A SUGGESTED METHOD OF DIAGNOSING PHYSICAL DEFECTS OF BOYS IN OKEMOS HIGH SCHOOL

Thesis for the Degree of M. A.

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A SUGGESTED METHOD OF DIAGNOSING PHYSICAL DEFECTS OF BOYS in OKEMOS HIGH SCHOOL

A Thesis Prepared by

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THESIS

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Dr. E. L. Austin

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A SUGGESTED METHOD OF DIAGNOSING PHYSICAL DEFECTS OF BOYS in OKEMOS HIGH SCHOOL

Chapter I.

INTRODUCTION.

The writer of this thesis believes that people are happier and much more efficient in meeting and solving the many problems of life when they are physically fit. It appeared to him from the viewpoint of an instructor of health and physical education that many of the pupils in his classes needed a considerable amount of corrective work to supplement or replace the regularly required program. A very serious problem then was to find a reliable and inexpensive method of recording and diagnosing physical development and defects of the boys. After a rather thorough search no reliable and inexpensive method was found.

The importance of reliable testing methods was forcibly brought to the attention of the writer when in 1929 he was tested at the Battle Creek Sanitarium. The tests devised by Dr. John Harvey Kellogg, (1) superintendent and medical director of the sanitarium, consisted of the shadowgraph method of recording and measuring posture, an elaborate

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(1). Kellogg, John Harvey, "An Inventory of Vital Assets," pp. 7-10. Pamphlet of the Battle Creek Sanitarium. 1930.

strength test (30 major muscle groups), and detailed anthropometric measurements. The Kellogg method of measuring posture and development was found to be too elaborate and too expensive for use within the typical public high school budget. The method was believed to have great merits for school use provided alterations and improvements to lessen the amount of time and cost of administration could be made.

Plans were formulated and the Barnhill Physical Development Recorder,[1] [2] described in Chapter II, was constructed. Experiments were performed and improvements were made between January 1934 and January 1937. In December 1936 the Board of Education of the Okemos Consolidated Schools gave consent and financial aid to administer a program of health and physical education in the Okemos High School using the Recorder as part of the testing equipment.

The purpose of this thesis is to present a method of recording and diagnosing physical development and defects which has been found to be very usable and inexpensive. It is the aim of this thesis to describe the testing device, its use, its records; list some of the things it has revealed; show how it was used as an administrative tool and list some of its possibilities.

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(1). Patent applied for
(2). Hereafter referred to as the Recorder

The study is limited to the boys in grades seven to twelve of the Okemos High School, Okemos, Michigan. This school is a teacher training center for Michigan State College. Senior students in physical education from the College assist with the teaching in the health and physical education classes of the writer. There are approximately one hundred and twenty boys enrolled in the upper six grades each year. All except four boys were tested in March 1937 and in March 1938. One boy refused to be tested each year, and the other three were absent when the tests were being given.

The Kellogg method of measuring posture and physical development was used as the basis on which the Barnhill Physical Development Record (1) was made. The Recorder was constructed to measure and record details by use of a direct positive photograph. These details were not recorded or revealed in the shadowgraph. In the Record both views were placed on one direct positive paper to reduce the cost. This was accomplished by constructing a special camera that would expose one half of the paper at a time. Footprints taken on Dr. Scholl's Pedograph (2) are included for it has been found that they contribute valuable information to the Record.

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(1). Hereafter referred to as the Record
(2). Scholl Manufacturing Company, Chicago, Illinois

Other items and facts included are: the date; the subject's age, height, weight, serial number, and grade in school.

Studies similar to this one have not been found with the exception of Kellogg's work, but many good methods of measuring posture have been presented. The following list mentions some of them.

1. The window pole test
2. Crampton's Back Wall Test (1)
3. The Schematograph (2)
4. A Device by Goldthwait (3)
5. Miss Drew's Method (4)
6. The University of Oregon Group Rating System
7. Lowman's Group Examination (5)
8. The Bancroft Test (6)
9. The Comparograph (7)

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(1). Crampton, W. C., "Work-a-Day Test of Good Posture" American Physical Education Review, 30:505-10, November 1925
(2). Korb, E. M., "A Method to Increase the Validity of Measuring Posture," p. 6, An unpublished thesis, Boston University 1938
(3). Goldthwait, Joel, "The Relation of Posture to Human Efficiency," American Journal of Orthopoedic Surgery, 7:372, 1909
(4). Drew, L., "Individual Gymnastics," Lea and Febiger Company, p. 87, Third Edition
(5). Lowman, C. L., "Preventative and Prophylactic Orthopoedic Practice," American Journal of Orthopoedic Surgery," 3:576-83, November 1921
(6). Bancroft, J. H., "The Posture of School Children," MacMillan Company, New York 1920
(7). Korb, E. M., Op. cit., p. 18

10. The Conformateur [1]

11. The Antero-Posterior Center of Gravity Test [2]

12. The Wellesley College Method [3]

The data were secured from the individual cumulative physical development records which are on file in the writer's office. Each boy has a folder containing his cumulative record. All data are kept in the folder including notes on interviews with students, parents and sometimes the family physician.

1. The testing materials and equipment are described in detail in Chapter II.

2. The Record is described in Chapter III and an illustration of the Recorder in use is presented on page twelve.

3. Chapter IV describes the administration of the test and the recording of results.

4. Chapter V presents illustrative cases.

5. A list of technical terms is included on page six.

6. Chapter VI includes a summary and conclusion.

It should be noted that no attempt to grade posture and development on the basis of "A", "B", "C", or "D" has been made; rather each individual's development is compared with a norm representing perfect development.

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(1) Cureton, T. K., "The Validity of Antero-Posterior Spinal Measurement", The Research Quarterly of the American Physical Education Association, October, 1931

(2) Cureton, T. K., "Reliability and Objectivity of the Springfield Postural Measurements", Supplement to the Research Quarterly of the American Physical Education Association, May, 1935

(3) MacEwan, Charlotte G. and Howe, Eugene C., "An Objective Method of Grading Posture", The Research Quarterly of the American Physical Education Association, October, 1932

Technical Terms

Chest Ratio--the ratio between the anterior and posterior chest angles in the Kellogg method of determining posture--it is expressed by a number which is obtained by dividing the anterior angle by the posterior angle.

Direct Positive Paper--a photographic paper which is a negative and positive on one paper--the positive is brought out by the reversal developing process--it is an exclusive product of the Eastman Kodak Company, Rochester, New York.

Head Angle---the angle at which the head is carried in the Kellogg method--it is formed by a line through the point of the chin and the upper end of the sternum and a line through the mid point of the body.

Pedograph----a machine on which foot prints are recorded--consists of an inked roll pad attached to a rubber sheet--it is a product of the Scholl Manufacturing Company of Chicago, Illinois.

Pelvic Obliquity--the tilt of the pelvis in the Kellogg method.

Physical Development Record--the two photographs and recorded data on one sheet of direct positive photographic paper.

Physical Development Recorder--the machine in which the subject stands when the Physical Development Record is made (1).

Michael's Rhomboid--a rhomboid on the backs of humans--it is formed by the two dimples, just above the sacrum, and the crease down the center of the back.

Shadowgraph--an improperly named silhouette--it is used in the Kellogg method by making a negative photograph on direct positive paper.

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(1) See p. 7 for illustration

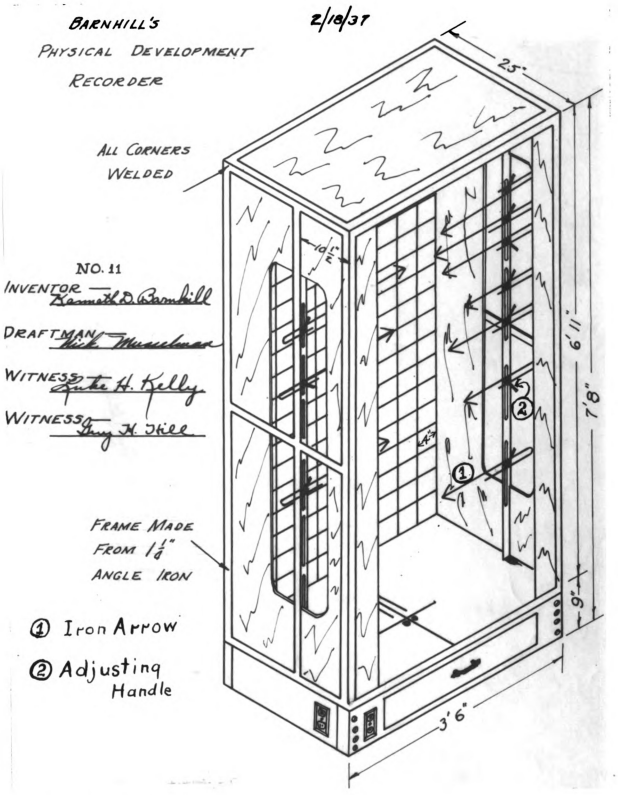

ILLUSTRATION I.
BARNHILL'S PHYSICAL DEVELOPMENT RECORDER

Chapter II.

THE TESTING MATERIALS AND EQUIPMENT

Materials.

1. The Direct Positive Paper and Developing Kit [1].

A direct positive paper 5" x 7" is used on which two 2½" x 7" views are recorded. It is developed by the direct positive developing process. The process is known as the reversal process. It consists of the following:

1. Exposure.
2. Development of negative.
3. Bleaching of negative.
4. Clearing.
5. Re-exposure.
6. Re-development.
7. Fixing (if desired, but not necessary).
8. Drying.

The entire process takes about four and one half minutes per picture with the solutions between 65° and 70° F. A fifteen second wash in water is necessary after each solution is used.

2. Dr. Scholl's Footprint Blanks [2].

One footprint blank is used for each foot.

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(1). The Direct Positive Paper and Processing Kit is an exclusive product of the Eastman Kodak Company, Rochester, New York.

(2). See Illustration p. 9

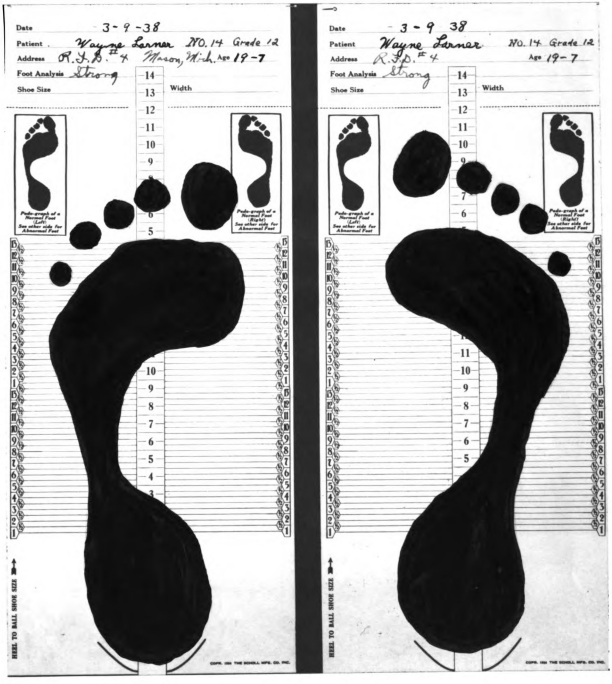

ILLUSTRATION II.
DR. SCHOLL'S FOOTPRINT BLANKS

3. Marking Materials.

Iodine, a black eyebrow pencil, or a red grease pencil may be used to denote the necessary points of alignment on the subject's back.

Equipment.

1. The Recorder.

The Recorder is the machine in which the individual stands while being photographed. It consists of a steel framework with a white plywood back wall lined with parallel lines, four inches apart, running horizontally and vertically. On the left side is a measuring scale in feet and inches. At the top is a similar scale measuring in each direction from the center line. Fifteen inches in front of the back wall and in the framework is an angleiron upright on each side of the apparatus. The upright angleirons serve as supports on which metal arrows are attached. These arrows are adjustable, up, down, backward and forward. They are used to mark important points of identification on the body in the profile view. Fifteen inches out from each of the uprights are two photo flood lights built into the framework in a manner which protects the camera from the glare of the lights. The sides and the platform, on which the subject stands, are painted with aluminum paint to diffuse and refract the light toward the subject. The lights

are placed in such a position that they are about three feet from the body of the subject. An additional light is placed approximately four feet from the body in front of the Recorder and about six feet above the floor. It was found that the four built-in lights did not give the proper distribution of light. The additional light is suspended from an arm on top of the Recorder.

The lights are controlled at the camera, which is in focus ten feet from the subject. The distance is measured so that conditions will be identical throughout. (1)

A chart form for recording data is located in each corner of the back wall of the Recorder. The upper left chart includes the date and age of the person being tested; the upper right chart records height and weight; the lower left chart presents foot conditions; and the lower right chart shows the grade level and a serial number substituted for the name of the individual.

2. The Camera. (2)

The camera was constructed so as to reverse the image before it sensitizes the direct positive paper. This apparently unimportant feature saves considerable time and eliminates much confusion.

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(1). See drawings of Recorder p. 7
(2). See Illustration p. 12

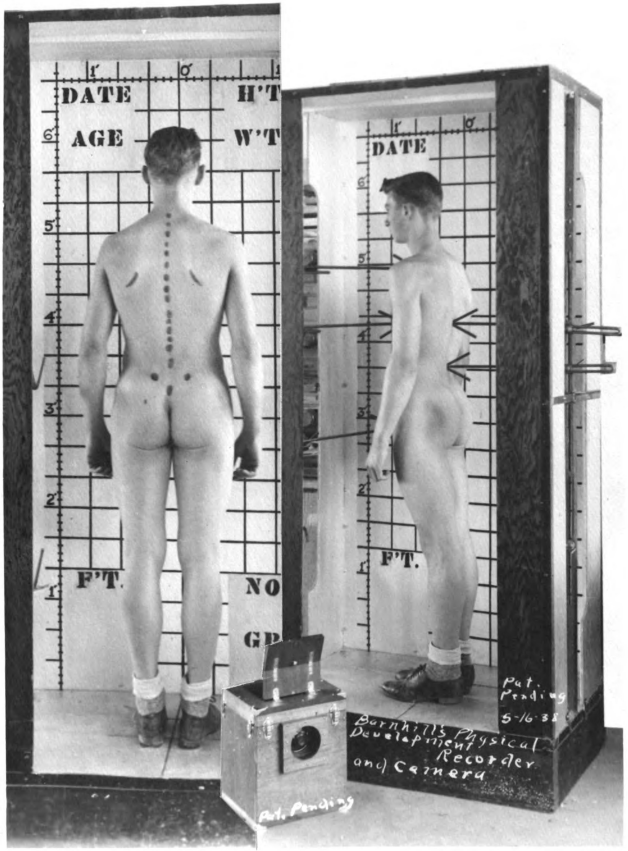

ILLUSTRATION III.
PHYSICAL DEVELOPMENT RECORDER IN USE
INSET--CAMERA

Direct positive paper brings out the objects and figures as a negative when used in an ordinary camera. A good lens and shutter must be used for reliable results. The ones used in securing the records for this study are from a portrait camera. The image coming through the lens is reflected in a mirror which is placed behind the lens on a 45° angle. The mirror projects the image upward and at the same time reverses it. In focusing, the camera line, which is in the center of the exposure opening, coincides with the center line on the Recorder.

Two 2½" x 7" photographs are obtained on one 5" x 7" paper by exposing half of the paper at one time. This is accomplished by means of the opening in the top of the camera which is 7½" x 7". The outer 2½" on each side is covered thus exposing only the center 2½". The paper is placed, emulsion side down, on the glass opening, as far to the left as possible. This position exposes the right half. The paper is then shifted as far to the right as possible, exposing the left half. The back view is taken first, making it come on the left side when one is looking at the picture. The charts on the back view are used, leaving the profile vacant for necessary space for measuring defects, posture and development. Best results are obtained when the camera is operated in a dark room with the exposures being made through a small opening in the wall.

3. Dr. Scholl's Pedograph.

The Pedograph makes a reliable, safe, simple, and inexpensive means of securing good footprints. It consists of a small box containing an inked roll pad over which runs a rubber sheet on which the subject steps while the sheet is over the footprint blanks. One foot is printed at a time.

4. Scales.

Any reliable scale for weighing may be used.

5. Ruler.

An ordinary straight edge ruler is used when inking the lines which are extended through the marked points on the profile photograph.

6. Protractor.

A protractor, preferably a celluloid one, with the center cut away is essential when measuring the marked angles on the profile view.

7. Proportional Dividers.

Proportional dividers are used to get one half the distance between the spinous process on the third lumbar vertebra and the most forward part of the pubic symphisis. The dividers save considerable time.

8. Fountain Pen.

A good fountain pen has been found to be the most satisfactory means of writing on the direct positive paper. A good black ink makes the best contrast.

Chapter III.

THE PHYSICAL DEVELOPMENT RECORD.

The Record consists of a back view and a profile view against a lined and measured back wall. In each corner of both views is a chart on which certain facts are recorded. The facts on the charts, the two photographs, the posture measurements and the developmental measurements make the Record complete on one sheet of 5" x 7" direct positive paper.

The Record includes the following items:

1. The back view shows markings with iodine spots on the ends of the spinous processes, on the lower posterior angles of the scapulae, on the tip of the acromion processes, and on the dimples of Michael's Rhomboid. These marks indicate the amount of malalignment in their respective parts of the body.

2. The profile view shows the metal arrows pointing to the upper end of the sternum, flush with the skin at the interclavicular notch, the lower end of the sternum, at the end of the bone not the cartilage, the spinous process opposite the lower end of the sternum, the spinous process of the third lumbar vertebra, and the most forward part of the pubic symphisis.

3. The date includes the month, day and year recorded as numbers.

4. Age is indicated in years and months.

5. Height is recorded to the nearest one-half inch.

6. Weight is shown at the nearest pound.

7. Foot conditions are noted by a word or a brief statement obtained after studying the footprints and photographs. A close relationship has been found to exist between a flat or weak foot and curves in the back and other forms of malalignment.

8. A number is used for identification. Each class has a set of numbers starting with one. Each number assignment is permanent.

9. The grade level in school is indicated by a number.

10. The lined and measured back wall serves as a measuring scale for any part of the body and very definitely shows any segment of the body out of alignment.

11. Kellogg's Postural Measurements. (1)

12. Pelvic Obliquity.

Pelvic obliquity is found by measuring the lower anterior angle and subtracting it from 90° which is the angle formed by the vertical line and a horizontal plane. The lower anterior angle is formed by two intersecting lines. One line is drawn through the most forward part of the pubic symphisis and the spinous process of the third lumbar vertebra flush with the skin. The other line is a

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(1) Adapted from Kellogg, J. H., "Observations on the Relationship of Posture to Health and a New Method of Studying Posture and Development", Bulletin of Battle Creek Sanitarium and Hospital Clinic, XXI (Sept. 1927)

perpendicular erected through the midpoint between these two points. The norm for pelvic obliquity is 45°--50° inclusive. It is expressed by using a number which is identical with the degree of pelvic obliquity.

13. Chest Ratio.

Chest ratio is found by extending one line from the mid-point between the pubic symphisis and the spinous process of the third lumbar vertebra through the point at the lower end of the sternum. The other line is extended from the same mid-point through the point on the vertebra opposite the lower end of the sternum. Each of those lines form an angle with the perpendicular which was erected through the mid-point. The angles are then measured and the anterior angle is divided by the posterior angle. The division carried out three decimals gives the ratio. Example: 22 ÷ 20 = 1.100 or a chest ratio of 110. The norm is 1.00--1.20 or 100-120.(1)

14. Head Angle.

The head angle is formed by extending a line through the upper end of the sternum and the point of the chin to intersect the perpendicular which is drawn through the mid-point ofthe body. The angle formed is measured and is the head angle. The norm is 18°--25°. By interpretation it is 18--25.

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(1) Each of the Kellogg norms is changed from degrees to numbers.

The Kellogg norms for posture are based on perfection rather than an average of a large number of people. They are: (1) (2)

1. Pelvic Obliquity 45--50
2. Chest Ratio 100--120
3. Head Angle 18--25

Values Shown by the Record

1. An actual photograph is used rather than a silhouette or a shadowgraph for the details of many strong points as well as the details of many defects are clearly brought out. These are partially obscured in either of the silhouettograph methods. The general muscular condition can be seen in the direct positive photograph.

2. It is a distinct advantage to have each of the items on one record. By way of illustration one may see on the Record that for July 21, 1938, number 11 was fifteen years and 0 months old; he was six feet four inches tall; he weighed 170 pounds; his left foot was normal, but the right foot had a low longitudinal arch; he carried his head slightly to the right and his right shoulder was one half inch lower than the left; he is ready to enter the tenth grade; his posture record was

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(1) The Kellogg norms were revised in 1937
(2) Abbreviations are used on the Record, for the Kellogg norms as follows: P. O. Pelvic Obliquity, C. R. Chest Ratio and H. A. Head Angle

pelvic obliquity 54, chest ratio 100 and head angle 27.

3. The Record gives one a clear and complete conception of the subject's physical make-up at the time of the recording.

4. The subject can see for himself the degree of change when comparing records for different dates.

5. The Record serves as a cumulative record of physical development.

6. It serves as a measure of accomplishment when structural corrective work is being done.

7. It is definitely objective.

8. Students, parents and teachers do not object to the photographs. (1)

9. Students are self-motivated to improve their physical condition after seeing their Record.

10. The Record is not a panacea and should be used accordingly.

11. It is a valuable guide when assigning students to physical activities.

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(1) One objection was received in 227 cases.

Chapter IV.

ADMINISTRATION OF THE TEST AND THE RECORDING OF RESULTS.

The Recorder is placed in a desired location where it remains until all of the boys are tested. The photoflood lights of the Recorder are controlled by an extension cord to the camera. The camera is placed in focus ten feet from the subject on a table 32 inches high so that the center line on the back wall of the Recorder coincides with the center line on the exposure glass of the camera. The desired position is secured when the two lines coincide throughout. The camera is held in position by two strips of wood or metal which are fastened to the table top at a 90° angle to each other. The table is securely fastened to the floor. This arrangement allows the camera to be moved to a dark room for reloading. (1)

The Pedograph is inked, filled with blanks, and placed in a convenient location on the floor. The scales for weighing are placed adjacent to the Pedograph. A small table for convenience in recording is placed nearby.

The identification points are marked on the subject's back with iodine. A dauber which makes spots about one-half inch in diameter is used. Footprints are taken;

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(1) A better method is to have the camera fastened in focus in a dark room where exposures are made through a small opening in the wall.

height is measured and weight is recorded. These data with the date, the subject's age, serial number and grade level are recorded with chalk on the respective slate charts. Height, weight and footprints are procured with shoes removed. Shoes are worn during the photographing because most people wear shoes during their active waking hours.

The subject takes a position on the platform of the Recorder facing the back wall with his heels on the marked heel spots. The camera is loaded while the subject is getting into position. The direct positive paper is sensitized while the individual is assuming his most natural standing position. The paper is shifted in the camera for the profile view while the subject takes a sidewise position in a natural pose. The metal arrows are adjusted to the necessary identification points flush with the skin. The identification points are, as was stated in Chapter III, the upper end of the sternum, the lower end of the sternum, the most forward part of the pubic symphisis, the spinous process of the third lumbar vertebra and the spinous process of the vertebra opposite the lower end of the sternum.

The arrows are strong enough to keep the individual from assuming an exaggerated pose just before the exposure is made. The one being tested is asked to look

straight ahead at a point on a level with his eyes.

The writer believes a much more valuable record is obtained when the subject is photographed in an habitual pose. Many posture measuring methods photograph the individual in his best standing position. The reason for the natural pose is that we are trying to help the individual correct faulty posture and development and when an exaggerated pose is assumed we do not get an accurate record of the individual's physical condition.

The sensitized direct positive paper is processed by the Eastman reversal process as follows:

1.	Exposure	one second
2.	Development of the negative	45 seconds at 65° F. - 70° F.
3.	Bleaching of the negative	30 seconds at 65° F. - 70° F.
4.	Clearing	30 seconds at 65° F. - 70° F.
5.	Re-exposure (daylight or artificial light)	
6.	Redevelopment	30 seconds at 65° F. - 70° F.
7.	Fixing (if desired, but not necessary)	
8.	Drying	

It is necessary to wash the prints well in running water for at least 15 seconds between the different solutions.

When the paper is thoroughly dry, measuring and recording is completed on the photographs. The footprints

are studied and the results are transcribed to the Record. A dot is placed at the point of each arrow. A line is extended through the point on the pubic symphisis and the point on the spinous process of the third lumbar vertebra. A vertical line is erected through the midpoint between these two points. Starting at the above mentioned midpoint a third line is drawn through the lower end of the sternum. A fourth line is extended through the point on the back opposite the lower end of the sternum. The fifth line is drawn through the point of the chin and is extended through the upper end of the sternum to intersect the vertical line.

Profile Measurements

The angles which indicate posture and development are measured with a protractor. The head angle is measured first for convenience and the number is written in the angle. The second step is to slide the protractor down to the angles which have their apexes at the midpoint between the pubic symphisis and the spinous process of the third lumbar vertebra. Both angles are measured without moving the protractor for the angles have a common side, the vertical line, and common apexes, the midpoint. The numbers are written in the respective angles. The anterior angle is divided by the posterior angle. The product interpreted gives the chest ratio. The protractor

is left in the same position to measure the angle which is subtracted from 90° to give the pelvic obliquity. This angle is formed by the lines drawn through the pubic symphisis and the spinous process of the third lumbar vertebra and the vertical line through the mid-point between these points.

On the Record abbreviations of H. A. for head angle, C. R. for chest ratio, and P. O. for pelvic obliquity are written on the respective shafts of the arrows pointing to that section of the anatomy.

Back View Measurements

Markings on the back show malignment of segments of the body. A perfectly developed individual has all vertebrae in alignment; shoulders are the same height; the dimples in Michael's Rhomboid are the same height and each dimple is the same distance from the center line on the Recorder; the tips of the ears are the same height and equidistant from the center line and the buttocks are the same height with the crease between them coinciding with the center line. Any deviation from perfect alignment indicates something is wrong. Although it is difficult to measure exactly the amount of malignment of any given segment, this fact does not lessen the value of the method. The real value is in showing the return to or further deviation from perfect alignment. Any segment out of alignment

shows up distinctly against the lined and measured back wall.

Conference with the Boy

A conference is held with the boy, often at his request, in which the accumulative Records are compared. The history of defects is obtained at the first conference if the boy can give it. The progress made or the lack of it, in correcting defects, is pointed out. Suggestions and plans are made for needed corrective work. Nothing about their Records is said to boys who do not need corrective work unless they ask to see their Records. General corrective exercises are given to all boys in the regular physical education classes.

The testing of each boy requires about five minutes when two student assistants help. Much time is saved when five or six boys are tested consecutively. Approximately five minutes is spent on each Record when completing the recording and measuring. No help is needed for this task. The amount of time for the conferences varies according to the needs of the boy.

Chapter V.

ILLUSTRATIVE CASES

The following selected cases will serve to illustrate the content and application of all the cumulative records.

The cumulative record of Case Number One [1] shows that this boy was fifteen years and one month old on March twenty second, the date the cumulative record was started. He was in the eighth grade; was five feet one and one half inches tall; weighed one hundred forty two pounds; both feet were weak; had a head angle of thirty three, a chest ratio of one hundred twelve and a pelvic obliquity of fifty three.

The second entry on the record was made March 14, 1938. He was in the ninth grade; was five feet four inches tall, a gain of two and one half inches. He weighed one hundred eighty pounds, a gain of thirty eight pounds in one year. Both feet were weaker; the head angle was forty, seven points worse than a year ago; the chest ratio increased from one hundred twelve to one hundred fifty, indicating his weight is carried too far forward; the pelvic obliquity dropped from fifty three to fifty one but was probably due to a widening of the body rather than a tilting of the pelvis.

The third entry was made December 16, 1938, nine months

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(1) See table number one, P. 27

TABLE I. CASE NUMBER ONE.

Date	Age	Grade	Height	Weight	Feet	Head Angle	Chest Ratio	Pelvic Obliquity	Defects
3-22-37	15-1	8	5-1⅛	142	Both weak	33	112	53	Weak feet. Overweight.
3-14-38	16-1	9	5-4	180	Both weak	40	150	51	Weak feet. Overweight.
12-16-38	16-10	10	5-5⅛	202	Left weak Right flat	47	139	51	Right foot flat. Very much over-weight.

after the second. The boy was in the tenth grade and was five feet five and one half inches tall, a gain of four inches in twenty one months. The weight went up to two hundred two pounds, a gain of sixty pounds since the first testing. The left foot was still weak and the right has broken down, being painful at times. The head angle increased from forty to forty seven, indicating the head was being carried forward; the chest ratio of one hundred thirty nine was better, but still much too high; the pelvic obliquity remains at fifty one.

It was suggested when the first record was made that the boy be taken to a physician to have an examination for glandular irregularity. The suggestion was not followed. Although he has been regularly enrolled in physical education classes the weight has continued to increase. He had grown less and less active as the weight increased. At the last testing he said he had been to a physician recently for treatment of his glandular condition. Medical treatment probably would have kept the weight down.

Without the cumulative record one might not have detected the condition constantly growing worse. The general appearance of the boy did not change much, but the comparison of yearly records made the facts stand out vividly.

Case Number Two [1]

The boy was fifteen years and seven months old March 12, 1937, the date the first record was made. He was in the tenth grade, five feet eight inches tall, weighed one hundred twenty one pounds, feet were normal, had a head angle of forty six, a chest ratio of one hundred and a pelvic obliquity of fifty seven.

An extreme thoracic curve was found during the first testing. Corrective exercises were suggested which were engaged in regularly during the next few months. The following summer months were spent doing manual labor which included considerable ladder climbing and the pulling of building materials up by means of ropes. One might expect much improvement in the curve which is shown in the second recording.

The second record was made March 10, 1938. The boy was in the eleventh grade, five feet ten inches tall, a gain of two inches; weighed one hundred thirty six pounds, a gain of fifteen pounds in one year; the feet were normal. The head angle had decreased from forty six to thirty eight, an improvement of eight points; the chest ratio increased from one hundred to one hundred fifty seven which is not significant in this case [2]; the pelvic obliquity increased from fifty seven to sixty which is no noticeable change.

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(1) See table p. 30
(2) When the pelvic obliquity is high the chest ratio is not reliable.

TABLE II. CASE NUMBER TWO

Date	Age	Grade	Height	Weight	Feet	Head Angle	Chest Ratio	Pelvic Obliquity	Defects
3-12-37	15-7	10	5-8	121	Normal	46	100	57	Exaggerated thoracic curve to left. Left shoulder low.
3-10-38	16-7	11	5-10	136	Normal	38	157	60	Thoracic curve much straighter. Left shoulder low.
12-16-38	17-4	12	5-10	140	Normal	40	150	47	Thoracic curve nearly gone. Shoulders normal.

The thoracic curve was very much improved. His general physical condition was also much improved.

The third test was given December 16, 1938. He was in the twelfth grade; was five feet ten inches tall, the same as at the second testing; weighed one hundred forty pounds, a gain of nineteen pounds in twenty one months; feet were normal. The head angle was forty, remaining the same as the previous year; chest ratio dropped from one hundred fifty seven to one hundred fifty but is of no significance in this case; pelvic obliquity remains high at fifty seven, the same as at the first testing.(1)

The thoracic curve had nearly disappeared. It was hardly noticeable. This case serves as a very good example to show what may be accomplished in correcting spinal curvatures. No exercises that were complicated or difficult to do were needed. Persistent efforts for one year will eliminate most curves during the teen ages.

The cumulative record in this case showed the condition when correction started, it showed the case a year later and twenty one months later presenting the progress made. Without such a record one would have to rely on memory which we know to be faulty. The boy was stimulated to keep on with the corrective exercises when he saw the results.

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(1) Normal pelvic obliquity is 45° - 50°. A normal pelvic obliquity is necessary for a meaningful chest ratio.

Case Number Three [1]

This boy was fifteen years old December 29, 1935, when the first test was made. The items height, weight and feet conditions were not included in the first test for the equipment was in the experimental stage and we had not decided to include them as part of the test. He was in the ninth grade; had a head angle of thirty; a chest ratio of seventy; a pelvic obliquity of fifty.

The second test was made March 12, 1937. He was in the tenth grade; was five feet nine inches tall; weighed one hundred twenty nine pounds; both feet were weak. The head angle of forty four was fourteen points worse than the previous year; the chest ratio increased from seventy to eighty nine; the pelvic obliquity was worse by six points being up to fifty six.

The third test was made March 11, 1938, when he was in the eleventh grade; was five feet ten inches tall, a gain of one inch in one year; weighed one hundred thirty three, a gain of four pounds since the last test; feet were still weak. The head angle was twenty six after having been up to forty four a year previous; the chest ratio had dropped six points during the past year after having gone up nineteen points between the first and second tests; the pelvic obliquity was fifty two, two points above the record two years previous and

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(1) See table p. 33

TABLE III. CASE NUMBER THREE.

Date	Age	Grade	Height	Weight	Feet	Head Angle	Chest Ratio	Pelvic Obliquity	Defects
12-29-35	15-0	9	--	--	--	30	70	50	Not complete.
3-12-37	16-3	10	5-9	129	Both weak	44	89	56	Weak feet.
3-11-38	17-3	11	5-10	133	Both weak	26	83	52	Weak feet.

four points below a year ago.

After the second test the weight went up to one hundred forty pounds in November, 1937. The weight started down and on March 11, 1938, was down to one hundred thirty three. The drop in weight plus the drop of six points in the chest ratio and a bad complexion made us realize something serious might be wrong. He was sent to a physician and was found to have tuberculosis. At the end of nine months in a sanitorium he weighed one hundred and twenty seven pounds. During the nine months in the sanitorium his weight dropped to one hundred thirty pounds, went up to one hundred thirty four, dropped again to one hundred twenty one and went up to one hundred twenty seven pounds again. His chances for recovery were fair.

The cumulative record in this case showed a condition that was being overlooked by a physician. It was not apparent from appearance that the boy's chest ratio had dropped and that he had lost weight. The normal condition for a boy of his age would be a gain in weight rather than a loss. The finding of a condition, by means of the cumulative record, that proved to be tuberculosis was more than the writer had expected the record to reveal.

Chapter VI.

Summary and Conclusion

Summary

The purpose of this thesis has been to present a method of diagnosing physical defects of boys. A lack of reliable and inexpensive testing methods prompted the efforts that developed this testing method. The Recorder is the product of the writer's efforts. The method is based on the work of Dr. John Harvey Kellogg of the Battle Creek, Michigan, Sanitarium. Several posture testing methods are listed in the introductory chapter. This is followed by a list of technical terms.

The testing materials include direct positive photographic paper, a direct positive developing kit, footprint blanks, and marking materials. The equipment consists of Recorder, camera, Pedograph, scales, protractor, proportional dividers and a fountain pen. The total cost of equipment was between two hundred fifty and three hundred dollars. Materials are comparatively inexpensive. The current cost of the direct positive paper varies between three and seven cents per sheet for the 5" x 7" size, depending on the amount being purchased. The developing kit costs one dollar and twenty five cents and will develop several hundred papers if used carefully. Materials will average about five cents per person for a complete test.

The Record consists of two direct positive photographs on one 5" x 7" sheet of paper. It includes a back view, a profile view and the following data; date, age, height, weight, foot conditions, serial number, grade level in school, lined and measured back wall and the Kellogg postural measurements.

The Record is made by placing the Recorder in the desired location with the camera placed in focus ten feet from the Recorder. The Pedograph for recording footprints and the scales for weighing are placed conveniently near by. After the necessary marking are put on the back of the subject, date, age, height, weight, foot conditions, serial number and grade level are recorded on the charts of the Recorder.

The subject is then placed in the Recorder facing the back wall while the back view photograph is being made. He is then turned sidewise for the profile view. The exposed paper is then put through the direct positive developing process. This process consists of exposure, development of the negative, bleaching of the negative, clearing, re-exposure, re-development and drying.

The dried photograph is marked and lined then the necessary measurements are completed. The boy is then called in for a conference at which time records are analyzed and recommendations are made for corrections.

Conclusions

It has been shown that this thesis presents a practical method of diagnosing the physical defects of boys.

Even a single Record provides many very valuable and helpful facts for diagnosing physical defects. Each item included has been found beneficial in diagnosing difficulties and making recommendations. The single Record shows the posture condition, physical defects, weight in relation to age and height and the age grade level.

It would seem that the most valuable feature of this method is the cumulative record. One can see by comparison the changes which have taken place in the boy's condition between testing dates. This feature is the most valuable part of the test because it gives objective data upon which to base conclusions when diagnosing physical defects.

One may justify the use of this test in a school program because it is inexpensive when the benefits received by the students are considered. Parents are enthusiastic about the records and the work being done to correct the physical defects of their boys for they can see the progress. The boys are much more interested in correcting their defects when they can see the results objectively.

This study suggests several problems for further study. One such problem is how often should corrective cases be

tested? A study should be made of junior and senior high school girls to demonstrate the possibilities in this field of endeavor. A third problem would be the conducting of a study to determine the advisability of administering the test to both boys and girls in the age group six to twelve. A great number of cases should be tested by this method to establish a higher degree of validity and reliability.