The occurrence of painful affections of the feet among trained nurses : a series of 500 observations upon normal and disabled feet / by Robert W. Lovett.

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THE OCCURRENCE OF PAINFUL AFFECTIONS OF THE FEET AMONG TRAINED NURSES.[1]

A Series of 500 Observations Upon Normal and Disabled Feet.

BY

ROBERT W. LOVETT, M.D.,

of Boston, Mass.

The liability of trained nurses to develop some static trouble with their feet during their hospital service is well known. In large hospitals it becomes a matter of economy to limit this so far as possible, and the following investigation was undertaken by me in a large general hospital in the hope of diminishing the trouble by seeing that all nurses wore during their course of training a proper boot and were placed so far as possible under conditions favorable for their feet. With this in view every nurse entering the hospital was examined soon after entrance, boots of a suitable shape were prescribed, and if trouble with the feet arose during the course, she was seen and prescribed for.

The number of nurses observed having reached 500 in the course of some eight years, it has seemed worth while to analyze the records of these observations. In addition to any information to be derived about the etiology of this acute form of static trouble of the foot, there are certain questions of specific interest to hospital superintendents, police commissioners, and civil service examiners which might well be elucidated by this mass of material. These questions are in part as follow:

1. Can it be told by examination whether the feet of an individual are likely to break down or not under the strain of constant use?

2. What are the factors in causing this breaking down?

3. What is the nature of the process giving rise to the painful condition?

4. How much may be done toward preventing it by the use of proper boots?

[1] Read before the American Orthopedic Association at Washington, May 14, 1903.

The material at my command consisted entirely of young women between the ages of 23 and 35. They were presumably healthy, having been selected from a large number of applicants who had answered a number of questions with regard to their general health when they filed their applications for admission to the school. The majority of them had previously earned their own living, having been school teachers, housekeepers, nurses or attendants in other institutions, stenographers, and the like. Many had, however, lived at home with no occupation.

During one period of a few months the nurses were

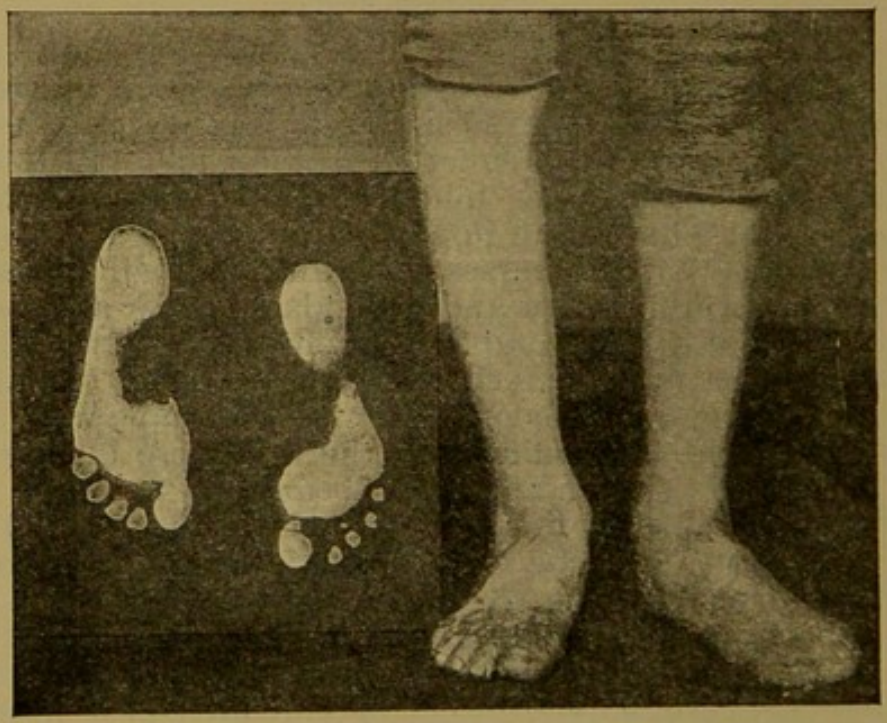

Fig. 1.—Pronated foot without breaking down of the arch. See tracing.

not examined at entrance, but were fitted to regulation boots in a routine way and only seen by me if they had trouble. But under these circumstances the percentage of trouble was higher than when they were examined at entrance and prescribed for individually, and that method was abandoned. With the exception of this time, during which no records were kept, and of another period of a few months when the work was undertaken by a substitute, the 500 nurses have all been seen by me and prescribed for individually, and the series of observations is continuous.

The conditions of their life in the hospital are of impor-

tance. The probationary period is 2 months, the course itself 2 years. The nurses on the average work 9¼ hours, with 2 hours off during the day. They do not live in the hospital building, but in a modern, well-ventilated dormitory near the hospital. There are now about 150 nurses in the school, but when the inquiry was begun the school contained only about 115. There have, therefore, been under my observation for 8

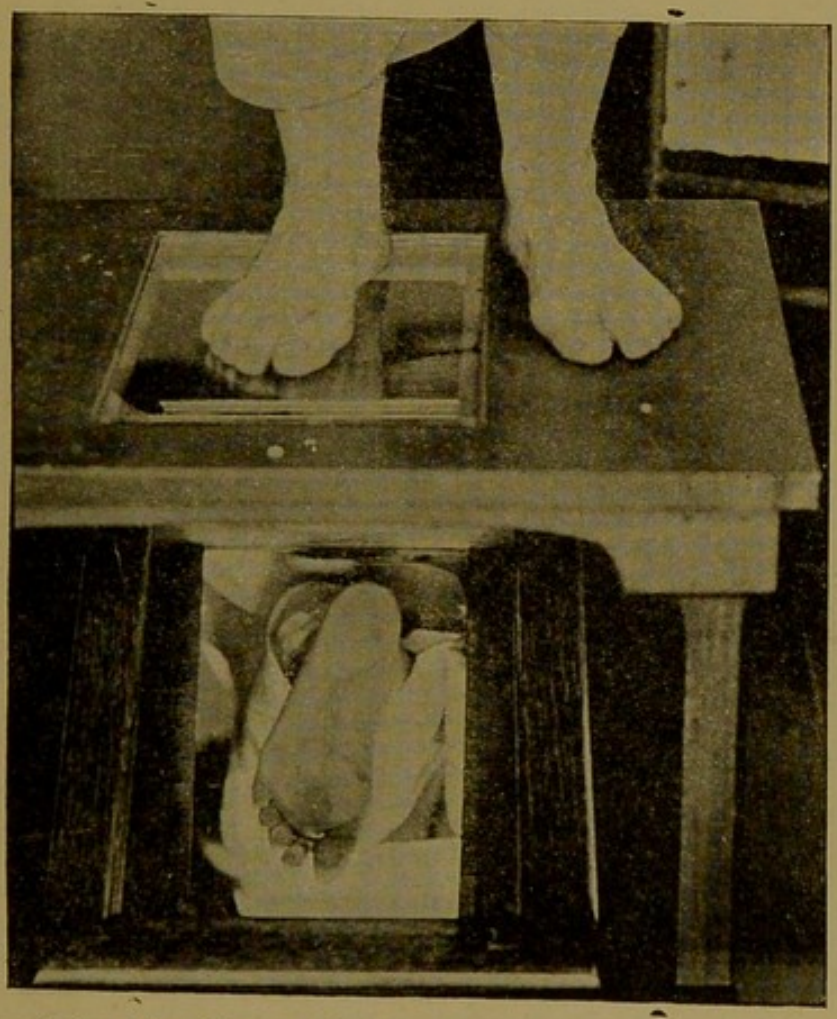

Fig. 2.—Patient standing on glass table with a mirror underneath. On the mirror is seen the weight-bearing surface of the foot.

years, at all times from 115 to 150 young women living under conditions entailing great strain on the feet. Having records of all these cases along with careful notes of the nurse's condition at entrance, I have been in a position to estimate the value of certain things observed in the feet at entrance and also the chance of familiarizing myself with the ordinary type of trouble

as it occurs in these nurses, of studying its character and progress, and of attempting to shorten its course.

Method of Examination.—Imprint tracings were first used by having the nurse step on smoked paper, but after 130 of these observations it became evident that they were practically worthless. An imprint of this sort is a composite record of two positions. The foot first touches the paper and records the nonweight-bearing imprint,

Fig. 3.—Tracing of a flat-foot. No symptoms, foot useful.

and then the imprint of the weighted foot. The two are merged and a foot, which in use really rests upon two points of pressure only, the ball of the foot and the heel, gives a mark as if the outer border touched also. This outer border touches at first, then lifts under weight (Fig. 1). The imprints not only gave no reliable information as to the durability of an individual foot, but when studied showed in most cases that they were

made up of two superimposed impressions and must be misleading. The method was therefore abandoned.

A plate of glass with a mirror placed at an angle underneath was from that time used in all examinations. The nurse was examined with her feet bare, facing the observer, on a glass plate raised 18 inches from the floor (Fig. 2). In her natural standing position the anemic weight-bearing surface of the feet was observed through the glass, being reflected in the mirror. The pressure surface was recorded by a pencil sketch in the record.

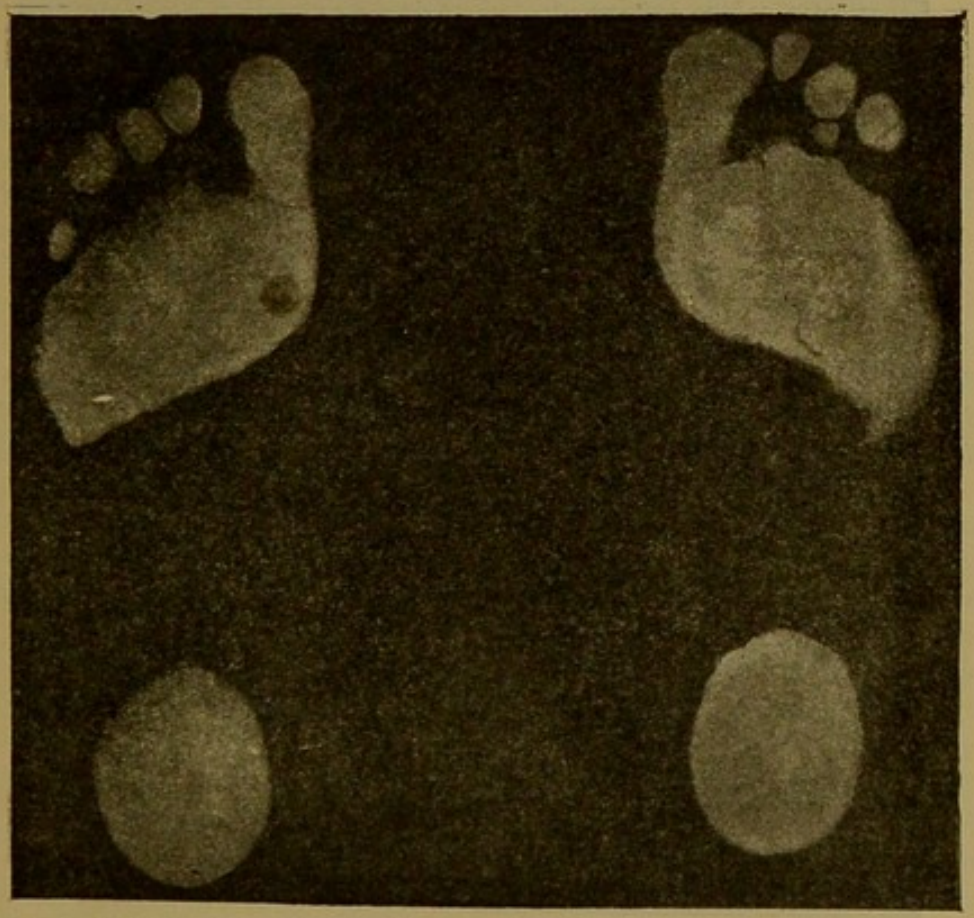

Fig. 4.—Tracing of a foot resting on two islands. No symptoms, foot useful.

These contact surfaces followed the same three types shown in the figures of the smoked tracings (Figs. 3, 4, and 5). By inspection of the feet from in front the degree of rolling in (pronation) of the foot was next noted and recorded as the nurse stood in a natural position. The condition of the circulation of the feet was noted in many cases, whether congested with distended veins or not. Calluses, bunions, crumpled toes, ingrowing nails, and other signs of abuse were noted. Finally, the

general appearance of the foot and an estimate of its probable usefulness was recorded as excellent, good, fair, suspicious, or poor. Each nurse was then given a note to a retail shoe store with suggestions as to any modification required in fitting her to the regulation boot.

Value of the Examination in Determining the Durability of the Feet of an Individual.—In forming the opinion expressed in the terms "excellent," "good," "fair,"

Fig. 5.—Type of tracing described as normal, with outer border touching ground.

etc., I was guided by the general appearance of the foot, chiefly whether or not it was pronated much, the condition of the circulation, the degree of flexibility to dorsal flexion in passive manipulation, and the nurse's previous history.

In analyzing the records I took the consecutive histories of a certain number of nurses who had during their course trouble of enough importance to lead them

to complain, and of a similar number of nurses who had no trouble and compared the later histories of the nurses of the two groups. The figures are given in percentages:

	Nurses having trouble.		Nurses having no trouble.	
Excellent	12%	60%	6%	62%
Good	28%		26%	
Fair	20%		30%	
Questionable	12%	40%	12%	38%
Poor	10%		10%	
Not classed	18%		16%	

It will be seen that my opinion of the usefulness of the foot, formed in this way was of no practical value in selecting the cases likely to give trouble. To reject applicants on an opinion formed by inspection would be unsafe. There have been five or six nurses with perfectly flat feet to go through the school without any trouble. There have been many nurses with the most unstable and threatening feet, which were badly pronated and bore heavily on the inner side of the ball of the foot and on the heel, who have gone through the school without discomfort, whereas nurses with feet in perfect relation to the leg according to all accepted ideas have been speedily incapacitated.

Weight and Size of Boot.—A series of 60 observations were made as to the relative weight of the nurse and the size of boot worn to see if the relatively small feet were the troublesome ones. The nurse was asked in each case what her weight was, and what was the size of her boot. Of the nurses having trouble the average weight was 132 pounds and the average boot No. 5. Of the nurses having no trouble the average weight was 131 pounds and the average boot No. 5. It was evident that no information was to be obtained from this line of inquiry.

Pronation.—The amount of pronation or rolling in of the foot was investigated (Fig. 6). It is generally assumed that although a certain amount of pronation is normal in weight-bearing, more than a moderate amount is an evidence of weakness in the foot and predisposes to breaking down. The figures to be quoted do not bear out the opinion that decidedly pronated feet are necessarily likely to break down under strain. This fact explains in a measure the foregoing statement that the estimate formed by inspection was of little value, for influenced by general opinion I was led to regard pro-

nation as the most important factor in forming my opinion. The estimate of pronation was made by the eye and was recorded when the nurse was first seen.

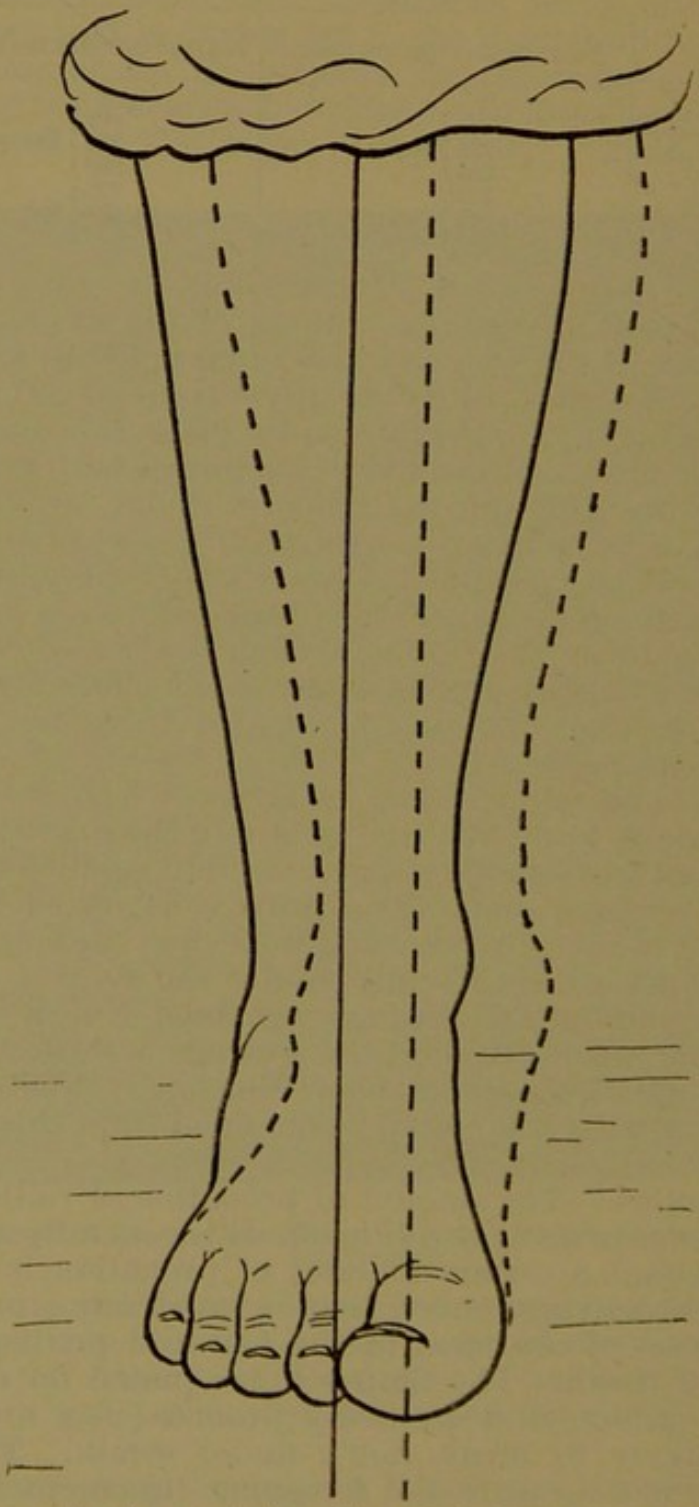

Fig. 6.—Normal and pronated position of the foot, the latter in dotted outline.

The table consists of the consecutive records of 185 nurses analyzed later to see what proportion of nurses who had trouble and who had no trouble had pronated feet when they entered.

In a general way the percentage of trouble was slightly higher when much pronation was present (23% as contrasted with 17%) and slightly lower when there was little or no tendency to pronation (40% as contrasted to 43%). But such a slight difference shows that the

	Nurses without trouble.	Nurses with trouble.
Pronation marked	13% } 17%	18% } 23%
Pronation more than average	4% }	5% }
Pronation average or moderate	30%	26%
Pronation slight	17% } 43%	20% } 40%
Pronation very slight	10% }	10% }
No pronation	16% }	10% }
Not noted	6%	7.5%
Feet flat	1.2%	.....

degree of pronation or "weak foot" is of little practical value in forming an estimate of the usefulness of an individual foot.

Pressure Areas on Glass.—The only sign observed at the first examination that seemed to be of prognostic value was the imprint of the nurses' weight-bearing foot as observed through the glass plate. The nurses showed three types of pressure areas (*a*) when the foot rested on two islands, one under the heel and one under the ball of the toe while the outer border did not bear weight. This type was classed as "two islands;" (*b*) when the outer border bore weight as well as the heel and front of the foot; (*c*) when the foot was more or less flattened and the outer border was very broad.

One hundred and fifty nurses were classed as follows:

	Both feet "two islands."	One foot "two islands." One foot outer border bearing weight.	Both feet outer border bearing weight.	Both feet flat.
Nurses having trouble	58%	18%	18%	6%
Nurses having no trouble	42%	15%	38%	2%

It will be seen that nurses whose feet bear weight along the outer border are less likely to have trouble than when the weight rests on two pressure islands.

Flexibility of the Foot, Circulation, etc.—The degree of flexibility of the foot in passive dorsal flexion proved not to be a sign of prognostic value, nor did disturbance of circulation in the foot, as shown by congestion and distention of the veins at the first examination, signify

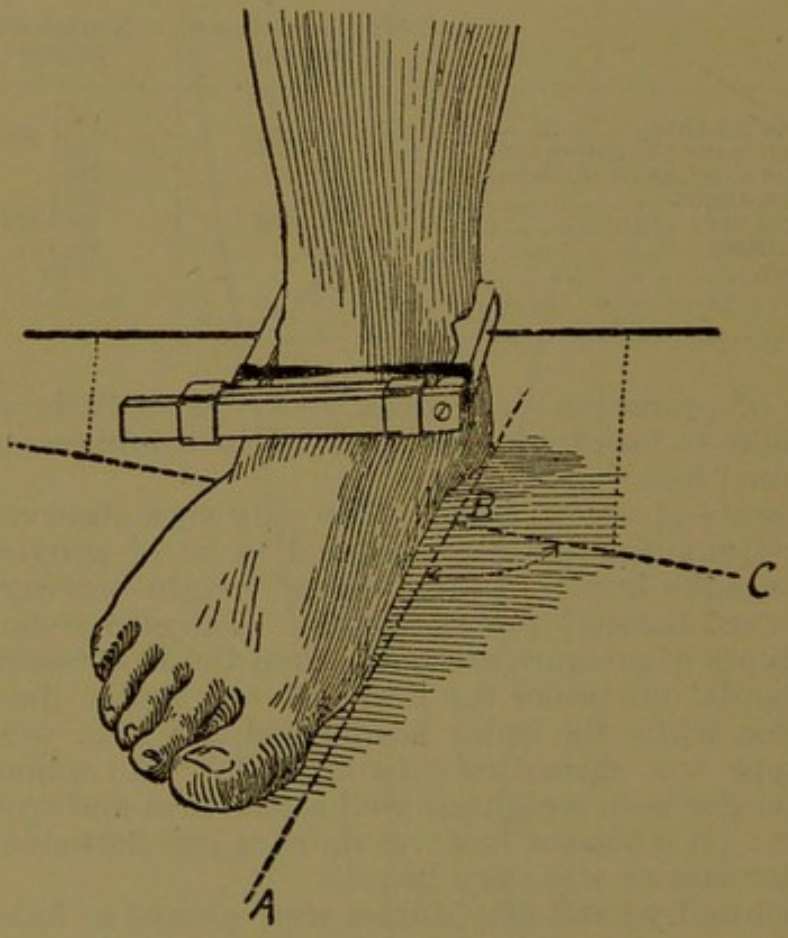

Fig. 7.—Apparatus for estimating index of pronation. The angle to be measured is A, B, C.

anything of importance, as at the beginning of the training such a disturbance was common.

The index of pronation of the foot, as measured by an instrument devised by Dr. F. J. Cotton and myself, did not prove of the value that we had hoped[1] (Fig. 7).

[1] Lovett and Cotton, Some Practical Points in Anatomy of the Foot, Boston Medical and Surgical Journal, August 4, 1898.

In 21 cases measured by this instrument the index averaged as follows:

Nurses without trouble....	Right foot supinated.	60 L.	P. 61.
	Right foot pronated.	63 L.	P. 65.
Nurses with trouble.....	Right foot supinated.	58 L.	P 61.
	Right foot pronated.	62 L.	P. 65.

Much to my regret, therefore, I am obliged to record the fact that the original examination has proved of little value so far as it indicates whether the feet of an individual nurse are likely or not to give trouble under the severe strain of use. The only point to which much importance can be attached is the character of the imprint on glass. The examination, however, is I believe of great value in suggesting precautions which may be taken which will be spoken of later.

Nature of Process.—The character of the disturbance when it occurred was next investigated.

Symptoms were of a pretty uniform character. Burning and a full feeling in the feet were succeeded by lameness and stiffness. Swelling of the feet and some restriction of the normal motion followed in the severer cases. These symptoms in favorable cases under proper treatment improved and disappeared. In certain cases, however, in spite of proper support, massage, douches, etc., these increased until the nurse was incapacitated from work for a few days. Tenderness appeared in nearly all these cases, either under the scaphoid or under the bottom of the heel, rarely in the great-toe joint. Pain in the knees and back were not uncommon symptoms. Rare symptoms were synovitis of the tendo-achillis and only in one or two cases was there complaint of pain in the front of the foot, and these seemed to be traumatic.

Change in Imprint.—The essential character of the static change causing the trouble was investigated and proved to be a moving inward of the bearing surfaces as seen through the glass, in a few cases observed no change had occurred, and the imprint was the same as at entrance. It seemed generally as if the muscles relaxed and allowed the foot to roll in. *Real breaking down of the arch of the foot in nurses having trouble was not observed in any case.*

Season of Year.—It became evident that nurses were more liable to have trouble at certain seasons

than at others. The cases classified by months are as follow:

January.....	8%	of all cases.		July	4% of all cases.
February ..	14%	" "		August.....	2% " "
March	24%	" "	64%	September.....	0% " "
April	10%	" "		October.....	0% " "
May.....	16%	" "		November.....	8% " "
June.....	6%	" "		December.....	6% " "

64% of all cases occurring in February, March, April, and May.

Time at Which Trouble Occurs.—Inquiry as to the period of the nurses' training at which trouble began gave the following result:

At once.....	2%	Four months.....	6%
One month.....	16%	Six months	6%
Six weeks.....	4%	Nine months.....	2%
Two months.....	20%	Twelve months.....	2%
Ten weeks	12%	Twenty-four months.....	4%
Three months	28%		

It will be seen that 60% of all cases of trouble occurred in from two to three months after entry. As the nurses are admitted more or less equally through the year it will be seen that there is another etiologic factor beside the seasonal one just mentioned.

Conditions Preceding the Trouble.—In nearly half of the cases no definite cause could be assigned for the trouble. The abnormal conditions preceding the trouble mentioned in the order of frequency were as follow: Tonsillitis or diphtheria, rheumatism, change in work, improper boots, confinement to bed, excessive heat, neurasthenia, trauma, amenorrhea. Nurses seemed inclined to experience their first trouble during menstruation, rather than between the periods.

The relation to rheumatism seemed of much interest. Three or four perfectly typical cases of trouble in the feet occurred in nurses previously free from rheumatism. These cases all proved resistant to ordinary supporting treatment, but in a few days developed signs of general rheumatism. No diagnosis of rheumatism was made in this connection unless the symptoms appeared in the upper extremity, as in the hips or knees they might have been purely irritative and due to the abnormal use of the foot. There was nothing to distinguish them from the ordinary painful affection in the beginning, but in their later course they proved obstinate and long continued. Such patients required support to the arch as much as if the affection were purely static, and derived as much comfort from it.

Another point of interest is that when trouble with the feet occurred during a long period of amenorrhea it was apt to be most troublesome. In one nurse in a period of severe discomfort, during which she was barely able to get about the ward, menstruation came on and the trouble at once improved.

Period of Disability.—When it became necessary to take a nurse off duty it was not done, of course, until it seemed that she would not recover by the use of a proper support while at her work. The period of disability lasted in most cases from two to three weeks. It always seemed at the beginning as if it would be less, but continued experience showed that if a nurse had once experienced severe trouble it was wiser to keep her off duty until the tenderness in the foot had practically disappeared.

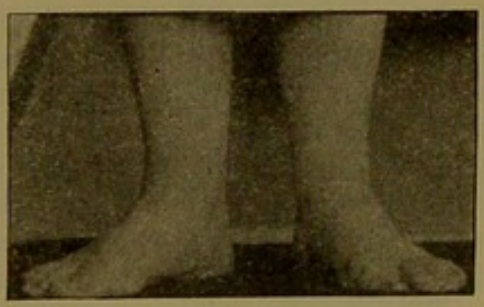

Fig. 8.—Photograph of a nurse who broke down after three months and who has been incapacitated from work for two months. In this case the foot appeared to be so good that the regulation boot was not ordered.

No statistical inquiry has been attempted as to the number of nurses having trouble or incapacitated each year, as it would have involved much more labor than it would have been worth. The causes of removing a nurse from duty are often complicated, and any such inquiry would have necessitated a search into the nurse's record in each case as well as into my own records. A fair statement of the case would be that for the last five years some nurses have each year been incapacitated from duty. During these years in a few cases nurses have left the school on account of continued or recurring disability in their feet.

The evidence so far adduced points rather to the general condition of the nurse than to the especial structure of her feet as the cause of the trouble. They have trouble in the spring when they have been housed all winter and when the work in the hospital is hardest. This trouble is more likely to come between the second and third month of their course than at any other time, when the novelty of the situation has worn off and the fatigue of the routine begins to be felt. The trouble is likely to follow diseases which debilitate the muscles.

Boots.—It is a matter that would be admitted without discussion that if a person is to undergo a severe test to the foot in the matter of standing that a good boot is better than a bad one. The chances of enduring the strain successfully would be diminished by wearing a tight boot with a pointed toe, a high heel, and a slender flexible shank.

At the time that these observations were begun there was no ready-made boot for women in the market worthy of serious consideration. It was, therefore, necessary to have one constructed on new lines, and in the boot devised and used since that time the following points were aimed at: 1. The boot should be as wide as the foot in front. 2. The inner edge of the front of the boot should be nearly straight, so as not to displace the great toe outward. 3. The boot should be constructed on a slightly curved line, the convexity being outward so as to hold the foot in its position of strength. 4. The shank should be fairly high and slightly stiff.

These propositions were submitted to a firm of shoe dealers and a last made on these lines. This boot has been used by these nurses and has not been radically changed. At first it was made a little too much curved, and was apt to cause corns on the little toe. At one time the shank was made stiffer, but shortly after this there was a good deal of trouble among the nurses and I returned to the original shank. But this outbreak of trouble was coincident with increased duty on account of the admission of soldiers returning from the Spanish war, and was probably due to that. The boot is not ideal, and may not be the best for the purpose, yet I have felt that experiments were risky and that I had at least a fair boot, the working of which I understood. My aim, in short, has been not to cramp the foot in front, to support the arch underneath, and to hold the foot slightly curved.

The difficulties have been to get the shoe dealer and the nurse to agree on a boot sufficiently wide in front and to get the manufacturer to make the last deep enough where the upper of the foot joins the vamp in front. The transverse seam below the lacings has been on the whole too tight and a source of much trouble. If it is made too loose the front of the boot wrinkles and the regulation boot and most others are too shallow where the upper joins the vamp in front. In each case the nurse has been given a letter stating her requirements and the instructions to the dealer have been that if she

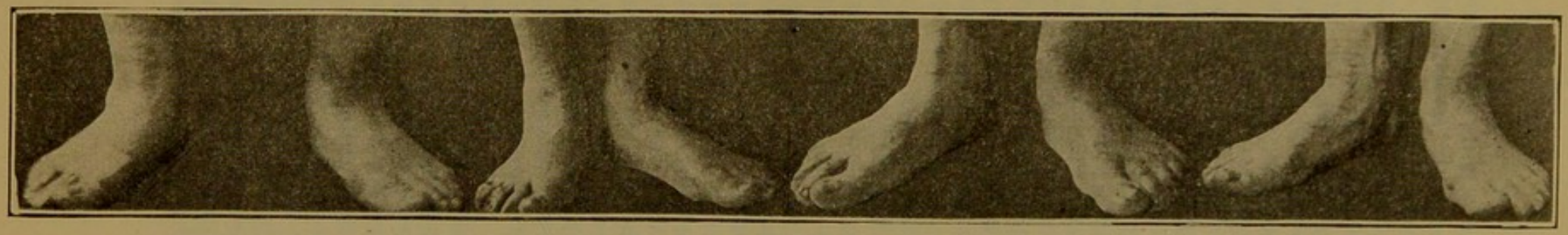

Fig. 9.—Four nurses with flattened or pronated feet, who after months of service had been comfortable at entrance. These were classed as "suspicious"

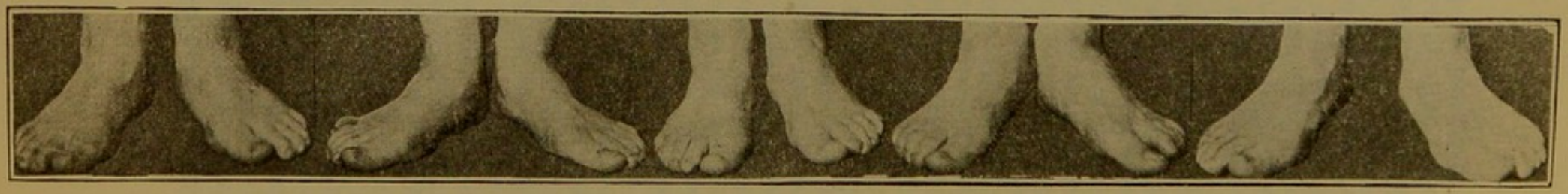

Fig. 10.—Photographs of the standing position in five consecutive probationers at admission. These were taken to show the average foot, and in no one of the cases had there been any trouble.

could not be fitted properly she must have a boot made on the same general lines but suiting her especial requirements. In perhaps 250 nurses the boots were inspected before being worn, but the system was abandoned on account of certain practical difficulties, and since then the nurses' instructions have been to report if the boot was not comfortable. Lace boots are ordered with rubber heels and low shoes are not allowed except by special permission in selected cases. The boots are made of kid, with a sole of medium thickness; the shank is stiffened by a light piece of spring steel and the heel is of medium height.

In 130 nurses I made outline tracings of the foot and of the boot worn at entrance and in practically all cases the result showed a gross disproportion between the size of the boot and the foot. Of later years the style of boot worn at entrance has improved and there are now in the market several styles of cheap boots which conform fairly well to the theoretic requirements. At one time when a nurse came to the hospital wearing a good boot which seemed to meet the requirements I did not order regulation boots but allowed her to wear what she had. But the experience was not favorable to the method and the proportion of trouble in such nurses was unduly large, and now the regulation boot is prescribed except in very exceptional circumstances.

It is a very common experience to have the slight trouble which very often occurs in the first days of duty immediately relieved on putting on the regulation boot. The outcome of my experience has been that I believe that a good boot diminishes trouble, but cannot prevent it, and that if nurses were allowed to wear boots of their own selection, there would be much more trouble than there is now. That as the cause of the trouble seems most often to be found in muscular relaxation due to fatigue and similar causes, the problem is so far as possible to supplement the action of the muscles in holding the foot in its supported position.

Prevention of Trouble.—At the first examination, if the nurse's boot was trodden over to the inside, or if much pronation was present, the inner side of the sole and heel was made ⅛ inch or even ¼ inch thicker than the outer side in order to tip the foot over onto its outer border somewhat.

Continued experience has not shown that this is a measure of much value, and its preventive effect was small, and in the last year or two it has been used much

less than at first. If the nurse's foot showed a very high arch, an order was given for a boot with an extra high shank. In some of these cases a cork pad was put in at the beginning to support the high arch. In a few cases of very severe pronation, and in one case of traumatic flat-foot, metal supports have been put in when the nurse was first seen with apparent prevention of trouble.

Treatment.—Every nurse has been asked to report at once any discomfort in the feet, but the disposition has been to put off "making any fuss" until the condition had existed some days at least.

In the milder cases the aim of the treatment has been to relieve the muscles from strain and to stimulate the circulation. Felt pads have at once been put in the boots to support the arch, and the nurse has been ordered to soak the feet in hot water at night for 10 minutes and then to shower the feet with cold water and to bandage the feet and legs with flannel for the night. The majority of early cases have, I think, yielded to this treatment. If, however, rapid improvement has not come on in two or three days, or if the first symptoms have been severe, a metal support to the arch of the foot has at once been put in and measures to stimulate the circulation have been used, as described above. In some cases plates have relieved the symptoms at once and have been worn for a few weeks or months, generally to be given up later.

In the severest cases all sorts of expedients have been tried to cure the pain while the nurse continued her work. The most efficient support of all is to apply a felt pad to the instep while the foot is held inverted by fastening the pad to the bare foot by several straps of adhesive plaster which pass from the outer border of the foot under the foot and up under the inner side of the arch over the top of the foot to the ankle. These straps overlie each other and are covered by a heavy cotton bandage. This dressing must be renewed every day or two. This dressing, which is distinctly more supporting than any metal plate, has in some cases carried nurses over a painful attack while on duty, but more often it has failed in the severest cases. In these severest cases hot air baths, massage, and stretching of the calf muscles have been faithfully tried with no brilliant success. They have helped the condition, but I cannot recall a severe case in which any one of these latter measures has made any serious difference.

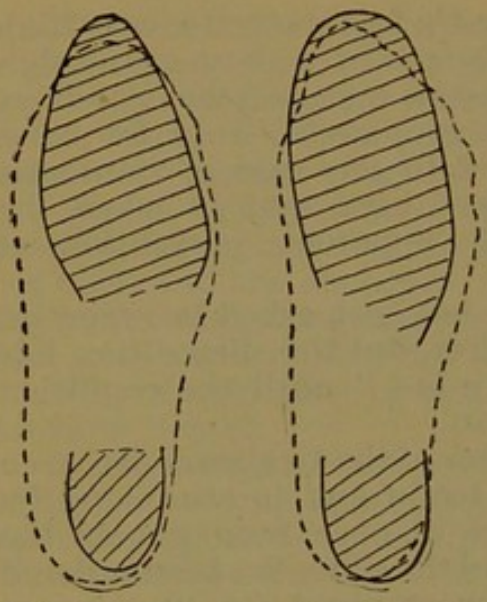

Fig. 11.—Feet and boots, typical tracings. The boots are shaded.

If a proper fitting metal plate fails to relieve symptoms within two or three days the sooner the nurse is laid off the better and the shorter her period of incapacity. When she is laid off she is not allowed to walk, but as she convalesces she is encouraged to take out-of-door walks and is not regarded as fit for duty until she can walk a mile or two on brick sidewalks without pain. Several times it has been demonstrated that it was unwise to allow nurses to go on duty under other conditions. Strychnin in fairly large doses has been used in a number of cases in the hope of improving the muscular tone when trouble was threatening but I have failed to see striking instances of its benefit.

In no case can I recall that a metal plate has been otherwise than helpful. It is often not enough to prevent laying off of the nurse, for the traumatism of constant walking and standing is too great for it to overcome, but as a preventive it is of great value and a great aid in protecting from strain convalescents from foot trouble. A few nurses have continued to wear plates throughout their course, but the majority have dispensed with them after a while.

A summary of this paper can perhaps best serve its purpose by attempting to answer the questions proposed at its beginning :

1. It has not been possible to tell with any certainty by examination whether or not the feet of an individual are likely to give trouble. The only reliable information obtained in these cases was given by the imprints seen through glass. A foot with a well-distributed pressure area seemed rather less likely to give trouble than one resting on two islands; the degree of pronation, the condition of the circulation, the relative weight of the nurse, and the dorsal flexibility of the foot all proving of little or no value as elements in prognosis. A flat foot may be perfectly serviceable as may also a

severely pronated one, while an apparently well-balanced foot may become painful.

2. The factors in causing the trouble among the nurses were to be sought rather in the general conditions than in any especial conformation of the foot. It followed in many cases, illness and other conditions causing muscular debility. It occurred in most cases from two to three months after entrance and it began most often in the early spring when the nurses had been indoors all winter, and least often in the fall.

3. The trouble was caused by a rolling in of the foot and a shifting inward of its weight-bearing areas and not in any case observed by a breaking down or even lowering of the arch.

4. Although proof by figures is lacking it is probable that the amount of trouble has been decidedly less than it would have been without the use of a proper boot.

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