted to the United States population, there was a difference of only 0.2 of a minute from the unadjusted figure.

Time per Operation

The average time spent on various specified operations is shown in table 2 for the three regular clinics, which are staffed by dentists already trained in the Children's Fund techniques and methods, and for the work done at the training center by the supervisor and the men who had just come to the Fund and were being trained in such techniques. The former is also shown in figure 1.

Examination—Time measurements were recorded for 797 dental examinations. As shown in the table, the examinations in the regular clinics averaged 1.8 minutes, with no appreciable difference between

boys and girls. At the training center an average of 2.3 minutes was given to an examination. It frequently happened that further inspection while work was being done revealed additional needs which would then be recorded.

Tooth-filling—The term "tooth-filling" is used here to indicate that fillings are being considered on a per tooth basis. The time recorded for a tooth-filling includes the time required for injecting the local anesthetic added to the time taken to prepare the cavity and to place a cement base and the filling. The average time for this operation came to 16.1 minutes in the regular clinics and to 31.4 minutes at the

TABLE 2. *Average time per specified operation in regular clinics and in the training center. Children's Fund of Michigan Dental Program, 1947.*

Clinic and sex	Examination	Tooth-filling [1]	Extraction		Polishing	Prophylaxis
			Deciduous teeth	Permanent teeth		
	Average time (minutes) ± 1 standard deviation [2]					
Regular clinics						
All children	1.8±0.8	16.1± 6.7	2.2±1.7	4.1±2.9	7.0±4.1	5.8±2.7
Boys	1.8±0.7	16.0± 6.4	2.3±1.7	4.3±3.2		5.8±1.9
Girls	1.8±0.9	16.3± 7.0	2.2±1.8	3.9±2.6	7.2±4.4	5.8±3.2
Training center						
All children	2.3±1.3	31.4±15.1	3.2±3.0	4.7±4.1	8.4±9.3	9.8±4.9
Boys	2.3±1.6	30.7±14.9	3.4±3.6	4.6±3.4		
Girls	2.2±1.1	32.0±15.3	2.9±2.4	4.8±4.7	7.2±5.9	10.5±5.4
	Number of observations					
Regular clinics						
All children	514	1,550	364	170	16	44
Boys	269	795	201	88	4	18
Girls	245	755	163	82	12	26
Training center						
All children	283	522	175	65	19	18
Boys	130	246	86	35	6	5
Girls	153	276	89	30	13	13

[1] The average time to completely fill a tooth irrespective of number of fillings or filling surfaces involved.
[2] Averages based on 10 or less observations are omitted.

training center. An average of 1.4 fillings per tooth was placed in the 16.1 minutes taken to complete a tooth-filling. Differences between boys and girls were too small to have any apparent significance.

To give the anesthetic generally took between one and two minutes. When more than one tooth was filled at a single visit, the time for the anesthetic was divided equally among the teeth filled.

Extraction—In the regular clinics, extraction time averaged 2.2 minutes for deciduous teeth and 4.1 minutes for permanent teeth. The corresponding figures for the training center were 3.2 and 4.7 minutes, respectively. These figures include the time taken to give the local anesthetic.

It was pointed out earlier that the anesthetic, which is required for all children, is given to a group of patients and that work is then begun directly on the first one anesthetized. Tabulations were made

of the time that each patient waited, after receiving the anesthetic, until the extraction was begun. Such observations of the interval between anesthetic and extraction, obtained on 512 children's visits averaged 34.1 minutes. The waiting period did not seem to present any hardship to the patients, as the school children generally would come in a group and be excused when treatment of the group was completed. Reasons for this arrangement were that it cut to a minimum the disturbance of the school's routine, permitted an easier check on the children's attendance at the clinic, and guaranteed the dentist a sufficient volume of work.

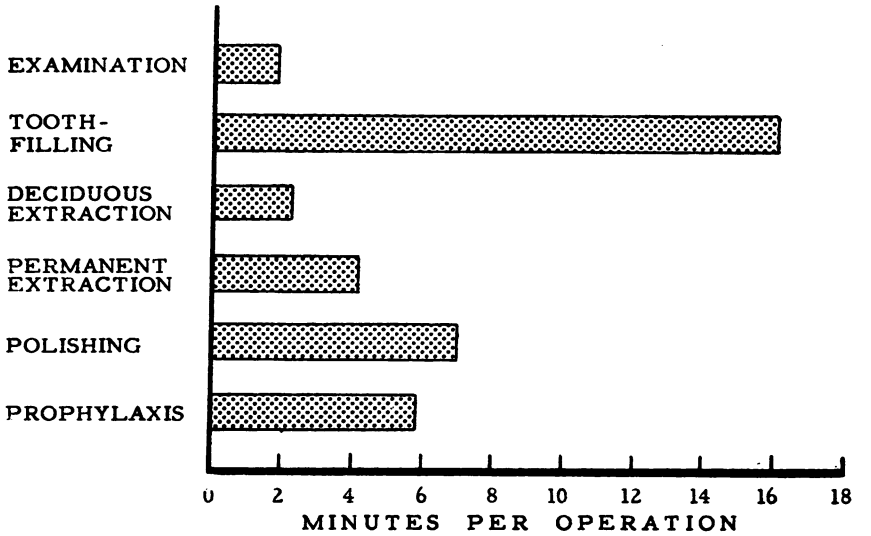

Figure 1. Average number of minutes per specified treatment in the regular clinics. Children's Fund of Michigan, 1947.

A comparison of multiple and single extractions done in the regular clinics shows marked differences. The average time taken for a deciduous extraction when only one was done was 3.1 minutes; when two teeth were extracted, each took 1.8 minutes. Single extractions of permanent teeth averaged 4.6 minutes while for two in a single sitting they averaged 2.8 minutes per tooth.

In one of the clinics a record was kept of the supervised bleeding time following extractions. The length of time a patient waited before being discharged averaged 23.6 minutes after deciduous extractions and 30.5 minutes after the extraction of permanent teeth. The child did not stay in the dental chair during this time.

Polishing—Only a small number of polishings were recorded because time for this operation was frequently either not reported or combined with time for prophylaxis. The average time in the regular clinics, based on 16 observations, was 7.0 minutes; the average for 19 observations at the training center was 8.4 minutes.

Prophylaxis—The average time per prophylaxis was 5.8 minutes in the regular clinics and 9.8 minutes at the training center. The prophylaxes were mainly in the nature of stain removal and restoration of the mouth to a state of reasonable cleanliness. It has been noted above that it is the practice of the Children's Fund to provide the prophylaxis at the end of a series of treatments. In two programs previously studied, the prophylaxis came first (*2*, *3*).

Time per operation and age of children—The average time per operation by single years of age is presented in table 3 and figure 2 for the children of the regular clinics. It is readily seen that age of

TABLE 3. *Average time per operation, by age of children. Children's Fund of Michigan Dental Program, 1947.* [1]

Operation	Age in years											
	Under 5	5–6	6–7	7–8	8–9	9–10	10–11	11–12	12–13	13–14	14–15	15–16
	Average time (minutes) [2]											
Examination		1.8	1.6	1.6	1.6	1.8	1.8	1.7	1.8	1.9	2.0	2.1
Tooth filling		14.6	15.5	15.4	18.7	16.4	16.3	16.9	15.1	16.0	15.5	14.4
Extraction:												
Deciduous		2.1	2.4	2.3	2.0	2.3	2.3	2.4				
Permanent						4.2	4.5	3.9	4.3	4.2	4.4	3.2
	Observations											
Examination	4	18	28	44	53	53	58	68	64	63	39	22
Tooth filling	8	48	82	90	130	148	149	235	233	231	119	77
Extraction:												
Deciduous	1	27	44	75	73	57	41	32	10	4	0	0
Permanent	0	0	2	6	9	13	16	35	30	25	23	11

[1] Regular clinics; i. e., the three observed clinics staffed with dentists already trained in the procedures of the Children's Fund dental program.
[2] Averages based on 10 or less observations are omitted.

the child has little effect on the time it takes for any of these operations. The time required to do a tooth-filling for the different age groups taken by single years from 5 through 15 years shows no discernible trend except a tendency to increase up to 8 years of age and to decline somewhat thereafter. The time taken for extractions shows only small variations from the average for all ages—not more than 0.2 of a minute for deciduous teeth and 0.4 of a minute for the permanent teeth. The 10-year olds required the greatest amount of time, 4.5 minutes, for the extraction of a permanent tooth.

Type of tooth—Some rather marked differences in time per filling appear when the teeth are classified roughly by morphological type and relationship to caries attack. The data are shown in table 4. The great majority of teeth filled are molars and premolars and it was to be expected that the bulk of the time recordings in a group of children such as this would involve fillings in the first permanent molars. These molars require more time for filling than any of the

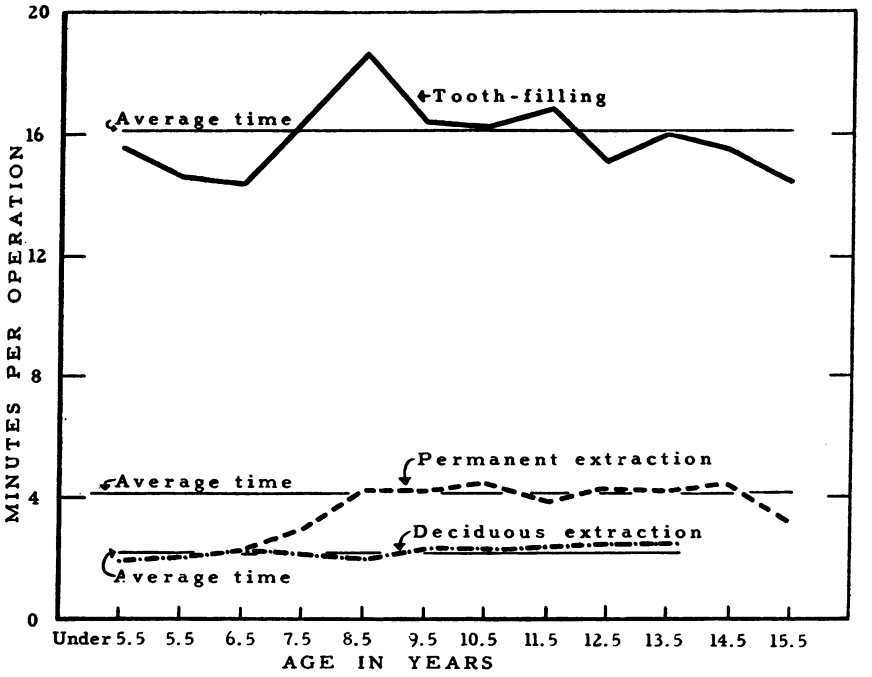

Figure 2. Average number of minutes per specified treatment and age of children treated. Children's Fund of Michigan, 1947.

others, 17.7 minutes on the average as compared with 13.2 minutes for the permanent upper incisors and 12.4 minutes for the permanent bicuspids. By the same token the dentists spend more time per tooth on the deciduous molars, 15.2 minutes, than on the other deciduous teeth, 11.3 minutes.

TABLE 4. *Average time to fill tooth, by type of tooth, for children attending the regular clinics. Children's Fund of Michigan Dental Program, 1947.* [1]

	Tooth groups [2]					
	I	II	III	IV	V	VI
Average time to fill tooth (minutes)	15.2	11.3	13.2	12.4	17.7	11.0
Number of teeth	259	10	50	287	939	5

[1] See table 3, footnote 1.
[2] Deciduous:
I Upper and lower molars.
II All other deciduous teeth.
Permanent:
III Upper central and lateral incisors.
IV Upper and lower pre-molars.
V Upper and lower molars.
VI All other permanent teeth.

Time per dentist—Observations of the time per operation are presented in table 5 for each of 8 dentists. Dentists A, B, and C are the operators in the regular clinics as defined above; the remaining

dentists are the supervisor and trainees at the training center. An appreciable difference is shown in the mean time per filling and extraction between the two groups. The trainees were just out of military service and were in the process of adjusting to somewhat different techniques. The data do not afford any reliable conception of age and experience as factors in the speed of these operators.

TABLE 5. *Average time per operation by dentist. Children's Fund of Michigan Dental Program, 1947.*

Operation	Dentists [1]							
	A	B	C	D	E	F	G	H
	Average time (minutes) [2]							
Prophylaxis	4.2	7.8	6.5					
Tooth-filling	18.2	16.4	15.5	23.0	29.8	33.3	37.8	32.6
Extraction	2.9	2.6	4.6	2.4	6.8	4.5	2.7	4.5
	Number of observations							
Prophylaxis	20	12	12	4	10	3	0	1
Tooth-filling	145	635	770	117	69	88	119	129
Extraction	89	410	35	88	16	20	43	73

[1] Dentists E, F, G, and H are operators in training.
[2] Averages based on 10 or less observations are omitted.

Comparison with Other Studies

In table 6, the data on the basic operations studied in the three regular clinics of the Children's Fund have been added to the tabular summary presented in the Philadelphia paper (*1*) in which comparisons with other studies were discussed. The same code used in the Philadelphia study was adapted to tabulating the Michigan data and

TABLE 6. *Comparison of time data from four studies. Children's Fund of Michigan Dental Program, 1947.*

Item	Children's Fund of Michigan Dental Program [1]	Philadelphia Mouth Hygiene Association [2]	Brandhorst [3]	Lee-Jones [4]
Number of dentists reporting	3	12	8	
Number of children	1,182	1,068	6,644	
Age group (years)	3–16	4–17	5	5–17
Minutes for:				
Prophylaxis and examination	7.6	15.5	20	30
Tooth-filling	16.1	16.8	37	45
Extraction:				
Deciduous	2.2	[5] 9.3		[5] 15
Permanent	4.1	[5] 12.5	[5] [6] 27	[5] [6] 20

[1] Data for regular clinics only; dentists worked with dental assistants.
[2] See reference (*1*). Dentists assisted by dental hygienists.
[3] See reference (*5*).
[4] See reference (*4*).
[5] Time spent in waiting for anesthetic to take effect is included.
[6] From data for young adults.

the same types of measurements were made whenever possible although the procedures and routines of the Michigan dental program were different.

These differences may explain such variations as are to be observed

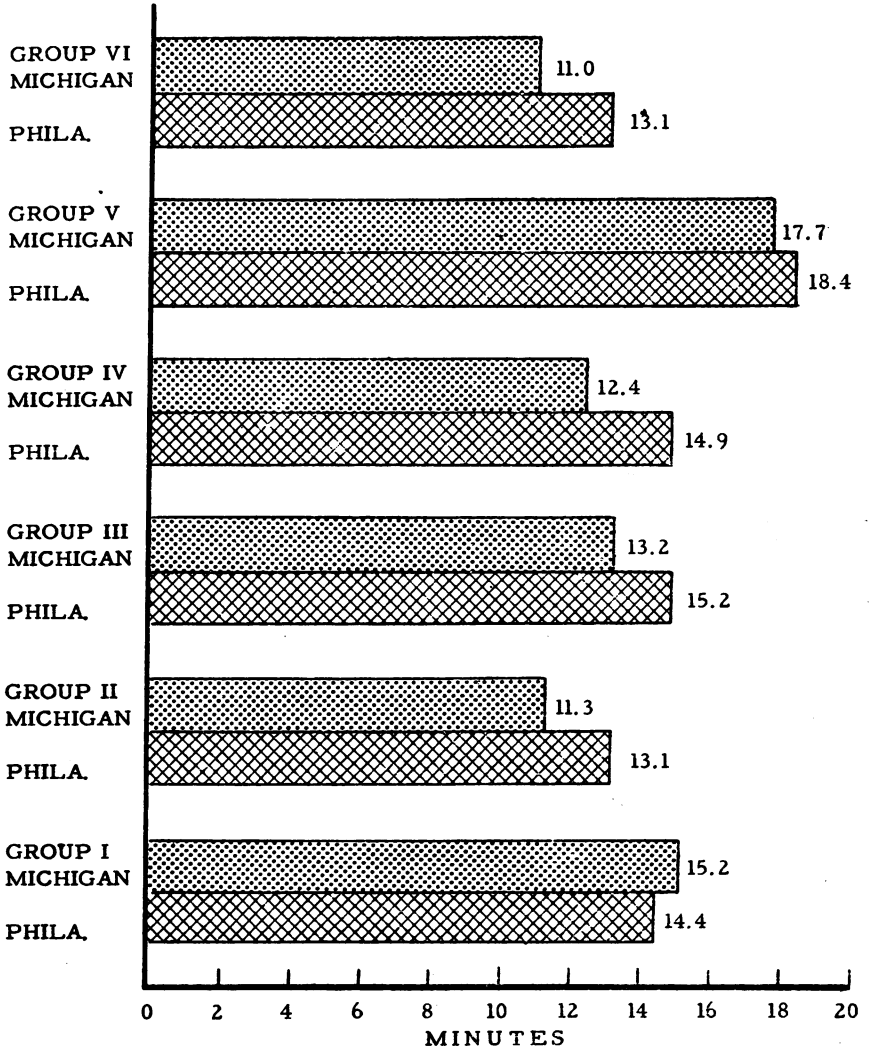

Figure 3. Average time to fill tooth, by type of tooth. Children's Fund of Michigan, 1947, and Philadelphia Mouth Hygiene Association, 1945. (For definition of each group, see table 4.)

in table 6. (1) The time for prophylaxis in Michigan is one-half that in Philadelphia because it is limited in the former to little more than stain removal. (2) Time per tooth filling may be shorter in Michigan because of the routine use of local anesthesia; this results in less discomfort to the patient and hence better child management. Also,

some minor cavities are not treated because of the Fund's aim to spread its services to as many children as possible. It is interesting to observe that when comparison is made of time per filling according to type of tooth the differences are fairly consistent. Figure 3 has been prepared to bring this out. (3) Extraction time is so very much shorter in Michigan because the child does not wait in the dental chair while the anesthetic takes effect.

The other studies have been reported in such a way as to make comparisons with the Michigan data difficult. The estimates of time by Lee and Jones (*4*) were made for them by practicing dentists, and the study of St. Louis children reported by Brandhorst is based on data "compiled from reports submitted by good operators" (*5*). As was said in the report of the Philadelphia study, "The time recorded in the two latter reports is far in excess of that observed in the present study, but we do not know just how the observations were made and what factors were taken into consideration; for example, the time for polishing is very likely included with the time for filling in these reports. Conditions may be sufficiently different between private practice and that in clinics, where assistants maintain a routine constant flow of patients, to account in large part for these variations in time." Valid contrast is indicated only between studies which are made by parallel methods and for which equivalent time measurements are defined.

Klein, Dollar and Bagdonas have also reported recently on dentist time required to perform dental observations (*6*). They found the average time per operative procedure—as distinguished from a prosthetic procedure—to be 8.7 minutes for children under 10 years and 14.2 minutes for patients 10 through 19 years. This is in general accord with the findings here and in the Philadelphia study.

Summary

1. Time per dental operation was recorded for some 3,700 services received by 1,632 children. The observations were made in four clinics of the Children's Fund of Michigan, including the center for training dentists new to the Fund.

2. The operations for which time was observed were the more routine ones: examination, filling, extraction, polishing, and prophylaxis. The average time for each procedure is presented in the text.

3. Age of the child showed no discernible relationship to time per specific operation.

4. The permanent molars were the teeth that took longest to fill, 17.7 minutes on the average.

5. Dentists already familiar with the Fund's procedures performed each operation in half the average time required by new trainees.

6. Comparison is made with time per service observed in an earlier study of the clinics of the Philadelphia Mouth Hygiene Association. Differences in the rates are apparently due to differences in the procedure for handling patients.

ACKNOWLEDGMENT

This study was made possible by the wholehearted interest and assistance of Dr. Kenneth R. Gibson, Director of the Children's Fund dental program. Dr. Gibson generously arranged for the use of the Fund's clinic facilities and records. Thanks are also due to the clinic dentists and all their staff who gave unstintingly of their time to provide the information needed.

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Effects of a New Tetrazolium Derivative on Tissue, Bacteria, and Onion Root Tips[1]

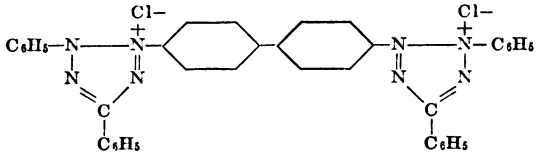
By WILLIAM ANTOPOL, SUSI GLAUBACH, and LESTER GOLDMAN

For the past few years we have used the nitroprusside reaction for localization of active -SH groups in tissues. However, because of the solubility and diffusion of the resultant colored compound, satisfactory microscopic preparations could not be obtained and therefore precise localization could not be determined. The use of tetrazolium derivatives as a test reagent for seed germination (*1, 2, 3, 4*) is of great interest in the field of cellular physiology as they represent promising tools in the study of active cell processes. Recently tetrazolium derivatives became commercially available and a substance called Neotetrazolium[2]

[1] From the Division of Laboratories, Newark Beth Israel Hospital, Newark, N. J. Aided by a gran from the Dorothea Lichtman Fund of the Newark Beth Israel Hospital Research Foundation. Presented at the National Institutes of Health, July 13, 1948.

[2] Purchased from the Pannone Chemical Company, Farmington, Conn. (Trade names are carried as a means of identifying the products under discussion, and do not represent endorsement by the Public Health Service.)

(hereafter designated as NT in text) was obtained. The formula for this compound is:



This derivative produced a stable purple to black color on reduction by living cells. In addition, the stained tissue could be fixed in neutral 10-percent formalin without loss of color. The substance also was less toxic than others previously tested and therefore could be used in vivo.

Reaction of Neotetrazolium on Supravital Tissues

Slices of fresh tissue, approximately 2 mm. thick, were incubated at 37° C. with 0.5 percent NT dissolved in 0.85 percent sodium chloride. The tissues assumed a purplish color, usually in less than one-half hour. This color increased in intensity, as a rule reaching a maximum in one hour. The development of the color appeared earlier in the more deeply immersed portions than on the surface closer to the air. In addition, the color in the former area was more intense. With fresh tissue the fluid as a rule did not become purple.

The color change varied strikingly with different tissues. Thus fibrous tissue stained little, if at all, in contrast to muscle, epithelial tissues, and parenchymal organs such as liver and kidney which stained deep purple to black. In the brain, the gray matter was stained intensely and the white matter weakly; malignant tumors stained very rapidly and more intensely than normal parenchymal tissue. Fat tissue took on a diffuse pink to orange hue.

Tissue immersed in NT and kept in the refrigerator for 24 hours showed no color development. However, if this was then placed in the incubator at 37° C., the same reaction, with slightly less intensity than for fresh tissue, was obtained. If the tissue was incubated overnight at 37° C. with 0.85 percent NaCl and then NT was added, slight color changes were produced in the tissue, but the fluid also became purple. If this fluid was boiled, a stained precipitate was obtained. Tissue which was kept at room temperature for 24 hours and then incubated with NT showed considerably less intense color change than fresh tissue. Boiled tissue did not react with NT.

Tissue immersed in NT at 37° C., even for seven days, did not autolyze or putrify and there was little effect on the cell morphology in stained sections. Tissues previously fixed in formalin or ethyl

alcohol did not react with NT. Tissue treated with NT and then fixed in neutral 10 percent formalin showed more contrasting color than before fixation. Frozen sections made of the formalin fixed tissue revealed intracytoplasmic purple to black granular and crystalline deposits. In some cells, it was suggestive that this reaction took place in organoid portions of the cell. The nuclei of normal cells did not stain. On the basis of alcohol and chloroform extraction, there appears to be more than one component of the colored substance.

A systematic investigation is being made of all organs. We are reporting here on the changes produced in the liver and kidney.

Microscopically in the liver (after one hour incubation), dark staining intracytoplasmic granules and needle-like intracytoplasmic crystals were present, most pronounced in the parenchymal cells and slightly in the duct cells. The nuceli remained unstained. If the tissue was incubated for 24 hours the cytoplasm of smooth muscle also contained the inclusions, and the endothelium stained only after prolonged incubation.

In the kidney, the deposition was also present only in the cell cytoplasm. This was most striking in the tubules. Cells of the glomeruli were stained but it was difficult to determine whether it was in the epithelial or endothelial elements; the impression was that it involved the former. Cells of the parietal layer of Bowman's capsule were stained.

In Vivo Effects of NT in Mice

Mice injected daily intraperitoneally in the lower abdominal quadrants with 0.5 cc. of a 0.1 percent NT, for periods varying from 1 to 21 days, showed intense staining of the skin, the liver, and the kidney cortex, in addition to the peritoneum. The peritoneal fat was diffusely pink.

Histologic examination of the liver showed changes similar to those produced in supravital tissues except that the color was due to very fine black granules in the cytoplasm of the parenchymal cells. The duct cells remained clear, the Kupfer cells were unaffected except after repeated dosing. The kidney also showed very fine black intracytoplasmic granules and these, in contrast to those in the supravital studies, were more pronounced in the collecting and convoluted tubules. The glomeruli remained clear.

If injections were made subcutaneously or intraperitoneally in mice with sarcoma 180, there was a faint purple hue in the non-necrotic portions of the tumor. The effect of this and related substances on various types of tumors are being studied.

Effects of NT on Bacteria

When 5 drops of a 0.5 percent solution of NT were added to 20 cc. plain broth containing actively growing (18-hour) cultures of *Bacillus pyocyaneous, Streptococcus viridans, Streptococcus haemolyticus, Staphyloccus aureus, Bacillus proteus, Bacillus subtilis, Escherichia coli* and *Bacillus mucosus capsulatus,* the preparation, in varying periods of time, usually less than 30 minutes, became purple in color. Microscopic examination of unstained preparations showed the color changes to be due to black inclusions in the organisms. This gave a striking beaded appearance to bacilli. In cultures of gram positive organisms, many of the bacteria lost their gentian violet fastness. In the case of cocci this was difficult to observe in organisms in which the entire body was black. The organisms revealed morphologic changes not unlike those obtained with penicillin. With time the color became progressively more intense and a black sediment of highly pigmented bacteria fell to the bottom of the tube. When NT had distinct bacteriocidal activity, the supernatant fluid became clear, i. e., with *Streptococcus haemolyticus.* With *Streptococcus viridans,* many of the bacteria died and fell to the bottom of the tube. Some survived as manifested by a slightly cloudy and faintly purple color in the upper layer. Microscopic examination showed the color here also to be due to inclusions in the bacteria. With other organisms, as *B. coli, B. proteus,* and *B. pyrocyaneus,* the color became diffusely black and the organisms apparently remain viable and multiply. Kuhn and Jerchel (*5*) found that their tetrazolium compounds also stained bacteria.

In the case of actinomycosis (obtained from a dental lesion) the organism was grown in 20 cc. semi-solid medium. Five drops of a 0.5 percent solution of NT dropped on the surface produced a purple color wherever the organism grew. Here also the color was due to intracellular inclusions.

The effect on *Mycobacterium tuberculosis* was similar. The organisms were grown on fluid and Petragnini medium. After the addition of 5 drops of 0.5 percent solution of NT to 20 cc. of medium, a purple color was apparent in the growing colonies in less than 5 minutes, gradually becoming more intense, finally black. The organisms still retained their acid fast properties and if no counterstain was used, black bodies contrasted with the fuchsin stained portions of the bacteria. The growth of the organism in the above culture was markedly inhibited after the addition of NT.

With all the above organisms, as the color changes occurred, there was marked swelling and distortion of the cell body with numerous bizarre shapes, giant forms, and chain arrangement.

With some organisms the changes in glucose broth varied somewhat from those in plain broth due in all likelihood to acid production. This is being studied.

Plate assays employing *Staphylococcus aureus*, using 3 drops of a 0.5 percent solution of NT in the cup, were set up. After 18 hours there was a clear zone, 20 mm. in diameter, in which there was no growth. About this was a thin purple-black ring. Peripheral to this ring was a wider light purple zone. Culture from the wide zone showed growth for the first 48 hours after which the organisms lost their viability. If the plate was permitted to incubate for 72 hours, a second thin deep purple ring formed at the periphery of the wide purple zone. This ring was less dense than the first ring.

In penicillin cup assays, a ring of increased growth in which -SH groups could be detected was obtained about the clear zone (*6*, *7*). With NT, both purple rings are also probably areas of increased growth with marked reducing activity as evident by increased formazan formation. Pratt and Dufrenoy (*7*) used triphenyltetrazolium chloride as an indicator for increased growth on penicillin assay plates.

Clear zones about the cup were obtained with *Streptococcus haemolyticus*, *B. mucosus capsulatus*, *Streptococcus viridans*, *Staphylococcus aureus*, and *B. subtilis*.

With *B. proteus*, *B. pyocyaneous*, and *E. coli*, no clear zones were present but purple zones and rings formed about the cup. These were often multiple with deep purple to black narrow rings separating lighter purple broader zones.

Effect of NT on Onion Root Tips [3]

Onion roots grown at room temperature in tap water containing NT in concentrations from 1:20,000 to 1:60,000 became purple within 2 to 6 hours at room temperature. The process was decidedly accelerated in the incubator at 37° C. The significant feature was the accumulation of the reduced substance in the merostematic portion of the tip, the site of marked growth. When excised root tips were placed in a 0.5 percent solution of NT in saline and incubated at 37° C. in the same concentrations of NT, reduction with the formation of a deep purple color also took place in the embryonic zone. Smear preparations showed discrete purple to black fine granules in the cytoplasm of the merostematic cells, with marked grouping of the granules in the perinuclear zone. Pratt and Dufrenoy (*7*) employed triphenyltetrazolium chloride to locate intracellular sites of dehydrogenase activity in sugar cane.

[3] This investigation is being conducted in collaboration with Dr. B. Sonnenblick.

Studies on Mechanism of NT Reduction

The conversion of colorless tetrazolium derivatives into colored formazan compounds represents a reducing process. The findings that living matter exposed to tetrazolium compounds in vivo or in vitro show accumulation of the formazan particularly in areas where growth, multiplication, and marked physiologic activity take place is significant, for these areas show high respiratory activity promoted by enzyme systems which are concerned with oxido-reduction processes.

It is known that the activity of a great number of these enzymes such as various dehydrogenases and oxidases is dependent upon the active form of their -SH groups (*8*); maintenance of this group is therefore of great importance. It is assumed that the reduced form of glutathione, a substance present in living cells, aids in keeping the -SH radical in reduced form. Glutathione is important also for maintaining ascorbic acid in its reduced form.

The role of cysteine, glutathione, and ascorbic acid as factors reducing tetrazolium compounds to formazan has been considered by Kuhn and Jerchel (*5*). However, due to the fact that reduction took place at pH 9 and not at pH 7, it appeared doubtful to the authors that these compounds were participating in the reduction of tetrazolium derivatives in the living cell. Recently Mattson, Jensen, and Dutcher (*4*) published a preliminary report in which the effect of pyridine nucleotide dehydrogenases on triphenyltetrazolium is discussed.

In the course of our experiments with NT it was observed that cysteine reduced NT in vitro at pH 7. It was, therefore, desirable to investigate whether active -SH groups play a role in the reduction of NT. The compounds used were cysteine, reduced glutathione, methionine, cystine, sodium cyanide, and arsphenamine.

The effect of cysteine, reduced glutathione, methionine and cystine on NT was tested at pH ranging from 4.5 to 8; phosphate mixtures were used as buffers. Cysteine hydrochloride and glutathione were neutralized before being added to the buffer-NT mixture.

With cysteine and glutathione a faint purple color appeared at the highest pH within 15 minutes. After one hour, the color was observed down to pH 6.9. On further standing the color became darker and after 3 hours a purple precipitate began to settle out. This was darker at the higher pH.

No reaction took place with the methionine and cystine. If cystine was treated with sodium cyanide which converts cystine to cysteine, NT was reduced to formazan. These results show the necessity of free -SH groups for the reduction of NT. For in methionine we are dealing with a compound where the H of the -SH groups is replaced by a CH_3 group, and in cystine we have the -S-S- form.

It was of interest to examine the effect of tissue exposed to arsphenamine since trivalent organic arsenicals combine with active -SH groups (*9*). Fresh tissue was incubated with asphenamine for one hour, removed from the solution, rapidly washed in saline, and then placed in the incubator with NT. No color developed although the specimen was incubated for 15 hours. The control tissue incubated for one hour in 0.85 percent NaCl and then treated the same as the arsphenamine tissue, showed typical purple color after one hour. Arsenic poisoning is treated with BAL (dimercaptopropanol), the thiol groups serving as arsenic acceptors, thus protecting the -SH group (*10*, *11*). The question arose whether BAL could not be used for the reduction of NT. BAL was mixed with NT and the reaction started in a few minutes. In 15 minutes a heavy reddish precipitate was formed.

The effect of cyanide on respiratory enzymes has been the object of many studies. Its inhibiting effect on oxidases such as cytochrome oxidase, ascorbic oxidase and others is established. Also well known is its reducing effect on oxidized glutathione (*12*). It could, therefore, be expected that tissue exposed first to cyanide and then to NT should more readily reduce NT to formazan. Experiments performed in this respect verified the assumption. Tissue incubated for one hour in NaCN and then transferred to NT solution showed faster and more intense color changes than normal tissue. Also of interest was the observation that the color appeared on both surfaces, that touching the bottom and that facing upward at the same time and intensity in contrast to control tissue in which the color appeared earlier and in greater intensity on the lower surface.

Experiments performed to test the reduction of methylene blue by minced tissue in the presence of NT, using the Thunberg method, failed to show decolorization of methylene blue. However, formation of formazan took place. If 0.5 cc. of a 0.1 percent solution of NT was injected into a rat muscle in vivo and excised after 24 hours, this muscle which was now purple, failed to decolorize methylene blue. The question therefore arises whether NT interferes with activity of -SH group of dehydrogenases. This subject is under investigation.

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United States-Canadian Boundary Waters Pollution Control

A pollution control program for United States-Canadian boundary waters has been proposed by the International Joint Commission of the two countries. Objectives of the program are now under consideration at hearings which began September 8 in Room 859, Federal Building, Detroit, Mich.

The program, covering the St. Clair River, Lake St. Clair, the Detroit River and the St. Marys River from Lake Superior to Lake Huron, was developed by a board of technical advisors to the International Joint Commission. The board consists of representatives from the Federal health agencies of the United States and Canada, and representatives from the State of Michigan and the province of Ontario whose boundaries are formed in part by the waters being investigated.

The objectives, given below, are for the boundary waters in general. More stringent requirements may be necessary in certain specific instances, influenced by local conditions. They are preliminary only, and are subject to change from time to time as the investigation of these waters continues, and until the final report has been adopted.

The International Joint Commission is interested in receiving comments on the program. Their offices are in the Department of Labor Building, Washington, D. C., and in the Victoria Building, Ottawa, Canada.

General Requirements

All wastes, including sanitary sewage, storm water, and industrial effluents, shall be in such condition when discharged into any stream that they will not create conditions in the boundary waters which will adversely affect the use of these waters for the following purposes: domestic water supply, industrial water supply, navigation, fish and wildlife, bathing, recreation, agriculture and other riparian activities.

In general, adverse conditions are caused by:

1. Excessive bacterial, physical or chemical contamination.
2. Unnatural deposits in the stream, interfering with navigation, fish and wildlife, bathing, recreation, or destruction of aesthetic values.
3. Toxic substances and materials imparting objectionable tastes and odors to waters used for domestic or industrial purposes.
4. Floating materials, including oils, grease, garbage, sewage solids, or other refuse.

Specific Requirements

In more specific terms adequate controls of pollution will necessitate the following requirements for:

(*A*) *Sanitary Sewage, Storm Water and Wastes from Water Craft*

Sufficient treatment for adequate removal or reduction of solids, bacteria, and chemical constituents which may interfere unreasonably with the use of these waters for the purposes aforementioned.

(*B*) *Industrial Wastes*

Sufficient treatment and control of:

Chemical Wastes—Phenolic Type

Industrial waste effluents from phenolic hydrocarbon and other chemical plants will cause objectionable tastes or odors in drinking or industrial water supplies.

It is considered feasible to reduce the phenolic content of wastes from chemical coke manufacturing and other industrial plants by not less than 90 percent by suitable treatment, recovery or control.

Adequate protection will probably be provided for the uses to which these streams are put if plant effluents are limited to 10 p.p.b. of phenol or phenolic equivalents.

Some of the industries producing phenolic wastes are: coke, synthetic resin, oil refining, petroleum, cracking, tar, road oil, creosoting, wood distillation, and dye manufacturing plants.

Chemical Wastes, Other than Phenolic

(*a*) To neutralize acidity or alkalinity to a value within the pH range of 5.5 to 10.6.

(*b*) To reduce the iron content of the effluent to 17 p.p.m. or less in terms of Fe.

(*c*) To reduce the odor content of the effluent to the point that when discharged to and mixed with boundary waters the mixed effluent and boundary waters shall not have a threshold odor of more than 8 due to such added material.

(*d*) To remove unnatural color and turbidity which render the water offensive in appearance or otherwise unattractive for the aforementioned uses of these waters.

(*e*) To remove oil or floating solids of waste origin which create fire hazards, coat hulls of water craft, injure fish or wild life or their habitat, or which adversely affect public or private recreational development or other legitimate shore-line developments or uses.

Protection will probably be provided for the uses to which these streams are put if plant effluents or storm water discharges from premises do not contain oils as determined by extraction in excess of 15 parts per million, or a sufficient amount to create more than a faint irridescence.

Some of the industries producing chemical wastes other than phenolic are: oil wells and petroleum refineries, gasoline filling stations and bulk stations, styrene co-polymer, munitions, synthetic pharmaceutical, synthetic fibre, iron and steel, alkali chemical, rubber fabricating, dye manufacturing, and acid manufacturing plants.

Highly Toxic Wastes

To eliminate or to reduce to safe limits substances highly toxic to human, fish, aquatic or wild life.

Some of the industries producing highly toxic wastes are: metal plating and finishing plants discharging cyanides, chromium or other toxic wastes; chemical and pharmaceutical plants and coke ovens. Wastes containing toxic concentrations of free halogens are included in this category.

De-oxygenating Wastes

To provide sufficient treatment for the substantial removal of solids, bacteria, chemical constituents and other substances capable of reducing the dissolved oxygen content of these waters unreasonably. Some of the industries producing these wastes are: tanneries, glue and gelatin plants, alcohol, including breweries and distilleries, wool scouring, pulp and paper, food processing plants such as meat packing and dairy plants, corn products, beet sugar, fish processing and dehydration plants.

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 AUGUST 28, 1948

Summary

An increase in the incidence of poliomyelitis of 100 cases was recorded currently (practically the same number as the decline reported last week). The current total is 1,412 cases, as compared with a 5-year (1943–47) median of 931 and 1,806 reported for the corresponding week of 1946. Of the 27 States reporting currently 10 or more cases each, 19 showed a combined increase of 181 cases (656 to 837), while a decline of 70 cases (508 to 438) occurred in 7 States, and one (Oklahoma) reported 25 cases for each week. The 17 States reporting more than 19 cases each and showing changes are as follows (last week's figures in parentheses): *Increases*—Massachusetts 21 (19), New Jersey 50 (40), Pennsylvania 47(43), Michigan 53(42), Minnesota 89 (67), Iowa 57 (37), Missouri 21 (17), Nebraska 54 (39), South Carolina 28 (25), Texas 71 (54), California 226 (206); *decreases*—New York 87 (99), Ohio 76 (82), Illinois 62 (66), Wisconsin 31 (36), Virginia 31 (38), North Carolina 133 (159). Since March 20 (approximate average date of seasonal low incidence), 10,806 cases have been reported, as compared with 10,187 for the corresponding period in 1946 and a 5-year median of 4,842.

During the current week, 1 case of anthrax was reported, in Pennsylvania. Of 24 cases of Rocky Mountain spotted fever reported (last week 25, 5-year median 22), 15 occurred in the South Atlantic and South Central areas, 3 in New York, 2 each in Indiana and Iowa, and 1 each in Pennsylvania and California. Of 14 cases of tularemia (last week 31, 5-year median 9), 10 occurred in the South Atlantic and South Central States and 4 in the Mountain area; no State reported more than 2 cases. For the year to date, the total is 686, the 5-year median 609.

Deaths recorded for the current week in 90 large cities in the United States totaled 8,471, as compared with 7,841 last week, 8,121 and 7,666, respectively, for the corresponding weeks of 1947 and 1946, and a 3-year (1945–47) median of 8,147. The total for the year to date is 316,081, as compared with 317,612 for the same period last year. Infant deaths during the week totaled 675, as compared with 592 last week, and 694 for the 3-year median. The cumulative figure is 22,614, as compared with 25,313 for the corresponding period last year.

Telegraphic case reports from State health officers for week ended Aug. 28, 1948

[Leaders indicate that no cases were reported]

Division and State	Diphtheria	Encephalitis, infectious	Measles	Meningitis, meningococcal	Poliomyelitis	Rocky Mountain spotted fever	Scarlet fever	Tularemia	Typhoid and paratyphoid fever [c]	Whooping cough
NEW ENGLAND										
Maine			31		5		2			2
New Hampshire										1
Vermont			7		5		1			7
Massachusetts	5		104	2	21		20		3	48
Rhode Island							2			3
Connecticut			12	1	7		5		1	14
MIDDLE ATLANTIC										
New York	10	1	172	1	87	3	[b] 32		4	122
New Jersey	1		78	1	50		5			40
Pennsylvania	6		31	3	47	1	20		5	71
EAST NORTH CENTRAL										
Ohio	4		22	1	76		30		3	22
Indiana	3		3		19	2	10		1	5
Illinois	2	1	10	4	62		15		2	43
Michigan [a]			33	1	53		11			23
Wisconsin			118		31		8			33
WEST NORTH CENTRAL										
Minnesota	2		29		89		15			20
Iowa	1	3		1	57	2	3			3
Missouri			4	5	21		4		3	3
North Dakota		4	4		5		2			4
South Dakota			6	2	10					1
Nebraska			4		54		3			17
Kansas	6	5	6		18		2			9
SOUTH ATLANTIC										
Delaware					5		1			
Maryland [a]	2	1	27	1	7	2	[b] 6		1	16
District of Columbia			2		12		9			2
Virginia	4		9	4	31	2	8	1	4	23
West Virginia	1				7		5			16
North Carolina	[1] 1		13	2	[1] 33	2	15		3	33
South Carolina	12	1	9		28		1		5	38
Georgia	4		2		18	1	5	1	13	3
Florida	2		4	1	5			2	1	8
EAST SOUTH CENTRAL										
Kentucky	5		6		8	2	10		11	8
Tennessee	6		12	3	18	3	17		3	4
Alabama	14		3	4	17		8	1	3	17
Mississippi [a]	9		7		9		6		2	2
WEST SOUTH CENTRAL										
Arkansas	1		7	2	7	1	4	2	8	7
Louisiana			1	1	9		1		3	7
Oklahoma	5		10	1	25	2	5	2	3	8
Texas	21		122	2	71		9	1	9	40
MOUNTAIN										
Montana			5	1	3			1		15
Idaho	2		16	1	3		[b] 13			1
Wyoming			6		9			1		2
Colorado			31	2	4		3	2	4	70
New Mexico			5		7		2			14
Arizona	5		15		14		1		6	5
Utah [a]	1		27		4					7
Nevada										
PACIFIC										
Washington	1	1	23	1	12		5			4
Oregon			34		3		1			20
California	9	4	117	1	226	1	28		6	45
Total	145	21	1,187	49	1,412	24	353	14	107	906
Median 1943–47	233	23	696	92	931	22	647	9	184	2,551
Year to date 34 weeks	[1] 5,452	349	550,538	2,314	[1] 11,156	434	56,320	686	2,269	58,359
Median 1943–47	7,498	401	538,338	6,268	5,239	381	98,496	609	2,918	86,745
Seasonal low week ends	July 10		Sept. 4	Sept. 18	Mar. 20		Aug. 14		Mar. 20	Oct. 2
Since seasonal low week	[1] 842		585,484	3,096	[1] 10,806		704		1,796	89,625
Median 1943–47	1,291		576,351	8,720	4,842		1,297		2,294	108,792

[a] Period ended earlier than Saturday. [b] Including cases reported as streptococcal infections and septic sore throat. [c] Including paratyphoid fever and salmonella infections; currently reported separately as follows: Massachusetts (salmonella infection) 1; New York (salmonella infection) 2; Illinois 1; Oklahoma 1; Texas 1; Colorado 2; California 2.

[1] Correction: North Carolina diphtheria week ended July 31, 4 cases (instead of 5); Poliomyelitis week ended July 17, 195 cases (instead of 196); week ended July 24, 204 cases (instead of 206); week ended July 31, 210 cases (instead of 211).

Psittacosis: California, January 1948, 1 case. Alaska: No cases reported. Territory of Hawaii: Measles 11; Whooping cough 2.

PLAGUE INFECTION IN CALIFORNIA AND NEW MEXICO

Under date of August 24, plague infection was reported proved in pools of fleas from rodents collected in California and New Mexico, as follows:

CALIFORNIA

Mono County.—A pool of 34 fleas from 38 ground squirrels, *Citellus beldingi*, taken on a ranch 3 miles west and 3 miles south of Bridgeport and proved positive on August 23.

NEW MEXICO

Rio Arriba County.—A pool of 66 fleas from 9 prairie dogs, *Cynomys gunnisoni*, shot August 11, in Canjilon Canyon, 2 miles northeast of a location 49 miles north of Espanola on U. S. Highway No. 84.

FOREIGN REPORTS

CANADA

Provinces—Communicable diseases—Week ended August 7, 1948.—During the week ended August 7, 1948, 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		6		21	91	22	6	18	43	207
Diphtheria		1		9		1		1		12
Dysentery, bacillary									1	1
German measles					4	1		7	5	17
Influenza		24			8	5				37
Measles				145	107	7	7	28	27	321
Meningitis, meningococcus						2				2
Mumps		1		11	56	18	7	19	3	115
Poliomyelitis		1	1	4	16	2	5	15	6	50
Scarlet fever		1		17	15	5	5	1	1	45
Tuberculosis (all forms)		10	24	71	26	21	19	5	76	252
Typhoid and paratyphoid fever			2	10	1		2	2	2	19
Undulant fever				11	4			1	3	19
Venereal diseases:										
Gonorrhea		12	4	92	68	20	13	31	71	321
Syphilis		7	5	85	47	10	5	3	15	177
Other forms									1	1
Whooping cough		22		60	20	2		21		125

NETHERLANDS

Amsterdam—Psittacosis—During the week ended July 31, 1948, 1 case of psittacosis was reported in Amsterdam, Netherlands.

MADAGASCAR

Notifiable diseases—June 1948.—Notifiable contagious diseases were reported in Madagascar and Comoro Islands during June 1948 as follows:

Disease	June 1948			
	Aliens		Natives	
	Cases	Deaths	Cases	Deaths
Beri-beri	1	0	1	0
Bilharziasis	0	0	171	0
Cerebrospinal meningitis	0	0	12	3
Diphtheria	1	0	0	0
Dysentery:				
Amebic	16	0	287	2
Bacillary	0	0	8	1
Encephalitis, lethargic	0	0	1	0
Erysipelas	0	0	6	0
Influenza	38	0	10,389	104
Leprosy	0	0	47	0
Malaria	519	4	38,840	301
Measles	3	0	33	0
Mumps	6	0	147	0
Plague	0	0	3	3
Pneumonia, broncho	3	0	346	61
Pneumonia, pneumococcic	13	1	785	140
Puerperal infection	0	0	5	2
Relapsing fever	0	0	1	0
Scarlet fever	1	0	0	0
Tuberculosis, pulmonary	7	1	178	37
Typhoid fever	3	1	11	0
Whooping cough	0	0	173	8

NORWAY

Notifiable diseases—May 1948.—During the month of May 1948, cases of certain notifiable diseases were reported in Norway as follows:

Disease	Cases	Disease	Cases
Cerebrospinal meningitis	9	Mumps	1,835
Diphtheria	34	Paratyphoid fever	5
Dysentery, unspecified	4	Pneumonia (all forms)	2,615
Encephalitis, epidemic	1	Poliomyelitis	16
Erysipelas	368	Rheumatic fever	116
Gastroenteritis	4,099	Scabies	1,979
Gonorrhea	385	Scarlet fever	174
Hepatitis, epidemic	151	Syphilis	124
Impetigo contagiosa	2,352	Tuberculosis (all forms)	468
Influenza	2,016	Typhoid fever	1
Laryngitis	10,465	Whooping cough	413
Measles	1,761		

REPORTS OF CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER, AND YELLOW 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

India—Madras.—Information dated August 10, 1948, states that cholera has been reported increasing in Madras Province and City. For the week ended July 31, 1948, 912 cases with 387 deaths were reported in the Province, and 12 cases with 2 deaths were reported in Madras City. During the week ended August 7, 17 cases with 2 deaths were reported in Madras City, and for the week ended August 14, 45 cases with 10 deaths were reported in the city.

Plague

British East Africa—Kenya.—For the week ended July 31, 1948, 7 cases of plague with 2 deaths were reported in Kenya, British East Africa.

Ecuador—Loja Province.—During the period July 1–31, 1948, 3 fatal cases of plague were reported in Loja Province, Ecuador—2 cases in Overal, Celica Canton, and 1 case in Zozoranga, Macara Canton.

Smallpox

Ecuador.—During the period July 1–31, 1948, 238 cases of smallpox with 21 deaths were reported in Ecuador.

Typhus Fever

Ecuador.—For the period July 1–31, 1948, 36 cases of typhus fever with 4 deaths were reported in Ecuador, including 5 cases (murine) with 1 death in Guayaquil, and 4 cases (murine) in Manta.

DEATHS DURING WEEK ENDED AUG. 21, 1948

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

	Week ended Aug. 21, 1948	Corresponding week, 1947
Data for 93 large cities of the United States:		
Total deaths	8,085	8,348
Median for 3 prior years	8,348	
Total deaths, first 34 weeks of year	317,064	318,515
Deaths under 1 year of age	618	684
Median for 3 prior years	684	
Deaths under 1 year of age, first 34 weeks of year	22,731	25,489
Data from industrial insurance companies:		
Policies in force	70,951,356	67,217,265
Number of death claims	11,496	10,280
Death claims per 1,000 policies in force, annual rate	8.5	8.0
Death claims per 1,000 policies, first 34 weeks of year, annual rate	9.5	9.5

Annual Conference at Washington

The Annual Conference of the Surgeon General with the State and Territorial Health Officers, the State Hospital Survey and Construction Authorities, and the State Mental Health Authorities will be held in Washington, D. C., from Sunday, November 14, through Wednesday, November 17. Meetings will be held in the Federal Security Building (North), Independence Avenue and Fourth Street SW. The headquarters hotel will be the Washington Hotel at Fifteenth Street and Pennsylvania Avenue NW. Requests for hotel reservations may be addressed to the Surgeon General, Public Health Service, Washington, D. C.