

THE SLEEP OF SCHOOL CHILDREN: ITS DISTRIBUTION ACCORDING TO AGE, AND ITS RELATION TO PHYSICAL AND MENTAL EFFICIENCY.¹

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PART I. THE DISTRIBUTION OF SLEEP ACCORDING TO AGE.

Among the important questions which may be raised regarding the sleep of school children are the following: What is the optimum amount of sleep for physical and mental efficiency, and how are we affected by variations above or below this amount? How great are the normal individual differences? To what extent is the instinct of sleep educable? How is it influenced by food habits, by rise and fall of barometric pressure, or by changes in humidity and other weather conditions? How is it affected in quantity and quality by ventilation, by light, by the presence of others in the same bed or rooms, etc.? How is it influenced by various evening occupations? How much and what kind of home study can be assigned by the school without a detrimental effect upon sleep?

One of the most important problems and the one which has caused the most speculation concerns the optimum amount of sleep for children at different periods of growth. In all of the discussions concerning school overpressure, care of infants, etc., authors have very generally laid great emphasis upon the necessity of a large amount of sleep for the developing organism. But exactly how much sleep is required by this developing organism for its healthy functioning and growth? We have a large number of *estimates based upon opinion and loose observation*, but no answer based on data of scientific validity.

¹This study will appear in three parts. The bibliography references will be found at the end of Part III.

The most quoted of these estimates is that of Dr. Clement Dukes, whose theoretical norms have been very generally accepted. Other notable standards are those of Hertel, Bernhard and Claparède. Physicians and writers on school hygiene agree in insisting that children are likely to receive less sleep than is needful to them, but disagree as to the exact amount which is needful. This difference of opinion is well shown in the following table of estimates by various authors:

TABLE I.—ESTIMATES OF SLEEP NEEDS IN HOURS.

Age.....	5 to 6	7	8	9	10	11	12	13	14	15	16	17	18
Duke	13½	13	12½	12	11½	11	10½	10	10	9½	9	9	8½
Bernhard		11	11	11	10½	10½	10	10	9½	..	..	..	..
Hertel	11	10½	10½	10	10	9¾	9½	9½	9	9	8¾	..	..
Claparède	11½	11½	11½	10½	10½	9½	9½	9½	9	9	..	..	..
Manacéine	14	11	11	11	10	10	9½	8½	8½	8	8 to 7	..	..
Krollich		11	11	11	10½	10½	10	10	9½	9	9	8½	8½
Cavanagh		12	..	..	..	..	..	..	..	..	..	..	9
Brown	11½	..	..	..	..	..	10	..	..	..	..	..	..
Pfauder	11	..	..	..	..	..	9	..	..	..	..	..	..
Key	11	..	..	..	..	..	10	..	..	..	..	..	..

The above table shows a difference of opinion amounting to 2½ hours for the age six, 2½ hours for seven years, 2 hours for eight years, 2 hours for nine years, etc. Duke recommends as many hours for age eighteen as Manacéine for age thirteen, and as many hours for age fourteen as Manacéine for age ten. Duke's estimate for eleven years also equals Key's for six years. In like manner twenty-nine medical officers of English schools who were interrogated by Acland (1)* estimated the sleep needs of twelve-year-old boys all the way from nine hours to ten or more.

Such extreme differences of opinion on this important subject emphasize the desirability of empirically ascertained standards of sleep for the various ages of childhood.

Several investigations have been made of the number of hours children do sleep, though obviously we cannot in this way determine conclusively how many hours they ought to sleep. One of the earliest of these was by Hertel, who, in his study "*Overpressure in the Schools of Denmark*," presents sleep records from 3141 boys and 1211 girls in the schools of

*Numbers in parentheses throughout the text refer to bibliographical references which will follow at the end of part III.

Copenhagen. These averaged about $10\frac{1}{2}$ to 11 hours of sleep at six years, the amount decreasing to $9\frac{1}{2}$ hours at twelve years and to about $8\frac{1}{2}$ at sixteen years. Sleep was most deficient among pupils pursuing the arduous classical courses, where it often fell to 6 or 7 hours.

The following table compiled by Acland shows the hours of "undisturbed rest" given to boys of 10 to 13 years of age in forty English public boarding schools. The actual time of sleep must be somewhat below these figures, and is certainly far below what physicians have usually considered the optimum:

TABLE II.—HOURS OF REST IN ENGLISH BOARDING SCHOOLS.

Class.	No. of Schools.	Ample Hours.	Moderate Hours.	Short Hours.
A.	5	$9\frac{3}{4}$ to 10 or more all the year.	9 during the summer term.	
B.	2	$9\frac{1}{2}$ to 10 the two winter terms.		
C.	7	$9\frac{1}{2}$ to 10 for a few weeks only.	9 to $9\frac{1}{2}$ the chief part of the year.	
D.	3		9 to $9\frac{1}{4}$ all the year.	
E.	7		9 to $9\frac{1}{2}$ the two winter terms.	8 to $8\frac{1}{2}$ during the summer term.
F.	8		9 to $9\frac{1}{2}$ for a few weeks only.	8 to $8\frac{1}{2}$ the chief part of the year.
G.	8			8 to $8\frac{3}{4}$ or less all the year.

The most extensive investigations of the sleep of school children are those of Dr. L. Bernhard (5) and Dr. Alice Ravenhill (31). Bernhard secured data from 6551 German children six to fourteen years of age; Ravenhill from 6180 English children of corresponding ages. The average amount of sleep for each year is shown in the following table:

TABLE III.—SLEEP OF GERMAN AND ENGLISH CHILDREN.

Age.....	6	7	8	9	10	11	12	13	
Sleep in	Bernhard..	10.20	9.50	9.25	9.20	9.10	8.55	8.25	7.50
hours and	Ravenhill..	10.30	10.30	9.30	9.15	9.15	8.45	8.15	8.30
minutes.		10.45	10.30	10.15	9.30	9.30	9.15	8.	7.30
									Boys
									Girls

Using his own estimate of the amount of sleep which children ought to have, Bernhard computes that the sleep deficiency among his 6551 pupils ranges from about an hour at the age of seven to nearly an hour and three-quarters at fourteen years. This would represent a total sleep loss per year of over 400 hours for the average child of six, and over 600 hours for the average child of fourteen years. Basing her estimate upon the standards furnished by Dr. Dukes, Miss Ravenhill finds an average sleep deficiency for English children of nearly 25 per cent., while that for girls of thirteen years amounts to a daily loss of $3\frac{1}{4}$ hours! Children of six years were found who slept only 7 hours, and children of twelve years 4 to 6 hours.

In America N. C. Johnson (21) investigated the sleep of 600 pupils in Indiana high schools, finding a range in the averages for the four high school classes from about $8\frac{1}{2}$ hours (among first-year girls) to $7\frac{1}{2}$ hours (among fourth-year boys). Prof. W. H. Burnham (6) found an average of about 7 hours 53 minutes among 297 American normal school students, most of whom were young women between 18 and 22 years of age. A report by J. Mace Andress (2) of the sleep of 49 normal school students, who kept careful daily records of their sleep for fourteen successive days, gave an average somewhat more than one-half hour in excess of that found by Burnham.

THE PRESENT INVESTIGATION.

During the year 1911-1912 the writers carried out an investigation of the sleep of school children which had for its three-fold purpose (1) to ascertain by more careful methods than had yet been employed the hours of sleep of children in the Western States of America, (2) to discover what correlation exists between hours of sleep and school success, and (3) to find the relation of hours of sleep to social status, home study and the possession of typical "nervous" traits. Through the generous co-operation of teachers and principals sleep records

were secured from 2692 children² between 6 and 20 years of age in the California cities of Stockton, San Jose, Alameda and Los Gatos; from Tempe, Ariz., and Monmouth, Ore.³

The records were secured by the teachers asking the pupils to fill out the following form immediately after the opening of the morning school session. (A somewhat simpler form was used for the first three grades:)

Name.....Age.....Grade.....

1. When did you go to bed last night?
2. How long do you think it took you to go to sleep?
3. When did you wake up this morning?
4. Did anyone have to wake you?
5. How many others slept in the same room?
6. How many others slept in the same bed?
7. How many windows are there in your bedroom?
8. How many windows were open during the night?
9. How wide were they open?
10. Did you sleep your usual amount last night? If not, was it more or less than usual? How much?
11. How many hours per week do you work outside of school?
 - a. In school study at home?
 - b. In elocution, music, drawing, etc.?
 - c. In carrying papers, running errands or other work?

In order to insure uniform procedure in the collection of the records the following instruction sheet was given each teacher in advance:

(1) On the day before the sleep records are to be collected say to the children, just before dismissal of school in the afternoon, that you would like to know how many hours they sleep. Tell them to look at the clock "tonight" just as they go to bed and to write down on a piece of paper the exact time. (Make it clear that they are to make the record just as soon as they look at the clock.) Tell them also to look at the clock again as soon as they wake up next morning and to record the time on the same piece of paper. This piece of paper they are to bring to school next day.

²Through the kind co-operation of Dr. H. H. Goddard sleep records were also secured from 383 feeble-minded persons. These records will be summarized in part III of this study.

³The writers desire to express their hearty appreciation of the intelligent and careful assistance rendered by all who co-operated in securing the records and in the somewhat laborious task of supplying the information asked in the supplementary blanks.

(2) Make no other request or announcement. Be especially careful to avoid giving any suggestion as to the amount of sleep you think children should have. Say nothing about windows.

(3) On the following day as soon as school assembles distribute the question sheets and request the pupils to answer all the questions they can. Tell them not to try to answer those they are not sure about. Make it clear that no one will be reproached for having forgotten to make the records or for inability to answer any of the questions. Pupils are not to be encouraged to guess.

The amount of sleep for these 2692 persons is shown in hours and minutes in the following table:⁴

Age.	No. of records.	Av. No. hours of sleep.	Age.	No. of records.	Av. No. of hours of sleep.
6-7	37	11:14	13-14.....	250	9:31
7-8	147	10:41	14-15.....	244	9:06
8-9	218	10:42	15-16.....	201	8:54
9-10.....	291	10:13	16-17.....	167	8:30
10-11.....	307	9:56	17-18.....	117	8:46
11-12.....	282	10:00	18-19.....	43	8:46
12-13.....	312	9:36	University students	51	7:47

The most important fact in the above table is the striking excess of sleep among these children compared with the German and English children of Bernhard and Ravenhill. This excess amounts for most ages to between one hour and one hour and a half. At the same time the sleep averages found in this investigation fall from three-quarters hour to two hours below the *theoretical standards* set by Dr. Dukes. These points of difference are shown graphically in the following figure:

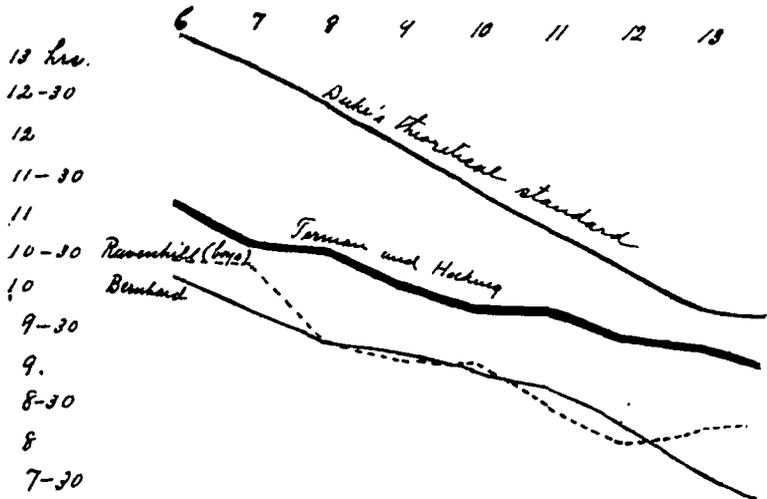


Figure 1.

⁴As the sex differences revealed by our results were exceedingly small, the figures for boys and girls have been combined in the above table.

For lack of space the curves of distribution for hours of sleep are shown only for ages six, nine, twelve, fifteen and eighteen.

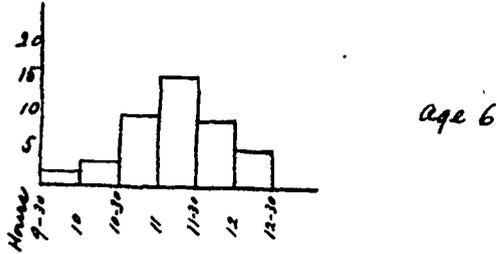


Figure 2. Curves of distribution of sleep.

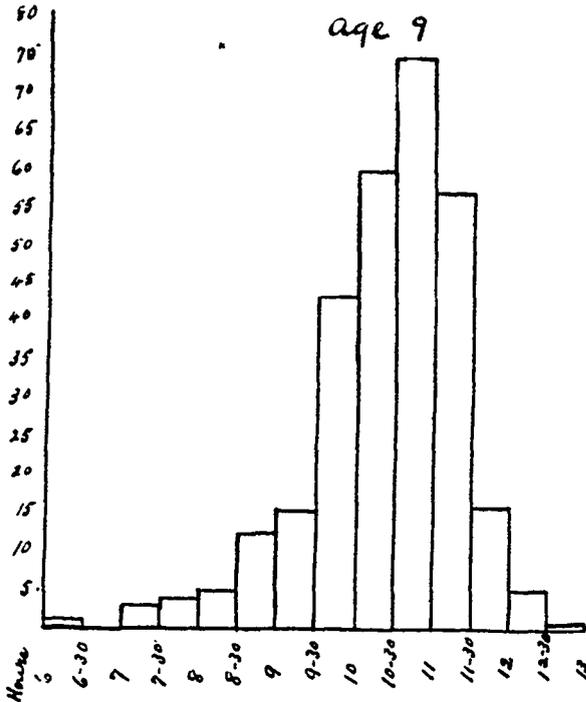


Figure 3.

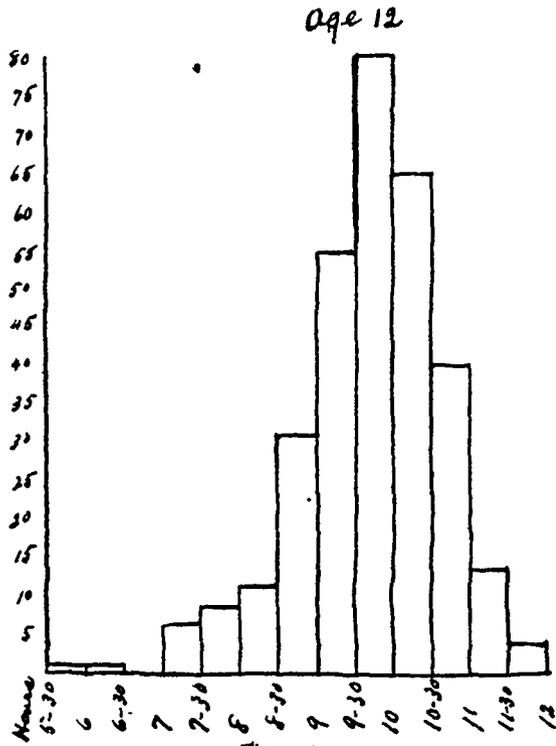


Figure 4.

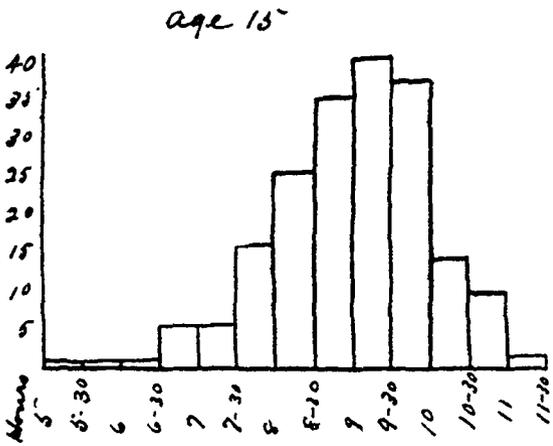


Figure 5.



Figure 6.

A further idea of variation may be secured from the following figure:

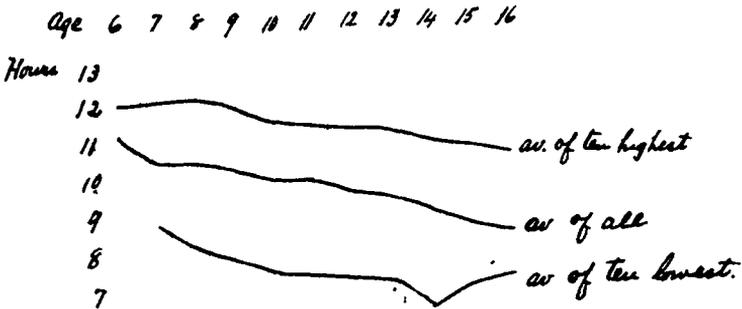


Figure 7.

It is seen, therefore, that the minimum amount of sleep received by children in the western part of the United States almost reaches the *average* for German and English children. Why this astonishing difference? Three explanations are at hand. *First*, and perhaps most important, the climatic conditions of the sections from which our data were gathered are such as to permit a far greater amount of outdoor life than is possible (or at least customary) in Germany and England. *Second*, the home environment of our children is probably much superior to that of the children studied by Bernhard and Ravenhill. Their statistics were collected mostly in industrial cities, ours in the smaller and more comfortable cities in the best sections of the United States, where the extreme overcrowding and poverty so common in European industrial cen-

ters are hardly known. *Third*, the forenoon school session begins with us at nine o'clock instead of eight, as is customary in European countries. There may be other factors, but all these are without doubt contributory to our results.

Our averages would have been still higher had all the children been permitted to sleep until they awakened spontaneously. The following figures show the percentage in each year who had to be awakened:

Age...	6	7	8	9	10	11	12	13	14	15	16	17	18
Per cent. awakened.	21.2	19	23.3	19.1	22.8	20.3	23.6	24.7	26	31.6	38.7	39.9	47.7

The interesting fact here is the rapid increase in early adolescence of the number who did not wake spontaneously. The reason for this is not clear. It may be that adolescence tends to change the individual from the vesperal to the matinal type of sleeper. It is more probably due to the fact that a majority of the records above the age of fourteen were high school pupils who were required to do more evening work than the younger children.

Though it cannot be assumed that averages secured in this investigation furnish absolutely reliable norms of the amount children of various ages ought to sleep, it is believed that our standards are of more value for comparative purposes than any which have hitherto been available. The averages of Bernhard and Ravenhill probably show a subnormal amount of sleep, while the theoretical and traditionally accepted norms of Dukes are so high that we may safely dismiss them as worthless and misleading.

(Continued in April Journal.)