TREASURY DEPARTMENT
UNITED STATES PUBLIC HEALTH SERVICE

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JUNE, 1916

RURAL SCHOOL SANITATION

INCLUDING PHYSICAL AND MENTAL STATUS OF SCHOOL CHILDREN IN PORTER COUNTY, INDIANA

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Surgeon, United States Public Health Service

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PREPARED BY DIRECTION OF THE SURGEON GENERAL

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RURAL SCHOOL SANITATION.

INCLUDING PHYSICAL AND MENTAL STATUS OF SCHOOL CHILDREN IN PORTER COUNTY, IND.

By Taliaferro Clark, George L. Collins, and W. L. Treadway.

Because of the recognized importance of school hygiene to public health and on request of the Indiana State Board of Health and the Porter County, Ind., health and school officials, a sanitary and medical survey of the rural schools of this county was made by the Public Health Service and completed on May 10, 1915.

This investigation included a sanitary survey of school locations and buildings, a study of the physical fitness of rural school children, and mental tests of these children. On the basis of the results obtained recommendations were made to the health and school authorities of Porter County. It is believed that many of these are of general applicability, and they are, therefore, included in the following report of the results obtained in this investigation.

PART I.

A SANITARY SURVEY OF RURAL SCHOOL LOCATIONS AND BUILDINGS.

GENERAL CONSIDERATIONS.

Porter County is the central of the three counties occupying the extreme northwestern corner of Indiana which are bordered by Lake Michigan on the north. It has an area of 415 square miles. Valparaiso, the county seat, is located near the center of the county in latitude 41° 28″, north, and in longitude 87° 04″, west. The population of Valparaiso in 1910 was 6,987. The schools of this city were not included in the survey.

Topographically, Porter County [1] is comprised in the prairie section of Indiana. The county is covered with a sheet of glacial drift, ranging in thickness from 90 to 141 feet. From north to south the surface of the county comprises three distinct belts: The Calumet, the Morainic, and the Kankakee Basin regions. Of these, the Morainic is the most elevated. The Calumet in the north and the Kankakee in the south are lower and more level.

The underlying rocks of this county are black Genesee shale of the Devonian age and are about 65 feet thick in the vicinity of Valparaiso. Beneath this shale is found Lower Helderburg and Niagara limestone strata in the order mentioned.

The geological formation of Porter County is interesting from a medical standpoint because the underlying rocks are of the same geological formation as has been found by one of the writers (Dr. Clark) in other regions associated with an extensive prevalence of simple thyroid enlargement. The wide prevalence of this condition observed during this survey will be discussed in greater detail in another place in this report. (See p. 92.)

Artensian waters in this county have a very high lime content.

The county is traversed by several trunk-line railways. The county roads are in good repair and of the macadam-gravel type. The schools of the county are so situated with respect to gravel roads that nearly all of them may be reached by automobile at any season of the year. The principal industry of the county is agriculture.

[1] The Geology of Lake and Porter Counties, Ind., by W. S. Blatchley.

Population.—The population of the county according to the 1910 census was 20,540, classified as follows: Males, 10,999; females, 9,541. These in turn are subdivided into the following classes: Native white persons of native parentage, 11,699; native white persons of foreign or mixed parentage, 5,880; foreign-born white persons, 2,939; negroes, 8. At the time of the census the foreign-born white persons comprised 14.5 per cent of the total population. The estimated population of the county at the completion of this survey, May 10, 1915, was 21,250.

School population.—The school population of the county, according to the annual school census completed subsequent to the termination of this survey, was as follows: Total number of unmarried persons from 6 to 21 years of age in the county entitled to free school privileges, 3,933; namely, 2,078 males, 1,857 females. Of these there were 621 individuals 14 to 16 years of age. The total school enrollment for the year was 3,103, which included one parochial school with an enrollment of 104 pupils.

School attendance.—The average daily attendance for all rural public schools was 2,264 in the elementary schools, and 248 in the high schools. The city of Valparaiso is not included in this enumeration. The total number of unmarried persons 6 to 21 years of age in the Valparaiso schools was 1,653. Of these 200 individuals were from 14 to 16 years of age. The total enrollment in the Valparaiso schools was 1,173. The average daily attendance in the Valparaiso schools, excluding one parochial school, during the year 1914–15, was 1,029. The average daily attendance was 835 in the elementary schools and 194 in the high school, exclusive of children attending the parochial school.

Sociological data.—The average number of children in a family in the county was found to be 4.8—2.44 boys and 2.36 girls. Seventy-four children reported the occurrence of tuberculosis at some time or other in the family, and 129 children reported the death of their father, 141 the death of their mother, and 11 the death of both parents.[1]

Extent of survey.—In all 75 school buildings were surveyed and medical tests were made of the children attending 76 schools, including one parochial school, in the rural districts of the county.

SCHOOL LOCATIONS.

In a number of communities, although due consideration had been given to the construction of the school building, the school site had been unwisely selected.

[1] There were 2,488 pupils in the county, while 5,998 boys and 5,785 girls were reported in all families.

Requirements.—The ideal requirements for school grounds are that they be of ample size to allow sufficient playground space for each pupil, protected from soil pollution by the establishment of sanitary privies, in a healthful location with sufficient elevation to insure good drainage, readily accessible to as large a part of the school population as possible, of ample proportions to furnish an unobstructed sky surface for illumination, and sufficiently isolated to avoid disturbing noises and other nuisances.

Elevation.—With the exception of the Morainic belt, traversing the county slightly north of its center, Porter County is largely level prairie land. However, the elevation of school sites was found to be good in 24, fair in 24, and poor in 27 instances.

Drainage.—In some locations special efforts had been made to secure subdrainage of school grounds. This was found good in 40, fair in 26, and poor in but 9 instances.

Walks.—The necessity for walks is apparent. One leading from the roadway to the school entrance is better than none at all, but others should lead to the fuel supply and to outside privies. Otherwise children are liable to refrain from attending to the calls of nature during inclement weather, and in so doing easily acquire the "constipated habit," which begets a condition of physical and mental hebetude incompatible with efficient school work. A large part of the dirt found in rural schools is brought into the classrooms on the children's feet. Where there are no walks this condition is aggravated.

Walks were observed at 30 schools in the county. Of these, 12 were entrance walks only. In the other 18 schools there were walks leading to one or both privies.

Shade.—At 17 schools the grounds are more or less shaded; in some cases sparsely, in a few others too thickly. The latter is especially true of the Washington Township High School and Flint Lake School, Center township. Too much shade promotes dampness and materially limits the daylight illumination of the classrooms.

Proximity to nuisances.—The location of 17 schools was in more or less close proximity to nuisances, as follows: Barnyards, 2; cemeteries, 3; marshy land, 1; ponds, 2; railroads, 10; trolleys, 3. The grounds of the Flint Lake School of Center Township are adjacent to a pond, barnyard, and a trolley line, a conspicuous example of subjection to nuisances.

The noise occasioned by the passage of trains over trunk-line railroads, near which so many schools in this county are located, must in time exercise an injurious effect upon teachers and pupils by exciting a condition of nervous irritability.[1]

[1] Notably is this the case in the Frye School, Boone Township, Kouts School, Pleasant Township, and at the Old Porter and Porter Schools in Westchester Township.

While objections to cemeteries in the immediate vicinity of schoolhouses are largely sentimental, such proximity should be condemned from a sanitary viewpoint also because of the danger of contamination of the school water supply. For this reason wells must often be located at an objectionable distance from these schoolhouses.

Playgrounds.—The great value of regulated physical exercise and play in the open air in connection with school work, which is otherwise a most sedentary occupation, is that it tends to overcome a one-sided development, increases the capacity and ability for work, intensifies the powers of observation, develops presence of mind, overcomes shyness and timidity so common in "shut-in" types of mentality, increases body elasticity, and promotes graceful carriage. Furthermore, the great hope of the future is that, in making school life as attractive as possible through regulated physical exercises during the years of school life on ample playgrounds and with appropriate apparatus, truancy may be reduced in frequency and conditions which make for juvenile delinquency largely eliminated from community life.

It is to be noted that in country districts children often have certain home work to do which is erroneously considered exercise. The fallacy of this lies in the fact that physical exercise by children without the stimulus of mental enjoyment is work which is soon followed by fatigue. Carried further, it produces exhaustion, harmful in effect. Exercise of this character is usually followed by a one-sided physical development.

The school grounds in the rural districts of Porter County, Ind., are without exception of ample area to admit the establishment of playgrounds. In a few schools, however, the areas are greatly restricted by reason of the topography, land unsuitable for other purposes having been chosen for the school site. Furthermore, an attempt had been made in but six schools to make any provision for playgrounds.

Grounds of sufficient area to permit an allowance of 30 square feet per pupil for playground purposes is considered ample in urban communities, where land is expensive. The necessity for so restricted an area is not apparent in rural communities. In Porter County the average school ground space per pupil, exclusive of area covered by the school building, was found to be 976.24 square feet.

Accessibility to school population.—One of the cardinal rules to be observed in the selection of a school site is that it be easily accessible to the greatest number of children. The average time spent by the children of Porter County in traveling to school was 18.8 minutes, and few children spent more than three-quarters of an hour. Thus the schools are within a reasonable distance from the majority of the homes.

Transportation of school children.—Free transportation of school children is practiced in 10 townships, 28 school busses being utilized. The number of children for whom free transportation to school was furnished by the county during 1914–1915 was 345, at a cost of $10,729.80, or $33 for each child.

The ability of the township to furnish free school transportation foreshadows a greater consolidation of schools, which is in accordance with the trend of modern practice in rural districts. By the consolidation of a number of the schools in any one community it becomes possible to employ a few well-equipped teachers in the place of several indifferently trained ones. Moreover, consolidation results in a saving in school lands, constructive material, and operating expenses. It also makes possible the erection of modern sanitary school buildings and the establishment of an efficient system of health supervision without great additional expense to the taxpayer. Porter County is particularly well situated for school consolidation by reason of the good roads which traverse the county in every direction.

The type of school bus used in the county, however, is open to criticism. During inclement weather the children are shut in by tightly-drawn curtains, are closely and promiscuously crowded together under conditions which are favorable to the transfer of communicable diseases, and offer opportunity to the vicious for immoral suggestion. The use of a number of motor-driven school busses on the good roads of Porter County is feasible.

PRIVIES AND SOIL POLLUTION.

Protection from soil pollution.—The prevention of soil pollution by the safe disposal of human excreta is one of the prime requirements for the protection of health, because of the not uncommon presence in such excreta of the living agents of disease. In schools with sewer connection this dangerous matter is carried far away and soil pollution, therefore, so far as the school premises are concerned, is generally entirely obviated. At one and two room rural schools, however, evidences of soil pollution are too commonly met with. Some of them have no privy accommodations; at others, these are badly located, improperly constructed, and poorly maintained.

INSIDE TOILETS.

Inside toilets were found at four schools.[1] At Chesterton, the toilets were connected with a sewer system, at Flint Lake and Hebron Schools with a cesspool, and at Porter with an incinerating apparatus.

In the latter school the toilet is a decided nuisance. The accumulated excreta is incinerated but once a week. At the time of this inspection, April 28, 1915, the odor from this accumulated filth was

[1] In all there were 16 seats for boys and 22 seats for girls.

highly objectionable and could be detected in a classroom situated immediately above. The boys' urinal was connected with a cesspool beneath the basement floor.

Location of inside toilets.—The desirability of locating sewered[1] toilets in the basement or on classroom floors formerly received considerable attention. It is now known that the volatile emanations from sewers and toilets do not carry bacteria, thus removing the most serious objection which could be raised against the practice of placing them on the same floor with classrooms. The advantage of so locating these toilets is that they are more readily accessible, can be provided with daylight illumination, and permit a more direct supervision of both the toilets and the children who use them. Insanitary conditions are more readily detached, and therefore more promptly corrected, than in the case of toilets placed in the basement. Toilets, wherever located, should be adequately ventilated, however, and kept scrupulously clean to avoid objectionable odors.

Toilets were located in the basement in three of the four schools mentioned above. In the Hebron School, however, the toilets were located on the classroom floors, one for each sex.

Number of toilet seats.—The English have adopted the requirement of five seats for each 100 boys, seven seats for each 100 girls and very young children. It is certainly more desirable to have a greater number of toilet seats than are actually necessary than too few. In new constructions this practice makes allowance for an increase in the population, avoids untoward accidents in the case of the very young, whose powers of inhibition are low, and cultivates a habit of regular response to the demands of nature so essential to perfect physical health.

The height of the seats should be graduated from 11 to 12 inches for young children to 14 to 16 for those who are older. These requirements are equally applicable to outside privies.

Toilet plumbing and other considerations.—Because of the thoughtlessness of the majority of children and the numbers involved, the plumbing of school buildings is often subjected to undue strain, a fact well recognized by most architects, who advise the use of fixtures and pipes of extra weight and thickness in school installations. All plumbing for school toilets should be exposed, easily inspected, and readily accessible for rapid repair.

Inside toilet construction.—The requirements for the construction of inside toilets are well understood. In general, for purposes of sanitation, urinals and toilet-room floors should be composed of nonabsorbent, noncorrosive materials. Urinals are usually constructed of slate. The toilet-room floors should never be of wood or con-

[1] It may be safely stated that no toilet unconnected with a sewer system should be located inside the school building.

crete, because the former is more or less absorbent and the latter rapidly deteriorates under action of the acid contained in urine.

A word, however, may be said of the manner of flushing toilets. The type which flushes automatically when the weight of the body is removed from the seat is desirable for very young children and in schools where but slight supervision of the toilet room is maintained. Under other conditions the type which necessitates the pulling of a chain or other device is preferable, because the habitual performance of this act is a part of the child's education in sanitation.

OUTSIDE TOILETS OR PRIVIES.

In the majority of rural schools reliance is placed on outside privies for the safe disposal of excreta. Such privies should be of a sanitary type and screened from view for the sake of privacy. They should be ventilated to remove offensive odors, located sufficiently far from the school building to avoid a nuisance and from the water supply to minimize the danger of contamination through accidental soil pollution and improper upkeep. Privies should be at least two in number at each school, one for boys and one for girls, and should be located on a lower level than the water supply.

Classification of privies.—Privies are classified according to the completeness with which the spread of infection by one or the other methods is excluded, namely, by man and animals, insects, and water. The virtual exclusion of any one of them is rated at 25 per cent, and of all three at 75 per cent.

A total absence of the privy or other installation for the disposal of excrement is rated at zero.

A surface privy open at the back decreases the chances for the spread of infection by the feet of man, and is rated at 10 per cent. A surface privy closed at the back largely eliminates the spread of infections by means of chickens, dogs, hogs, and man, but not rats, and is, therefore, rated at 25 per cent.

The privy with a water-tight receptacle eliminates the spread of infection by seepage and by birds and mammals, and is rated at 50 per cent.

A water-tight receptacle privy closed in the back and thoroughly fly proof is rated at 75 per cent.

The sanitary value of the "pit" privy varies with the soil formation, the contour of the school ground, the height of the ground water level, vegetation, climate, and construction. A privy of this type may rank as low as 10 per cent and lower, or as high as 75 per cent when fly proof, closed in the back, and in an impervious soil.[1]

[1] A leaflet prepared by Prof. C. W. Stiles, of the U. S. Public Health Service, outlining the above classifications of privies, was distributed to the school teachers throughout the county.

According to the classification outlined above, no privy in the county attained a rating higher than 50 per cent. These figures, however, do not accurately represent the efficiency of all the privies so rated, because the nature of the soil and the manner of obtaining water for use in the schools of this county afford greater protection from contamination than would be the case in communities not so advantageously situated.

Sanitary privies.[1]—Two types of sanitary privies are now recognized, namely, removable-receptacle and stationary-receptacle privies. The essential part of a removable-receptacle privy is a water-tight receptacle, screened against flies. An arrangement of this sort can be adapted to any substantial existing privy house after minor and inexpensive alterations. Experience has shown that strong

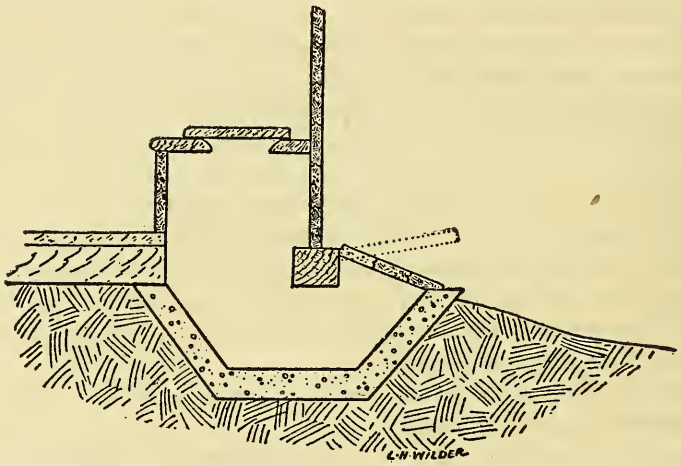

FIG. 1.—A stationary-receptacle sanitary privy with a cement vault arranged for convenient cleaning.

(From Public Health Bulletin 68.)

cylindrical galvanized iron tubs or cans are most suitable for this purpose. Wooden receptacles soon warp, leak, and are entirely objectionable. The adoption of this type of privy necessitates careful attention to ventilation measures to avoid odors. These measures may be supplemented by the use of drying powders, such as lime, earth, or ashes, or by the use of disinfecting solutions.

The principal objection to this type of privy for school purposes is due to the necessity of emptying these receptacles at more or less frequent intervals and of disposing of the contents safely, a task not likely to be regularly performed.

The most suitable manner of disposing of the contents, where privies of this type are in use, is by burial, which should be in the upper layers of the soil, at a depth not greater than 2 feet, in order

[1] Public Health Bulletin No. 68, Washington, D. C.

to take advantage of the natural purifying agencies, animal and vegetable, contained in the soil. The contents of privy receptacles should be buried not nearer than 100 feet to any water supply, in a place which is not likely to be disturbed by animals and which drains in the opposite direction.

The excreta may be disinfected before burial by adding a freshly-made solution composed of 1 pound of chloride of lime to 8 gallons of water.

A stationary-receptacle privy is far more suitable for rural schools than the removable type. In this type of privy advantage is taken of a phenomenon observed in ordinary cesspools—that is, that their contents liquefy, and solid matter is found only near the bottom. This is due to the action of certain living bacteria, which under favorable conditions exert a liquefying action on the solid organic

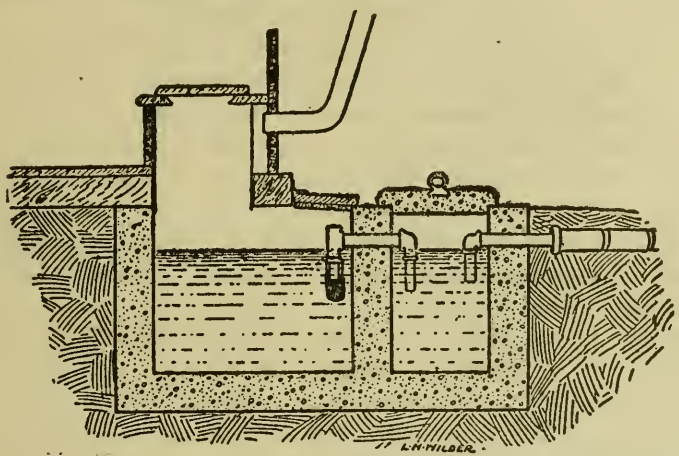

FIG. 2.—An L. R. S. privy with tanks made of concrete and with direct distribution of effluent into top soil.

(From Public Health Bulletin 68.)

matter contained in human excrement. Privies of this type are easily maintained, are sanitary, and usually free from marked odors.

In figures 1 and 2 are shown types recommended by the United States Public Health Service. The former represents a sanitary privy with a cement vault arranged for convenient cleaning, which is suitable for small schools; the latter comprises two tanks made of cement with direct distribution of the effluent into the top soil. A privy of this type may be constructed on a sloping surface in such manner that the effluent pipe discharges into a suitable receptacle where it can be sterilized by heating, or by the use of disinfectants.

As the living agents which bring about liquefaction lose their activity somewhat in cold weather and are killed by disinfectants, the concrete vault should be sufficiently deep to be protected from

freezing, and the use of disinfectants is inadmissible. Privies of this type, in fact all school privies, should be supplied with toilet paper, because it breaks up quite promptly. The use of heavy paper, cobs, and pieces of fabrics should be avoided.

Privies were inspected at 73 schools. Of these the type was open-in-the-back at 9 schools, receptacle in 3, "pit" in 54, and cesspool and brick or cement vault in 8. There were 181 seats for boys and 190 seats for girls.

In figure 3 is shown an unsatisfactory girls' privy, found at one of the schools. Figure 4 represents a privy which is closed at the back, ventilated, and screened for privacy.

The receptacle used in the three receptacle privies found during this survey was made of heavy planking. These receptacles, however, were leaky, full to overflowing with excrement, and apparently had not been emptied since their installation.

The majority of the privies inspected during this survey were of the pit type, which may be considered safe under certain rigid conditions of soil and climate, ground water level and proximity to water supplies. The use of driven wells at most of the Porter County schools, in connection with the glacial drift soil found over land of this kind, offers reasonable protection to the water supply from a privy located more than 100 feet distant, a protection not to be relied on in limestone districts and in marshy regions with a high ground water level.

Distance of privy from water supply and from school buildings.—The privies of a number of schools were located at a distance considerably over 100 feet from the water supply, the average for the county being 90.7 feet. The distance, however, from the privy to the well varied in different townships.

The average distance from the privy to the school building likewise varied in different townships, being 48.3 feet for all schools.

State of repair and maintenance of privies.—Privies were found in good repair in 18 schools, in fair repair in 27, and in poor repair in 23. In addition, privies for girls were found in good repair in 1 instance and in fair repair in 3 other instances, while the corresponding privies for boys were in poor repair at all 4 of these schools.

The cleanliness of privies, however, was found to be good in 7 schools only, fair in 22, and poor in 39. In other words, the upkeep and sanitary policing of the majority of the school privies in use in the county were bad. The privies for girls were found in much better condition than those used by boys. An exception to this general rule is shown in figure 3.

The question of soil pollution has received detailed consideration because of its important bearing on the problems of rural sanitation.

FIG. 3.—Girls' privy at Porter County School.

It is felt that insistence upon the construction of sanitary privies for use at rural schools with due attention to their upkeep will probably do more to impress the rising generation with the importance of observing hygienic laws than any other measure which may be employed for that purpose in connection with school life.

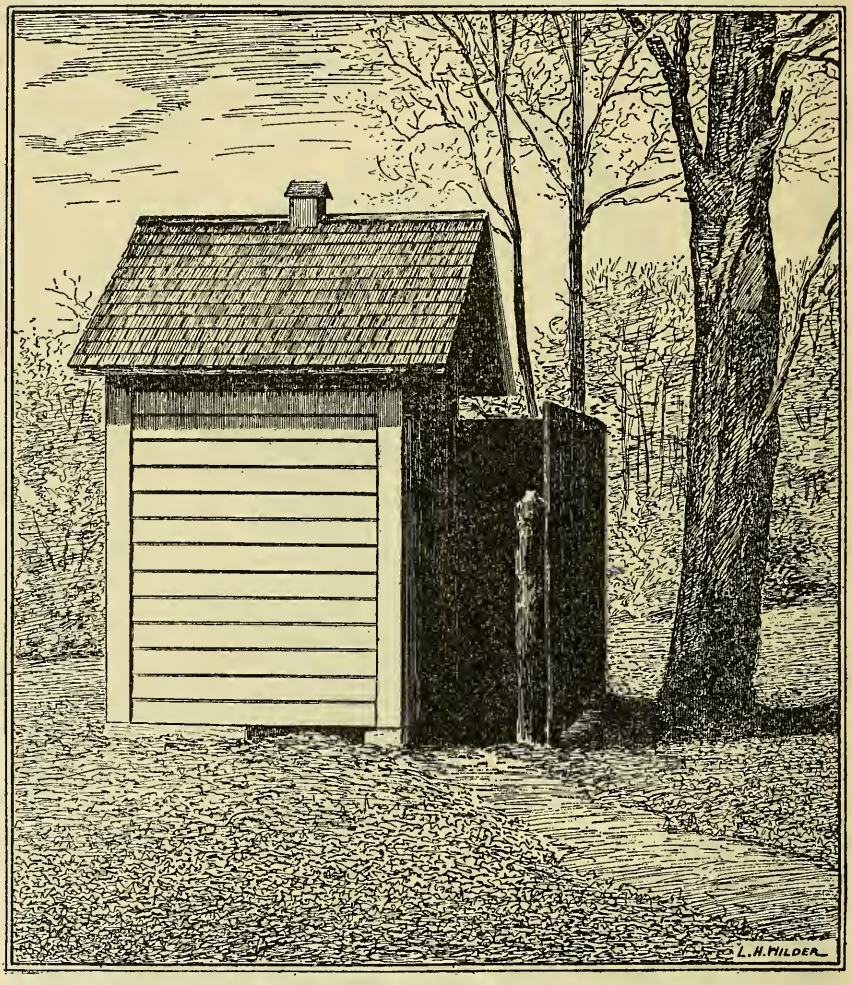

FIG. 4.—Type of "pit privy," ventilated and screened for privacy.
(U. S. Public Health Service.)

SCHOOL BUILDINGS.

NUMBER AND CONSTRUCTION.

At the time of this survey, May, 1915, 77 rural schools were in actual operation in Porter County. Two of these were not inspected, namely, the parochial building at Chesterton and the Hayes

School, Center Township. Of 75 schools, 44.5 per cent were frame structures, 2.6 per cent cement, and 52.9 per cent brick.

Number of stories.—Eighty-nine and three-tenths per cent of all the rural school buildings inspected in the county were one-story structures. Of these one-story buildings, 34, or 50.7 per cent, were frame, and 33 were brick. None of the school buildings of the county consisted of more than two stories with a basement and all of these, eight in number, were of brick.

In all, there were 114 classrooms, of which number 5 were either not in use or used for recitation purposes only. Of the remaining 109 classrooms, 31 per cent were in one-story frame buildings, 27½ per cent in brick or cement structures, and the remainder, 41.5 per cent, were in two-story brick schools. It will be observed that the greatest number of classrooms in any one school was 9. In two other schools, however, the number of classrooms was 8 and 6, respectively.

Basements.—The height of basement ceilings and the distance of the floor level below ground are largely influenced by the use for which the rooms are intended. When used for play purposes, or manual training and domestic science classes, the ceiling should be high, 12 or more feet, to make due allowance for ventilating ducts and other necessary piping. It is desirable in all cases for basements to receive daylight illumination. The top of the foundation, therefore, should be well above the ground level—from 3 to 5 feet, according to whether or not manual training and domestic science classrooms are to be located in the basement.

A record was kept of the illumination of all basements inspected during this survey. These were classified as good in 12 schools, fair in 6, and poor in 5. The term "good" in this classification is relative, because in no case classified was the basement used for classroom purposes, which would require a better natural illumination than was found in any basement inspected during this survey.

All school basements should be waterproof. Failure in this respect results in dampness. The basements were practically waterproof in 16 schools and without any attempts at waterproofing in 7 others. This latter condition was due largely to the material used in floor construction. In 16 instances the basement floors were of cement, brick in 3, and earth in 4.

Toilets were located in the basements in but three schools. The disadvantages of this system have been discussed elsewhere in this report. (See p. 14.)

The ventilation of the basements was accomplished by windows in 21 schools, and in two others they were connected with the general ventilation system. At all schools with artificial ventilation installations, however, insufficient precautions were taken to exclude cellar

air from the fresh-air intakes, a matter discussed more fully in the section of this report dealing with ventilation. (See p. 59.) Finally, seven basements were found in a dirty condition that should not be tolerated because of its bad example in sanitation.

Orientation of school buildings.—The direction in which the school building faces influences largely the arranging and distributing of classrooms so that a maximum illumination efficiency may be secured with the greatest comfort to the eye. There is also the necessity of providing for the admission of sunlight to each classroom during some hour of the day because of its germicidal properties. Classrooms, therefore, which have north, northwest, west, southwest, and south exposures receive the least sunlight, in the order mentioned.

The orientation of the school building a few points off the compass permits the easiest arrangement of classrooms for the purposes mentioned. The roads of Porter County, however, either follow or parallel section lines: that is, they are north and south, and east and west. For this reason the school buildings set square with the compass, otherwise their relation to the school plot would be an irregular one. The majority of the Porter County schools are one-room structures which readily lend themselves to classroom orientation best adapted to the purposes of daylight illumination, irrespective of the direction in which the building faces.

The orientation of the school buildings of the county was as follows: Ten faced north, 23 east, 25 south, and 17 west. Of 109 classrooms investigated from the standpoint of orientation, 35, or 32.5 per cent, faced north; 21, or 19.2 per cent, east; 23, or 21.1 per cent, south; and 30, or 27.2 per cent, west.

Date of construction.—The greatest number of sanitary defects met with during this survey were in connection with very old buildings, erected long before the development of school hygiene as a factor in the education, sanitation, and economics of communities. In a measure this is fortunate, because it encourages school consolidation by lessening the objection to the abandonment of buildings which have almost passed the limit of usefulness.

Ten of the rural school buildings were less than 5 years old, 6 between 5 and 10 years, 16 between 10 and 20 years, and 43, or 57 per cent of the total number, were more than 20 years old.

Attempts at renovation had been made in a few instances. In general, the expense of remodelling a number of these old buildings to meet the requirements of school hygiene would be nearly as great as new construction. This is another argument in favor of consolidation of rural schools as an economic measure, as is the fact that the attendance at some of these schools was very small. In one school there were only 4 pupils present and but 6 in another. Never-

theless, the operating expenses of these schools are as great as that in schools with larger attendance and more modern equipment.

Foundations.—It is not unusual to find one-room school buildings in remote districts on inadequate foundations. The most serious fault in this respect is the use of pillars, an arrangement that gives free sweep to the winds beneath the buildings, causing cold floors, cold feet, and adding materially to the cost of heating.

The foundation of all small school buildings should be closed in and provided with screened ventilation openings. The Indiana law requires that the top of these foundations shall be at least 3 feet above the ground level to provide against damp and rotting floors.

The foundations of all the rural schools of the county were of the closed-in type. In one or two instances these were in poor repair.

Roofing.—The material used for the roofing of school buildings is important from the standpoint of fire protection and frequency of renewal. Slate roofing is probably the most desirable in this respect. The roofs of nine schools of the county were of this type. In spite of its desirable qualities, the use of slate for roofing is a doubtful economy in small one-story school buildings, where it may be easily broken by children at play. The repair of a slate roof necessitates the employment of one skilled in this work and not usually available in rural communities.

The greatest number of rural schools, 64 or 85 per cent, had shingle roofs. Two had tin roofs.

STATE OF REPAIR.

The upkeep of school buildings is as necessary an educational and sanitary measure as the establishment of hygienic structures. The cost of maintenance and repair constitutes not an inconsiderable part of the operating of school plants, but neglect of this duty is obviously a false economy.

The state of repair of 43 buildings inspected was good, of 24 fair, and of 8 poor. This classification takes into consideration the grossest conditions of structure only, without reference to the number of schools in need of interior redecorations.

FIRE PROTECTION.

Brief consideration only is given in this report to measures of fire protection. The requirements for this purpose are incorporated in the building codes of the several States.

As a life-saving measure protection against fire in small one-story rural schools is of secondary importance to insurance against property loss. It is inconceivable that a fire should gain sufficient head-

way in a building of this type effectually to close the avenues of exit before the building could be emptied.

Nevertheless, the natural increase in population and the modern tendency to consolidate rural schools call for larger buildings of more than one story, a type of construction demanding greater safeguards against fire for the protection of life. Briefly, the extent of fire protection afforded in any one building is measured by the materials used in its construction, height of the building, presence or absence of fire escapes, location and arrangements of exits, stairways, and classrooms, heating system used and isolation of the heating apparatus in fireproof structures, location of the heating apparatus with respect to entrances, installation of fire plugs and hose, provision of hand grenades and patent fire extinguishers, and finally, institution of fire drills.

It is exceedingly difficult to make a school building completely fireproof. The extent to which such material is employed in schoolhouse construction will depend largely on the accessibility of different localities to the sources of supply.

The higher the building the greater the danger to life in case of fire. The Indiana law limits the height of buildings used for school purposes to two stories and a basement. All the two-story school buildings inspected during this survey were of brick construction. The greatest number of highly inflammable buildings were one-story frame structures, which constituted 44.5 per cent of all the rural school buildings in the county. No fire-fighting apparatus was observed in any rural school building in the county, a condition which should be remedied.

Five buildings were provided with fire escapes of the open-ladder type, which in one case consisted of a simple iron ladder without a platform leading from the classroom window to the ground. The open type of fire escape doubtless answers the requirements of rural communities where the school attendance is relatively small and the children accustomed to climbing. In congested districts, however, the inclosed type of fire escape is desirable.

Buildings with central heating plants should have the heating apparatus placed in a fireproof inclosure. The new school at Hebron is equipped in this manner. The heating plant of the Crisman school, consisting of furnaces located in the cellar, is a distinct menace by reason of the close proximity of the furnace top to the low wooden ceiling. The heating apparatus should be located as far as possible from exits to avoid cutting off avenues of egress in the case of fire originating at this source.

The value of fire drills, as a life-saving measure, has been demonstrated time and time again in the case of fire. This practice enables the building to be emptied not only in the shortest possible time, but

in an orderly manner necessary to avoid panics and injury. Aside from these considerations fire drills are of distinct value for teaching self-reliance in time of stress.

Lastly, the arrangement of building exits which open out and are provided with fire bolts is a further precaution for the protection of life in case of fire. Entrance doors opening in the wrong direction were observed in 53 per cent of the schools of the county, 38 opening out, 40 opening in.

Outside doors opened into halls in 29, or 34.7 per cent, of the schools; into vestibules in 37, or 49.3 per cent; and directly into the classroom in 12, or 16 per cent.

WATER SUPPLY AND LAVATORY FACILITIES.

Due attention must be paid to the water supply of schools to secure a supply which is free not only from contamination with disease agents, but from other objectionable features that might cause children to refrain from its use in desirable quantities.

The detection of the presence of harmful agents in drinking water requires special facilities which are lacking in nearly all rural communities. Therefore, especial attention must be paid to the installation of sanitary privies to protect water supplies.

Sources of water supply.—Rural schools secure drinking water largely from shallow wells, which frequently become contaminated. The water obtained in this manner is that part of the rainfall which sinks into the ground until an impervious layer of clay or rock is reached and which finds an outlet at lower levels. A shallow well taps this flow of ground water and drains an area in the form of an inverted cone, with the point at its bottom. The diameter of the area thus drained is variously estimated by authorities to be 20 or more times the depth of the well, depending on the nature of the soil. The soil of Porter County, however, is a natural filter, so that the protection afforded the water from natural means is far greater than that afforded by the sanitary conveniences most frequently found at the schools.

Unless due precautions are taken, the shallow well is a constant source of danger. It should be protected from surface drainage to a depth of several feet and located as far as practicable from sources of contamination.

Three of the rural schools of Porter County are connected with the town water systems, namely, Flint Lake, Chesterton, and Porter schools. The new school at Hebron has been fitted for connection with the town supply, which, however, had not been introduced at the time of this inspection. Two other schools are supplied by wells from 125 to 130 feet in depth, respectively.

Driven wells.—The water used in nearly 75 per cent of the rural schools of the county was obtained from shallow driven wells.[1] Thirteen, or 17.3 per cent of all the schools of the county, were without wells. In these cases all water used for school purposes was brought from neighboring farmhouses, in some instances one-quarter of a mile or more distant. This practice is bad because of the possibility of obtaining water from infected wells.

The wells of four schools were not in use, and at nine other schools the pumps were out of order. This increased the number of schools taking water from neighboring farmhouses to 26, or nearly 35 per cent of all the rural schools in the county.

The distance at which the well is located from the privy is a factor in the freedom from contamination of the water supply. The average distance separating the well from the privy for the county was 90.7 feet, as stated elsewhere (p. 18).

Wells should not be located near the entrance to school buildings. In places where due care is not given to the drainage of waste water, the space surrounding the well becomes an unsightly mudhole, from which dirt may be carried directly to the schoolroom. Furthermore, the floor sweepings added to this mass increase the liability of such wells to contamination with infectious material.

At four schools in the county the well was located within 6 feet of the building and under the basement in two other instances,[2] the average distance for all schools of the county being 32 feet. The objection to locating the well under the basement is largely due to the difficulties of repair and to the dampness by water wasted on the basement floor.

Protection from surface drainage.—The protection of the wells of the county from surface drainage seems to have been influenced largely by the desire to avoid a muddy approach rather than from the viewpoint of sanitation. This is indicated by the use of boards for this purpose at a large number of the schools.

In figures 5 and 6 are shown types of pump installations and the extent of protection from surface and waste water drainage. In but few instances has this been done in the proper manner.

In a number of instances the upper part of the well consisted of a walled-in pit several feet in diameter, ranging from 6 to 8 feet in depth, through the bottom of which the well had been driven. In some cases the bottom of this pit contained a layer of charcoal for

[1] Driven wells are those constructed by driving an iron pipe into the soil and completed by fitting the pump to its top after being driven to such a depth as to obtain a sufficient flow of water.

[2] Two schools other than the ones mentioned, namely, Kouts and Porter schools, had wells located under the basement. These wells, however, were no longer used to supply drinking water.

the filtration of waste waters. The boards covering these pits in most instances had been disarranged, and in consequence they served as a catchall for very offensive substances.

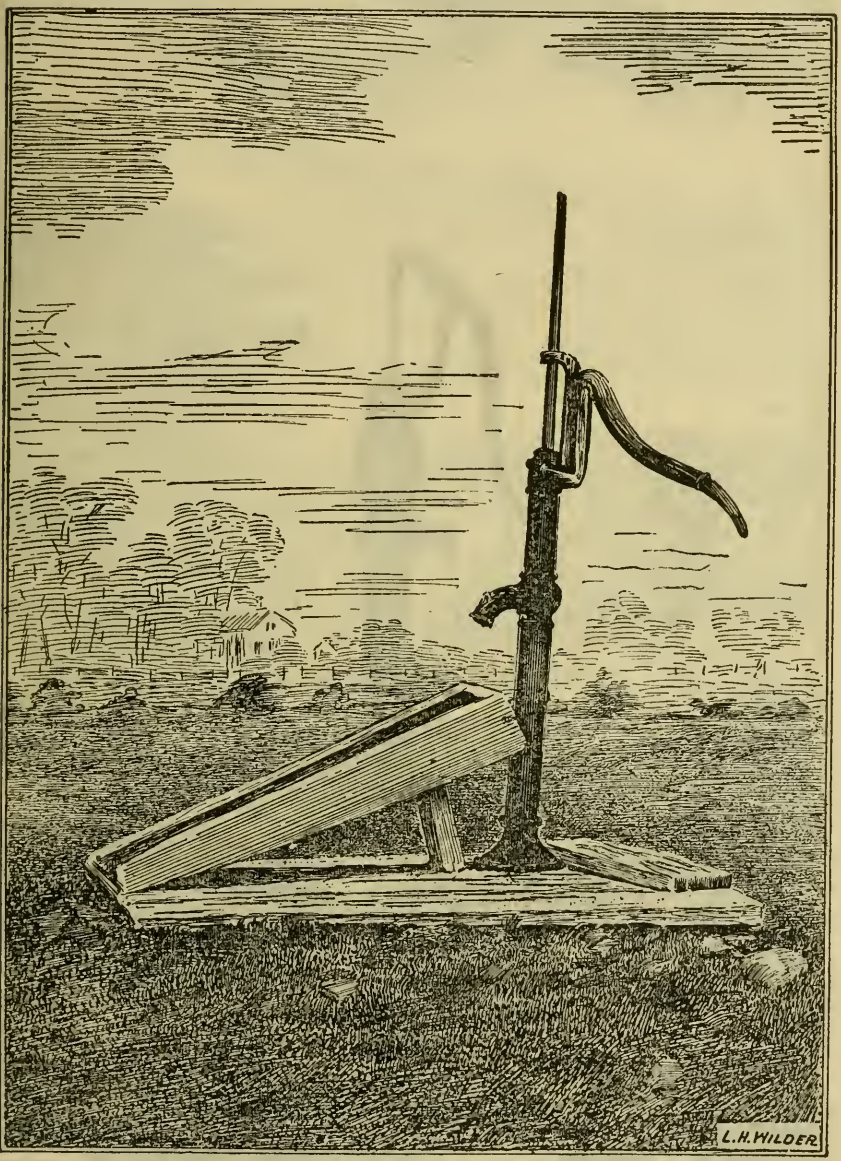

FIG. 5.—Shallow-driven well with trough for drainage of waste water.

Water containers.—Sanitary drinking fountains of the various stationary types were found in seven schools. Of these, two were out of order and one was not in use.

In all other cases the children drink at the well, a common practice also in a number of schools provided with water buckets and

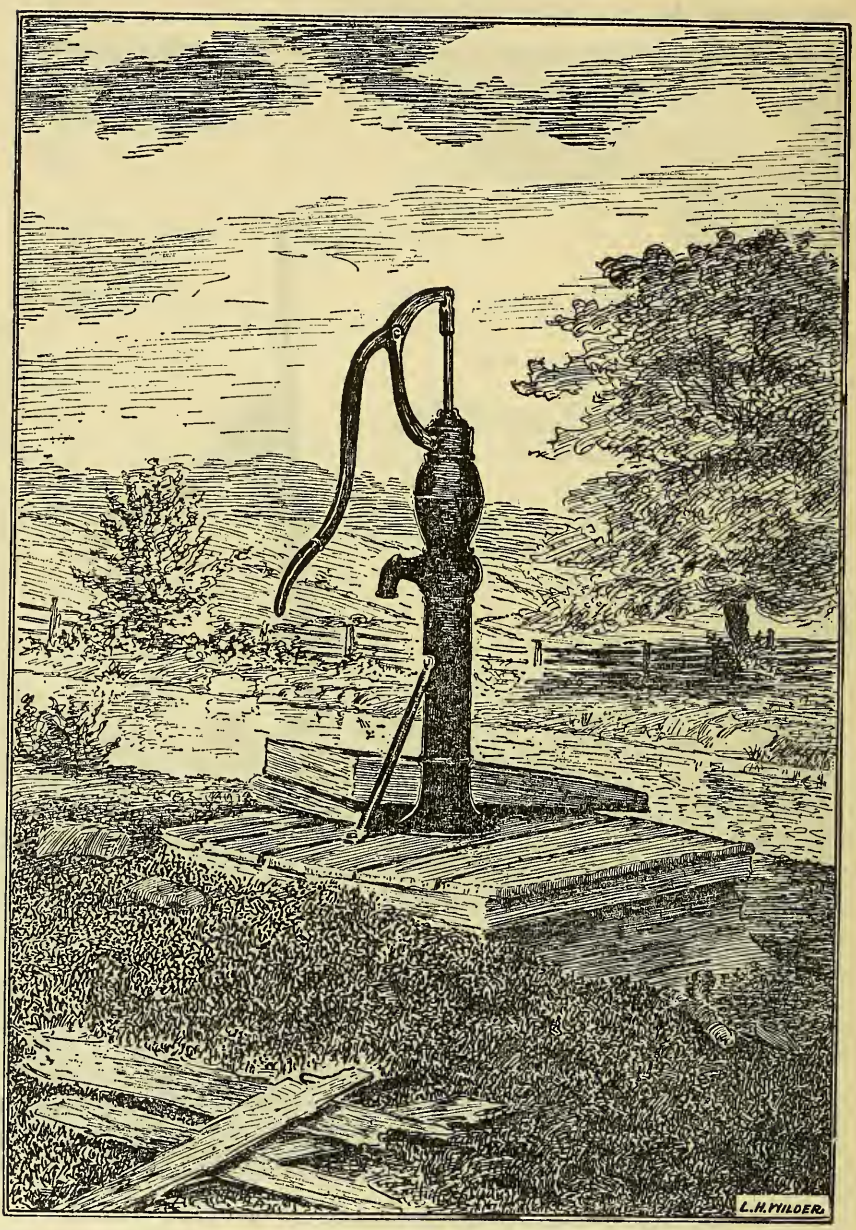

FIG. 6.—School well surrounded by shallow pit and board protection from surface drainage.

drinking fountains. Bubbling-fountain attachments to the town water supply were observed in Chesterton and Porter schools. The new school at Hebron is now equipped in like manner.

Facilities for washing hands.—Children should be taught the value of personal hygiene in the maintenance of health. This is especially true of the necessity of cleaning the hands frequently. They become soiled during play, while attending to the calls of nature, through handling soiled objects, and are carried immediately to the face, perhaps introducing infectious material into the mouth, nose, or eyes. In the same manner books, pencils, and other objects may become infected.

Sinks were provided in three schools, and were a part of the water and sewer systems. At 56 schools, practically 75 per cent of the total, common washbasins were provided. At three of these schools the basins were frankly, and in a number of other instances obviously, not in use. Paper towels were provided at eight schools, notably at all six of the schools in Pleasant Township. Individual or "family" towels provided by the parents were reported in use at three schools, common towels at 41.

Use of common drinking cup.—The use of the common drinking cup in public places is not prohibited by law in the State of Indiana, notwithstanding they are dangerous to health. Prof. Davison,[1] of Lafayette College, found human cells scraped from the lips of persons while drinking so numerous on the upper third of a glass in use only nine days that the head of a pin could not be placed anywhere thereon without touching one or more of these small pieces of human tissue.

More to the point, however, is that he found germ cells left by the saliva deposited while drinking in such a quantity that not less than 100,000 bacteria were present on every square inch of this glass. He found by special methods that a number of these organisms were of the kind which produce disease.

During this survey the common cup only was in use in 14.3 per cent of the rural schools of the county, individual cups only in 42.5 per cent, and individual cups by some of the pupils and the common cup by the others in 40 per cent.[2] In most coses, however, the so-called individual cup was a "family" cup used by the members of the same family. The practice of lending the individual cups to others was found on inquiry to be quite common, so that these were essentially common drinking cups.

The use of individual cups, with a suitable place for keeping them and due explanation of their need, should be imperative in all schools as an object lesson in personal hygiene.

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[1] Prof. Davison: Technical World Magazine, August, 1908.

[2] Water buckets in 24 schools, common cups in 31, individual cups in 52.

CLASSROOM EQUIPMENT.

The essential features of the classroom equipment from a hygienic standpoint are briefly: The number, type, and arrangement of desks; the location of blackboards; their composition, width, and height above the floor level; and provisions for the collection of dust and the use of window shades, their color and adjustment. Preliminary to a discussion of these features of classroom equipment brief mention may be made of classroom walls and floors.

CLASSROOM WALLS.

The color and finish of classroom walls are of prime importance from the standpoint of illumination. In general, classroom walls should be of hard plaster and tinted some pleasing color of high reflection coefficient, using oil paint. The finish should be without gloss to avoid glare. The use of wainscoting is intended primarily for the protection of the walls from injury. For this purpose some form of tiling may be used in halls and corridors. Classroom walls, however, are not subjected to the same danger of mutilation; and the wainscoting is used largely to tone down the light reflected by the lower portion of the walls. This can be accomplished readily by painting a strip of the plastering to the necessary height, about 4 feet above the floor level. Its color should have a reflection coefficient not higher than 30.

The use of wooden wainscoting is undesirable in classrooms because it adds to the inflammable material. Painted burlap for this purpose is also undesirable. This substance presents a roughened surface for the collection of dust and does not readily lend itself to washing.

All corners, as well as the junction of the walls with the ceiling and floor, should be rounded. This arrangement is intended to avoid the collection of dust and to permit washing the walls effectively.

FLOORS.

The use of wood in the construction of classroom floors is advocated from the standpoint of comfort. The flooring material in all cases should be narrow, not over 2 inches wide, and laid as tightly as possible, using concealed nails.

To reduce dust the floor may be oiled, and where vacuum cleaners are not available a sweeping compound may be employed. The Indiana law requires the oiling of classroom floors twice during the school year. Oiling of floors was observed in nearly all the schools inspected to the extent of at least once annually, generally at the beginning of the school year. Further consideration of dust and its effects will be given under another caption (p. 59).

SCHOOL DESKS.

It is not possible to dissociate the consideration of school desks from posture in school children and the effect of faulty posture on health. The deformity most usually associated with faulty posture is some form of functional spinal curvature. For this reason posture and postural defects will be considered in another section of this report which deals with defects among school children (p. 88).

Irrespective of the cause of postural defects, many of them may be overcome by appropriate measures during the period of school life. Of these measures may be mentioned the adjustment of the desk to the child. Probably upon no single physical feature connected with schools have such definite conclusions been reached as upon the relation of school desks to children. It is now quite generally agreed that the height of the desk should be so adjusted that the arms of the seated child will rest naturally on the desk in an easy position, with the elbows at the side.

The size of the desk top should vary according to the grade. That advocated in the Boston code is as follows: Grades I to III, 12 by 18 inches; grades IV to VI, 15 by 21 inches, and for grades VII to VIII, 16 by 23 inches. The slope of the desk should vary from 15° for writing, to 30° or 45° for reading. These regulations are intended to cause the child to maintain an upright position and to prevent his bending the head unnaturally while performing school tasks.

The desk seat should be adjusted to allow the feet to rest squarely on the floor when the legs are flexed at right angles. It may be flat or curved to fit the buttocks. The front edge should be rounded. The depth of the seat from front to back should be two-thirds the length of the thigh.

The relation of the seat to the desk has been described as minus, plus, and zero, depending on whether the front edge is in front, to the rear, or on a line with a perpendicular from the edge of the desk to the floor. This measurement should never exceed 1 inch in any direction. The plus arrangement has been found most suitable for general school purposes.

The distance from the seat to the top of the desk should equal about one-sixth of the height of the body. The back should be placed at right angles to the seat and extend to the shoulder blades, curved concavely from side to side and convexly from above downward, giving support to the lumbar spine. These desk requirements cause the child to assume an upright posture, prevent sprawling and the assumption of slouchy postures, and place the work at the proper angle and distance for visual comfort. These requirements, however, cause considerable restraint to the natural activities of young children and therefore necessitate frequent rest periods, especially in the lower grades.

Adjustable desks.—The use of some form of adjustable desk is necessary to fulfill all the requirements of an ideal school seat. The frequency of adjustment depends upon the sex and age of the child. Adjustments should be made, however, in all cases at the beginning of the school year. As a rule, girls grow more rapidly in height between the ages of 12 and 14 and boys between the ages of 14 and 16. The girls in Porter County schools, however, attain their most rapid growth from 12 to 14 and the boys from 13 to 15 years. Special care should be given to the more frequent adjustment of desks to children at these periods of rapid growth than at other age periods.

Adjustable desks are in use in only 9.15 per cent of the classrooms of the county. Most of the classrooms with nonadjustable desks, however, were supplied with desks of various sizes for children of different heights.

Number and arrangement of desks.—The average number of desks per classroom for the county was 33.7, influenced by the necessity of seating an undesirable number of children in the one-room schools of the county. The number of seats provided, however, was in excess of the children present. Ten classrooms had adjustable seats; 95 nonadjustable.

Desks should be arranged with a view to obtaining the greatest visual comfort and separation of the pupils in the interest of health. The desks should be arranged in parallel rows, with windows to the left and rear. To avoid shadows the smallest seats should be nearest the windows and successive rows in regular gradation. Desk rows should not be nearer the wall than 24 inches. Aisles separating desk rows should be 18 to 20 inches wide, according to the grade.

The average width of aisles separating desks from classroom walls in the county was as follows: Right aisle, 39.7 inches; left aisle, 29.7 inches; front, 7.8 feet; rear, 3.3 feet; and the average distance between desk rows was 21.4 inches. In a number of schools, however, the desks were placed as closely as possible to the windows and walls, a very undesirable situation from the standpoint of illumination, and also undesirable because this arrangement interferes materially with the cleaning of floors. Furthermore, window ventilation can not be practiced without subjecting the children occupying these seats to objectionable drafts.

WINDOW SHADES.

The requirements to be fulfilled by window shades are that they be translucent, be adjustable from either top or bottom, and be kept in good repair. A window shade which transmits colored light rays is undesirable. The translucent shade should be supplemented by an opaque one between it and the light source to shut out direct sunlight.

Window shades adjustable from top and bottom were found in 51.5 per cent of the classrooms of the county.[1] There were no shades whatever in three schools, and the shades were in poor condition in at least nine other classrooms. The latter statement is conservative, because a number of window shades in other classrooms were badly faded and require replacement at an early date. All of the window shades in the county were semiopaque, the predominant colors being some shade of green or yellow.

In a large number of classrooms inspected during this survey the lower sashes of windows were more or less obscured by muslin window curtains. No doubt this arrangement imparts a more homelike aspect to the classroom; but the practice is objectionable, because these curtains not only reduce the amount of daylight admitted to the classroom but do so increasingly by reason of the accumulation on them of dust and dirt.

BLACKBOARDS.

The use of blackboards is so necessary to classroom instruction that careful attention should be given to their construction, width, height, distance from the floor level, and location with respect to windows.

The use of wood for this purpose is no longer tolerated in well-regulated schools. The surface of such boards soon acquires a polish which causes glare that markedly interferes with vision. Composition blackboards are now on the market which give good service for a time. A number of these, however, have no very great lasting qualities and soon acquire an irregular surface which interferes with both writing and vision. Liquid slate applied directly to the wall or to a concrete surface requires frequent renewal, pending which unsatisfactory service is given.

The cheapest blackboard material in the end is slate. To meet the requirements of an ideal blackboard, however, the slate must present a dull black surface.

Slate was used for this purpose in 89, or 85.5 per cent, of the classrooms of the county. Composition blackboards were used in 7 classrooms, wood in 1, and a painted wall strip in 8 others.

Blackboard dimensions.—The statement that a classroom can not have too much blackboard space needs qualification, because it was made evidently without due regard to the requirements of classroom illumination. The light absorption by black surfaces is so great that an undue proportion of blackboard space reduces the amount of light diffusion in the room. Where the demands for large black-

[1] Window shades in 54 classrooms were adjusted from top, in 46 from top and bottom, In 67 they were green and in 30 tan.

board surfaces are imperative, however, the blackboards might be fitted with curtains of light color adjusted to rollers, which could be drawn when the boards are not in use.

The standard width up and down of blackboard surfaces is 4 feet, the average for the county being 41.6 inches. In practice it has not been found necessary for the top of the blackboard to reach a higher level than 6½ feet above the floor.

Blackboards in classrooms intended for the primary grades should be placed at a lower level than in the case of those for the higher classes. When placed too high the arms are raised to a height while using them which soon induces fatigue. An acceptable measurement from the floor level now advocated is 26 inches for the primary grades and 30 inches in the higher grades. The average distance from the floor for all grades in the classrooms of the county was 33.5 inches, ranging from 24 to 40 inches.

Location of blackboards.—Blackboards should never be placed between windows nor in obscure parts of the classroom. In the former position the contrast between this dark surface and the window brightness causes glare which is so great as to render such boards practically useless for classroom instruction. In the latter case the obscurity of that portion of the classroom is intensified by the light absorption by these black surfaces. The best location for the blackboard is the front wall of the classroom. This space may be supplemented by utilizing the right-hand wall. In both of these locations blackboards receive good light and are visible without discomfort to the entire class. Blackboards should never be placed on walls having windows or on the rear wall of the classroom under any circumstances. In classrooms lighted from one side only, the location of blackboards on the opposite wall causes great light absorption, which may be avoided by the use of curtains in the manner already described. In 36 per cent of the classrooms of the county the blackboards were located with windows to the left and opposite, on either side in 33 per cent, on either side and opposite in 21 per cent, and to the right and opposite in 7 per cent.[1]

Chalk troughs.—Classrooms may be protected to a large extent from blackboard dust by the use of shallow troughs, from 3 to 4 inches wide, which are placed at the bottom of the blackboards and covered by a detachable wire screen of coarse mesh. This latter arrangement protects the fingers, crayons, and erasers from the accumulations of powdered chalk. Dust from these sources is irritating to the respiratory mucous membrane. These receptacles, therefore, should receive careful attention and be emptied daily after school hours. Practically all of the classrooms of the county were equipped

[1] Windows to right in 7 rooms, to left in 36; blackboards between windows in 56, windows opposite in 70.

with some arrangement for this purpose; but few of them were protected by wire screens.

DAYLIGHT ILLUMINATION OF CLASSROOMS.

Studies were made of the daylight illumination of 109 classrooms in 75 rural schools during the course of this survey. Faulty illumination may cause lasting injury to the visual health; for instance, not only may it aggravate the condition of nearsightedness in young children, but it is also considered by many authorities a cause of this condition.

Defective illumination of classrooms has an adverse influence also on the activity of the intellectual processes of children. The young child requires greater intensity of illumination than the adult to enable it to interpret the meaning of written or printed characters. One reason for this is physiological. Another is that these characters are familiar to an adult, and are, therefore, easily recognized and interpreted under conditions of poor illumination. Furthermore, the mind of the young child functionates largely in proportion to the volume of stimulation received through the eye. Whenever, by reason of faulty illumination, extra effort is required of the ocular muscles to accommodate for the recognition of written or printed characters, fatigue is soon produced, and the intellectual development of the child is hampered.

Faulty illumination causes the assumption of injurious postures and the acquirement of a "postural habit" that may aid indirectly in the production of postural defects which may ultimately act injuriously on the general health in later life. In fact, the faulty posture frequently assumed by the child under conditions of poor illumination has been assigned by a number of medical authorities as a causative factor in the production of nearsightedness.

SECURING AN ABUNDANCE OF ILLUMINATION.

The whole subject of illumination is highly technical, and the practical application of the principles involved, in so far as daylight illumination is concerned, is not easy, due to the absence of working standards occasioned by the numerous accommodation factors involved. In recent years, with increased knowledge of the fundamental principles of illumination, the illuminating engineer and the architect have deduced certain requirements for the daylight illumination of classrooms. The object of these requirements is to secure an abundance of light from the right direction, to insure a maximum diffusion with the avoidance of objectionable glare, and to make suitable provision for its regulation by increasing or diminishing the amount of light admitted as necessity may demand.

Window area.—In order that sufficient light may enter classrooms properly to illuminate all desks under all conditions, certain measures of illumination have been adopted from time to time. Perhaps the most widely accepted of these, at least in this country, is the one

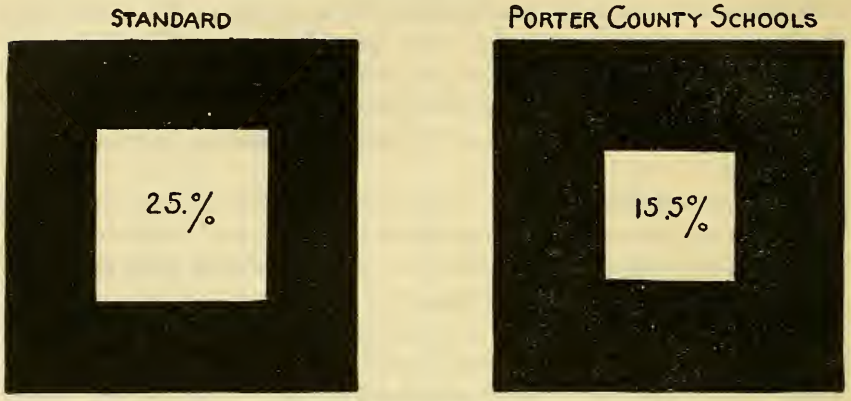

CHART 1.—Standard ratio of glass area to floor space of schoolrooms and average ratio in Porter County.

which requires the glass area of classroom windows to be not less than one-fourth the floor space of the classroom. In Porter County the average ratio of glass area to floor space was 15.5.

In charts 1 and 2 are shown graphically the standard ratio of glass area to floor space, the average for all the rural schools of

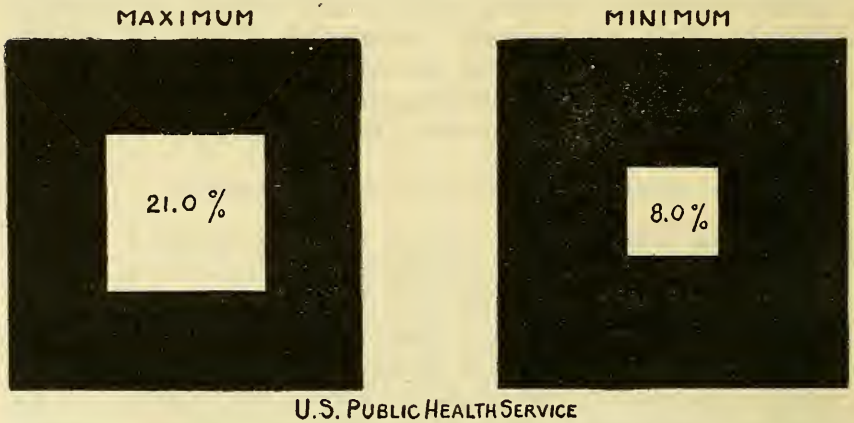

CHART 2.—Maximum and minimum ratios of glass area to floor space in classrooms of Porter County.

Porter County, and likewise the county maximum and minimum. It will be seen at a glance that even the maximum architectural provision for classroom illumination is considerably less than the generally accepted standard.

It must not be supposed that the desk illumination of all the rural schools of Porter County is as deficient as indicated by the foregoing charts. Actual photometric observations made in a number of schools representing county types show that this is not the case. The apparent discrepancy is due to the relatively small number of desks, which may therefore be grouped near to windows and occupy a space commensurate with lighting efficiency.

In chart 3 is given the desk illumination of the fifth grade in the Chesterton school, Westchester Township. It will be observed that this classroom, with a window-glass area of 17 per cent, had a high desk illumination, nowhere less than 23.3 foot-candles. These observations were made under favorable meteorological conditions.

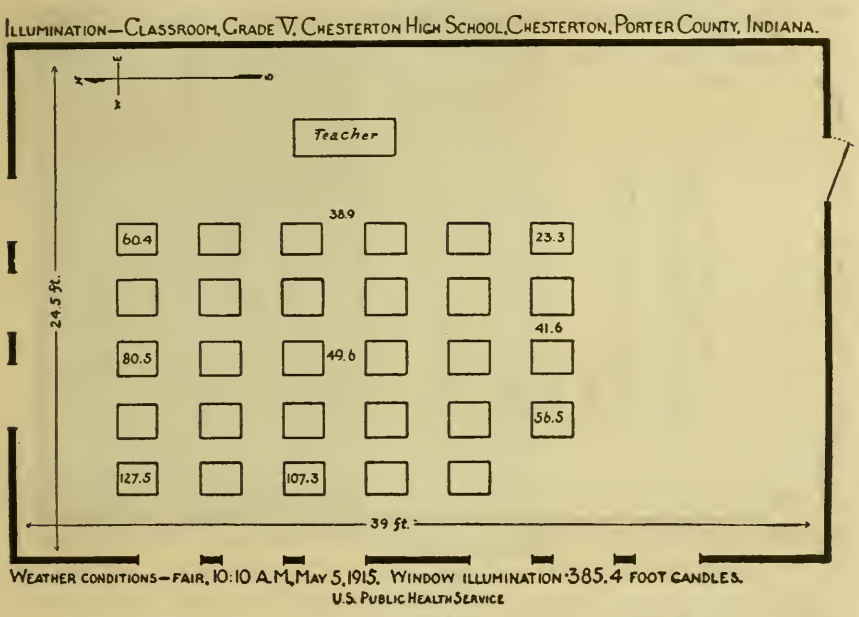

CHART 3.

The high illumination intensity, however, was due largely to windows on the left and rear of the seated pupils and to the location of the classroom on the second floor, which permitted an unobstructed sky surface.

The high illumination intensity shown in this classroom calls for regulation by appropriate means.

Chart 4 is particularly instructive because it shows the necessity of a different desk arrangement in closer proximity to windows and the serious consequences from the standpoint of illumination of classrooms of great depth in a direction opposite the light source. In cloudy weather it is necessary to supplement the illumination of

this room by artificial means, an exigency which could be obviated in a measure by grouping the desks nearer the windows.

The utilization of this standard, however, is conditioned by certain more or less rigid restrictions. In the first place, it must not be forgotten that the illumination of a given desk in a classroom is inversely as the square of the distance from the source, which in this instance is the classroom window. The adoption of this standard of illumination, therefore, fixes the width of classrooms within very definite limits, so that no desk should be removed further than 20 feet from the source of light under average conditions of one-sided illumination.

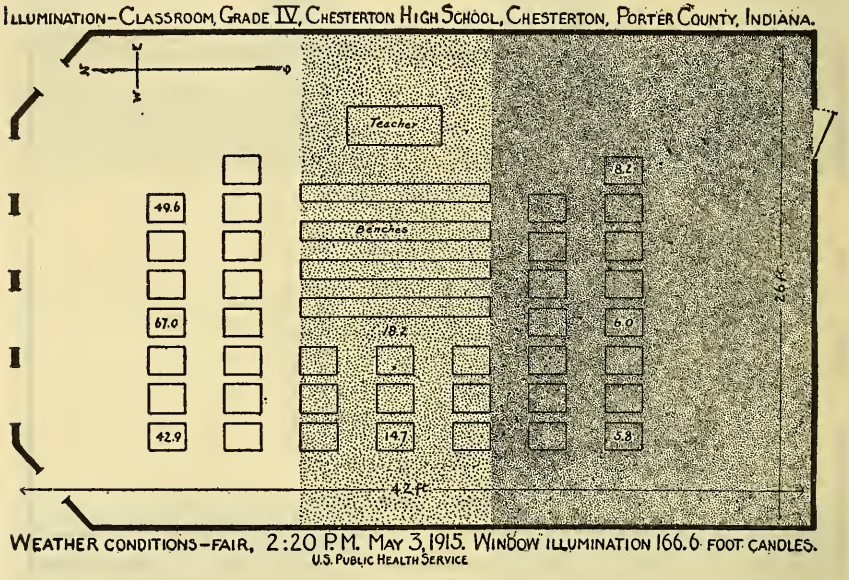

CHART 4.

The amount of light entering classroom windows of a given area is modified by the angle of incidence, by the proximity and color of neighboring buildings, by the presence or absence of shade trees, by projecting eaves, by variation in the number of sunny days, by the distance of the upper edge of the window from the ceiling, and even by the thickness and quality of the glass used in windows.

Nearness of neighboring buildings hardly enters the problem of rural school construction. Nearness of shade trees, however, may seriously interfere with the admission of daylight to classrooms.

Visible sky vault.—In order that the pupil may receive the light necessary for the illumination of his desk, a measure has been suggested which demands that the child shall be able to see a part of the sky vault from his seat. It has been suggested that this sky

surface be measured by a reduced solid angle of not less than 50 square degrees. This provision presupposes that the angle of incidence of luminous rays, that is, an angle formed by a plane from the upper surface of the desk cutting the upper edge of the window, and another plane from the same point cutting the lower edge of the visible sky surface, should be not less than 5°. Moreover, the angle of elevation of the luminous rays, that is, the angle included between the upper of these two planes and the horizontal, should not be less than 25°. These and similar measures of illumination, however, admit of wide variations, because they take into consideration direct light only, without reference to the important factor of reflected light from whatever source.

Photometric standards.—The adoption of a standard of desk illumination based on actual photometric observations is the most rational of all requirements to secure the proper illumination of classrooms. The amount of light so measured should not be less than 10 foot-candles at any desk under all conditions. The measure suggested is higher than that usually advocated. But it must be remembered that it is easier to regulate an excess of light than to provide for more after the school building has been constructed.

One of the difficulties attending this standard, however, is the necessity of working out all architectural features affecting illumination, because of the wide daily and seasonal variation of meteorological conditions in different sections of the country.

On the other hand, there are certain architectural features having a direct bearing on the amount of daylight entering the classroom which should not be omitted under any climatic conditions. Not only is it desirable to have a certain extent of sky surface visible from the desk, but the light proceeding from these sources should enter the classroom at as great an angle of inclination as possible. For this reason the upper edge of all windows should reach the ceiling so that the rays of light entering may approach more nearly the perpendicular and insure a maximum of diffusion with the elimination of objectionable glare. On an average the top of the windows were 25.6 inches from the ceiling and the lower edge 35.2 inches from the floor.

Less reliable measures of illumination efficiency.—In remote districts and even in communities having model facilities for illumination, it is very desirable to provide teachers with some simple and practical guide for determining the illumination efficiency in classrooms. Even where proper facilities have been provided, good illumination depends largely on the efficiency of the janitor's service and the personal equation of individual teachers. For example, the absorption of light transmitted through ordinary window glass is about 10 per cent. This loss is greatly augmented where the cleaning of win-

dows has been neglected and dust and dirt allowed to accumulate on the window panes. Not infrequently, opaque window shades are drawn to exclude excessive illumination and left in this position when the necessity is past. Curtain fixtures readily get out of repair and remain so through neglect of the janitor or school authorities, and are thus a disturbing factor in the proper illumination of the classroom.

Probably the most readily available measure suggested is the ability of the normal eye to read diamond type readily at a distance of 20 inches. A framed card bearing one or two paragraphs printed in diamond type may be utilized for this purpose.

It has also been suggested that a row of square dots, 1.4 millimeters each way, separated by 1.4 millimeters, be added to the ordinary test card. Under usual conditions these dots are seen as a row of squares at a distance of 20 feet. If the light be poor, however, the dots become fused into a continuous line.

These tests are purely relative and serve solely to call attention to possible deficiencies of illumination. The use of such tests by far-sighted persons or by persons more than 40 years of age would call for correction by glasses.

POSITION OF ILLUMINATION SOURCE WITH RESPECT TO DESK ARRANGEMENT.

The provision of an abundance of light is but one of the requirements for satisfactory illumination. Daylight must be admitted from the proper direction also if the maximum effect with the least discomfort to the visual apparatus is to be secured. Classroom windows, therefore, must never be located in such a manner as to permit light to fall in the faces of the seated children, nor should they be opposite each other because of the cross lights and confusing shadows produced by this arrangement.

Unilateral window arrangement to the left of the seated pupils is quite generally adopted in this country. There are two serious objections to this practice. In the first place, frequently the shadow of a very stout child, seated between the window and the desk occupied by a child who is much smaller physically, reduces the illumination of the latter's desk. In the second place, in all cases where unilateral illumination is practiced, the desks immediately adjacent to the windows at times receive illumination of so great an intensity that it is hard to regulate without throwing a part of the classroom in shadow. The situation is comparable to artificial lighting, where better illumination is secured by the proper distribution of a number of small lighting units than by the use of a few concentrated units. Two-sided classroom illumination, by windows to the left and rear of the seated pupils, is therefore preferable. This arrangement

secures a more uniform light distribution which may be more easily regulated with respect to intensity than is the case with unilateral illumination.

The sole reasonable objection to this arrangement of classroom windows is the annoying effect on the teacher, who is usually seated facing windows when they are located in the rear walls of the classroom. There is no valid reason for this usual arrangement of the teacher's desk, which seems to be a matter of hoary custom. The above-mentioned disadvantages are obviated readily by placing the teacher's desk diagonally in the left front of the classroom, causing the teacher to face in a direction opposite light sources when seated, at the same time permitting supervision of the seated pupils.

The accompanying chart (5) is a graphic representation of the direction of classroom illumination and the relative proportion of 109 classrooms lighted from one, two, or more directions. The periphery of the dark sphere here shown represents 109 classrooms to be illuminated, and the light segment the proportion of classrooms receiving light from a particular direction. It will be seen from this chart that the greatest number of these classrooms were lighted by windows placed to the left. The next greatest number by windows to the left and rear, 18.8 per cent and 27.2 per cent of the total number respectively. In other words, daylight was admitted to classrooms from a desirable direction in only 46.2 per cent of the rural classrooms of this county.

Of the classrooms in which windows were improperly located with respect to the desk arrangement, 20.5 per cent had cross illumination from right to left, 5.8 per cent right and rear, 21.2 per cent, left, right, and rear, and practically 3 per cent had windows on all four sides. In one school the light was received from the rear; in one from the front and left, and in two schools it was from the front, right, and rear. In nearly all these schools with faulty window arrangement, it would be practicable to close certain windows, enlarge others, and to modify the desk arrangement in a manner to secure better and more comfortable light at moderate expense.

DIFFUSION OF LIGHT AND AVOIDANCE OF GLARE.

The daylight illumination of classrooms is often defective because due measures have not been taken to secure the maximum diffusion of light entering such rooms. The diffusion of light depends upon the fact that all materials reflect light and under varying conditions scatter it in a greater or less degree. Some materials reflect nearly all the light diffusely, others specularly after the manner of a mirror. The ratio of diffusion to specularly reflected light by objects varies greatly according to the degree of surface polish and color.

CHART 5.—Relative position of windows in Porter County classrooms. (Explanation of chart in text, page 41.)

Types of diffusion.—The measures necessary to secure the proper diffusion of light will be better understood in connection with a clear conception of what is meant by types of diffusion. The following definitions are taken from the report of a committee of the Illuminating Engineering Society on the "Optical Properties of Diffusing Media:"[1]

1. Specular reflection is that exhibited on a plain, polished surface, neither scratched, dirty, wavy, nor, if not opaque, reflecting diffusely within the surface.

2. Partly specular diffusion is the reflection of light in which a distinct image of the source may be seen, as by a dusty mirror, or sheet of glass overlying paper.

3. Near diffuse reflection is when the specular image is completely broken up, yet the diffusion is far from complete. Reflection from calendared paper and other wavy surfaces is of this class.

4. Diffuse reflection is when a surface is uniformly illuminated and appears equally bright, viewed at all angles of reflection. Blotting paper, felt, snow and other masses of fine crystals exhibit nearly perfect diffuse reflection.

This latter is the desirable type of light reflection in interiors. The more completely light is diffused the greater will be the avoidance of glare.

Glare.—Glare, as ordinarily defined, is a condition of reflection arising when the brightness of an object reflected peripherally on the retina is relatively greater than that of the object whose image is centered on the yellow spot.

In the report of the Illuminating Engineering Society on "Diffuse Media—Interior Furnishings,"[1] glare has been classified, as involved in interiors, into—

(1) *Brightness glare.*—Excessive brightness, such as occurs with the sun shining directly on snow, white paper, or a white window shade.

(2) *Contrast glare.*—Contiguous bright and dark objects cause disturbance of vision if their relative brightness is excessive. A bright illuminant viewed against its background, a dark window frame against sky or landscape, and glare exhibited on a glossy surface are familiar examples.

(3). *Veiling glare.*—That condition in which the surface to be observed appears covered with a light or dark veil of different or imperceptible pattern. A blackboard viewed from near the specular angle, when imperfectly located with respect to windows, often furnishes this type of glare.

Glare is observed when light rays are nearly parallel to the eye level. Therefore, light sources situated above this level are more likely to be free from glare. For this reason the lower edge of the classroom windows should be well above the visual level of the seated pupils.[2]

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[1] Transactions of the Illuminating Engineering Society, July 20, 1915.

[2] The Boston school code requires the lower window sill to be 2½ feet from the floor, a distance not considered high enough from the standpoint of illumination. This distance is fixed by other authorities at 3.75 feet to 4 feet.

Furthermore, the more diffusely light is reflected and the lower the ratio of specular reflection thereto, the greater is the freedom from glare. Certain polished surfaces, largely influenced by their color, reflect light in a specular manner. The side walls of a schoolroom, therefore, should have a mat surface free from gloss. In the case of ceilings, however, no such objection exists, because the light reflected therefrom is at the greatest possible angle to the visual level, and therefore not likely to produce glare.

Classroom walls should also be colored in a manner to obtain reflection with a maximum of diffusion. For this reason shades of the primary colors, yellow and green, found near the center of the luminous portion of the solar spectrum, are selected because they not only have a high reflection coefficient, but possibly absorb other rays of the spectrum not concerned in illumination which may be injurious to sight.[1]

The use of a white coloring for the side walls of schoolrooms is objectionable because of glare, although the reflection coefficient is high. Its employment for ceilings, however, is admissible because the angle of reflection therefrom is nearly perpendicular to the visual level in classrooms of ordinary dimensions.

In 46 classrooms both the walls and the ceilings were painted green. Unfortunately the shade of green selected in many instances was so dark as to appear almost black, so that the light absorption thereof markedly diminished the illumination of said classrooms.

In 20 classrooms the walls and ceilings were both white. This is undesirable because of the eye discomfort induced by the high reflection coefficient of these surfaces at a level parallel to the eye.

In three classrooms both walls and ceilings were painted blue, and in three other instances were painted pink.

Some interesting combinations of color from the standpoint of undesirability were found in 13 classrooms. The most striking of these were green walls with natural wood ceilings in three instances; green and blue in two others; white and blue in one, and green and pink in one instance. These combinations are not pleasing to the

[1] The following table of coefficients of reflection is given by Harrison and Anderson (Transactions of the Illuminating Engineering Society, Sept. 23, 1915):

Ceiling.		Walls.		Floors.	
Color.	Per cent.	Color.	Per cent.	Color.	Per cent.
White	81.0	White	81.0	White	84.0
Light gray	61.0	Medium	42.5	Natural wood	14.0
Dark gray	33.0	Black	4.3	Black	7.6
Black	4.3				

eye, and a number of the ceilings have a very low reflection coefficient instead of a high one.

Wainscoting of wood was found in 50 classrooms. In eight others the lower part of the wall was painted a darker shade to a height ranging from 48 to 54 inches. The average height of wainscoting in all the schools of the county was 38.5 inches, ranging from 31 to 60 inches.

The ceilings of classrooms were of metal in 16 instances, wood in 5, and were papered in 2 schools. The side walls were papered in 4 schools. For sanitary reasons schoolroom walls should not be papered.

In 39 classrooms the wall and ceiling surfaces were gloss, mat in 61, and a combination of mat walls with gloss ceilings in 8 others.

In view of the definite value of proper illumination as an aid to the educator, the data relative thereto collected during this survey clearly emphasizes the need of scientific advice in planning the natural illumination facilities of schools. The average builder can not be relied on to plan buildings for educational purposes. In a matter apparently so small as the finish and coloring of classroom walls, this survey shows the need of due consideration of the principles of illumination rather than deference to the individual liking of school trustees or other influential persons. The cost of redecorating every classroom in the county where the color and finish were found objectionable would be small in comparison to the increased attractiveness and illumination efficiency.

REGULATION OF INTENSITY OF CLASSROOM ILLUMINATION.

It has been shown in another place in this report (see p. 22) that the orientation of school buildings is largely influenced by the desire to admit sunlight to all classrooms during some hour of the day. Direct sunlight shining on bright paper, books, and the like, however, will cause brightness glare. This may be avoided by the use of translucent window shades backed by another shade which is opaque to shut out direct sunlight. Window fixtures should be of a type to permit the adjustment of window shades from either the top or bottom of the window.

HEATING OF CLASSROOMS.

Under modern conditions the problems of heating and ventilation are so closely associated that either question can scarcely be considered separately in the planning and erection of school buildings. This is due to the necessity of warming fresh air introduced into classrooms in cold weather to replace that removed in the course of ventilation.

The physical laws which govern heat demand careful observance in the planning of buildings and form problems which require the assistance of skilled engineers whenever large installations are to be made. School trustees and principals, however, should acquire a certain familiarity with the general principles involved, to enable them to appreciate the necessity of expenditures for this purpose and to act intelligently.

EFFICIENCY OF DIFFERENT TYPES OF HEATING APPARATUS.

Grates.—It has been said that the best form of open grate gives only 20 per cent of the heating value of fuel. The intensity of heat from a grate varies inversely as the square of the distance from the source. Furthermore, the air of a classroom is not warmed directly by radiated heat, which passes through it without raising its temperature. For this reason an open fire warms surfaces of the body directly exposed to radiation only, while the rest of the body remains cold. An open fire acts, however, as an effective means of ventilation in rooms of reasonable size. It also causes a minimum reduction in the relative humidity of the confined air. Open fires may be appropriately utilized for heating classrooms in small mining towns and other localities where the fuel supply is plentiful and cheap.

Stoves.—From an economic standpoint the closed stove is the most effective method of warming rooms. The modern base burner is said to utilize 70 to 80 per cent of the fuel value of coal. Stoves heat by direct radiation from their surfaces and by convection due to changes in the weight of air heated by contact. It is of interest to note in this connection that the radiation of heat by stoves, and by radiators as well, is not influenced by their form, but that this power is affected by the color and condition of the radiating surfaces. In this respect polished surfaces radiate less heat than rough ones, and surfaces painted with lampblack or similar material radiate greatly in excess of those that are not.

The objection to closed stoves is due to the space occupied by them, the dust and dirt occasioned by their care, the difficulty of regulating temperatures, and the harmful influences on atmospheric conditions in confined spaces.

Closed stoves were used for heating purposes in 31 instances, or in 41.1 per cent of the rural schools.

The use of these stoves is usually accompanied by wide fluctuations in classroom temperatures and variations in different parts of the classroom at the same time, which are incompatible with physical comfort and educational effort.

The average temperatures observed in 21 schools so heated was 68.5° F., ranging from 59° F. to 81° F. These extremes of tempera-

ture, even though temporary, emphasize the difficulty of maintaining an equable temperature with this type of heating apparatus.

The use of the closed stove, furthermore, is accompanied by great reduction in the relative humidity of the classroom atmosphere. No steps had been taken in any of these classrooms inspected to obviate this condition. Measures usually adopted for this purpose in connection with closed stoves are far from adequate; but their use has an educational effect and serves to impress the pupils with the hy-

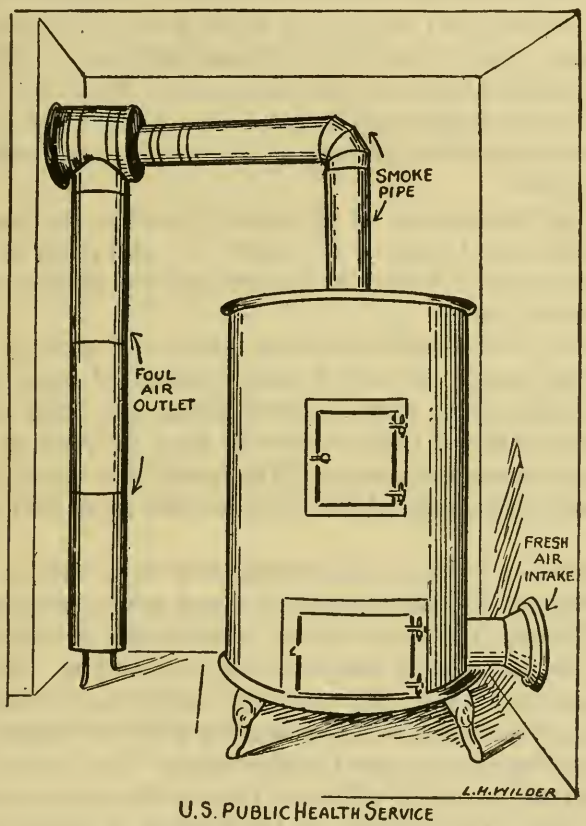

FIG. 7.—Type of jacketed stove.

gienic value of a requisite amount of moisture in the air of classrooms and homes.

Jacketed stoves.—An attempt to overcome the defects of heating by closed stoves, and at the same time retain their economic heating efficiency, is seen in the so-called jacketed stoves now in use in quite a number of rural schools, a type of which is shown in figure 7. The outside air is introduced directly to a space between the stove and a jacket surrounding it. The air expands on coming in contact with

the warm surface, rises, and carries heat to all parts of the classroom. The advantages of this method of heating are largely those of ventilation. These will receive further consideration under the proper caption (p. 54).

Jacketed stoves were installed in 26 instances or in 34.5 per cent of the rural schools of the county.

The care of jacketed stoves is more complicated than that of the ordinary closed type. The fresh-air connections were broken, disconnected, and otherwise rendered useless in a number of instances, so that the air supplied was drawn either from the building or cut off altogether. As a result the combined efficiency of the heating plant was reduced to that of the closed stove. Moreover, collections of dirt and other débris were found accumulated in the spaces surrounding the stove and its jacket and in a number of instances in the air supply pipes.

The average temperature of 22 schools heated in this manner was 74° F., the extremes being 65° F. and 85° F. All parts of the classrooms, however, were heated in a more uniform manner than with the closed stove type.

Humidifiers were attached to these stoves and were in use in 11 schools. The average amount of water evaporated from receptacles in 10 schools employing them was 1.25 gallons per diem, an amount so small as to make but little impression upon the relative humidity of the air in an average classroom. The humidifiers usually met with in connection with stoves of this type are too small and are badly located.

Hot-air furnace.—The hot-air furnace is essentially a stove the heating surface of which is inclosed in a case with a space separating the two. Through this space the air from outside sources circulates and when warmed rises to the points of distribution. The furnace is usually located in the cellar, and the heated air is conducted by flues to the various rooms. These heating flues are usually covered by a grating where they enter the classroom. The total area of the openings in the grating should equal that of the cross section of the conducting flue. The register, as the grating is called, should be fitted with a damper, by which the flow of heated air may be regulated.

The circulation of air takes place because of the difference in the weight of the heated air inside and of the air outside of the conducting flues. This difference in weight is small; consequently, in installations where the furnace or conducting flues are improperly located certain classrooms are insufficiently warmed during stormy weather, depending on the intensity and direction of the wind.

The efficiency of a hot-air furnace, when the air to be warmed is taken from the outside, is said to be 50 to 60 per cent of the heating value of the fuel.[1]

Temperatures in 15 classrooms, heated in this manner, were recorded, the average being 73.5° F., and the extremes 67° and 84° F., respectively.

Hot-air furnaces were installed in 16, or 21.1 per cent, of the schools of the county. The air used for purposes of warming was carried by gravity to the classrooms of 10 schools, or 62.5 per cent of those warmed by this system. In 6 other schools the hot air was introduced to the classroom with mechanical assistance.

Temperature observations were also made in 12 classrooms in 4 schools, where mechanical aids to hot-air conduction were employed. The average temperature of 12 classrooms was 72.5° F., the extremes being 70° and 79° F., respectively.

The humidification of the classroom atmosphere in all these schools was entirely inadequate.

Steam and hot-water heating.—In but two schools of the county, Kouts and Porter, were steam or hot-water systems used. The advantage of these systems lies in the ease and certainty with which heat may be conveyed from a central plant to distant points, practically uninfluenced by the force and direction of the wind.

From the standpoint of ventilation, however, direct heating by steam or hot water differs but little from the closed stove. The efficiency of direct steam or hot-water heating is said to be 60 to 70 per cent.

Direct hot-water heating has certain advantages over steam, due to the circulation of the former taking place at a lower temperature, namely, about 140° F. for hot water and 212° F. for steam. Hot-water plants, therefore, begin yielding heat much more quickly after starting the fire than is the case with steam and continue to do so for a longer period after the fire has died down. Furthermore, by reason of these characteristics of hot-water heating, a more uniform temperature may be maintained in rooms heated in this manner.

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[1] Certain rules which give approximate results have been devised for the guidance of those unable to obtain expert advice with respect to hot-air installation (John R. Allen: Heating and Ventilation):

1. The volume of the house divided by 50 equals the square feet of heating surface in a furnace radiator.

2. The volume of the house divided by 20 equals the number of square inches of grate area in the furnace.

3. Divide the volume of the room by 20 and the square root of the quotient will be the diameter of the furnace pipe for the first-floor rooms. For the second-floor rooms, divide the volume by 25, and the square root of the quotient will be the diameter of the furnace pipe.

It must be emphasized that rules of this character give only approximate results. The necessity of some easily calculated standard to supersede the hit-or-miss installations so commonly found in these schools is apparent in many rural communities.

TEMPERATURE REGULATION IN CLASSROOMS.

Objection has been made to the maintenance of a uniform classroom temperature because, by so doing, certain stimuli habitual to ordinary everyday environment are removed; as, for example, the effects of variations in heat and cold on the blood pressure. This stimulation is doubtless of considerable value in certain general disorders, where education assumes a position of secondary importance. In the case of healthy children, however, the maintenance of a desirable uniform temperature in a healthful environment is unobjectionable from the standpoint of health and is most conducive to mental application, by removing the physical stimulation in question.

The temperature usually advocated for classrooms in this country varies from 68° to 70° F. This standard, however, may be modified by climatic conditions. For example, 60° to 65° F. is considered a desirable indoor temperature in England, where the climate is uniform and the air is of high relative humidity. Similar conditions are found in localities in this country, in which places the maintenance of classroom temperatures should be regulated accordingly. Variations in either direction from this standard cause physical discomfort incompatible with the best mental effort.

The maintenance of classroom temperatures above 70° F. is an economic loss through increased coal consumption. In schools in which no provision is made for heat control an unnecessary amount of fuel is consumed and heat is wasted through doors and windows opened for cooling purposes.

Temperature observations[1] in individual schools and classrooms are recorded in the following table:

TABLE I.—*Atmospheric conditions in 72 classrooms in the rural schools of Porter County, Ind.*

Township and school.	Temperature.	Carbon dioxide per 10,000.	Relative humidity.	Humidifier.	Water evaporated daily.
Boone:	°F.		*Per cent.*		*Gallons.*
Aylesworth				+	1
Bryant	77		0.44		
Frye	71	8	.53		
Hebron, 1	71		.44		
Grades 1–2, 2	72		.41		
Grades 3–4, 3	71		.69		
Grades 5–6, 4	72		.47		
Grades 7–8, 5	72		.47		
Tannehill	74		.35		
Center:					
Cooks Corners	74	[2]—6	.31		
Flint Lake	79	8.75	.18		
Leonard	77		.21		

[1] A number of temperature observations made in this survey were discarded because, the weather being mild, they represented outside atmospheric conditions rather than methods of heat regulation.

[2] —6=less than 6 quarts per 10,000.

TABLE I.—*Atmospheric conditions in 72 classrooms in the rural schools of Porter County, Ind.*—Continued.

Township and school.	Temperature.	Carbon dioxide per 10,000.	Relative humidity.	Humidifier.	Water evaporated daily.
Jackson:	° *F.*		*Per cent.*		*Gallons.*
Burdick	85	−6	0.21	+	.....
Carter	79	8.5	.32	+	1.5
Coburg	71	−6	.29	+	1.0
County line	65	7	.52	.....	.....
Jackson Center, 1	67	−6	.52	.....	.....
Grades 1–2	.....	.....	.....	.....	.....
Grades 7–8, 2	79	−6	.29	.....	.....
Quakerdom	66	−6	.39	+	.75
Liberty:					
Babcock	81	8	.42	.....	.....
Coles	70	8	.35	+	1
Crocker	81	10	.46	.....	.....
Liberty Center (H. S.), 1	70	−6	.38	.....	.....
Grade 2	71	−6	.33	.....	.....
Linderman	67	−6	.30	.....	.....
Phares	73	−6	.54	.....	.....
Salt Creek	71	8.15	.45	.....	.....
Morgan: Schroeder	61	−6	.32	.....	.....
Pine:					
Bayles	79	8	.30	.....	.....
Brick	75	9	.30	.....	.....
Carver	72	7.5	.36	.....	.....
Frame	70	10	.40	+	1
Smoky Row	70	10	.42	+	1
Pleasant:					
Kouts, H. S. (H. S.), 1	74	−6	.31	.....	.....
Grades 6–7, 2	.....	.....	.....	.....	.....
Grades 4–5, 3	70	−6	.44	.....	.....
Grades 2–3, 4	74	−6	.35	.....	.....
Grade 1, 5	78	−6	.39	.....	.....
Lauer	77	−6	.36	+	2
Morrison	70	7.5	.....	.....	.....
Stowell	88	−6	.24	+	1.5
Portage:					
Crisman (high)	71	5.2	.41	+	5
Grades 1–2	69	8	.52	+	5
Grades 3, 4–5	84	8.2	.35	+	5
Grades 6, 7–8	76	6.5	.42	+	5
Dombey	70	8	.36	+	.5
McCool	78	7.5	.46	.....	.....
Peak	67	7.5	.....	.....	.....
Wolf	68	.....	.....	.....	.....
Porter:					
Gates Corners	65	.59	.....	.....	.....
Hurlburt	56	.....	.....	.....	.....
Porters Cross Roads	67	.....	.48	.....	.....
Skinner	71	.....	.39	.....	.....
Union:					
Cherry Glenn	76	.....	.35	.....	.....
Foster	68	−6	.46	.....	.....
Peck	71	.....	.31	.....	.....
Union Center—					
Grades 1–4	72	8	.27	.....	.....
Grades 5–8	76	8.5	.30	.....	.....
Wheeler—					
Grades 1–2	67	−6	.40	+	1
Grades 3–5	78	−6	.27	+	1
Grades 6–8	69	−6	.41	+	1
High School	71	−6	.41	+	1
Washington:					
Blake	68	−6	.46	.....	.....
Bryerly	69	.....	.34	+	3
Luther	64	−6	.44	.....	.....
Washington Township—					
Grades 1–6	77	−6	.25	.....	.....
Grades 7–8	76	−6	.25	.....	.....
Westchester:					
Baileytown	71	8	.56	.....	.....
City West	63	7.5	.40	.....	.....
Furnessville	75	8.75	.35	.....	.....
Mosquitotown	59	−6	.53	.....	.....
Old Porter	76	9	.27	.....	.....
Salt Creek	64	.....	.38	.....	.....
Waverly	67	9.15	.41	+	1.75
Average	72	.....	.363	15	1.4

[1] Quarts.

The widest variations in classroom temperatures were observed in schools heated by closed stoves, the average being 68° F. and the highest 81° F. Furthermore, the temperature varied in different parts of these classrooms, according to the distance from the stove.

Considerable variations of classroom temperatures were observed in all cases where heating was by jacketed stoves and hot-air furnaces located in basements. The average temperature in the former was 74° F. and in the latter 73.5° F., the highest being 85° F. and 84° F., respectively. The warming of all parts of these classrooms was more uniform than by either of the other methods discussed. These observations, however, plainly indicate the maintenance of too high classroom temperatures at times and undue fuel consumption. These faults are due, in part, to the type of heating system installed and in part to careless supervision.

Variations in the temperature in the classrooms warmed by hot air, mechanically assisted, were unnecessarily great. This was usually due to the absence of automatic temperature regulators.

Measures.—The efficiency of regulating temperatures where the closed stove is used depends largely on the care and attention given by some competent person, the size of the stove in relation to the cubic capacity of the classroom, the fuel used, and the material used in the building construction and its state of repair. The use of closed stoves in one-room rural schools, though economic from the standpoint of fuel consumption, is being rapidly abandoned because of the difficulty experienced in securing constant temperatures and the harmful influence of the stoves from the standpoint of ventilation.

The regulation of temperature in the case of hot-air furnaces supplying heat by gravity is accomplished by the proper adjustment of dampers in supply pipes and furnaces, and through due attention to the installation of conducting flues in inside walls protected, so far as possible, from outside atmospheric influences. Furthermore, the size of the furnace in use contributes largely to the uniformity of classroom temperatures. A furnace which has to be fired until it becomes red-hot to secure a desirable classroom temperature is too small for the building.

Steam, hot water, and mechanically assisted hot-air heating systems readily lend themselves to the use of automatic devices for securing constant classroom temperatures. The essential feature of an automatic heat regulator consists of a thermostat so constructed that its parts will move with a change of temperature in the surrounding air and furnish power to operate the air valves or electric contrivances which cause the opening and closing of valves or dampers of the heating system involved. The great advantage of

an automatic temperature control device, aside from securing a constant classroom temperature, is that the heating of classrooms is removed from the control of teachers and therefore uninfluenced by personal bias or judgment. The expense of temperature regulating installations, though considerable, is more than counterbalanced by the saving in fuel consumption incident to a regulated classroom temperature.

Electrothermic indicators are of value for the regulation of classroom temperatures in schools where full-time janitors are employed. By means of this indicator the janitor can instantly determine the temperature in any classroom from a point near the furnace and thereby determine defects or disarrangement of the automatic heat-regulating system which require attention.

The jacketed stove remains the best solution of classroom heating in the one-room rural schools. The system of hot-air heating by a centrally-located furnace in the basement is particularly adapted to local conditions in isolated rural schools of more than one room. Heating by hot water and steam requires greater care and attention between the closing and opening hours of school than is usually available for schools so situated. Where gravity is relied on to carry the air, the use of a hot-air system of heating is limited to the classrooms of schools compactly built and covering comparatively small ground areas; otherwise the inclination of certain conducting flues will be so great that the forces of gravity inducing air currents will be nearly equalized.

VENTILATION.

GENERAL CONSIDERATIONS.

The injurious effects of more or less prolonged exposure to conditions of imperfect ventilation in restricted spaces such as assembly halls and classrooms are well recognized. The exact manner in which these influences operate to cause injury, however, is not easily explained and concerning it there exists considerable difference of opinion.

Recent investigations tend to show, however, that the injurious results of confined air in crowded places are due to certain physical changes, involving temperature, humidity, and movement of the air in these confined spaces, which operate to create disturbances of the heat regulation of the body and cause variations in the blood pressure. The manner in which these disturbances affect health is not thoroughly understood at present.

It matters not whether one accepts the theory that confined air spaces vitiated through human occupancy contain some harmful

substances which require removal or the contention that the sole necessity, from the standpoint of ventilation, is to keep the air cool and in motion, the fact remains that the requirements demanded of a satisfactory system of ventilation are an abundance of outside air, not unduly heated, properly moistened, and free from mechanical impurities; in other words, a supply of air approximating natural conditions as closely as possible.

Changes of air.—Although the discomfort induced by a "close" atmosphere may be dispelled by setting the air in motion, and under certain restrictions a confined atmosphere can be rebreathed without appreciable harmful effect, after being washed and deodorized, nevertheless, for the purposes of practical ventilation, the necessity remains to supply a definite volume of air to densely populated classrooms.

Supply of air necessary for classroom purposes.—The calculation of the requisite volume of air necessary to supply a classroom under given conditions for practical purposes is based on certain compositional differences between air before and after respiration, represented by the amount of carbon dioxide present.

For the want of more precise knowledge of the influences of the volume of the air in ventilation, an arbitrary standard has been adopted which requires fresh air to be supplied in volume sufficient to keep the amount of carbon dioxide down to not more than 6 parts in 10,000.

The accepted requirement heretofore has been that each pupil should receive 30 cubic feet of air per minute, or 1,800 cubic feet per hour. The number of air changes per hour necessary to supply this amount depends on the cubic capacity of the classroom and the number of pupils. The cubic space allotted each child should be large enough to demand not more than six changes of air per hour in order to avoid objectionable drafts. The Indiana law provides 225 cubic feet of space for each child, the floor space in each case being 20 square feet.

Carbon dioxide was present in seven classrooms to the extent of 8 parts in 10,000 and in four classrooms to the extent of 10 parts in 10,000. In other words, fresh air was admitted to a large number of rural classrooms in deficient amounts, as represented by these figures. The number of carbon dioxide determinations was limited, due to several causes, principally the advent of warmer weather, followed by more open windows.

Methods of securing requisite air allowance.—There are two general methods of ventilation: namely, the gravity system, or so-called natural ventilation, and mechanical ventilation, with the use of fans. In addition to these two general ventilating systems, window

ventilation, jacketed stoves, perflation, window sash openings, flues in the ceiling leading to louvered outlets and other forms of ventilators in the roof, perforated bricks, or other openings are aids to ventilation which may be employed in small one-room schools. With respect to the relative advantages of these various systems, those that ventilate by means of open windows and other similar devices are more healthful. Mechanical ventilation presupposes closed windows, a disadvantage from the standpoint of hygiene. The advantages of this system of ventilation, however, are due to the ability to deliver air in definite quantities at a given rate to a particular place, to take it from a selected source, to warm it to the desired temperature, to wash and free it from mechanical impurities, and to add a desired percentage of moisture.

Mechanical ventilation.—In all systems of mechanical ventilation due attention must be given to the installation of conducting air flues, their size, the friction and velocity of air currents—matters of technical detail requiring the attention of skilled engineers. In general, the size of the conducting pipe should be calculated to supply not less than 1,800 cubic feet of air per pupil per hour, or six changes per hour, as the case may be, with a velocity of the air current at the register of not more than 300 feet per minute. In the case of very large registers, so located that the air current will not strike the pupils directly, a velocity as great as 500 feet per minute is said by ventilation engineers to be permissible.

Rate of air exchange.—In Table 2 is shown the rate of air exchange in 33 classrooms of Porter County, as determined by actual measurements with an anemometer:

TABLE II.—*Rate of air exchange in 33 classrooms of the rural schools of Porter County, Ind.*

Township.	School.	Total.		Per pupil.		Per desk.	
		Inlet per second.	Outlet per second.	Inlet per second.	Outlet per second.	Inlet per second.	Outlet per second.
		Cu. ft.	*Cu. ft.*	*Cu. ft.*	*Cu. ft.*	*Cu. ft.*	*Cu. ft.*
Boone	Hebron:						
	High School	32.45	34.80	0.53	0.57	0.44	0.48
	Grades 1–2	17.98	34.65	.45	.87	.43	.82
	Grades 3–4	22.80	12.40	.69	.38	.54	.30
	Grades 5–6	19.72	19.53	.73	.72	.66	.65
	Grades 7–8	36.26	23.78	1.81	1.19	1.34	.88
Center	Leonard	15.39	.....	1.02	.....	.51	.....
Jackson	Carter	.....	3.59	.....	.18	.....	.14
	County Line	1.73	1.92	.10	.11	.09	.10
	Jackson Center:						
	Grades 1–2	30.00	26.35	1.50	1.32	1.50	1.32
	Grades 7–8	34.00	24.18	2.62	1.86	1.10	.78
Liberty	Crocker	4.59	.98	.19	.04	.13	.03
	Daley	4.62	.....	.26	.....	.11	.....
	Liberty Center:						
	High School	25.20	25.30	1.15	1.15	.84	.84
	Grades	22.80	3.80	1.14	1.90	.95	.16
Pine	Smoky Row	.....	1.33	.....	.06	.....	.05

TABLE II.—*Rate of air exchange in 33 classrooms of the rural schools of Porter County, Ind.*—Continued.

Township.	School.	Total.		Per pupil.		Per desk.	
		Inlet per second.	Outlet per second.	Inlet per second.	Outlet per second.	Inlet per second.	Outlet per second.
		Cu. ft.	*Cu. ft.*	*Cu. ft.*	*Cu. ft.*	*Cu. ft.*	*Cu. ft.*
Pleasant	Kouts:						
	High School	15.60	17.16	0.30	0.33	0.26	0.29
	Grades 6–7	8.28	15.60	.30	.56	.19	.36
	Grades 4–5	14.30	16.90	.41	.48	.29	.34
	Grades 2–3	19.15	.....	.58	.....	.42	.....
	Grade 1	.....	4.68	.....	.15	.....	.11
Portage	Crisman:						
	High School	18.85	10.80	1.57	.90	1.26	.72
	Grades 1–2	31.62	12.60	1.51	.60	.81	.32
	Grades 3–5	21.70	8.82	.59	.24	.53	.22
	Grades 6–8	30.07	2.16	1.16	.08	.97	.07
	Dombey	.....	15.40	.....	.70	.....	.53
	McCool	.....	2.03	.....	.10	.....	.05
	Wolf	3.40	1.82	.28	.15	.09	.05
Union	Wheeler:						
	Grades 1–2	8.25	5.85	.52	.37	.24	.17
	Grades 3–4	11.60	8.64	.31	.23	.28	.21
	Grades 7–8	11.20	1.60	.32	.05	.32	.05
	High School	9.75	4.50	.49	.23	.33	.16
Washington	Bryarly	19.78	3.60	1.80	.33	.79	.14
Westchester	Furnessville	.....	.62	.....	.05	.....	.02

The number of these observations was restricted owing to the early advent of spring and the discontinuance of fires. It will be seen, however, that the requisite number of cubic feet per minute is supplied in the Hebron, Jackson, and Liberty Center schools, where the Plenum system is in use. In other cases, where the systems depended on gravity, the amount of air supplied per minute for each pupil was largely deficient, if measured by accepted standards. It varied from more than the necessary amount in some classrooms of the larger schools to hardly any exchange in others, depending on the direction and force of the wind.

Air space per pupil.—The smaller the cubic allotment per pupil, the greater will be the required number of air changes to secure due allowance of fresh air per hour. The space for each pupil should, therefore, never be less than 250 cubic feet with a floor space allowance of about 20 square feet.

The air space and floor area per pupil in actual attendance at Porter County schools was greatly in excess of the usual requirements, being 443 cubic feet and 36 square feet, respectively. Calculations were also made on the basis of the number of desks observed in each classroom. According to this measurement the average air space and floor space for each desk were 285 cubic feet and 23 square feet, respectively.[1] In other words, even with a full attendance, ample provision of air space was made in practically all of the schools of the county.

[1] The average number of pupils per classroom was 23.36 and the number of desks 33.5.

Inlets and outlets.—The actual and relative location of inlets and outlets in classrooms is important. Air circulated in a classroom rises to the ceiling, is cooled by coming in contact with the cold walls and windows, and falls to the floor. Inlets, therefore, should be on the inner wall of the classroom, so that the current of fresh air entering is directed toward the outer wall. The location of the inlet should be high enough to be well above the breathing level of the pupils—usually about 8 feet above the floor. The outlet should be on the same side of the room as the inlet; it should be high enough from the floor to avoid accumulations of dust and dirt. The size of the inlets and outlets is also of importance and can be calculated either with respect to the cubic capacity of the classroom or the number of pupils to be supplied with fresh air at a given velocity at the register. Tables for this purpose are to be found in works on ventilation.

The minimum size of inlets and outlets given by various observers, on an empirical basis, varies from 2½ to 24 square inches for each pupil. Certainly an area of 2½ square inches would call for air delivered at very high velocities, which is undesirable from the standpoint of both comfort and economy. When practicable, the outlet should be larger than the inlet.

Of 63 classrooms noted, 43, or 68 per cent, were provided with inlets of too small area. In no instance was the area of the extracting flue used in connection with jacketed stoves (similar to the one shown in fig. 7, p. 47) great enough to make much impression on atmospheric conditions in the classrooms. No mechanical ventilating devices were found in use in any of the schools of the county heated by stoves.

The ventilation of 27.6 per cent of the classrooms of the county depended entirely upon the natural circulation of the air through the walls, window openings, and crevices of various kinds. The Plenum System of ventilation was employed in ventilating 20.8 per cent of the classrooms and the gravity system, which included the use of jacketed stoves, in 51.6 per cent.

HUMIDITY.

The humidity of the surrounding air assists in the maintenance of uniform bodily temperature and, in desirable amounts, operates to promote bodily comfort, to increase resistance to disease, and to reduce fuel consumption.

A dry classroom atmosphere is harmful to the respiratory apparatus, because of the absorption of moisture of the respiratory mucous membrane, causing dryness and fissures through which the infectious agents of respiratory diseases may gain entry.

The effect of high humidities in a warm atmosphere, on the other hand, tends to cause heat stagnation and a disturbance of heat elimination from the body, inducing the well-known feeling of discomfort experienced on humid summer days.

Desirable classroom humidities.—The question of the most desirable humidity for classroom purposes is not fully determined. Certainly a very high humidity in cold weather is liable to cause undesirable condensation of moisture on windows and outside walls. It is agreed quite universally, however, that, depending on the outside temperature, a relative humidity below 35 per cent is injurious, 50 per cent is desirable, and 70 per cent at 70° F. causes no harm.

The greater number of classrooms had a relative humidity of less than 40 per cent. Furthermore, 41.7 per cent of these classrooms had a relative humidity of 35 per cent or less, largely due to failure to provide and utilize measures intended to obviate this condition. Humidity determinations were made by the use of a sling psychrometer.

Measures for regulating humidity.—Cold air contains less moisture proportionately than warmed air. During cold weather it becomes necessary, therefore, to add moisture to heated air used for ventilating purposes. For example, to supply a classroom of 35 pupils with 1,800 cubic feet of air each per hour at 70° F., with a relative humidity of 70 per cent for seven hours, would require the evaporation of over 30 gallons of water, when outside air is taken at a temperature of 30° F., with a relative humidity of 70 per cent. The futility of pans on stoves and radiators for the purpose of securing the necessary humidification of classroom atmospheres is evident. In fact, as mentioned in the section on heating, the humidifiers connected with the usual jacketed stoves were too small to supply anywhere near the desired amount of moisture. They were located badly in most instances, being low down near the firebox, so that the air passed over them before being heated instead of afterwards, as should be the case.

Use of humidostat.—One of the great advantages of mechanical ventilation is that it lends itself readily to the maintenance of a desirable relative humidity, which may be regulated by the humidostat. This apparatus is arranged to act automatically. When the humidity in the surrounding air decreases it opens steam or water jets necessary to supply moisture to the incoming air and closes them when the required humidity is obtained.

Air washing.—It has been found practicable by a system of air washing for the purpose of abstracting mechanical impurities also to supply necessary moisture, an excess of which can be abstracted in chambers arranged for that purpose. These measures are impracticable in small rural schools. It has been shown by actual experi-

ment, however, that indoor humidity may be maintained as well by a judicious routine opening of windows as with the use of mechanical devices.

In large and consolidated schools, air washing may be economically practiced, thus permitting the recirculation of inside air, heated by the so-called rotation method. This reduces coal consumption by obviating the necessity of taking colder outside air and heating it to the required temperature. The effect of recirculated air on health, however, has not been definitely determined.

As stated in the section of this report devoted to heating (p. 48), no adequate attempts were made in any of the rural schools of the county to secure proper classroom humidities.

DUST.

Dust and other impurities.—Evidence has accumulated to show that there is less dust and bacteria in mechanically ventilated classrooms than in those which are unventilated. As many as 256 bacteria per cubic foot have been found by one observer in unventilated rooms, as compared to practically none in ventilated rooms.

The effect of breathing dusty air is largely mechanical and results in excoriations and irritation of the mucous membrane that cause it to be receptive to the entry and lodgment of disease-producing organisms.

Aerial infection with bacteria is possible only at very short distances, and is largely due to the expulsion of infected particles by those harboring the germs of disease during sneezing and coughing. These suspended particles soon settle, however, and the majority of them become innocuous through drying. Nevertheless, the causative agents of tuberculosis and pneumonia, when protected from oxidation by an albuminous coating derived from the secretions, may withstand drying for a long period and must, therefore, be removed by ventilating methods.

Measures for eliminating dust.—Air-washing stands at the head of the list of methods for removing the dusts from air used for ventilation. This method has been found more effective than the former practice of straining the outside air through burlap or some similar material. The use of devices of this character is restricted to large schools which have competent supervision, and is therefore not applicable to the rural schools of Porter County; but certain precautions may be taken to minimize the dust nuisance, of which the following are important:

(1) *Fresh-air intakes.*—The location of fresh-air intakes has a definite bearing upon the amount of dust admitted to classrooms. In general, the fresh-air intake should be located on the warm side

of the school building—preferably the south. It is undesirable to locate the fresh-air intake close to the roof because of the danger of drawing smoke into the classroom. The intake should be of ample proportions to furnish an abundant supply of air, should be screened and elevated to a point well above the ground level. To exclude cellar air and the gases of combustion, all connections leading to the furnace should be tight. In all cases the fresh-air intakes should be screened to shut out coarse material which otherwise might plug the ventilating ducts.

In no instance was the cold-air intakes of the schools of the county elevated more than 3 feet. A few of them were even below the ground level; others were so situated and connected as to act as improvised vacuum cleaners for basements and spaces beneath the floors between the foundation walls.

(2) *Chalk troughs.*—The use of troughs for the collection of powdered chalk and the avoidance of blackboard dust has been discussed in connection with classroom equipment (p. 34).

(3) *Door mats.*—In rural districts mud carried into the classroom on the children's feet is largely responsible for dust and dirt accumulations. Provision should be made for the purpose and children required to clean their boots and shoes before entering school.

(4) *Sweeping.*—The frequency with which sweeping is done and the time and method of sweeping are of importance for controlling and preventing the accumulation of dust in classrooms. Sweeping should preferably be done after school hours; if before school, at least not later than one hour before the assembling of the pupils.

In country schools during muddy weather, sweeping is necessary at more frequent intervals than once daily, in which case it should be done as long as possible before the assembling of classes in order that sufficient time may elapse for the settling of dust. Moist sawdust and sweeping compounds might be used to advantage in places where vacuum cleaners are not available.

(5) *Dusting.*—Schoolroom furniture requires careful attention to dusting. This procedure should follow sweeping regularly as soon as the dust has settled. In places where the sweeping is done after school hours, dusting could well be deferred until the following morning. A moist cloth should be used for this purpose, or preferably a paraffin cloth or one moistened with kerosene.

CLASSROOM CLEANING IN PORTER COUNTY SCHOOLS.

Observations were made with respect to the janitor's service in a number of classrooms in the course of this survey. It was found that sweeping was done daily in 80 per cent of the schools, twice a week in 12 per cent, and three times a week in 8 per cent. Sweeping was done twice daily in 3 of the schools of the county.

Dry sweeping was practiced in 80 per cent of the rural schools, and the use of moist sawdust or sweeping compounds in the remaining 20 per cent.

The time of sweeping was after school hours in 82.5 per cent of the schools, before school in 12 per cent, and at the noon hour in 4 schools.

Dusting was done in but 71 per cent of all the schools. Moist cloths were used for dusting purposes in 39 schools, dry cloths in 16, and a cloth which had been oiled in 2.

The floors in 87 per cent of all the schools of the county had been oiled once during the year. The use of oil on floors for the elimination of dust in classrooms is free from the danger of fire, provided the oil used for this purpose has a flash point not under 150°.

ELIMINATION OF ODORS FROM CLASSROOMS.

The presence of odors in rural one-room schools is especially noticeable, due to rural conditions and rural occupations which occasion greater or less intimacy of contact with the stable, horses, and other domestic animals. The elimination of odors can be accomplished by the admission of ozone in due amounts to classrooms. It must be remembered, however, that an amount of ozone in the atmosphere in excess of 10 parts per million is incompatible with comfortable respiration and causes irritation of the eyes, nose, and throat.

The use of ozonizers is impractical in these schools; but this can be compensated for by routine opening of windows and other ventilating devices.

OTHER MEASURES FOR SECURING OUTSIDE AIR CONDITIONS FOR SCHOOLS.

In recent years the use of muslin screens in the place of the lower sashes and panes of glass is classroom windows has been advocated. This device is said to bring about classroom atmospheric conditions, comparable to outside air, that more than compensate for any additional coal consumption occasioned by their use. Among the disadvantages of this device may be mentioned the reduction of classroom illumination in certain localities by the accumulations of soot and dust on the screens. The suggestion, however, is worthy of further trial in selected rural communities where the surrounding air is comparatively free from mechanical impurities.

Cold rooms.—The maintenance of a classroom temperature of 55° to 60° F. has been advocated in the case of children with latent noncommunicable infections, anemic children, those with enlarged tonsils and adenoids, mouth breathers, and children who take cold easily and are subjected to headaches from constitutional causes. Cold classrooms are also advocated for children who fail to make grade, especially when this is due to poor physical condition.

Cold classrooms, however, are not desirable or demanded for normal children from an educational standpoint. Their use in rural communities for the purposes outlined is necessarily restricted to consolidated schools with attendance large enough to warrant this arrangement.

Open-air schools.—No study of atmospheric conditions in connection with school life would be complete without some mention of open-air schools.

In certain chronic affections advantage is taken of the restorative action of open-air conditions upon health to combine it with education by the use of open-air schools. Schools of this character are especially desirable for children suffering from clinical tuberculosis and subnormal children received from a tubercular environment.

CLOAKROOM ACCOMMODATIONS IN RURAL SCHOOLS.

Probably no single feature of rural school construction has received so scant attention as the provision of appropriate conveniences for the care of wraps and other articles of extra clothing of school children. Frequently in the schools surveyed no cloakroom accommodations whatever were observed, the classroom walls being utilized for this purpose. In other instances the cloakrooms were mere makeshifts, too small for the purposes intended, and also used as a storage place for discarded school furniture and other equipment.

The need of suitable cloakroom accommodations is especially apparent in country districts, where children often travel considerable distances and are exposed for long periods to inclement weather conditions. The cloakrooms of country schools should, therefore, afford ample space for drying wraps. Furthermore, country school children necessarily wear much clothing. As this excess must be taken care of, the cloakrooms in country schools should be proportionately larger than in urban communities.

The use of halls and walls of classrooms for wraps is objectionable because of the untidy appearance. When installed in halls, racks are decided obstacles in the case of fire and a distinct menace to life.

The most suitable location for the cloakroom in schools is yet a mooted point. There seems to be no very sound reason why cloakrooms should open into the classroom, as advocated by some authorities. Furthermore, there is but little to commend the practice advocated of ventilating the classroom through the cloakroom by an outlet placed in the lower part of the communicating door.

In general, the cloakroom should be easily accessible, with an outside exposure to insure the admission of sunlight and window ventilation. It is desirable that cloakrooms should be separately ventilated, so that, when the ventilating system is out of order, the odors will not pass into the classroom.

The width usually advised for cloakrooms is about 4 feet, with 50 linear feet of wall space for each 25 pupils. Suitable pegs or hooks should be provided and located on the wall at various levels for the accommodation of children of different heights. Racks or frames for drying moist clothing are desirable.

The installation of individual keyless lockers, though not at all essential, is an advantage. Lockers of this type are usually of metal, and each locker should be ventilated.

Separate cloakrooms were provided in 38 per cent of the schools inspected. Halls and entrance vestibules were used for cloakroom purposes in 34 per cent, and the classroom walls in slightly more than 25 per cent. In addition, in two schools, a classroom alcove was used for cloakroom purposes and in one school the hall was used in addition to cloakrooms.

In numerous instances the cloakrooms inspected were inadequate in size, without heat, and presented a neglected appearance.

JANITOR SERVICE.

Many of the undesirable aspects of rural school hygiene could be directly improved by an efficient janitor service. In large schools where janitors are employed, certain definite rules should be made with respect to the hours for making fires, the sweeping of classroom floors, the dusting of classroom furniture, the removal of powdered chalk accumulations, and the routine airing of classrooms after school hours. Owing to the ever-present danger of fire, janitors should be required to remain on the school premises during the hours of school to be of assistance in an emergency of this nature.

Paid janitors were employed in 6 schools of the county. Janitor's work was performed by the teacher in 58 schools, by the teacher and pupils in 4 schools, by the teacher and help paid by herself in 5 schools, and by the pupils in 2 schools.

PART II.

PHYSICAL FITNESS OF RURAL SCHOOL CHILDREN IN PORTER COUNTY.

INTRODUCTORY OBSERVATIONS.

It is now known that the rate of growth of the human body varies in a definite manner. The highest rate is attained during the earlier months of embryonic life, from which point it declines until about three or four years before puberty. The rate is accelerated during adolescence and declines rapidly after mature establishment of the reproductive functions. Physiological development, however, presents wide individual variations from the normal.

Definite knowledge of the physical development of the children of a county or community is of great value in determining the existence of unhealthful influences. The well-known hampering effect on growth of hookworm, chronic malaria, and conditions which induce nutritional diseases is reflected to a great degree over wide areas of this country by the stature and rate of growth at different age periods of the children of communities so affected.

The legal limitation of the age at which children may enter certain occupations is becoming definitely fixed in an increasing number of States. But the intent of these laws will be largely defeated unless child labor be restricted to certain occupations according to the physical development of a child at a given age period.

The educator is vitally interested in the physical development and perfection of the school child. It enables him to adapt mental instruction to physical imperfections in individual cases.

Because of the wide variations in climate, the influences of immigration still operating, and the extremes in density of population, no uniform standard of physical growth would seem possible in this country as a whole. The population is not homogeneous racially, and until racial amalgamation shall have been completed the necessity of determining the mean physical development of children in different sections of the country will remain.

The physical averages of children determined in the past have been based largely on an examination of nonrepresentative groups in hospitals, orphanages, and other institutions. In more recent years, however, extensive studies of this nature have been made among urban school children. There is need for an extension of these investigations to rural communities, where measurements of school children of all classes will furnish representative standards.

Finally, the school building must be considered as a factory, exercising a marked influence on the physique of children. Indeed, observations made in other countries show greater physical development both in height and weight among children attending the better class schools.

Number of children studied.—A total of 2,488 rural school children[1] were studied during this survey. Of these, 1,253 were boys, and 1,235 were girls; showing an almost equal distribution of the sexes attending school.

The average daily attendance in these rural schools during the school year 1914–15 was 2,512 (2,264 for elementary schools; 248 for high schools). These examinations, therefore, are considered representative of the youthful population of the county. Because of a number of attendant circumstances, not every child was examined in all the details outlined in this report. The number of individuals furnishing data, however, is stated in all statistical tables based on physical measurements obtained during this survey.

Age of school entrants.—The proper age for a child to enter school is an educational problem which has not yet been solved satisfactorily. This is due largely to the relative influence of the personal equation of individual children, the home environment, and the community school facilities. This problem can not be settled fully without due investigation and an analysis of a great number of cases bearing on this point.

School attendance is compulsory in the State of Indiana from 6–14 years of age, and from 6–16 years of age for those children unable to show necessity for engaging in some gainful occupation.

In Porter County 25 boys and 31 girls were between 5 and 6 years of age, and but 86 boys and 111 girls attending the schools were over 15 years of age, as shown in the following table:

TABLE III.—*Age distribution by sex and one-year age periods.*

	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Total
Boys	25	79	136	121	127	125	110	125	116	112	74	49	20	7	6	2	2	1,236
Girls	31	89	104	118	135	127	115	128	109	91	67	50	28	17	5	1	0	1,215

In chart 6 is plotted the curve of age distribution for both sexes. It is observed that practically one-half the children of either sex in school attendance were 10 years old and under, and that practically 8 per cent of the boys and 10 per cent of the girls were 6 years old and under, and less than 10 per cent of all the children of either sex were over 15 years of age.

[1] The enrollment was: Boys, 1,609; girls, 1,504; total, 3,113. The total number of unmarried persons between 6 and 21 in the county was 3,935 (males, 2,078; females, 1,857).

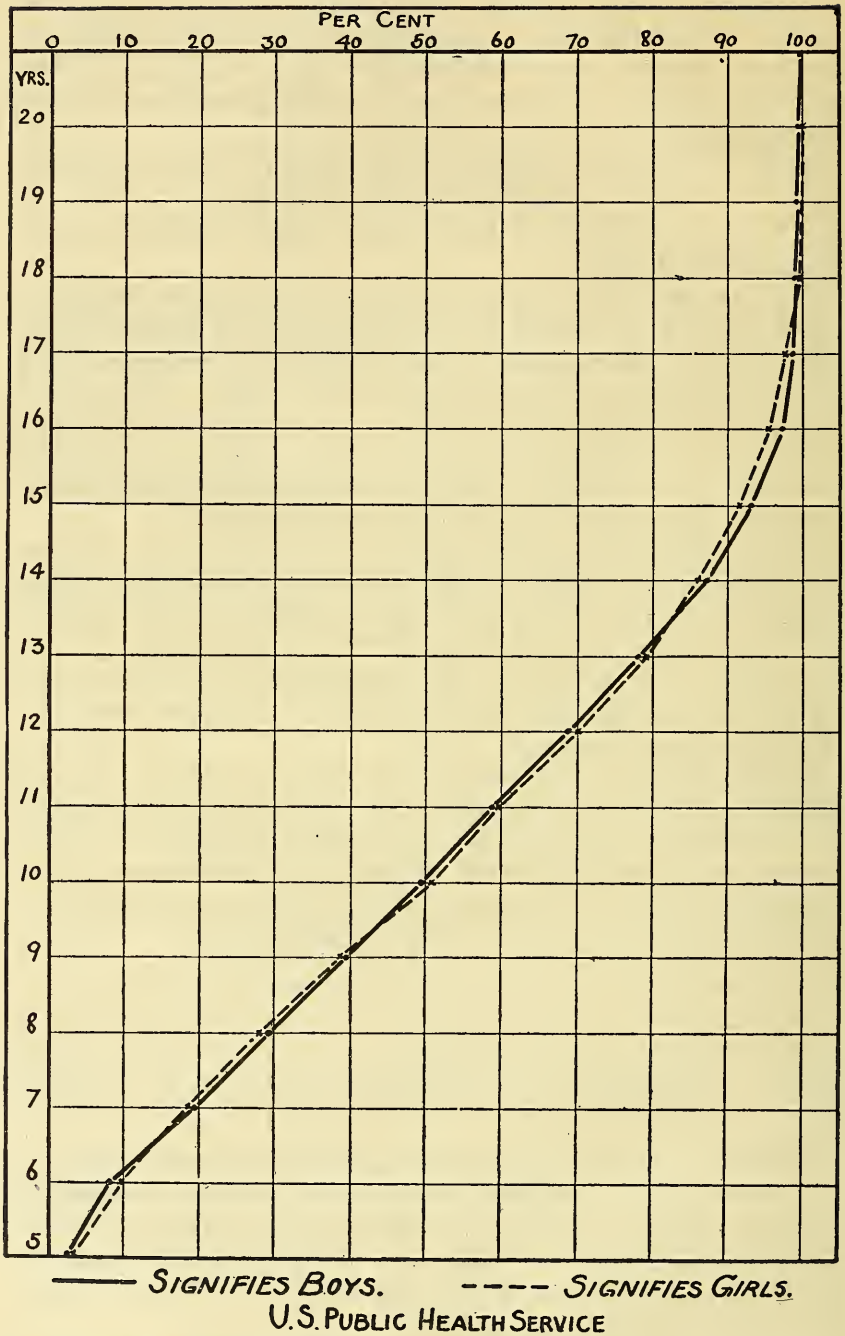

CHART 6.—Age distribution by sex for one-year periods of 1,236 boys and 1,215 girls attending the rural schools of Porter County.

According to the calculations of Prof. Thorndyke, 40 per cent of the children of New England cities of 25,000 inhabitants or more finished the eighth grade. In comparison, the number of children who finished the eighth grade in Porter County is small indeed. That fewer boys than girls from 14 to 17 years of age were attending school in this county is due probably to the demands of the farm being more insistent than those of domestic occupations.

PHYSICAL DATA.

HEIGHT AND WEIGHT.

Because of circumstances the height and weight of children were made in their ordinary clothing and shoes. Due allowance for this fact must be made in calculations of the exact weights and heights of the children here tabulated. According to the figures of Bowditch, the clothing of both sexes at 7 years of age weighs 3½ pounds, at 10 years of age, 5.7 pounds for boys and 4½ for girls, at 13 years of age, 7.4 pounds for boys and 5.6 for girls, and at 16 years of age, 9.7 pounds for boys and 8.1 pounds for girls. The height to be subtracted for shoes averages about seven-eighths of an inch. For practical purposes, however, these subtractions are unnecessary, because in all occupations where physical measurements are liable to be taken into consideration these are made with children wearing their ordinary clothing. It may be mentioned, however, that where children were wearing more than one coat or jacket these were removed before the weights were taken during this survey.

The rate of growth in both height and weight varies with the sex at different age periods.[1] Boys attending the rural schools of Porter County were taller than girls up to the ninth year, after which period the girls were taller than the boys up to the fourteenth year; from that age on the boys rapidly grew much taller than the girls.

The greatest rate of annual increase in height in boys was between 9 and 10 years of age (2.5 inches), 14 and 15 (2.7 inches), and 15 and 16 (2.5 inches). In girls it may be observed that the rate of annual increase was greatest between 9 and 10 years (2.7 inches),

[1] According to the anthropometrical committee of the British Association, quoted from Parks (Practical Hygiene) :

Boys are heavier than girls up to 12, but soon after they lose their superiority for three years, regaining it at 16.

In boys the greatest increase occurs from 14–16; in girls from 12–15.

The rate of growth is irregular or interrupted. Boys are taller than girls up to 12, when girls pass them and retain an advantage to nearly 15.

In boys the greatest annual increases are from 5–6 (almost 3 inches), and from 14–15 (about 3 inches), namely, at the beginning and the end of elementary school education.

In girls the greatest annual increase is about 12.

In girls the annual increase is more uniform than in boys up to 14.

In girls the growth begins to slow down between 12 and 13, and at 14.5 girls have nearly completed their growth, while boys grow rapidly up to 19.

Girls of 13 and 14 are generally taller and heavier than boys of the same age.

and 12 and 13 (2.6 inches), which figures correspond very closely to those quoted above.

From 16 to 17 years of age there is a remarkable decline in the annual rate of increase in height of both boys and girls, corresponding to the maturation of the sexual functions in cold climates. The rate remains low in the case of girls, but continues high for boys during the two following years. It will be observed further on in this report that this decline is noticeable in all of the physical measurements recorded, but more noticeable in the case of girls.

Boys were heavier than the girls up to 9 years, and the girls were heavier than the boys from the ninth to the fifteenth year, at which period the weight of the girls declines quickly to rise again slowly. From 15 years of age on, the boys rapidly grow much heavier than the girls.

The greatest annual increase of weight in boys was between 15 and 16 years of age (14.8 pounds), the rate also being high between 14 and 15 years of age (10.3 pounds).

The greatest increase in weight of girls was between 14 and 15 years of age, followed by a decided decline between 15 and 16. The annual increase in weight of girls continued small from the sixteenth year on.

The decline in the annual rate of increase in weight of boys is not so decided as in the case of girls and occurs one year later, corresponding to a similar decline in the height rate.

MEAN HEIGHT AND WEIGHT.

A comparison of the mean height and weight of the Porter County school children to that of the children of other localities is shown in the following table:

TABLE IV.—*Mean height and weight of rural school children, Porter County, Ind., with comparative tables of height and weight, for one-year age periods.*

Age period.	Porter County, Ind.				Landois.		Boas.	
	Male.		Female.		Male.	Female.	Male.	Female.
	Height in inches.	Height in centimeters.	Height in inches.	Height in centimeters.	Height in centimeters.	Height in centimeters.	Height in inches.	Height in inches.
Years.								
5–6	46.73	118.6	44.74	113.6	99.0	97.0	41.7	41.3
6–7	47.17	119.8	46.66	118.2	104.6	103.2	43.9	43.3
7–8	48.73	123.7	47.98	121.8	111.2	109.6	46.0	45.7
8–9	49.61	126.0	49.67	126.1	117.0	113.9	48.8	47.7
9–10	52.08	132.2	52.35	132.9	122.7	120.0	50.0	49.7
10–11	54.09	137.3	53.96	137.0	128.2	124.8	51.9	51.7
11–12	55.50	140.9	55.67	141.1	132.7	127.5	53.6	53.8
12–13	57.51	146.0	58.27	148.0	135.9	132.7	55.4	56.1
13–14	58.70	149.0	60.06	152.5	140.3	138.6	57.5	58.5
14–15	61.40	155.9	61.83	156.9	148.7	144.7	60.0	60.4
15–16	63.93	159.7	62.63	159.0	153.9	147.5	62.9	61.6
16–17	64.52	163.8	63.01	159.5	161.0	150.0	64.9	62.0
17–18	66.67	166.7	63.63	161.5	167.0	154.4	66.5	62.7
18–19	68.96	175.1	63.57	161.4	176.0	156.2	67.4	.....

TABLE IV.—*Mean height and weight of rural school children, Porter County, Ind., etc.*—Continued.

Age period.	Porter County, Ind.				Landois.		Burke.	
	Male.		Female.		Male.	Female.	Male.	Female.
	Weight in pounds.	Weight in kilos.	Weight in pounds.	Weight in kilos.	Weight in kilos.	Weight in kilos.	Weight in pounds.	Weight in pounds.
Years.								
5–6	49.68	22.50	45.31	20.50	16.70	15.50	.....	.....
6–7	51.75	23.25	48.68	22.10	18.04	16.74	45.2	43.4
7–8	54.72	24.75	51.60	23.40	20.16	18.45	49.5	47.7
8–9	60.21	27.35	57.66	26.30	22.26	19.82	54.5	52.5
9–10	64.56	29.25	64.36	29.15	24.09	22.44	59.6	57.4
10–11	71.75	32.60	70.03	31.80	26.12	24.24	65.4	62.9
11–12	73.30	33.25	79.07	36.05	27.85	26.25	70.7	69.5
12–13	84.00	38.00	86.78	39.50	31.00	30.54	76.9	78.7
13–14	92.48	42.00	95.20	43.25	35.32	34.65	84.8	88.7
14–15	102.74	46.75	105.90	48.20	48.50	38.10	95.2	98.3
15–16	117.56	53.50	105.38	47.75	46.41	41.30	107.4	106.7
16–17	121.95	55.45	113.98	51.75	53.39	44.44	121.0	112.3
17–18	134.05	61.00	120.75	54.77	57.40	49.08	.....	115.4
18–19	140.00	63.75	117.23	53.40	61.26	53.10	.....	114.9

Age period.	Porter County, Ind.				Comparative table (Boas).			
	Absolute annual increase in height in inches.		Per cent absolute annual increase in height.		Absolute annual increase in height in inches.		Per cent absolute annual increase in height.	
	Male.	Female.	Male.	Female.	Male.	Female.	Male.	Female.
Years.								
6–7	0.44	1.9	0.9	4.2	2.2	2.0	5.3	4.8
7–8	1.56	1.3	3.3	2.7	2.1	2.4	4.8	5.5
8–9	.88	1.7	1.8	3.5	2.8	2.0	6.1	4.4
9–10	2.5	2.7	4.9	5.4	1.2	2.0	2.5	4.2
10–11	2.0	1.6	3.8	3.0	1.9	2.0	3.8	4.0
11–12	1.4	1.7	2.1	3.1	1.7	2.1	3.3	4.1
12–13	2.0	2.6	3.6	4.6	1.8	2.3	3.4	4.3
13–14	1.2	1.8	2.0	3.1	2.1	2.4	3.8	4.3
14–15	2.7	1.8	4.6	3.0	2.5	1.9	4.3	3.2
15–16	2.5	1.8	4.1	1.3	2.9	1.2	4.8	2.0
16–17	.6	.8	.9	.6	2.0	.6	3.2	1.0
17–18	2.2	.4	3.4	.9	1.6	.5	2.5	.8
18–19	2.3	.6	3.4	.....	.9	.....	1.4	.....

Age period.	Porter County, Ind.				Comparative table (Burke).			
	Absolute annual increase in weight, pounds.		Per cent absolute annual increase in weight.		Absolute annual increase in weight in pounds.		Per cent absolute annual increase in weight.	
	Male.	Female.	Male.	Female.	Male.	Female.	Male.	Female.
Years.								
6–7	1.5	3.4	3.0	7.5	.....	.....	.....	.....
7–8	3.6	2.9	7.0	5.9	4.3	4.3	9.5	9.9
8–9	5.5	6.0	10.1	11.6	5.0	4.8	10.1	10.0
9–10	4.4	6.7	7.3	11.6	5.1	4.9	9.3	9.3
10–11	7.2	5.7	11.1	8.9	5.8	5.5	9.7	9.6
11–12	1.6	9.0	2.2	12.8	5.3	6.6	8.1	10.5
12–13	10.7	7.7	14.1	9.7	6.2	9.2	8.7	13.2
13–14	8.5	8.3	10.1	9.5	7.9	10.6	10.3	12.7
14–15	10.3	10.7	11.1	11.3	10.4	9.6	12.3	11.9
15–16	14.8	−.5	14.4	−.4	12.2	8.4	12.8	8.5
16–17	14.4	8.6	12.2	8.2	13.6	5.6	12.7	5.2
17–18	12.1	6.8	10.0	5.9	.....	3.1	.....	2.8
18–19	6.0	−1.4	4.0	−1.1	.....	.....	.....	.....

TABLE IV.—*Mean height and weight of rural school children, Porter County, Ind., etc.*—Continued.

Age period.	Relation of annual increase in height of Porter County children to the comparative (Boas).				Relation of annual increase in weight of Porter County children to the comparative (Burke).			
	Absolute in inches.		Per cent.		Absolute in pounds.		Per cent.	
	Male.	Female.	Male.	Female.	Male.	Female.	Male.	Female.
Years.								
6–7	−1.8	−0.1	−4.4	−0.6	.....	.....	.....	.....
7–8	− .5	−1.1	−1.5	−2.8	−0.7	−1.4	−2.5	−3.6
8–9	−2.0	− .3	−4.3	− .9	+ .5	+1.2	.0	+1.6
9–10	+1.3	− .3	+2.4	+1.2	− .7	+1.8	−2.0	+2.3
10–11	+ .1	− .4	.0	−1.0	+1.4	+ .2	+1.4	− .7
11–12	− .3	− .4	−1.1	−1.0	−3.7	+2.4	−5.9	+2.3
12–13	+ .2	+ .3	+ .2	+ .3	+4.5	−1.5	+5.4	−3.5
13–14	− .9	− .6	−1.8	−1.2	+ .6	−2.3	− .2	−3.2
14–15	+ .2	− .1	+ .3	− .2	− .1	+ .9	−1.2	− .6
15–16	− .4	+ .6	− .7	− .7	+2.6	−8.9	+1.6	−8.9
16–17	−1.4	+ .2	−2.3	− .4	+ .8	+3.0	− .5	+3.0
17–18	+ .6	− .1	+ .9	+ .1	.....	+3.7	.....	.....

It may be observed that the mean height of boys of Porter County is less at the 6–7, 7–8, 8–9, 11–12, 13–14, 15–16, and 16–17 age periods. The girls in comparison are under the mean height at 12–13, 15–16 and 16–17 year age periods. The per cent of deficiency ranges from 0.7 per cent to 2.3 per cent among the boys and 0.2 per cent to 2.8 per cent among the girls.

With regard to weight, the boys are under the mean at the 7–8, 9–10, 10–12, and 14–15 year age periods. The girls are under the mean weight at the 7–8, 12–13, 13–14, and 15–16 year age periods. The per cent of weight deficiency varies from 0.2 per cent to 5.9 per cent among boys and 0.6 per cent to 8.9 per cent among the girls.

RACIAL DIFFERENCES IN PHYSICAL DEVELOPMENT.

In Table V is given the statistical tabulation of the mean physical measurements of 2,488 school children of the county compared to similar mean measurements of 364 boys and 377 girls of the county who were either foreign born or of parents one or both of whom were of foreign birth:

TABLE V.—*Mean physical measurements of all children attending the rural schools of Porter County, Ind., 1914–15, compared with those of 364 boys and 377 girls who are foreign born or have one or both parents foreign born.*

[Classified by race, sex, and 1-year age periods.]

Race.	Males.										
	Age period.	Cases furnishing data.	Mean height.	Mean weight.	Vital capacity.	Chest expansion.	Dynamometer.		Cephalic index.		
							Right.	Left.	Dolichocephalic.	Mesaticephalic.	Brachycephalic.
	Yrs.		*Inches.*	*Lbs.*	*Cu. in.*	*Inches.*	*Kilos.*	*Kilos.*	*Per ct.*	*Per ct.*	*Per ct.*
All races	5–6	25	46.73	49.68	.....	.....	.....	.....	52.20	34.80	13.00
Scandinavians	5–6	1	47.00	49.00	35.00	1.75	5.00	5.00	.....	100.00	.....
All races	6–7	78	47.17	51.15	.....	.....	.....	.....	46.00	31.00	23.00
Dutch	6–7	1	46.00	57.00	45.00	1.50	8.00	8.00	100.00	.....	.....
German	6–7	7	48.50	53.42	36.15	2.08	8.7	8.7	57.10	42.90	.....
Polish	6–7	6	46.37	57.50	50.00	2.25	8.3	6.3	.....	15.75	84.25
Scandinavian	6–7	7	47.50	51.00	48.23	1.80	8.0	6.2	85.70	14.30	.....
All races	7–8	139	48.73	54.42	46.62	2.00	9.2	8.4	34.00	43.75	22.25
English, Scotch, Irish	7–8	3	47.91	53.33	35.00	2.35	8.7	10.6	33.33	66.66	.....
German, etc	7–8	9	49.50	58.22	52.75	1.90	10.5	9.4	11.10	77.80	11.10
Polish, etc	7–8	10	47.77	53.10	37.55	1.95	9.6	9.2	10.00	20.00	20.00
Scandinavian	7–8	13	49.23	55.00	48.00	2.00	9.1	6.5	25.00	75.00	.....
All races	8–9	123	49.61	60.21	61.72	2.21	11.2	10.1	33.75	41.25	25.00
English	8–9	3	50.75	55.66	57.65	3.00	10.0	11.5	33.33	33.33	33.33
German	8–9	14	57.10	57.57	65.35	2.10	11.6	10.3	14.25	71.50	14.25
Polish	8–9	6	50.54	60.00	61.65	2.05	12.7	11.3	33.33	16.67	50.00
Scandinavian	8–9	11	49.11	59.63	60.00	2.15	10.9	10.0	45.45	36.35	18.10
All races	9–10	131	52.08	64.56	71.71	2.43	11.7	11.3	37.00	48.75	14.25
Dutch	9–10	1	51.50	67.00	60.00	2.00	15.0	11.5	100.00	.....	.....
English	9–10	2	52.25	67.50	67.50	2.50	.....	.....	50.00	.....	50.00
German	9–10	13	50.48	64.07	70.35	2.40	13.4	12.3	23.10	38.45	38.45
Polish	9–10	11	52.29	65.63	65.90	2.55	13.6	12.0	9.10	27.25	63.65
Scandinavian	9–10	14	52.08	63.07	72.50	2.40	11.0	9.7	61.55	30.75	7.70
All races	10–11	124	54.00	71.75	87.01	2.59	14.3	13.4	40.50	44.50	15.00
Dutch	10–11	1	54.00	68.00	100.00	3.00	11.5	11.5	100.00	.....	.....
English	10–11	5	53.54	67.60	65.00	3.00	13.4	14.4	80.00	20.00	.....
German	10–11	15	55.95	81.86	106.35	2.55	16.2	15.4	46.65	40.00	13.35
Italian	10–11	1	51.00	65.00	55.00	2.00	8.0	8.0	.....	100.00	.....
Polish	10–11	10	56.15	72.77	92.00	2.65	14.6	12.8	.....	60.00	40.00
Scandinavian	10–11	12	52.74	69.25	75.00	2.45	14.7	14.5	58.25	41.75	.....
All races	11–12	110	55.50	75.30	93.72	2.29	15.0	13.6	39.25	43.50	17.25
Dutch	11–12	1	56.25	85.00	145.00	3.00	16.9	18.5	.....	100.00	.....
English, etc	11–12	2	54.00	63.50	75.00	2.10	12.4	11.5	.....	100.00	.....
German	11–12	16	56.48	78.75	96.25	2.55	17.5	15.1	25.00	37.50	37.00
Polish	11–12	8	52.12	66.62	66.60	2.45	12.7	11.8	.....	25.00	75.50
Scandinavian	11–12	12	55.45	78.66	91.25	2.40	15.9	15.0	41.60	50.00	8.40
All races	12–13	123	57.51	84.00	110.25	2.89	17.3	16.5	37.35	47.20	15.45
Dutch	12–13	1	57.75	87.00	135.00	3.00	18.5	20.3	100.00	.....	.....
English	12–13	2	57.25	85.00	127.00	3.25	18.5	17.8	100.00	.....	.....
German	12–13	15	56.16	78.86	104.65	2.50	16.9	15.7	42.85	42.85	14.30
Polish	12–13	12	58.21	88.12	125.00	2.55	18.5	16.1	14.30	57.15	28.55
Scandinavian	12–13	12	60.08	84.08	104.85	2.75	18.4	16.2	75.00	16.65	8.35
All races	13–14	116	58.70	92.48	127.46	2.85	19.6	17.0	36.00	46.00	18.00
Dutch	13–14	1	60.25	101.00	165.00	2.50	20.3	16.9	.....	.....	100.00
English	13–14	3	58.91	114.00	118.35	2.50	20.3	17.8	66.66	33.33	.....
French	13–14	1	61.00	90.00	100.00	3.50	25.5	18.5	.....	.....	.....
German	13–14	13	60.60	100.15	138.20	3.00	22.3	19.8	28.55	57.15	14.30
Polish	13–14	5	59.70	99.40	141.00	2.70	20.3	18.9	.....	75.00	25.00
Scandinavian	13–14	11	58.50	93.45	136.50	2.75	20.4	19.3	50.00	40.00	10.00
All races	14–15	112	61.41	102.74	147.34	2.87	24.0	21.9	42.65	41.10	15.75
Austrian	14–15	1	54.25	67.00	90.00	3.00	15.0	15.0	100.00	.....	.....
English	14–15	2	64.12	117.00	160.00	3.50	24.8	24.8	100.00	.....	.....
German	14–15	15	61.33	109.13	157.35	.....	23.8	23.0	43.00	57.00	.....
Polish	14–15	6	58.25	103.00	131.00	2.40	23.1	21.9	16.65	50.00	33.35
Scandinavian	14–15	14	61.50	103.35	160.00	2.95	25.2	24.2	46.25	38.45	15.30

TABLE V.—*Mean physical measurements of all children attending the rural schools of Porter County, Ind., 1914–15, etc.*—Continued.

Males.

Race.	Age period.	Cases furnishing data.	Mean height.	Mean weight.	Vital capacity.	Chest expansion.	Dynamometer.		Cephalic index.		
							Right.	Left.	Dolichocephalic.	Mesaticephalic.	Brachycephalic.
	Yrs.		*Inches.*	*Lbs.*	*Cu. in.*	*Inches.*	*Kilos.*	*Kilos.*	*Per ct.*	*Per ct.*	*Per ct.*
All races	15–16	72	63.93	117.56	180.42	3.11	28.6	27.9	35.10	43.25	21.65
Austrian	15–16	1	62.50	127.00	175.00	2.25	29.0	29.0	.....	.....	100.00
English	15–16	2	64.87	123.00	160.00	3.60	23.8	21.3	100.00	.....	.....
German	15–16	9	65.50	111.77	163.35	3.00	25.0	25.0	42.50	57.50	.....
Polish	15–16	5	60.23	113.00	113.00	2.35	21.5	22.4	.....	40.00	60.00
Roumanian	15–16	1	53.50	130.00	260.00	3.50	30.8	35.5	.....	.....	100.00
Scandinavian	15–16	6	64.50	122.35	197.50	3.85	31.7	29.0	66.66	33.33	.....
All races	16–17	48	64.52	121.95	188.75	3.29	30.2	26.8	38.35	51.00	10.65
English	16–17	3	64.50	113.35	175.00	4.50	30.8	28.5	33.33	66.66	.....
German	16–17	1	66.50	125.00	185.00	3.50	20.3	18.5	.....	100.00	.....
Scandinavian	16–17	7	64.07	115.85	172.15	3.20	30.0	27.0	57.15	14.30	28.55

Females.

Race.	Age period.	Cases furnishing data.	Mean height.	Mean weight.	Vital capacity.	Chest expansion.	Dynamometer.		Cephalic index.		
							Right.	Left.	Dolichocephalic.	Mesaticephalic.	Brachycephalic.
	Yrs.		*Inches.*	*Lbs.*	*Cu. in.*	*Inches.*	*Kilos.*	*Kilos.*	*Per ct.*	*Per ct.*	*Per ct.*
All races	5–6	29	44.74	45.31	.....	.....	.....	.....	44.85	31.00	24.50
English	5–6	1	41.50	40.00	.....	.....	3.00	3.00	100.00	.....	.....
German	5–6	2	45.37	49.00	32.54	.....	3.00	3.00	50.00	50.00	.....
All races	6–7	90	46.66	48.68	.....	.....	.....	.....	46.15	35.85	18.00
English	6–7	2	45.75	45.00	17.50	.....	8.00	8.00	100.00	.....	.....
German	6–7	7	49.85	48.55	38.35	1.50	8.00	6.1	42.85	42.85	14.30
Italian	6–7	1	46.00	50.00	20.00	.....	.....	.....	100.00	.....	.....
Polish	6–7	4	47.00	49.50	36.65	1.35	8.00	8.00	25.00	.....	75.00
Scandinavian	6–7	9	46.00	46.65	26.25	2.00	5.00	5.00	50.00	50.00	.....
All races	7–8	105	47.98	51.60	37.45	2.05	8.0	6.2	35.20	52.35	11.45
English	7–8	3	48.41	52.65	41.65	2.00	.....	.....	33.33	66.66	.....
German	7–8	10	48.60	52.60	41.50	1.60	10.0	9.6	20.00	40.00	40.00
Italian	7–8	1	46.50	52.00	35.00	1.50	8.0	8.0	.....	100.00	.....
Polish	7–8	3	48.25	50.35	26.65	2.00	5.0	5.0	.....	100.00	.....
Scandinavian	7–8	9	48.75	53.44	41.65	1.90	11.6	11.5	55.55	33.35	11.10
All races	8–9	120	49.67	57.66	48.31	1.94	8.8	8.0	42.75	45.30	11.95
English	8–9	3	49.58	55.00	48.35	1.50	8.0	8.0	66.66	33.33	.....
German	8–9	17	43.85	57.75	47.50	1.85	9.2	8.4	25.00	56.25	18.75
Polish	8–9	10	50.20	61.10	38.00	1.60	9.0	7.5	20.00	50.00	30.00
Scandinavian	8–9	9	50.15	58.90	56.65	2.15	8.2	8.2	44.45	22.20	33.35
All races	9–10	133	52.35	64.36	58.73	2.17	10.5	9.6	44.15	42.25	13.30
English	9–10	1	49.20	56.00	55.00	2.50	10.0	8.0	.....	.....	.....
German	9–10	12	53.15	71.60	59.50	2.20	11.4	10.5	45.45	54.55	.....
Polish	9–10	9	53.75	61.20	50.00	1.85	10.4	9.4	22.20	33.35	44.45
Roumanian	9–10	1	54.00	74.00	90.00	2.00	11.5	11.5	.....	100.00	.....
Scandinavian	9–10	10	51.40	59.00	56.65	1.80	9.1	7.4	88.90	11.10	.....
All races	10–11	129	53.96	70.03	69.81	2.49	11.4	10.4	40.50	43.00	16.50
Austrian	10–11	1	55.00	54.00	35.00	2.75	10.0	10.0	.....	100.00	.....
English	10–11	1	52.25	54.00	65.00	3.00	13.4	11.5	.....	.....	.....
French	10–11	1	57.75	82.00	100.00	3.00	15.0	11.5	100.00	.....	.....
German	10–11	13	54.55	75.70	73.85	2.65	14.0	12.8	46.20	38.45	15.35
Polish	10–11	9	52.70	65.10	61.10	2.00	11.2	10.4	11.10	44.45	44.45
Scandinavian	10–11	17	54.20	71.65	72.50	2.40	11.2	10.4	56.20	37.55	6.25

TABLE V.—*Mean physical measurements of all children attending the rural schools of Porter County, Ind., 1914–15, etc.*—Continued.

Race.	Females.									
	Age period.	Cases furnishing data.	Mean height.	Mean weight.	Vital capacity.	Chest expansion.	Dynamometer.		Cephalic index.		
							Right.	Left.	Dolichocephalic.	Mesaticephalic.	Brachycephalic.
	Yrs.		*Inches.*	*Lbs.*	*Cu. in.*	*Inches.*	*Kilos.*	*Kilos.*	*Per ct.*	*Per ct.*	*Per ct.*
All races	11–12	114	55.67	79.07	83.38	2.51	13.7	12.2	36.50	51.00	12.50
Belgian	11–12	1	54.25	41.00	100.00	2.75	18.5	16.9	.....	100.00	.....
English	11–12	1	55.50	85.00	70.00	2.50	11.5	10.0	.....	.....	.....
German	11–12	13	56.15	77.40	87.70	2.50	13.3	11.4	27.40	54.40	18.20
Polish	11–12	7	53.75	65.30	50.70	2.00	11.6	11.3	.....	71.45	28.55
Scandinavian	11–12	18	56.65	76.95	78.60	2.45	13.3	12.3	31.25	25.00	43.75
All races	12–13	128	58.27	86.78	87.54	2.68	15.0	12.7	43.00	44.10	12.40
English	12–13	4	56.95	77.75	68.35	2.25	13.4	14.0	75.00	25.00	.....
German	12–13	16	59.15	91.60	86.25	2.60	15.6	14.4	68.75	31.25	.....
Polish	12–13	7	56.90	75.85	76.15	2.55	14.7	13.9	50.00	35.33	16.66
Scandinavian	12–13	10	58.65	93.10	97.00	2.70	17.5	14.6	60.00	40.00	.....
All races	13–14	109	60.06	95.20	96.57	2.78	17.6	15.6	37.20	48.30	14.50
English	13–14	2	59.00	78.00	67.50	2.60	13.4	14.4	100.00	.....	.....
German	13–14	20	60.21	98.55	102.00	2.70	17.7	16.5	40.00	50.00	10.00
Polish	13–14	8	58.56	86.25	71.25	2.40	16.9	14.6	16.65	16.65	66.70
Scandinavian	13–14	12	59.35	89.75	100.40	2.75	17.3	16.2	75.00	12.50	12.50
All races	14–15	91	61.83	105.90	110.00	2.77	20.2	16.1	49.40	50.00	10.60
English, Scotch, Irish	14–15	6	60.70	99.33	117.50	2.25	17.5	13.7	20.00	80.00	.....
German	14–15	10	60.97	109.30	106.50	2.50	21.0	17.8	20.00	60.00	20.00
Polish	14–15	9	61.61	109.77	95.60	2.95	21.2	18.5	.....	85.75	14.25
Scandinavian	14–15	18	60.00	102.50	98.60	2.60	18.4	20.3	68.25	28.55	7.20
All races	15–16	67	62.63	105.38	114.32	3.00	20.1	17.9	51.40	45.75	2.85
English	15–16	4	62.06	94.50	102.50	2.60	18.5	18.0	100.00	.....	.....
German	15–16	10	63.52	111.42	104.50	2.90	20.5	17.4	40.00	40.00	20.00
Polish	15–16	1	59.00	87.00	65.00	2.50	18.5	15.0	.....	100.00	.....
Scandinavian	15–16	8	64.53	113.12	126.25	3.30	22.9	19.7	.....	100.00	.....
All races	16–17	50	63.01	113.98	119.37	3.00	21.0	18.8	60.00	28.00	12.00
Belgian	16–17	1	61.25	116.00	110.00	3.25	30.8	25.5	.....	.....	.....
German	16–17	3	63.41	106.33	136.65	3.25	22.0	18.5	100.00	.....	.....
Polish	16–17	1	63.75	118.00	110.00	2.50	20.3	18.5	.....	100.00	.....
Scandinavian	16–17	1	63.25	114.00	175.00	3.50	25.5	25.5	.....	.....	.....

In general, the mean height and weight of children of German, Polish, and Scandinavian origin were greater than the corresponding heights and weights for the county as a whole. Of these, boys of German origin were tallest at the 6–7, 7–8, 8–9, 11–12, 13–14, 15–16, and 16–17 year age periods, the Polish at the 9–10 and 10–11 year age periods, and Scandinavian at the 12–13 and 14–15 year age periods. In weight, the boys of German origin were heavier at the 8–9, 10–11, 11–12, 14–15, and 16–17 year age periods, boys of Polish origin at the 6–7 and 13–14 year age periods, and boys of Scandinavian origin at the 7–8, 9–10, and 15–16 year age periods.

In the case of girls, those of German origin were the tallest at the 6–7, 10–11, 12–13, and 13–14 year age periods, Scandinavian at the 7–8, 11–12, and 15–16 year age periods, and the Polish girls at the 8–9. 9–10, 14–15, and 16–17 year age periods.

With regard to weight, the girls of Polish extraction were the heaviest at the 6–7, 8–9, 14–15, and 16–17 year age groups, and the German at the 9–10, 11–12, and 13–14 year age periods.

The number of units in each of these nationality groups was too small to give more than approximate results. In the cases quoted, however, the collected data are sufficient to warrant the statement that the mean height and weight for the county at large has not been reduced by the admixture of these elements.

VITAL CAPACITY.

The mean vital capacity was determined in the case of 1,122 boys and 1,079 girls, using the dry spirometer for this purpose. Detachable glass mouthpieces were made use of, a special mouthpiece being furnished each child which was sterilized in every case before it was used again.

Vital capacity is influenced by a number of factors. Of these may be mentioned stature, body weight, age, sex, and occupation. It increases with age, attaining the maximum at about the thirty-fifth year; it is greater for men than for women, the average for the former being about 3,700 cubic centimeters and for women 2,500 cubic centimeters. The vital capacity is also influenced by posture and the condition of the stomach, being greater in the standing position and when the stomach is empty.

The mean vital capacity of the rural school children of Porter County is plotted in chart 7, showing interesting differences between the sexes. The rise of lung capacity is constant in boys from the seventh to the eighteenth year, the curve showing a decided break between the fifteenth and sixteenth years, corresponding to the decline in rate of increase of other physical measurements observed at this age period.

In the case of girls, however, the increase in vital capacity is similar to that for boys up to the eleventh year, the only difference being the lesser capacity influenced by sex. At this period of life the outdoor activities of girls are very much the same as those of boys of the same age. From this time on girls begin to wear corsets, though their outdoor activity may continue for a period. The effect of these changes is reflected probably by the vital capacity curve which falls away from that for the boys and continues to decline gradually to the fourteenth year. After the fourteenth year, the average girl becomes more sedate, her outdoor activities are lessened, and she undergoes certain functional disturbances which are reflected by an obvious decline in the vital capacity increase. This continues to the seventeenth year, after which there is a still more decided fall.

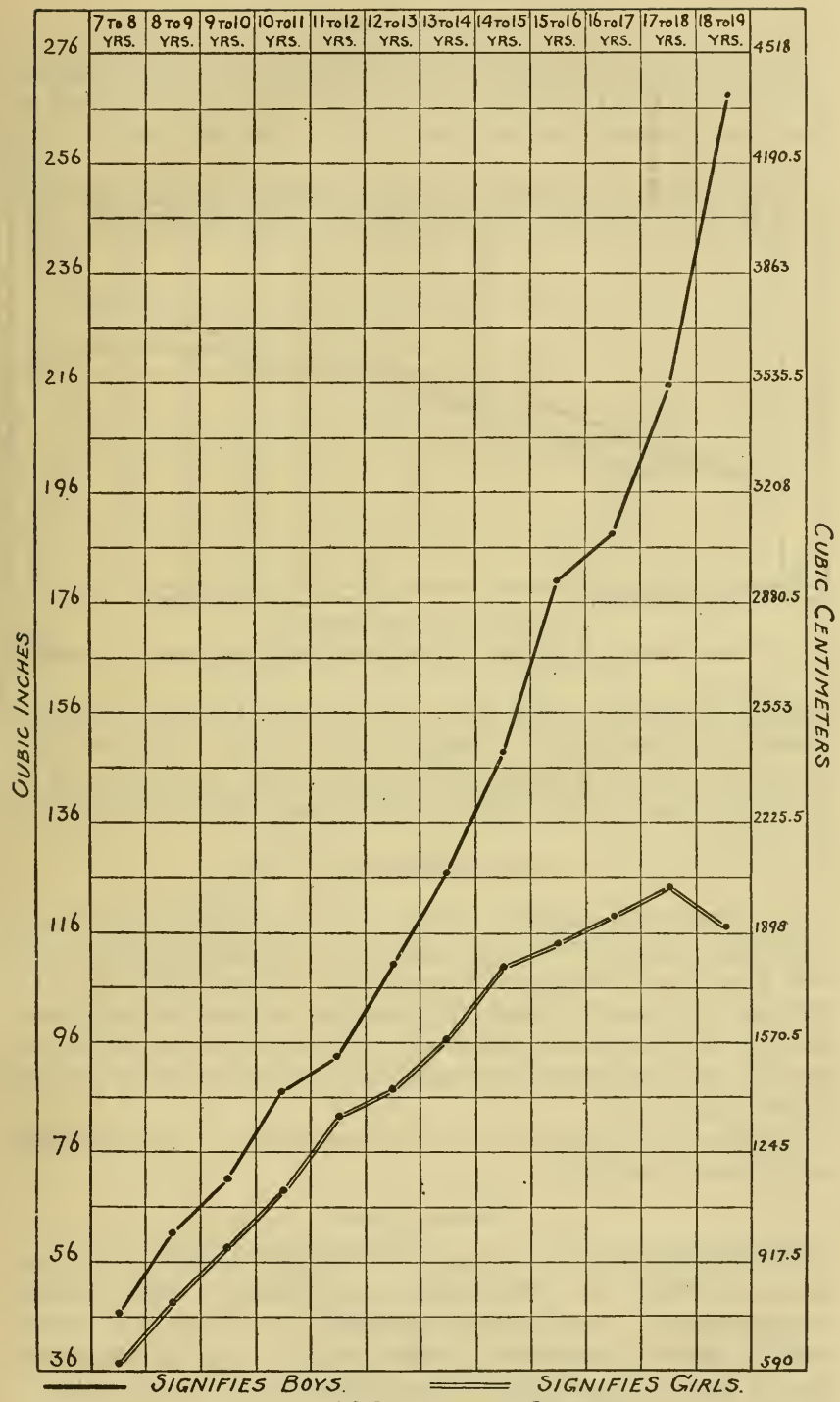

CHART 7.—Mean vital capacity in cubic inches of 1,122 boys and 1,079 girls from 7 to 18 years of age attending Porter County rural schools.

CHEST EXPANSION.

Measurements of the mean chest expansions were made in the case of 1,122 boys and 1,079 girls (see chart 8). The chest expansion for boys rose gradually from less than 1 inch at the sixth year to nearly

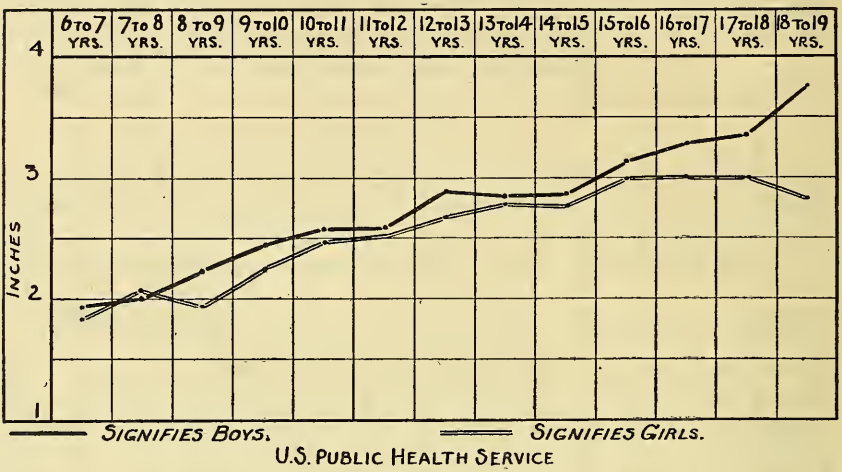

CHART 8.—Chest expansion in inches of 1,046 boys and 1,029 girls from 6 to 18 years of age attending the rural schools of Porter County.

4 inches at the eighteenth year. In the case of girls the rise was likewise gradual from less than 1 inch at the sixth year to a maximum of about 3 inches at the fifteenth year. It remained practically stationary for girls from 15 to 16 and declined sharply between 17 and 18.

DYNAMOMETER TESTS.

The muscular strength of the hands of boys increased constantly from the seventh to the eighteenth year. A slight decline in the rate took place between the fifteenth and sixteenth year. In girls, the rate of increase was also fairly constant and remained stationary between the fifteenth and sixteenth year, corresponding in this respect to other physical measurements of girls at this age period (see chart 9, page 77).

There were recorded 25 cases of left-handedness, 19 among the boys and 6 among the girls.

CEPHALIC INDEX.

The size and shape of the head is determined largely by environment, sex, and race. The ethnical significance of these cephalic measurements is great when employed in communities having racially mixed populations to determine the extent of amalgamation of races and to explain certain habits, customs, and trends of mind.

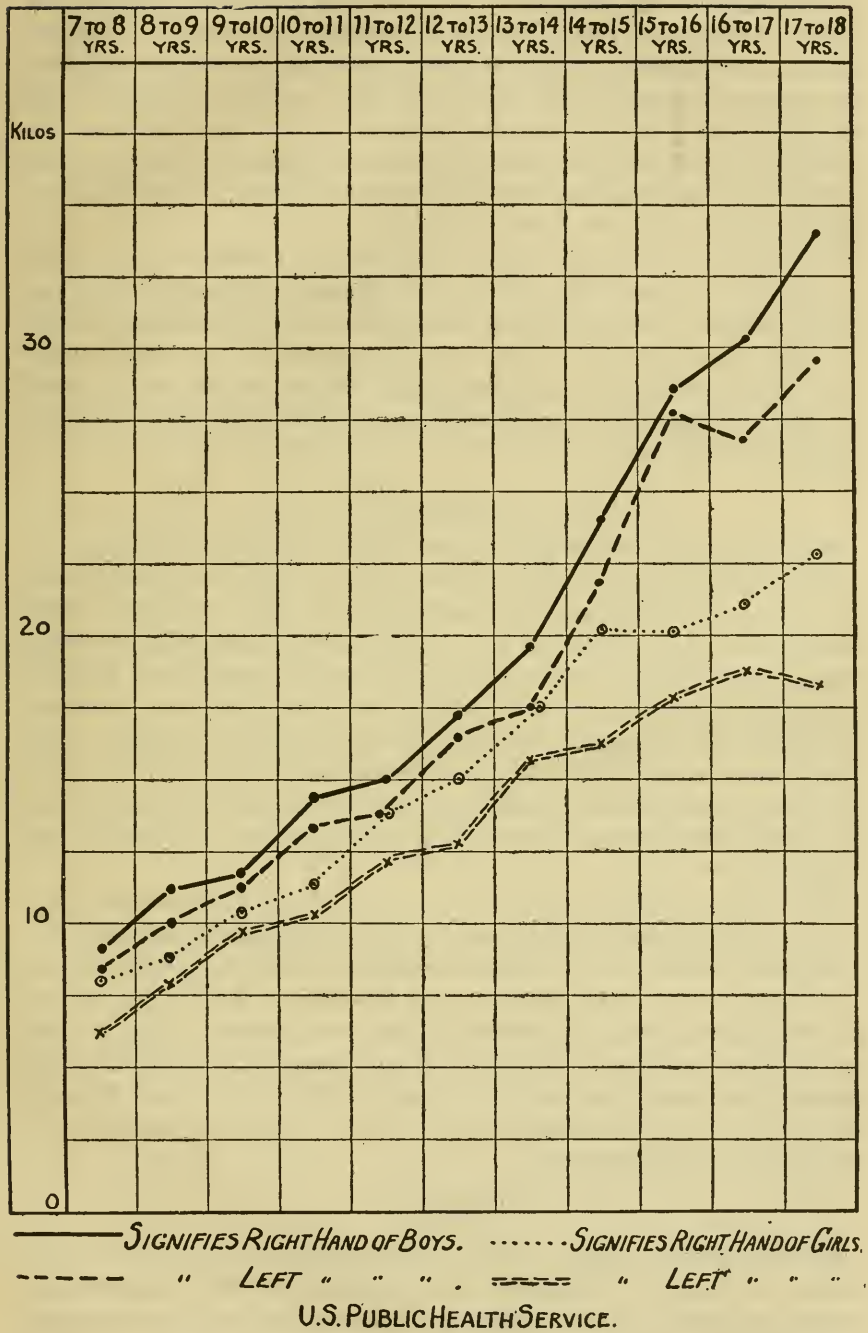

CHART 9.—Average muscular strength of the hands of 987 boys and 920 girls attending Porter County rural schools.

The shape of the head has been tabulated in Table V in the case of 1,195 boys and 1,055 girls and classified according to sex and one-year age periods. Of the boys, 38.15 per cent were dolichocephalic, 44 per cent mesaticephalic, and 17.85 per cent brachycephalic. Of the girls, 41.8 per cent were dolichocephalic, 44.7 per cent mesaticephalic, and 10.5 per cent brachycephalic. In other words, 84.35 per cent of all these children were either long headed or round headed, and 15.65 per cent were broad headed.

It is interesting to observe in Table V (p. 71) that the highest per cent of dolichocephalic children of German, Scandinavian, and Polish extraction was observed among those of Scandinavian origin, and the highest per cent of the brachycephalic of the same extraction among children of Polish origin. These results are of great ethnical significance, though they may receive but passing notice in a report of this nature.

PULSE AND RESPIRATION RATE.

The rate of the pulse and respiration are influenced by age, sex, emotions, and many other factors. The average respiration rate per minute of 1,208 boys decreased gradually from 21.1 at the fifth year to 16.8 at the sixteenth year, rising again during the following two years, beyond which age the cases herein recorded are too few to give reliable indications. Although not so regularly as in the case of respiration, the pulse rate of 1,196 boys likewise decreased from 92.05 per minute at the sixth year to 78 at the seventeenth year, above which age period the number of observations recorded are too few to compensate for the influences of emotion and exercise on the pulse rate.

The average respiration per minute of 1,193 girls decreased gradually from 21.3 at the fifth year to 16.3 at the nineteenth year. A noticeable decline in the average respiration rate is recorded at the seventeenth year. The average pulse rate of 1,193 girls per minute decreased from 94.26 per minute at the fifth year to 74 per minute at the nineteenth year. Variation in the pulse rate at different age periods was more marked in the case of girls than that of boys, which is probably accounted for by a more emotional temperament in the case of the former.

NUTRITION.

Observations on the nutrition of the pupils were made in the course of these examinations. The accuracy of these observations must necessarily be purely relative. The nutrition of 28 of the boys and 27 of the girls was considered fair. The development of 231 boys, roughly 18 per cent of the total examined, and of 207 girls, or 16 per cent of the total, was fair.

Hemoglobin.—While the value of hemoglobin determinations as an index of nutrition is unquestioned, these tests could not be made generally. However, 158 boys were examined in this respect, using the Von Talquist scale. Of these, 3 boys had a hemoglobin per cent of 75; 16 of 80; 51 of 85; 77 of 90, and 11 of 95 per cent. Of the girls, 130 in number, 18 had a hemoglobin per cent of 80; 29 of 85; 70 of 90; and 13 of 95 per cent. These determinations correspond quite closely to the observations relative to the nutrition of the pupils in the county as a whole.

Diet.—As having a bearing on nutrition, observations were made with respect to the habitual use of certain articles of food by the school children of the county. The rôle of food in the causation of disease is becoming increasingly apparent. The effect of diet on scurvy has been known for a long time. A faulty food supply is definitely related to beriberi, and only quite recently it has been determined that a diet deficient in certain proteids stands in direct causative relation to the wide prevalence of pellagra.

The breakfast of 901, or 40 per cent of the total children reporting, was composed of carbohydrates principally, and that of 1,338, practically 60 per cent, was a mixed diet of carbohydrates and proteids. In addition, 1,277 children, or 57 per cent of the total, used coffee for breakfast, while only 315 children, or 15 per cent of those reporting, used milk. This condition is remarkable in an agricultural community in which dairy farming is so largely practiced. With respect to the use of starchy food, 839 children, or 37 per cent, had potatoes for breakfast, and 735 children, or 32 per cent, had some form of prepared cereal. Of the children whose breakfast contained some form of proteids 973, or 43 per cent, ate eggs for breakfast and 544, or 23 per cent, meat in some form, usually pork.

Of the total reporting, 29 children did not eat breakfast habitually. In addition, the breakfast of a number of other children was defective, largely through capriciousness of the appetite rather than inability of the parents to provide the necessary food supply. Examples of this capriciousness may be seen in the case of some children who reported that their breakfast was composed of bread and coffee, pancakes, tea and crackers, coffee cake and coffee, pumpkin pie and coffee, an orange only in two instances, coffee and bread and lard in two other instances. This last observation is of peculiar interest in that it shows the retention of a custom or habit brought from the old country, because among certain Polish people lard is used on bread instead of butter, as a matter of choice.

Parents should be impressed with the necessity of providing children with a substantial breakfast before proceeding to school, because, in the cases where children live too far from the school to return for lunch, the amount of nourishment consumed by reason of

these limitations is too small to afford proper nourishment. The child, improperly fed and poorly nourished, can not do effective work, either physical or mental. An empty stomach is incompatible with the acquirement of mental training. The requirements of a desirable diet are: That it be sufficient in amount, varied and well balanced, contain starches and sugars to furnish heat and energy, and proteids, most readily available in the form of beans, milk, eggs and fresh meat, for the repair and upbuilding of growing tissues.

DEFECTS AND DISEASES FOUND.

The belief is quite common that a greater number of rural school children suffer from physical defects than is the case in cities, because of the greater medical facilities enjoyed by the latter. When compared with the reports of inspections made in urban communities, the results of this survey do not confirm this belief. The fact remains, however, that an undue number of the children in rural schools are found suffering from the results of the misuse of the special senses and from diseases of these organs which require the services of specialists, unfortunately denied in great measure to this large part of the general population.

In the following table is given the statistical results of the medical examination of the children of Porter County:

TABLE VI.—*Physical defects found in an examination of 2,488 children attending the rural schools of Porter County, Ind.*

BOYS.	Number.
Circulatory system:	
Irregular heart action	2
Valvular disease of	5
Extremity, upper:	
Ankylosis—	
First and second fingers, right	1
First finger, left	1
Second joint, fourth finger, right	1
Third joint, second finger, right	1
Fourth finger, left	1
Contracture—	
First and second fingers, right	1
Fourth finger, left	1
Deformity—	
First, second, and fourth fingers, left	1
Left forearm (old fracture)	1
Fracture—	
Bones, left forearm, recent	1
Colle's, left, recent	1
Hearing, defects of (see Tables VII and VIII)[1]	392
Hernia:	
Inguinal—	
Left	3
Right	1
Umbilical, relaxed ring	1
Nervous system, paralysis, hemiplegia, cerebral type:	
Left	1
Right	1
Nose and throat:	
Adenoids[2]	166
Nasal catarrh, chronic	16
Nasal septum, deflected	13
Nasal spur	14

[1] Tonsils and adenoids associated with defective hearing in 97 cases.
[2] Adenoids associated with enlarged tonsils in 140 cases.

TABLE VI.—*Physical defects found in an examination of 2,488 children attending the rural schools of Porter County, Ind.*—Continued.

BOYS.	Number.
Nose and throat—Continued.	
Pharyngitis—	
Catarrhal, subacute	5
Chronic, atrophic	2
Chronic, hypertrophic	16
Soft palate, cleft	1
Tonsils—	
Enlarged	89
Requiring surgical treatment	106
Respiratory system, general, bronchitis, subacute	15
Skin:	
Eczema	3
Impetigo	3
Ringworm of the face	2
Ringworm of the scalp	2
Speech, defective	8
Spinal curvature:	
Functional	25
Organic	2
Systemic: Pretubercular	2
Teeth, defective	749
Vision, defective (see Tables IX and X)	592
Total defects for boys	2,228

GIRLS.	Number.
Circulatory system:	
Irregular heart action	1
Valvular disease of	3
Extremity, lower:	
Shortening of left leg, coxitis	1
Ankylosis, left hip, incomplete	1
Extremity, upper:	
Anklyosis—	
Second finger, left	1
Fourth finger, both hands	1
Second joint, fourth finger, right	1
Deformity—	
Fourth finger, left hand	1
Fourth finger, both hands	1
Rudimentary fingers, fourth, both hands	2
Hearing, defects of (see Tables VII and VIII)[1]	348
Nervous system:	
Paralysis—	
Infantile, both legs	1
Spastic (infantile and cerebral type)	1
Infantile	1
Nose and throat:	
Adenoids[2]	122
Nasal catarrh, chronic	10
Nasal septum, deflected	6
Nasal spur	9
Pharyngitis—	
Catarrhal, subacute	8
Chronic, atrophic	1
Chronic, hypertrophic	31
Tonsils—	
Enlarged	106
Requiring surgical treatment	84
Uvula absent	1
Respiratory system, general:	
Asthma	1
Bronchitis, subacute	17
Tuberculosis	2
Skin:	
Impetigo	3
Ringworm of the face	3
Ringworm of the scalp	1
Speech, defective	6
Spinal curvature:	
Functional	11
Organic	2
Systemic: Pretubercular	10
Teeth, defective	637
Vision, defective (see Tables IX and X)	550
Total defects for girls	1,985

[1] Tonsils and adenoids associated with defective hearing in 80 cases.
[2] Adenoids associated with enlarged tonsils in 110 cases.

In this table it will be observed that, although the school population of the county is almost equally divided between the sexes, 1,253 boys and 1,235 girls, defects associated with the organs of hearing were more prevalent among the boys to the extent of 31.2 per cent compared to 28.2 per cent among the girls, affections of the respiratory system including the upper air passages in 35.4 per cent of the former and 32.2 per cent of the latter, and defects of the visual apparatus in 47.2 per cent and 45.5 per cent of the boys and girls, respectively. A number of these defects, however, were of minor character. Their relative significance will be discussed under special headings.

CIRCULATORY SYSTEM.

Surprisingly few of the children examined during this survey presented grave disturbances of the circulatory system. Of the boys, only five were noted with valvular disease of the heart and two with irregular heart action. Among the girls were found three cases of valvular disease of the heart and one of irregular heart action.

DEFORMITIES OF THE EXTREMITIES.

Defects of both the upper and lower extremities encountered were of minor importance, the results in the main of minor accidents. They consisted largely of ankylosis of one or both joints of the fingers and of deformities following fracture of the long bones. In the case of the lower extremity, however, one girl was suffering from shortening of the leg due to a former inflammation of the hip joint and one from partial ankylosis of the hip due to the same cause.

DEFECTIVE HEARING.

Auditory acuteness was determined by a watch calibrated for the normal ear. Hearing was expressed in the form of a fraction, the distance at which a watch could be heard by the normal ear being the denominator and the distance at which it was actually heard by the child examined, the numerator. In Table VII is given the results of the tests of hearing made in this manner:

TABLE VII.—*Degree of impairment of hearing, in terms of tenths of the normal distance, in 164 boys and 140 girls with defective hearing attending the rural schools of Porter County, Ind., 1914–15.*

Boys.			Girls.		
Right hearing.	Left hearing.	Number.	Right hearing.	Left hearing.	Number.
0/0	3/10	1	0/0	8/10	1
1/10	1/10	3	1/10	1/10	2
1/10	2/10	1	1/10	2/10	1
1/10	3/10	3	1/10	10/10	3
1/10	10/10	1	10/10	1/10	1
2/10	1/10	1	2/10	4/10	1
5/10	1/10	2	2/10	10/10	2
10/10	1/10	1	4/10	2/10	1
2/10	2/10	2	5/10	2/10	1
2/10	3/10	1	6/10	2/10	1
2/10	7/10	1	10/10	2/10	2
5/10	2/10	1	3/10	3/10	2
3/10	4/10	2	3/10	9/10	1
3/10	10/10	1	4/10	3/10	1
10/10	3/10	2	10/10	3/10	1
4/10	4/10	2	4/10	4/10	1
4/10	5/10	1	4/10	5/10	1
4/10	7/10	1	4/10	6/10	1
4/10	8/10	1	4/10	8/10	1
4/10	9/10	1	4/10	10/10	2
4/10	10/10	2	8/10	4/10	1
6/10	4/10	3	10/10	4/10	10
8/10	4/10	1	5/10	5/10	1
10/10	4/10	3	5/10	7/10	1
5/10	5/10	1	5/10	8/10	2
5/10	6/10	1	6/10	6/10	7
5/10	9/10	1	6/10	7/10	2
5/10	10/10	4	6/10	8/10	4
9/10	5/10	1	6/10	9/10	1
10/10	5/10	2	7/10	6/10	1
6/10	6/10	8	8/10	6/10	1
6/10	7/10	1	9/10	6/10	1
6/10	8/10	2	10/10	6/10	6
6/10	9/10	2	7/10	7/10	3
6/10	10/10	3	7/10	8/10	3
7/10	6/10	1	7/10	9/10	2
8/10	6/10	1	7/10	10/10	2
10/10	6/10	3	8/10	7/10	1
7/10	7/10	4	9/10	7/10	4
7/10	8/10	2	10/10	7/10	5
7/10	9/10	1	8/10	8/10	13
7/10	10/10	2	8/10	9/10	9
8/10	7/10	1	8/10	10/10	3
9/10	7/10	1	9/10	8/10	3
10/10	7/10	5	10/10	8/10	12
8/10	8/10	20	9/10	9/10	8
8/10	9/10	2	9/10	10/10	2
8/10	10/10	8	10/10	9/10	5
9/10	8/10	1			
10/10	8/10	20	Total for girls....		140
9/10	9/10	21			
9/10	10/10	5			
10/10	9/10	2			
Total for boys....		164			

Of the boys, 164, or 13 per cent of the total examined, suffered from impaired hearing which ranged from the total loss of hearing in one ear to the ability to hear at 9/10 of the normal distance in one ear. Among girls, 140, or 11.3 per cent of the total examined, suffered from impairment of hearing extending over the same range as in the case of boys.

In Table VIII is tabulated the defects of hearing found among all the children examined during this survey:

TABLE VIII.—*Auditory defects in 2,488 children attending the rural schools of Porter County.*

Defects.	Males.	Females.	Total.
Impairment of hearing in terms of tenths of the normal distance	164	140	304
Condition of ear drum:			
Adherent to promontory	2	3	5
Congested	4	6	10
Dull in one ear	19	18	37
Dull in both ears	64	63	127
Obscured by ceremum and scales, one ear [1]	37	48	85
Obscured by ceremum and scales, both ears [1]	25	33	58
Perforated in one ear	15	12	27
Perforated in both ears	6	5	11
Retracted in one ear	54	43	97
Retracted in both ears	74	55	129
Retracted and dull in one ear	24	11	35
Retracted and dull in both ears	63	27	90
Deafness	1	.....	1
Discharging ears	6	2	8
Eczema, external auditory canal	.....	1	1
External auditory canal closed, injury	.....	1	1
Otitis media, subacute	1	4	5
Otitis media, chronic	8	3	11
Total	567	475	1,042

[1] Associated with impaired hearing in 21 boys and 33 girls.

In this table it will be observed that 24 children were suffering from inflammation of the middle and discharging ears, conditions which require prompt treatment to avoid involvement of the mastoid cells. Furthermore, 27 children suffered from perforations of the eardrum of one ear and 11 children of both ears, indicative of a past prevalence of inflammation of the middle ear with its potential dangers to life.

Of more than passing interest was the presence of 21 boys and 33 girls with impaired hearing due to accumulations of ceremum (wax) and scales in one or both ears. The unsuspected existence of so large a number of cases of impaired hearing due to causes so easily remedied and their hampering effect on intellectual training emphasize the need and the value of making school inspections more emphatically than do defects of a more serious nature.

It will be observed that 30.9 per cent of the boys and 26.3 per cent of the girls examined presented some impairment of the eardrum, ranging from perforation to a slight dullness of one or both eardrums. In all cases of adherent eardrums, dullness, congestion, and retraction the underlying causes are either some involvement of the middle ear or of the Eustachian tube. A number of these conditions of the eardrum demand treatment at an early date for the removal of the underlying causes in order to prevent more serious impairment of hearing later in life.

NERVOUS SYSTEM.

But few cases of involvement of the nervous system were observed during this survey. Two boys, however, were suffering from paralysis of one side, the infantile cerebral type. Of the girls, one suffered from spastic paralysis of the infantile cerebral type, one from paralysis of both legs due to a previous attack of anterior poliomyelitis, and one from paralysis of one leg due to the same cause.

DEFECTS OF NOSE AND THROAT.

Adenoids.—Adenoids were present in 13.2 per cent of the boys and 9.8 per cent of the girls. In all the cases noted the adenoids were developed to the extent requiring operative procedure.

Adenoids exercise a harmful effect on the physical and mental development of the child. Adenoid tissue, represented most conspicuously by the tonsils, is normally present in the upper and back part of the throat just behind the posterior openings of the nasal passages. Overdevelopment of this structure in this situation results from causes not well understood, but generally thought to be due to irritation induced by variations in temperature and humidity associated with poor ventilation. In time the free passage of air through the nose is restricted, mouth breathing supervenes, and the inspired air is not properly filtered, moistened, and warmed by contact with the nasal mucous membrane.

Neglect of adenoids and failure to cause their prompt removal when indicated is responsible for a train of uncomfortable symptoms, is fraught with danger to life, and is largely contributory to mental retardation and failure to make grade.

Diseased tonsils and adenoids were associated with impaired hearing in 97 boys and 80 girls, or over 7 per cent of all the children examined during this survey. Adenoids were associated with enlarged tonsils, in all cases, in 250 children—140 boys and 110 girls—or over 10 per cent of the total examined.

Pharyngitis and nasal catarrh.—Inflammation of the upper air passages represented by chronic nasal catarrh and various grades of pharyngitis were observed in 39 boys and 50 girls, or 3.6 per cent of the total examined.

Deflections of the nasal septum and nasal spurs were encountered among 27 boys and 15 girls, or 1.6 per cent of the total examined.

Involvement of tonsils.—Enlarged or diseased tonsils were observed in 195 boys and 190 girls, or 15.4 per cent of all children examined. Not all of the enlarged tonsils observed were in need of immediate surgical attention, a distinction often overlooked, which causes children to be subjected needlessly to the nervous shock of an operation for the removal of tonsils simply because they are en-

larged. Tonsils in need of surgical attention were noted among 190 children, or 7.6 per cent of the total examined.

The tonsils readily become the seat of inflammatory processes, which are more or less chronic in character and which often extend to the middle ear, causing deafness. At times diseased tonsils are not enlarged but are embedded in the surrounding tissues, where they undergo slow suppuration followed by absorption of toxic substances injurious to health. In cases of this nature the offending organs should be removed.

DISEASES OF THE LUNGS.

The school children of the county were remarkably free from diseases of the lungs. Only two cases of tuberculosis were encountered during this survey, both of them being girls. A very low, general tuberculosis rate is reported by the State and county health officials in Porter County. As stated elsewhere, 74 children reported the occurrence of tuberculosis in the family, which represents a total prevalence during a number of years rather than the actual number of cases of this disease in existence in families of school children at the time of this survey.

In all, 2 boys and 10 girls were noted as being of a pretubercular type. This classification included children with nutrition below par, small chest expansion, development under the average, and apparently diminished powers of resistance.

The most frequent respiratory affection noted was a mild type of bronchitis, of which 15 cases were among boys and 17 among girls.

Bronchial asthma was diagnosed positively in only one instance. Several children, however, reported themselves suffering from this affection, the existence of which could not be confirmed by physical examination.

DISEASES OF THE SKIN.

Cutaneous diseases were not noticeably prevalent among the school children of the county. A few cases of eczema and impetigo were noted.

Ringworm of the face was observed in 2 boys and 3 girls, and ringworm of the scalp in 2 boys and 1 girl. Ringworm of the scalp is remarkably resistant to treatment. This disease is transmissible, is loathsome in appearance, and causes baldness. For this reason cases of ringworm should be excluded from school under treatment.

DEFECTS OF THE TEETH.

A total of 2,451 children were examined during this survey for dental defects, 1,236 boys and 1,215 girls. Of this number, 479 boys and 637 girls, 60 per cent of the former and 50 per cent of the latter, had some form of dental defects.

Of the boys, 54.5 per cent had 2 or more defective teeth, and of the girls, 44.2 per cent. The highest percentages of defective teeth were observed among boys from the fifth to the eleventh year and among girls from the fifth to the tenth year. The reduction in the number of defective teeth during the following age periods was steady in the case of girls, but more irregular among the boys.

The highest percentages of children with two or more teeth missing were encountered between the fifth and eleventh years among the boys and the fifth and ninth years among the girls, ranging from 28 per cent in the fifth year and 45.5 per cent in the eighth year to 28.2 per cent in the eleventh year. The per cent of the girls with two or more missing teeth ranged from 25.8 per cent during the fifth year, 37.5 per cent in the seventh year, and 26.7 per cent in the ninth year. It will be observed, therefore, that the highest percentages of defective and missing teeth were encountered during the period of the deciduous teeth. The general average for boys was 23.4 and for girls 18.9.

Malocclusion.—This was observed in marked degree, with equal frequency in boys and girls, in 4.8 per cent of those examined.

Dental work.—The extent to which dental correction had been practiced was slight up to the eighth year. From this age period the percentage of dental work increased appreciably and in greater relative proportion among the girls for corresponding age periods. Of 20 boys and 28 girls at 17 years of age, 45 per cent of the boys and 71.5 per cent of the girls had had some form of dental work. The general average for boys was 14.1 and for girls 19.7.

Toothbrush.—The use of the toothbrush by boys and girls presents some interesting comparisons. In all, 1,039 boys and 1,020 girls were classified with respect to the use of the toothbrush according to age periods, whether daily, occasionally, or never. Of the total, 18.3 per cent of the boys and 10.5 per cent of the girls never used a toothbrush at all, 67.8 per cent of the boys and 48.6 per cent of the girls used the toothbrush occasionally, and the daily use of the toothbrush was noted in but 13.9 per cent of the boys and in 40.9 per cent of the girls.

The greatest number of children never using the toothbrush was encountered between the fifth to the ninth year age periods, boys in greater number than the girls. The daily and occasional use of the toothbrush increased with more advanced age among the boys, but among the girls the number using the toothbrush occasionally decreased, while that of those using it daily increased. In other words, 70 per cent of the girls at 6 years of age used the toothbrush occasionally, and 94 per cent of them used it daily at the eighteenth year.

Oral hygiene.—The results of these examinations show the necessity of greater care of children's teeth in rural communities. Especially is this true of deciduous, the so-called "milk" or temporary teeth. These should be preserved as long as possible. When the temporary teeth are lost too early or at too long an interval before the eruption of the permanent teeth, shortening of the jaw takes place, and the permanent teeth erupt in an irregular manner.

The child should therefore be trained in the use of the toothbrush at an early age.[1]

The undue number of children who never used the toothbrush, as revealed by these examinations, the still greater number who used it only occasionally, and the failure to provide for dental service in the case of the younger children call for greater attention on the part of the parents for the protection of the physical and mental fitness of their offspring.

SPEECH DEFECTS.

Two general types of speech defects are met with in school inspection. In one class the children are without full control of the nerve mechanism of speech, a type represented by children who stammer. In the second class are those unable to articulate clearly because of some defect or deformity. Defective speech, when marked, prevents children from taking advantage of educational opportunity and, furthermore, in later life, renders it difficult for them to secure desirable positions.

Except in populous districts where the total number of children so afflicted is proportionately great, the special teaching measures devised for these defects are not available for school purposes.

In the course of this survey 8 boys and 6 girls with speech defects were encountered. The defect in the main was some form of stammering.

SPINAL CURVATURE AND FAULTY POSTURE.

Deviations of the spinal column from the normal are either functional or organic in character. In the latter the defect is usually due to past or present involvement of the bony structure in some disease process.

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[1] Certain rules for the preservation of the teeth recommended by the British Dental Association are as follows:

1. The teeth should be cleaned at least once daily.
2. The best time to clean the teeth is after the last meal.
3. A small toothbrush should be used, brushing up and down and across, inside and outside, and between the teeth.
4. A simple tooth powder or a little soap and some precipitated chalk taken up on the brush may be used if the teeth are dirty or stained.
5. It is a good practice to rinse the mouth out after every meal.
6. The rough use of the teeth, such as cracking nuts, biting thread, etc., should be avoided, but the proper use of the teeth in chewing is good for them.

The number of cases of spinal curvature due to organic lesions encountered during this survey was not large, there being but 2 boys and 2 girls so afflicted. Of the so-called functional spinal curvatures, however, 25 were among boys and 11 among girls, largely of the lateral type.

The most noticeable defect associated with faulty posture among school children is some form of functional spinal curvature.

It is doubtful, however, if the school can be considered the most prominent factor in the production of spinal curvature. The principal and underlying cause of this defect is a weakened and relaxed musculature. This results in a tendency to assume slouching attitudes which has usually been contracted by the child before entering school.

Effects of faulty posture on vision.—The relatively short anterio-posterior diameter of the eyes of very young children renders it difficult for them to see near objects without great efforts of accommodation, during which the ocular muscles become fatigued. The assumption of postures which bring the work nearer the eyes of young children therefore sets up a vicious train, the fatigue induced causing straining of accommodation, and still greater bending of the head to secure a clearer image by this closer approximation.

Other effects of faulty posture.—The habitual assumption of an incorrect posture with bended back and drooping shoulders causes contraction of the chest, incomplete expansion of the lungs, and reduced aeration of the blood. The full nutritive value of the food supply is not utilized and children so hampered are usually anemic, flabby, and improperly developed.

Although the school can not rightly be considered responsible for the tendency of children to assume faulty postures, it does crystallize, as it were, permanent faulty postural habits, unless measures be taken to overcome them. The installation of well-devised desks and their frequent adjustment to the needs of children insure the assumption of an upright position by placing the school work at a comfortable and convenient distance from the eyes. Children who display a tendency to faulty postures may and should have the muscle sense developed by appropriate regulated exercises. It must be remembered, however, that slouching attitudes are due to relaxation of easily fatigued muscles. Children of this type, therefore, require more frequent intervals of rest from positions of restraint than the normal child.

HERNIA.

Loss of tone by the abdominal muscles, caused by faulty postures, doubtless is responsible in a number of instances for the incidence of hernia. Hernias encountered among young children, however,

are usually congenital in type, the genesis of which has no connection with habitual positions assumed by the child. Because of the restriction of physical examinations of this character in school work, the incidence of hernia among the school children of the county was considered from the standpoint of boys only. Among these, there were observed 5 cases of hernia, 4 of which were of the inguinal type and 1 umbilical.

DEFECTS OF VISION.

The association of two or more visual defects in the same subject was quite frequently observed during this survey. Including the errors of refraction, 1,335 visual defects were distributed among 1,142 children, or not quite 1.2 defects for each child examined. Visual defects were present in 45.9 per cent of the total children examined. The greatest number of visual disturbances encountered during this survey were due to errors of refraction which are tabulated in Table IX:

TABLE IX.—*Snellen chart visual test readings in 169 cases of faulty refraction.*

Boys.			Girls.		
Right vision.	Left vision.	Number.	Right vision.	Left vision.	Number.
20/200	20/200	4	20/200	20/200	9
20/200	20/70	1	20/200	20/30	3
20/140	20/200	1	20/140	20/140	3
20/50	20/200	1	20/70	20/200	1
20/30	20/200	1	20/30	20/200	1
20/100	20/100	4	0/0	20/200	1
20/100	20/20	1	20/100	20/100	4
20/100	20/30	1	20/100	20/30	1
20/100	20/40	1	20/100	20/40	1
20/20	20/100	1	20/80	20/100	1
20/70	20/70	6	20/70	20/100	2
20/70	20/20	1	20/80	20/80	2
20/50	20/50	7	20/70	20/70	4
20/50	20/30	4	20/70	20/50	2
20/50	20/20	1	20/70	20/30	1
20/40	20/50	3	20/50	20/70	1
20/30	20/50	2	20/40	20/70	1
20/40	20/40	12	20/50	20/50	10
20/40	20/30	4	20/50	20/40	3
20/40	20/20	1	20/50	20/30	5
20/40	0/0	1	20/50	20/20	1
20/30	20/40	8	20/40	20/50	4
20/20	20/40	1	20/30	20/50	1
			20/20	20/50	1
			20/40	20/40	14
			20/40	20/30	10
			20/40	20/20	2
			20/30	20/40	12
			20/20	20/40	1
Total for boys..		67	Total for girls...		102

Only marked refractive errors were recorded in the table, errors which require correction by glasses. Of these there were 169 cases, 67 boys and 102 girls, or 5.3 per cent of the former and 8.2 per cent

of the latter, among the total examined. It would seem, therefore, that refractive errors are almost twice as common among girls as among boys. Correction by glasses had been attempted in 33 instances, or in 19.2 per cent of those suffering from marked refractive errors.

The specific visual defects are recorded in the following table:

TABLE X.—*Defects of vision in 2,488 children attending the rural schools of Porter County, Ind.*

Visual defects.	Males.	Females.	Total.
Absorption of lens with opaque capsule, right	0	1	1
Anemia (nerve head), left	3	3	6
Astigmatism:			
Against the rule, both eyes	75	63	138
Against the rule, left eye only	45	51	96
Against the rule, right eye only	37	50	87
Against the rule, right, with the rule left eye	30	34	64
With the rule, both eyes	139	111	250
With the rule, left eye only	62	57	119
With the rule, right eye only	60	59	119
With the rule, right, against the rule left eye	46	33	79
Mixed	0	1	1
Atrophy, tissues of orbit	1	0	1
Blepharitis	28	45	73
Blind, one eye:			
Right	1	4	5
Left	1	0	1
Choroid, pathological accumulation of pigment	1	0	1
Choroid, thinned	0	1	1
Coloboma of choroid and iris, left	1	0	1
Congestion of nerve head, left	0	1	1
Conus:			
Infratraction	2	2	4
Supratraction	1	3	4
Defective color sense	26	3	29
Exophoria	3	1	4
Hordeolum	2	4	6
Hyperopia, marked	10	12	22
Iris, adherent, central leucoma	0	1	1
Myopia:			
Marked	4	15	19
Right eye, hyperopia, left eye	0	1	1
Nebulae with defective vision	0	3	3
Nystagmus, spontaneous	3	2	5
Polycoria, left	1	0	1
Opacity, both lenses, congenital	0	1	1
Strabismus:			
External	1	0	1
Internal	8	6	14
Trachoma	5	2	7
Vision uncorrected, 20/200 to 20/40 in one or both eyes	67	102	169
Total	663	672	1,335

Astigmatism.—Astigmatism was present in one or both eyes among 953 children, or 38.3 per cent of the total. With regard to sex, 39.4 per cent of the boys and 36.3 per cent of the girls were astigmatic.

Hyperopia.—Hyperopia was determined by the ophthalmoscope and only marked cases of this refractive error were recorded because the eyes of young children are normally hyperopic. Twenty-two cases of hyperopia were recorded, 10 of them in boys and 12 in girls.

Myopia.—This was likewise determined by the opthalmoscope and the marked cases only were recorded. Of these, there were noted

19 cases, 4 in boys and 15 in girls. It is seen from the foregoing observations that refractive errors of all types were encountered among girls in larger proportion than among boys.

Extreme types of myopia are found associated with poor school environment more frequently, probably, than any other form of grave refractive error. The influence of marked myopia upon the future possibilities of the child is very pronounced, limiting to a noticeable degree the occupations in which he can engage.

In schools he should be protected from glare and undue brightness and provided with a desk of such a type that the work may be placed at the most suitable angle and distance for visual comfort. Although there may be doubt that faulty position and poor illumination and posture are causative factors of myopia, still it is well recognized that these conditions may intensify the degree of myopia originally present.

Defective color sense.—This was noted in the case of 29 children, 26 of these being boys and 3 girls. The inability to distinguish colors limits the number of occupations in which boys so afflicted may profitably engage. This is especially true in railroading, navigation, and in the manufacture of certain textiles. It is a singular fact that a number of people with faulty color sense are unaware of this defect. The determination of this fault at an early age, therefore, may be of value in directing the activities of the child to fit him for occupations in which the possession of the normal color sense is not a matter of such great importance.

Trachoma.—Trachoma is a contagious disease of the eyes potentially dangerous to vision. This disease is now known to be more widely prevalent in this country than was formerly thought to be the case. Unfortunately mild types of trachoma may exist without producing noticeable symptoms for long periods, yet eyes in this condition are potentially infectious to others. The necessity for the inspection of the eyes of school children for the detection of cases of trachoma is therefore apparent.

In the course of this survey but 7 cases of trachoma were encountered, 5 among boys and 2 among girls. The slight prevalence of trachoma in Porter County, Ind., as indicated by these figures, is an evidence of the care exercised in the inspections for this disease at the ports of entry, because a considerable proportion of the population of this county is drawn from sections of Europe in which trachoma prevails extensively.

GOITER.

Simple thyroid enlargement, commonly called goiter, is more or less prevalent in practically all localities. This condition, however, has been found unduly prevalent in regions underlaid by ancient

limestone formations. The actual cause of goiter has not yet been determined, though by many it is thought to be due to the drinking of unduly hard waters. While the presence of simple thyroid enlargement is not particularly harmful, nevertheless from the esthetic standpoint its correction is highly desirable.

Records were made, therefore, of the prevalence of this defect among the school children of the county and classified according to whether the enlargement was pronounced or only slightly noticeable. Among the 2,488 children examined, 872 girls and 648 boys, or 61 per cent of the total examined, presented some degree of thyroid enlargement. Of the 1,235 girls examined, 43.4 per cent presented noticeable thyroid enlargement, and in 24.3 per cent it was only slightly so. Of the 1,253 boys examined, 26.7 per cent presented noticeable thyroid enlargement and in 27.6 per cent the enlargement was slight. The distribution of goiter in this county is remarkable in that this gland is involved in such a high percentage of the boys examined, in marked contrast to the observations of one of the writers (Dr. Clark) in other localities.

PART III.

MENTAL STATUS OF RURAL SCHOOL CHILDREN OF PORTER COUNTY.

In the course of this survey, a study was made of the mental condition of each child. The purpose was not only to determine the number of mental defectives which require special or individual treatment, but to study the influence of school surroundings on mental status. Coincidently, studies were made to determine the value of the Binet-Simon tests for grading intelligence.

A total of 2,185 children were thus examined, special reliance being placed in the Binet tests with some modifications. In the case of exceptionally retarded children revealed by these tests, however, special methods were employed to determine the degree of mental impairment.

HISTORY OF THE TESTS.

As is known, Binet and Simon, on data collected during the examination of 200 normal French school children, devised a series of tests for different age periods. As originally devised, the number of tests for each age group varied from four to seven. In 1911, the tests were revised and the number for each age group was fixed at five, except that of the four-year group, which contains four tests. This revision was based on the examination of 203 French school children. Of this number, the observers gave tabular results for 192, as follows:

TABLE XI.—*Mental and chronological ages of 192 French school children examined by Binet and Simon.*[1]

Chronological age.	3	4	5	6	7	8	9	10	11	12	Total.
Regular	3	9	13	5	7	16	11	14	13	2	93
Advanced 1 year	3	2	6	8	7	5	9	2	....	....	42
Advanced 2 years	....	1	....	....	....	1	....	....	....	....	2
Retarded 1 year	4	4	4	6	3	1	2	9	5	5	43
Retarded 2 years	....	1	....	1	1	....	....	3	2	4	12
Total	10	17	23	20	18	23	22	28	20	11	192

[1] In this classification, "regular" signifies that the child's mental age is the same as the chronological age. Advanced and retarded are self-explanatory.

It will be observed in the above table that nearly half the children were regarded as regular, while those retarded and those advanced one year were about equal in number. Only 14 of the 192 showed a departure from the regular of more than one year.

These tests were the first of this character devised for the purpose of determining the degree of intelligence of children in terms of mental ages. By reason of their simplicity they became widely popular.

The tests have been objected to by some on the ground that they are mainly tests of the intelligence. They certainly do not aim at a systematic determination of the development of any particular mental function. They have been found, however, in an empirical way to give results which show the general mental development of the child.

The Binet-Simon tests do not extend beyond the chronological age of 12, because, following this age period, the mental content becomes more intricate, and a small number of tests at any subsequent age would be far from accurate.

Because of the objection that Binet and Simon examined too small a number of children to establish norms, Goddard determined the norms for these tests in the case of 2,000 American school children. His results in the case of 1,532 children are given in the following table:

TABLE XII.—*Mental and chronological ages of 1,532 American school children examined by Goddard.*

Chronological age.	Mental age.												
	2	3	4	5	6	7	8	9	10	11	12	13	Total.
4	....	1	**2**	2	3	.....	.....	.....	.....	.....	.....	.....	8
5	2	4	8	**40**	40	16	4	.....	.....	.....	.....	.....	114
6	1	....	3	29	**48**	69	9	.....	1	.....	.....	.....	160
7	....	1	2	8	15	**14**	50	4	3	.....	.....	.....	197
8	....	....	2	2	1	87	**86**	16	12	3	.....	....	209
9	....	....	....	.....	.....	27	54	**56**	58	4	2	....	201
10	....	....	....	.....	.....	15	24	19	**124**	27	8	2	219
11	....	....	....	.....	.....	4	13	25	50	**60**	12	1	165
12	....	....	....	.....	.....	4	10	13	42	36	**39**	7	151
13	....	....	....	.....	.....	1	5	6	30	19	21	**3**	85
14	....	....	....	.....	.....	.....	1	1	6	5	4	....	17
15	....	....	....	.....	.....	.....	.....	3	.....	1	2	....	6
Total	3	6	17	81	107	337	256	143	326	155	88	13	1,532

It will be observed in the above table that up to the age of 9 nearly all of the children of each age group graded either regular, one year advanced or one year retarded. In the succeeding age groups, nearly all of them graded either regular, one year advanced or two years retarded with the exception of the 10-year-age group, in which nearly as many children graded three years retarded as were retarded only one year.

METHOD OF EXAMINATION AND GRADING.

Goddard's revision of the Binet-Simon scale, with the addition of his 15-year old and adult test groups, was used in this survey. In one-room schools the children were examined in the classroom, in schools of more than one room in a room where physical examinations were being made. In other words, the examination was not made in a quiet place, but in one that represented in part the child's daily schoolroom environment.

The following method of grading was employed: The child was given a basal mental age corresponding to the age group in which he successfully passed all the tests, and to this one year was added for each five tests passed successfully in the higher age groups. For example, if in addition to all the 8-year tests he also passed 3 in the 9-year group and 2 in the 10-year group, he was graded as having a mental age of 9 years.

In the case of the 12-year-old group, however, in view of the inability of a large number of 12-year-old children to repeat a sentence of 24 syllables, a child successfully passing all five of these tests and one of the 15-year group was classed as 13 mentally.

Children were classed as 15 years old mentally when they passed all of the 15-year-old tests but less than half of the adult tests, and as adults when they passed 75 per cent of the adult tests.

Statistical results of the application of the Binet-Simon tests to 2,185 rural school children of Porter County in the first to eighth grades inclusive, are given in the following table:[1]

RESULTS OF MENTAL EXAMINATION.

TABLE XIII.—*Chronological and mental ages of 2,185 children attending the rural schools of Porter County, Ind., in terms of per cent.*

Chronological age.	Mental age in terms of per cent of the total in each age group.												Total examined.
	4	5	6	7	8	9	10	11	12	13	15	A.	
5	.....	**23 +**	42.25	23 +	11.5+	.....	.....	.....	.....	.....	.....	.....	26
6	2.8	18.7	**27.+**	33.7	16.8	.....	0.93	.....	.....	.....	.....	.....	107
7	.43	5.6	23.7	**37.9**	25.8	5.2	8.6	.....	0.43	.....	.....	.....	232
8	.42	1.7	6.0	12	**44.5**	18.8	6.4	2.1	.....	.....	.....	.....	234
9	.92	.92	3.7	6.5	29.1	**31.4**	22.7	4.1	.46	.....	.....	.....	216
10	.....	.36	.72	2.5	16.3	23.7	**40.7**	12.9	2.5	0.36	.....	.....	278
11	.....	.....	.....	1.8	6.6	9.9	35.3	**35.3**	8.9	1.8	.....	.....	212
12	.....	.....	.....	.....	2.6	10.3	21.0	37.8	**22.2**	5.7	0.82	.....	243
13	.....	.....	.....	.4	2.4	5.6	19.5	35.8	20.1	**13.6**	2.8	.....	249
14	.....	.....	.....	.55	.55	4.9	7.7	28.7	24.3	21.5	11.6	.....	181
15	.....	.....	.....	.....	2.9	11.7	8.8	14.7	13.4	19 +	**28 +**	1.4	136
16	.....	.....	.....	.....	.....	7+	10.5+	15.8+	22.8+	14 +	28 +	1.7+	57
17	.....	.....	.....	.....	9 +	9 +	9.0+	18.2	18.2	9 +	18.2	9 +	11
18	.....	.....	.....	.....	.....	.....	.....	50	50	.....	.....	.....	2
19	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
20	.....	.....	.....	.....	.....	.....	.....	.....	.....	100.	.....	.....	1
Total	7	46	119	204	324	280	387	390	210	128	86	4	2,185

[1] In this tabulation a child was recorded as having the chronological age of his nearest birthday and likewise as having the nearest mental age (when grading mentally in fractions of a year.

LIMITS OF NORMALITY.

A glance at the foregoing tables of Binet-Simon and Goddard will show that large numbers of normal children, chronologically 6, 7, 8, and 9 years of age, graded either regular, one year advanced, or one year retarded. In the case of children 10, 11, and 12 years old, chronologically, large numbers graded either regular, one year advanced, or one or two years retarded.

In the case of 13-year-old children, however, those retarded as much as three years are regarded as normal, because nearly all of the children of the series come within these limits. Thirteen-year-old children who grade 15, however, must be regarded as "exceptional children." The 14, 15, and 16 year old children graded largely within the limits of 11 and 15 years mentally and those of 17 to 20 years of age from 12 to adult.

CLASSIFICATION OF RETARDED AND EXCEPTIONALLY RETARDED CHILDREN.

The mental progress of a child is rapid for the first few years of its life but becomes slower as maturity is approached. There is, as yet, no means of measuring this rate of progress. The difference in the mental development of a normal 2-year-old child and one 3 years old is readily recognized. This difference becomes difficult to note between the ages of 6 and 7, and between 11 and 12 years of age the recognition of mental difference by ordinary observation is quite impossible.

Mental development during any one-year period does not represent accurately a unit of mental growth, because the older the child the less rapid is the rate of mental development and the less noticeable is the retardation in any one year age period.

Moreover, retardation in very young children presents two possibilities. In the first place, owing to the greater number of years intervening before maturity, these children eventually may attain normal mental development. On the other hand, retardation may accumulate and become increasingly evident with advancing age. In consequence, the ultimate mental development of young children thus classified can not be foretold.

The problem is not so complex, however, in the case of adults or individuals who have reached a chronological age at which the rate of mental development is slower. Retardation below a certain point can not be overcome in the short time intervening before maturity at the slower rate of development, and the mental status in these cases may be determined with certainty.

The classification used in this report is based on the above considerations and children are recorded as retarded and exceptionally

retarded. With the former the possibility remains of ultimate normal mental development, while with the latter the mental development will never be greater than that of a child when adult age is reached.

A graphic representation of the classification employed in these studies is shown in chart 10. Reference to it will show that children of 6 years who were 4 mentally, of 7 who were 5, of 8 who were 5 or 6, of 9 who were 6 or 7, of 10 who were 6 or 7, of 11 who were 7 or 8, of 12 or 13 who were 8 or 9, of 14 or 15 who were 9 or 10, of 16 who were 10, of 17 to 20 who were 11, are classified as exceptionally retarded.

The method of classification used is considered conservative. Although this classification may not include all the mental defectives in a school population, because of the inability to determine positively subnormality in the very young children of the lower grades, and who must, therefore, be regarded as retarded only, still the method is more reliable than the arbitrary grading children as defectives who are retarded as much as three years. The adoption of the latter procedure would have recorded a percentage of feeble mindedness for this county far in excess of actual conditions.

RETARDED CHILDREN.

Retarded children are to be found in every large school system. It has been stated that 50 in every 1,000 public school children have difficulty in keeping up with their work and are in need of individual assistance.

Of the 1,087 girls and 1,098 boys examined in the rural schools of Porter County, 93 of the former and 100 of the latter were retarded, and excluding the exceptionally retarded children, constituted 8.7 per cent of the number examined. Including the exceptionally retarded children, the whole number of children requiring special attention was 214 or 9.3 per cent.

DEFECTS ASSOCIATED WITH RETARDATION.

The delicate physical and mental adjustments of children are much more easily upset than is the case with adults. Minor physical defects which ordinarily make no impression upon a grown person may prevent the normal physical and mental growth of the child. Defects of vision and hearing, defective teeth, adenoids, enlarged tonsils, nutritional disturbances, and certain general diseases react injuriously on both the physical and mental development of the child. It becomes important, therefore, to consider the hampering effects of physical defects and diseases in connection with mental retardation, and to take steps for their correction when possible.

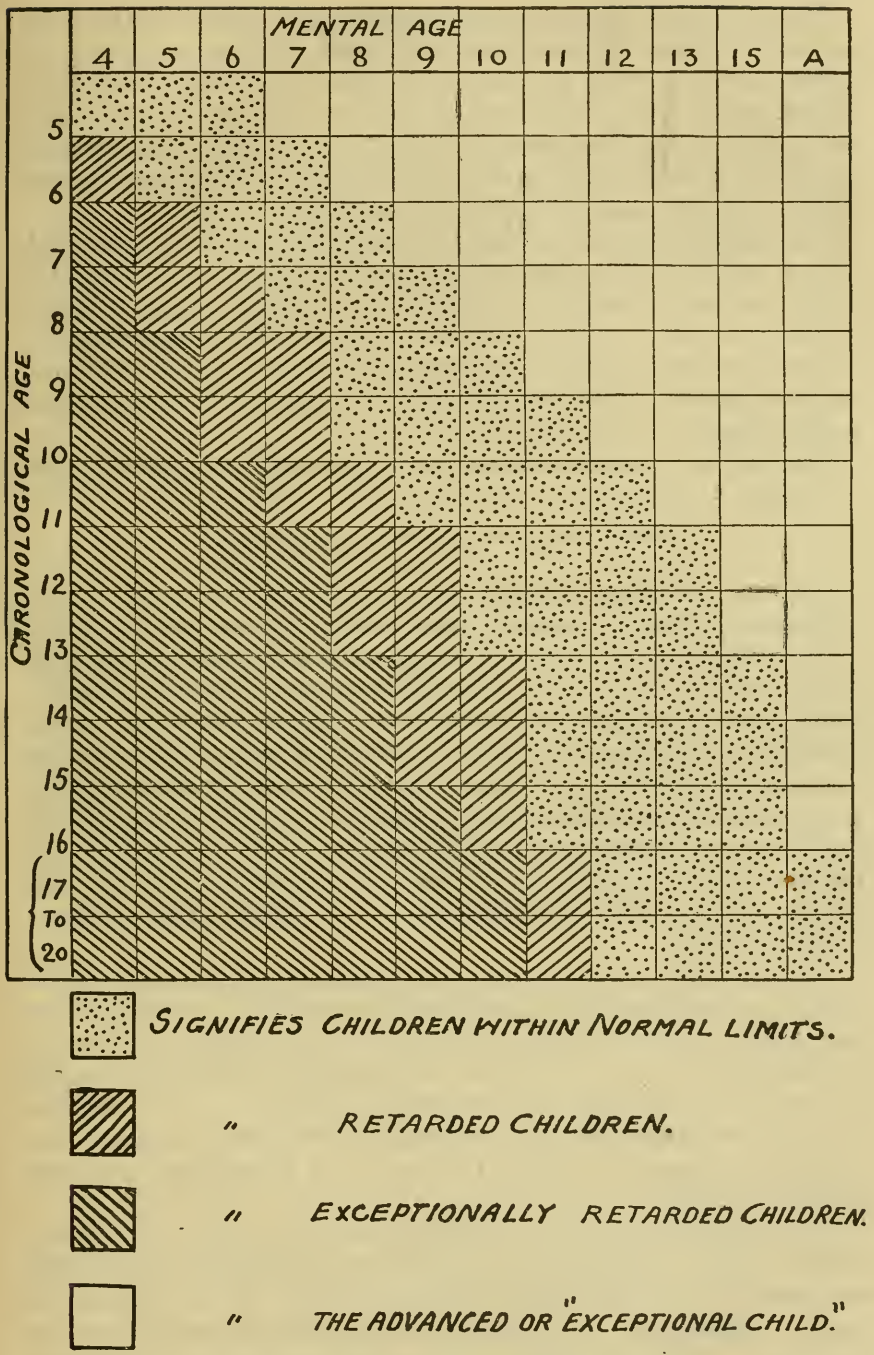

CHART 10.—Normal mental age limits for one-year chronological age periods, and limits for advanced, retarded, and exceptionally retarded children, measured by Binet-Simon scale.

Thirty-five per cent of the 93 retarded girls found in the rural schools of Porter County were undersized, 41.1 per cent were of normal size, and 23.5 per cent were above the county average in height and weight. Furthermore, 58.8 per cent had defective eyesight, 26.4 per cent had defective hearing, 1.7 per cent had adenoids associated with enlarged tonsils, 2.9 per cent had enlarged tonsils without adenoids, and 17.6 per cent had defective teeth.

Thirty-eight per cent of the 100 retarded boys were undersized, 30 per cent were of normal stature, and 32 per cent were above the county average of height and weight. In addition, 47 per cent had defective eyesight, 19 per cent had confused color discrimination, 34 per cent had defective hearing, 6 per cent had adenoids and enlarged tonsils, 17 per cent had defective teeth, and one child had a cleft palate.

Two or more physical defects were frequently associated in the same child.

OTHER CAUSES OF MENTAL RETARDATION.

Improper teaching methods are responsible for much of the retardation found in schools. The teachers of the public schools of the country have imposed upon them a great responsibility, no small part of which is the molding of character. Education is something more than imparting instruction. Young people who adopt teaching as a temporary avocation do not meet with the same success in training children as do those who make this profession a life work. The training of teachers, therefore, and their selection, warrants the most careful consideration, because, in addition to technical training, the successful teacher must be adaptable and have the ability to broaden the outlook upon life of certain types of introspective children.

Poorly equipped school buildings, defective illumination, faulty ventilation and heating, uncomfortable seats and unattractive surroundings operate to cause retardation. The discomfort experienced in buildings of this type produces a hampering effect on the mental concentration necessary for educational purposes. The provision of school buildings erected in accordance with modern sanitary principles will do much to reduce the amount of retardation appearing in school children.

In a number of instances, children have been advanced in grade without proper preparation. A child who has failed to acquire the fundamentals in a lower grade can not properly do the work in the higher classes and, when unduly promoted, suffers injurious retardation. Children of this type frequently quit school with a poor educational equipment.

In Porter County the average loss of grade by retarded children, as recorded by teachers, was 1.28 years for girls and 1.5 years for boys.

Mental retardation is most frequently met with in crowded one-room schools where several grades are taught by one teacher. A number of schools of this type are in operation in Porter County. Where the number of pupils in attendance is large, the time of the teacher is too occupied by routine duties to permit of individual instruction of children who find difficulty in mastering the fundamentals of education.

CARE OF RETARDED CHILDREN.

Children who are unable to advance in school work by methods which are effective in regular classes require special educational facilities, which are of practical attainment through the organization of special classes. The organization of such classes rarely can be accomplished in districts where there are principally one-room schools by reason of the increased cost. The consolidation of rural schools, however, offers facilities for special classes and individual instruction to larger groups of children, who would otherwise remain misfits in the smaller schools.

Wherever such classes are organized, the retarded children should not be segregated in the most undesirable room in the building. Moreover, the teachers should have special qualifications for this kind of instruction and not be selected because of years of experience in other branches of pedagogy. They should have training in the management of children, a knowledge of the methods employed in correcting speech defects, and a fair understanding of some of the problems of psychology as related to the child and of the principles of physiology.

The value of special classes for retarded children is shown by the fact that 50 per cent of the children who are placed in such classes rejoin their proper grade when faulty methods are corrected and physical conditions improved.

EXCEPTIONALLY RETARDED CHILDREN.

Of the 1,087 girls and 1,098 boys examined in the rural schools of Porter County, 7 or 0.6 per cent of the former, and 14 or 1.2 per cent of the latter were so exceptionally retarded that their mental development at no time will be greater than that of a child.

DEFECTS ASSOCIATED WITH EXCEPTIONAL RETARDATION.

Twenty-eight per cent of the exceptionally retarded girls were undersized and 57 per cent were above the average physical development of the county, as compared with only 23.5 per cent of the girls

who were simply retarded. Furthermore, 42.8 per cent had defective eyesight, 14.2 per cent had defective hearing, and 2.9 per cent had enlarged tonsils.

Of the exceptionally retarded boys, 28.5 per cent were undersized, 28.5 per cent were of normal physical development, and 42.8 per cent were above the average for the county in height and weight. In addition, 34.2 per cent had defective eyesight, 57.1 per cent had defective hearing, and 7.1 per cent had enlarged tonsils.

Among the exceptionally retarded children the average loss of grade, as recorded by teachers, was 2.1 years for girls and 2.5 years for boys.

The number of exceptionally retarded children constituted 0.9 per cent of the total number examined. This does not include all of the defectives among children of school age in the county. It must be assumed that some children, by reason of grave mental defects, were unable to attend school.

CHARACTERISTICS OF EXCEPTIONAL RETARDATION.

Mental deficiency, or feeble-mindedness, as it is more often termed, has been defined as a lack of normal mental development. Individuals of this class can be educated to a degree, but with them mental progress is so decidedly slow that their mental capacity is no greater than that of a child, even when adult life is reached. Persons whose intelligence is developed to so slight a degree are misfits in a society arranged for people whose mental development continues until the retrogressive changes of old age begin. They become dependents because of their inability to compete with persons of higher intelligence, immoral because unable to adjust their sexual problems to moral laws, and delinquent because they do not understand the significance of laws devised for the protection of society.

CAUSES OF EXCEPTIONAL RETARDATION.

A defective heredity, insanity, alcoholism, and syphilis in one or both parents are considered responsible for most of the cases of mental defectives. A large part of the evidence that heredity is an important causative factor of mental deficiency is based on indirect testimony. The great value of investigations of this character is the determination of existing cases of mental deficiency as a starting point for future studies of the influences of heredity on succeeding generations.

Of the other causes of mental deficiency may be mentioned congenital defects, injuries, and nutritional disturbances. Improvement by better sanitation of the health of communities will be followed also by a reduction in the number of mental defectives.

NUMBER OF EXCEPTIONALLY RETARDED CHILDREN.

According to the United States census report, 1910, 20,000 mental defectives were in special institutions in this country. Mental examinations of a large number of persons in prisons, penitentiaries, jails, and workhouses during the last few years show at least a third of the number examined to be mentally defective. At this rate not less than 40,000 of the 136,472 persons in such institutions, including those for juvenile delinquents, in 1910 were mental defectives.

It has been estimated that 20 in each 1,000 American school children are mental defectives,[1] and that 2 in 1,000 of the general population are mental defectives. On the basis of the lowest figures it is estimated there are at least 200,000 feeble-minded persons in the United States. As a conservative estimate, about 130,000 feeble-minded persons are without institutional care of any description. Only 26 States have provided institutions for the feeble-minded.

CARE OF MENTAL DEFECTIVES IN INDIANA.

In 1879 a department for feeble-minded children was established as an adjunct to the Soldiers' and Sailors' Orphans' Home at Knightstown, Ind. The legislature, by an act approved March 7, 1887, gave the institution an independent existence and changed the name to Indiana School for Feeble-Minded Youth. A new institution was built at Fort Wayne. It was not occupied, however, until July 8, 1890.

The privileges of the school are extended to feeble-minded, idiotic, epileptic, and paralytic children under 16 years of age. Since 1901 the school has maintained a custodial department for feeble-minded women between the ages of 16 and 45 years. These women are committed by the courts (Laws, 1887, p. 47; 1901, p. 156). A colony farm containing 509⅓ acres has been in operation since 1893.

The superintendent of the various almshouses in Indiana, in 1914, reported 489 feeble-minded men and 380 feeble-minded women in the various almshouses of the State. Of the 380 feeble-minded women, 118 were within the child-bearing age period. Of the 3,228 almshouse inmates, 1,389, or 43 per cent, were insane, feeble-minded, or epileptic.[2]

EDUCATION OF FEEBLE-MINDED.

The aim of the education of feeble-minded children should be to train them to be self-supporting. Intellectual training, in its narrower sense, is of secondary importance.

[1] The number of mental defectives found in this survey are not greater than 9 in 1,000.
[2] Twenty-fifth Annual Report of the Board of Charities of Indiana, September, 1914.

Most American institutions for the feeble-minded are broadly divided into two departments—educational and custodial. The education of the feeble-minded, compared to that for normal children, differs in degree only and begins at a lower plane. Satisfactory gradations or classifications are made so that children with irregular and unusual deficiencies receive individual training in special classes.

The most prominent feature of the education of the feeble-minded, however, is their training in industrial occupations and manual labor, as now successfully and profitably carried on by the pupils in these schools. Through correct training of this character a certain number of these individuals lead useful lives after leaving the institutions. About one-half the higher grades of mental defectives who have been under training from childhood are self-supporting, under intelligent supervision, whether in an institution or at home. It is especially important to begin training of this character early in the child's life.

MENTAL DEFICIENCY AND ITS RELATION TO THE COMMUNITY.

Recent investigations of the defective and delinquent classes have demonstrated that a large percentage of criminals, paupers, tramps, and prostitutes are really congentital imbeciles who have been allowed to grow up without training or discipline. Society suffers the penalty of such neglect through an increase in pauperism, vice, and crime, and the greatly increased cost of the care of adult feeble-minded persons.

Feeble-minded girls, exposed to evil influences, are unable to protect themselves from the perils peculiar to women. There is hardly a poorhouse in this country which has not one or more feeble-minded women who are mothers of several illegitimate children. It is often the case, in rural communities, that a girl of this type, when illegitimately pregnant, has no place to go except to the almshouse. After the community has borne the expense of three or four confinements, she is finally committed to an institution for the feeble-minded. From every consideration of morality, humanity, and public policy, feeble-minded women should be under permanent and watchful guardianship, especially during the child-bearing age.

OTHER MENTAL CONDITIONS WHICH REQUIRE SUPERVISION.

EPILEPTICS.

During the course of this survey three epileptic children were observed. One of these was feeble-minded.

The State of Indiana has provided an institution for cases of this type, which is located near New Castle. All epileptics having a legal settlement in the State are admissible.

Recent studies of juvenile offenders show that a fair per cent of them are afflicted with epilepsy. It is estimated that every juvenile epileptic offender, because of his constitutional tendency to corrupt others, in the end will cost the State the sum of $6,000. It is important, therefore, for communities to realize that, because mental conditions play no small part in the production of crime, early recognition of these cases and suitable provisions for their supervision and training will obviate future expense.

JUVENILE DELINQUENT.

In every community there is a number of children who are morally irresponsible. They showed no marked deficiency of the intellectual faculties, but early in childhood manifest a perversion of the moral sense, which is shown by motiveless, persistent lying and thieving, an impulse to arson and cruelty to animals and to younger or helpless companions. These constitutionally inferior persons comprise a large percentage of habitual criminals. The presence of one or more children of this type in school exercises a pernicious influence that is usually associated with an increase in the number of children who fail to make grade. It is undesirable to permit children of this type to attend school. It is still more undesirable to turn them loose on the community without restraint, because they are potential criminals in a poor environment. It is incumbent on the State, therefore, to care for such children and give them suitable training.

During the course of this survey two marked cases of this type of mentality were found.

State provision for juvenile offenders.—The State of Indiana has established two schools for the correction and reformation of juvenile offenders. That for boys is established on a farm near Plainfield and receives boys committed for crime from 8 to 16 years of age. In the case of incorrigibility, however, the commitment age is from 10 to 17. The term of commitment continues until the boy is 21 years of age. One-half of the cost of caring for each boy is paid by the county from which he is committed.

The daily average attendance is near 600 boys.

The Indiana girls' school is situated on a farm near Clarmont. The age of commitment for girls is from 10 to 18 years of age. The term of commitment is until 21 years of age.

The daily average attendance is a little over 300.

In Indiana the judge of the circuit court is the guardian of all children who need State protection. In addition the State has formed a board of children's guardians, which is composed of six members, three of whom are required to be women. Each member must be a parent.

The practice of committing juvenile offenders without an attempt to determine their mental status is not a good one. The possibility of a miscarriage of justice by this procedure is very great. It is desirable that courts which deal with children should have attached to them a competent psychologist to determine the children's mental status. Furthermore, the combination of these duties with that of the mental inspection of school children would be practicable. A psychologist attached to the courts could bring about the proper segregation of the feeble-minded in places other than the county almshouse, which is so unsuitable for the purpose.

SUMMARY.

In all, 75 school buildings were surveyed in the rural districts of Porter County, 2,488 children were studied physically and 2,185 mentally.

SANITARY SURVEY.

SCHOOL LOCATIONS.

The elevation of school sites was good in 24 instances, fair in 26, and poor in but 9. Walks were observed at 30 schools, 12 being merely entrance walks. Some of the schools were located in more or less close proximity to nuisances.

The average time taken by children in reaching school was 18.8 minutes. Free transportation was practiced in 10 townships, 345 children being transported at an annual cost of $10,729.88.

A sanitary rating of the school privies never reached higher than 50 per cent at any school. The majority of the privies were of the "pit" type. The upkeep and sanitary policing of the greater number of privies were bad.

SCHOOL BUILDINGS.

Of 75 rural schools inspected, 89.3 per cent were one-story structures and 50.7 per cent were frame. Fifty-seven per cent were more than 20 years old. The basements were waterproof in 16 of the 23 schools having basements.

Ten of the schools faced north, 23 east, 25 south, and 17 west. The state of repair of 43 was good, of 24 fair, and of 8 poor. No fire-fighting apparatus was found in any school; 5 were provided with fire escapes. Cloakrooms were provided in only 38 per cent of the schools inspected.

WATER AND LAVATORY FACILITIES.

The water used in 75 per cent of the schools was obtained from shallow driven wells; 3 schools were connected with town water systems and 2 had wells from 125 to 130 feet deep. Protection from surface drainage was not satisfactory. Sanitary drinking fountains of various stationary types were found in 7 schools, but were in use in only 4.

Facilities for washing the hands were limited, common wash basins being provided in 75 per cent of the schools but not being in use in many.

CLASSROOMS.

Adjustable desks were found in 9.15 per cent of the classrooms. Slate was used for blackboard purposes in 85.5 per cent of the schools. Window shades adjustable from top and bottom for the regulation of admission of sunlight were used in 51.5 per cent of the classrooms.

Daylight was admitted from a desirable direction in only 42.2 per cent of the classrooms. The average ratios of window glass area to floor space for all schools was 15.5 per cent, the maximum being 20 per cent and the minimum 8.

Wainscoting was found in 50 classrooms. The walls and ceilings were painted too dark a green from the standpoint of illumination in 46 classrooms and were white in 20, undesirable because of the high reflection coefficient.

HEATING.

Closed stoves were used for heating purposes in 41.1 per cent of the rural schools, jacketed stoves in 34.5 per cent, and hot-air furnaces in 21.1 per cent. Humidification of classroom atmospheres in all schools was inadequate, the relative humidity being under 40 per cent in a majority of cases. Carbon dioxid was present in 7 classrooms to the extent of 8 parts per 10,000 and in 4 classrooms to the extent of 10 parts in 10,000.

VENTILATION.

Ventilation of 27.6 per cent of the classrooms depended entirely upon a natural circulation of air. The Plenum system of ventilation was employed in 20.8 per cent of the classrooms and the gravity system in 51.6 per cent. In most classrooms depending upon the latter the amount of air supply for each pupil per minute was insufficient. An ample provision of air space was found in practically all of the schools.

PHYSICAL STATUS OF CHILDREN.

A total of 2,488 children (1,253 boys and 1,235 girls) were studied, against a daily attendance of 2,512. Practically 8 per cent of the boys and 10 per cent of the girls were 6 years old and under, and less than 10 per cent of either sex were over 15 years of age.

PHYSICAL DATA.

1. A comparison of the mean height and weight of Porter County rural school children with those of children in other localities shows a deficiency in the former during certain age periods. In general the mean height and weight of children of German, Polish, and Scandinavian origin in the county were higher than the corresponding heights and weights for the county as a whole.

2. The rise of lung capacity in boys from 7 to 18 was constant, except for a decided break between the fifteenth and sixteenth years. The vital capacity of girls was similar to that of boys up to the eleventh year, when a decline in the rate of increase commenced, becoming more marked after the fourteenth year.

3. The chest expansion of boys rose from 1 inch at the sixth year to nearly 4 inches at the eighteenth, while that of girls rose from less than 1 inch at the sixth year to 3 inches at the sixteenth, followed by a sharp decline.

4. The strength of the right hand for boys increased from 9.2 to 34 kilos from the seventh to seventeenth years; for girls the increase was from 8 to 22.9 kilos.

5. Of the boys, 35.1 per cent were dolichocephalic, 44 per cent mesaticephalic, and 17.8 per cent brachycephalic. Of the girls, 41.8 per cent were dolichocephalic, 44.7 per cent mesaticephalic, and 10.5 per cent brachycephalic. The highest per cent of dolichocephalic children were Scandinavian, the highest per cent of brachycephalic Polish.

6. The average respiration rate per minute of boys decreased gradually from 21.1 at the fifth year to 16.8 at the sixteenth year, to rise again slightly later on; the pulse rate decreased rather irregularly from 92 per minute to 78. For girls the average respiration rate decreased from 21.3 at the fifth year to 16.3 at the nineteenth year; the pulse rate varied markedly at different age periods, decreasing from 94.2 at the fifth year to 74 at the nineteenth year.

7. Owing to parental objection, only 158 boys were examined for hemoglobin. Of these, 3 had a hemoglobin per cent of 75, 16 of 80, 51 of 85, 77 of 90, and 11 of 95. Of 130 girls, 18 had a hemoglobin per cent of 80, 29 of 85, 70 of 90, and 13 of 95.

8. The breakfast of 40 per cent of the total number reporting on this point was composed chiefly of carbohydrates (that is, bread and cereals), and that of practically 60 per cent was a mixed diet of carbohydrates and proteids. Only 15 per cent used milk, while 57 per cent used coffee.

DEFECTS AND DISEASES.

Defects associated with the organs of hearing in the case of 1,253 boys and 1,236 girls were observed in 31.2 per cent of the boys and 28.2 per cent of the girls. Affections of the respiratory system including the upper air passages were noted in 35.4 per cent of the boys and 32.2 per cent of the girls. Defects of the visual apparatus were noted in 47.2 per cent of the boys and in 45.5 per cent of the girls. A number of these defects were of minor character.

Impaired hearing was observed in 13 per cent of the boys and 11.3 per cent of the girls.

Adenoids were present in 13.2 per cent of the boys and 9.8 per cent of the girls. Various grades of pharyngitis and nasal catarrh were observed in 39 boys and 50 girls, or 3.6 per cent of the total examined. Enlarged or diseased tonsils were observed in 195 boys and 190 girls, or 15.4 per cent of the total examined.

Only 2 cases of tuberculosis were encountered.

Sixty per cent of the boys and 50 per cent of the girls had some degree of dental defectiveness. Of the boys, 54.5 per cent and of the girls 44.2 per cent had two or more defective teeth. The extent to which dental correction had been practiced among children was slight up to the eighth year. The percentage of dental work increases from this year on, but in greater relative proportion among the girls. Eighteen and three-tenths per cent of the boys and 10.5 per cent of the girls never used a toothbrush, 57.8 per cent of the boys and 48.6 per cent of the girls used it occasionally, and its daily use was noted in but 13.9 per cent of the boys and 40.9 per cent of the girls.

Including errors of refraction, 1,335 visual defects were distributed among 1,142 children, or not quite 1.2 defects for each child. The greatest number of these defects were due to errors of refraction; astigmatism was noted in 953 children, 39.4 per cent of the boys and 36.3 per cent of the girls being astigmatic. Seven cases of trachoma were encountered.

Goiter, or simple thyroid enlargement, was noted in 61 per cent of the school children.

MENTAL STATUS.

Children were classified as normal, retarded, and exceptionally retarded, the latter comprising all children with mental deficiency.

The Binet-Simon tests were used in this survey to show the general mental development of the children examined. In the case of the exceptionally retarded children, however, special methods were employed to determine the mental status of each child so recorded.

Of the 1,087 girls and 1,098 boys examined in the rural schools, 93 of the former and 100 of the latter were below the average mentally, or 8.7 per cent of the whole number. The total number needing specialized instruction was 214, or 9.3 per cent.

Seven girls, or 0.6 per cent, were retarded in such degree that their mental development at adult life would not be greater than that of children. Of these, 28 per cent were below the mean physical development for the county.

Of the boys, 1.2 per cent were exceptionally retarded. Of these, 28.5 per cent were below the mean physical development of the county as a whole. Of the total school population, 0.9 per cent were mental defectives. The percentage of exceptionally retarded chil-

dren recorded in the county is considerably less than that found by other observers in other localities.

Of the physical defects associated with retardation, those of the special senses, with the exception of defective hearing, were found in greater proportionate numbers among children who were simply retarded. The exceptionally retarded children were above the average stature of the county in greater proportionate numbers than retarded children.

The undue number of one-room rural schools in the county which were of faulty construction, with poor equipment, and with imperfect teaching facilities were largely responsible for the retardation found in the county.

The average loss of grade by 193 children, as recorded by teachers, was 1.28 years for girls and 1.5 years for boys, a total of 269 school years.

No special classes for the instruction of retarded children were found in any of the rural schools of the county.

In addition to the 214 children who were retarded and exceptionally retarded, 3 epileptics and two constitutionally inferior children were found among the school children of the county.

CONCLUSIONS.

The conclusions based on these surveys are to the following effect:

(1) There is an undue number of one-room rural schools in the county.

(2) An attempt has been made in the construction of the larger consolidated schools of the county to rectify some faults of school construction outlined in this survey.

(3) Of the special causes of unfitness of school buildings for school purposes may be mentioned an undue number of old buildings which have largely passed the limits of usefulness for educational purposes. A number of these schools were situated in undesirable proximity to nuisances; were not provided with sanitary privies; were without a water supply; had faulty illumination of classrooms; were without adequate classroom equipment; were improperly heated and poorly ventilated; were deficient in cloakroom accommodations; and presented evidences of inefficient janitor's service.

(4) The large number of children presenting physical defects of such gravity as to demand specialized medical and surgical attention is an evidence of the need of medical supervision of the school children of the county in the interests of the child's educational advancement and for the protection of the community health.

(5) The undue number of mentally defective and retarded school children revealed by these examinations emphasizes the necessity of the mental classification of the children of the county for the purpose of revealing those who are in need of institutional or individualized treatment.

RECOMMENDATIONS.

The following recommendations are in harmony with the conclusions specified:

(1) Especial effort should be made to consolidate an additional number of the rural schools of the county wherever this may be practicable.

(2) In cases where consolidation can not be accomplished a number of rural schools should be remodeled so as to render them sanitary.

(3) Greater attention should be given to the daylight illumination of a number of classrooms of the county. Windows should be rearranged and the interior decorations selected to meet the requirements of light diffusion most desirable for visual comfort.

(4) All of the schools of the county should be provided with sanitary privies for the protection of the school water supply and as an example in personal and public hygiene.

(5) Each school in the county unconnected with a general water system should be provided with individual sources of water for drinking purposes. These should be properly protected against surface drainage. Furthermore, the practice of obtaining the water for school puposes from neighboring farmhouses should be discontinued.

(6) The heating of classrooms by closed stoves should be prohibited and greater attention given to the upkeep and installation of heating plants.

(7) Ventilation by the routine opening of windows should be a requirement, and the installation of protected openings to the outside air should be provided in all classrooms heated and ventilated by the gravity method.

(8) Better cloakroom accommodations should be provided in all schools and the use of classroom walls and entrance halls for this purpose prohibited.

(9) Greater security against fire in the larger consolidated schools should be obtained through the installation of fire-fighting apparatus, properly arranged fire escapes, and the institution of regular fire drills.

(10) The duties of medical inspector of schools should be combined with those of local health officer.

(11) A full-time officer should be required to be appointed for the discharge of these combined duties, thereby preventing the

spread of disease in the school and improving health conditions in the county.

(12) It would be desirable for the above-mentioned officer to be affiliated also with the juvenile courts or other courts having jurisdiction over juvenile delinquents to make mental examinations of such offenders for the purpose of mental classification in the interest of justice.

(13) Steps should be taken to secure institutional treatment for the mental defectives in the county.

(14) Measures should be taken to secure special classes and individualized instruction for children who are simply retarded and fail to make grade.

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INDEX.

RELATED PUBLICATIONS.

(Literature bearing upon school hygiene issued by the U. S. Public Health Service, from which copies may be obtained without charge.)

PUBLIC HEALTH BULLETINS.

52. Vaccination. An analysis of the laws and regulations relating thereto in force in the United States, containing court decisions and a summary of some foreign vaccination laws. By J. W. Kerr. January, 1912.
58. Open-air schools for the cure and prevention of tuberculosis among children. By B. S. Warren. October, 1912.
62. Communicable diseases. An analysis of the laws and regulations for the control thereof in force in the United States. By J. W. Kerr and A. A. Moll. July, 1913.

REPRINTS FROM THE PUBLIC HEALTH REPORTS.

101. Trachoma in Kentucky. Reports of investigations into the prevalence of trachoma in the mountains of eastern Kentucky. By John McMullen. Nov. 8, 1912.
116. Country Schools and Rural Sanitation. Six sample public schools in one county. Does this county need medical inspection in its schools? The country school-teacher. By Ch. Wardell Stiles. Feb. 7, 1913.
118. Snuff and Tobacco. Their use by school boys and girls in county Z. By Ch. Wardell Stiles and S. B. Altman. Feb. 28, 1913.
142. Medical Inspection of Schools. A lecture delivered at the Summer School of the South University of Tennessee, Knoxville, Tenn. By J. W. Schereschewsky. Aug. 29, 1913. (Reprint No. 142 may be obtained only from the Superintendent of Documents, Washington, D. C., at a cost of 5 cents.)
143. Trachoma. Its prevalence and control in the public schools of Cebu. By Louis Schwartz. Sept. 12, 1913.
144. School Hygiene. Report of the meeting of the Fourth International Congress on School Hygiene, Buffalo, N. Y., Aug. 25–30, 1913. By J. W. Schereschewsky. Oct. 3, 1913.
177. Rural Schools. Sanitary survey of schools in Bartholomew County, Ind. By J. A. Nydegger. Feb. 6, 1914.
184. Endemic Goitre. Its possible relationship to water supply. By Taliaferro Clark and Claude C. Pierce. April 17, 1914.
196. Trachoma in Kentucky. A report of a sanitary inspection of the schools of Jefferson County, Ky., with special reference to the prevalence of trachoma. By J. H. Oakley, Dunlop Moore, and Lawrence Kolb. May 29, 1914.
198. Trachoma. A survey of its prevalence in the mountain sections of Virginia and West Virginia. By Taliaferro Clark. July 5, 1914.
207. Trachoma. A survey of its prevalence in the mountain sections of North and South Carolina. By A. D. Foster. July 10, 1914.

211. School Hygiene. A report of a sanitary survey of schools and of medical inspection of school children in certain sections of North and South Carolina. By A. D. Foster. July 31, 1914.
219. The Hygiene of Rural Schools. By Taliaferro Clark. Sept. 11, 1914.
220. Trachoma. A survey of its prevalence in the mountain sections of east Tennessee and northern Georgia. By Charles A. Bailey, Sept. 18, 1914.
236. Mental Deficiency. Some of its public health aspects, with special reference to diagnosis. By E. H. Mullan. Nov. 27, 1914.
237. School Hygiene. A report of the sanitary inspection of rural schools of east Tennessee and northern Georgia. By Charles A. Bailey. Dec. 4, 1914.
241. Trachoma in the Schools of Porto Rico. By W. W. King. Dec. 18, 1914.
263. Trachoma. A survey of its prevalence in the mountain section of eastern Kentucky. By John McMullen. March 5, 1915.
286. Zooparasitic Intestinal Infections. An analysis of infections found among 1,287 school children (776 white, 511 negro) of the city of X. By C. W. Stiles. July 2, 1915.
288. Intestinal Infections. The school grades attained by 2,166 white school children (1,062 boys, 1,104 girls) in the city of X, classified by age, sanitation, and intestinal parasites. By C. W. Stiles. July 2, 1915.
301. Tobacco and Snuff. Their use by white school children in the city of X. By C. W. Stiles and D. N. Richards. Oct. 1, 1915.
303. Heights and Weights of Children. Classification, by age and by sanitation, of 1,652 white school children (771 boys, 881 girls) in the city of X. By C. W. Stiles and George A. Wheeler. Oct. 8, 1915.
306. Lung Capacity of Children. Spirometer tests of 1,618 white school children (751 boys, 867 girls) in the city of X. C. W. Stiles and Floyd Graves. Oct. 15, 1915.

SUPPLEMENTS TO THE PUBLIC HEALTH REPORTS.

6. Contagious Diseases. Their prevention and control in children's institutions. By James P. Leake. April 11, 1913.
18. Malaria—Lessons on its cause and prevention. (For use in schools.) By H. R. Carter. July 17, 1914.
25. School Hygiene. Survey of schools in Manatee County, Fla. By J. A. Nydegger. July 30, 1915.

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