Thesis on Rickets

by J. Coull. MacKenzie
Notwithstanding the large amount of literature on the subject of Ricketts, considerable doubt still exists as to the nature of the complaint. There are still very considerable differences of opinion as to whether Ricketts is a disease in the strict sense of the word, or is not a disease whether it is merely a symptom of disease, or the normal state of the British poor, or an abnormal state dependent upon some disease. It would appear that most writers on the subject seem rather inclined to shirk the task of defining Ricketts. Perhaps from want of complete knowledge it is not possible to produce a perfect definition. Let us consider some of the definitions which have been advanced. "Ricketts is a chronic disease of nutrition. While the only important anatomical changes are found in the bones, it is not to be
regarded as a bone disease; but as a very complex pathological process which affects the bones, muscles, ligaments, mucous membranes and nearly all the organs of the body, particularly those of the nervous system.

Holt's Diseases of Infancy and Childhood, page 215

"Rachitis is a disease of infancy, rarely of early childhood and is closely associated with impaired nutrition. It shows itself mostly in alterations of the growing bones. Its most marked symptoms are met with between the sixth month and the second year but it can occur at all ages and may be congenital."

Hygienic and Medical Treatment of Children, 1st ed. Vol 2, page 1065

"Rickets is a constitutional disease but its most conspicuous anatomical characters pertain to the nervous system."

Starr's Diseases of Children, page 335
"Rickets is a disease that usually makes its appearance during the first two or three years of life. It is characterised by chronic congestion, deformities of the bones, weakness of the muscles and ligaments and various peculiar nervous disorders. Dentition is retarded: there is frequently enlargement of the liver and spleen."

Ashby and Bright: Diseases of Children, page 393.

Let us consider all these statements merely in the form of a definition and we find them very inadequate. Firstly, all we have no proof that rickets is a disease; for anything we know it may be only a symptom of disease like jaundice or hypertrophy of the heart. Some authorities have boldly asserted that rickets is a result of syphilis. This of course is not the opinion of the majority, but still the
very fact that such a theory has been put forward by recognized authorities shows that there is some uncertainty as to whether Rickets is a special disease in itself. One might suggest that Rickets was merely a part of many other diseases besides Syphilis and perhaps in some cases with quite as much reason. Some prefer to look upon Rickets not as a disease but as a state of perverted nutrition. Of course it is very hard to say where perverted nutrition ends and disease begins. We should hardly call every middle-aged man who had too much fat and too little muscle diseased and so why should we call a child diseased because it has too much cartilage and connective tissue and too little bone and muscle. Some say that we ought to call Rickets a disease
Clinically but not pathologically.
On the other hand there is
evidence abundant if not con-
elusive indicating Pneumonia
to be a special disease just
as much as gout or diabetes
and in all probability we shall
find when we have learnt
more about the disease that
this is the case.
The following might be given
as reasons why Pneumonia should
be looked upon as a disease
1. Because it can be diagnosed
on its own account and treated
with certainty impossible in the
case of mere symptoms of disease
such as jaundice for
2. Because it is admitted to be
hereditary
3. Because so many cases
occur in which we find
nothing but Pneumonia
The following might be given as
reasons why Pneumonia should not
be looked upon as a disease
4. Because it can not be
properly included in any known class of diseases
(2) Because it is neither contagious nor infectious and no micro-organism has been proved
(3) There is no departure from the normal histology. That is to say that the elements are the
same as in the normal only that the amount of each varies
(4) Because we believe that if a child is born and reared under conditions entirely un-
favourable to sickness both as regards parents' hygiene & it is impossible for it to contract the disease.

Many more reasons might be given both for and against the theory, but all things considered it is perhaps best to accept the idea that it is a disease.

The great fault in the definition which I have quoted is that they embrace statements which are not by any means universally admitted. My attempt
to give a concise description of a subject which is not concise and no definition of rickets can be considered correct which is not made sufficiently vague to steer clear of any doubtful points, but still this can be carried too far as for instance in the following:

"A disease of childhood characterized by general malnutrition and a soft pliable condition of the bones; and resulting in certain characteristic deformities." D. J. Hamilton's Textbook of Pathology Vol II part 2 page 830.

Here it might be suggested that as many early cases treated in time never get the length of general malnutrition nor of a soft pliable condition of the bones nor in certain characteristic deformities, this definition hardly embraces the whole subject. If I were to attempt to define rickets I should be inclined
to proceed somewhat as follows.

Rickets is an improper state of the infant's organization characterized by various departures from the normal in many organs and tissues; probably originating in some obscure affection of the nervous system and accelerated by all that is unsanitary. I think that this is as much as we have any right to say about it.

The disease is not comparatively one of very great historical interest, but the following extract from The Lancet Dec 11 1880 is too good to be missed:

"Dr. Norman Moore first referred to a point in the history of Rickets suggested by a reference of Dr. Fugge to Whistler as the discoverer of Rickets: this claim rests only on the assertion of Whistler that he printed a thesis on it in 1645 but there is no trace of this thesis and in the face of the fact that Whistler appropriated
to his own use some of the funds of the College of Physicians this own unsupported statement was of small value.

There is no doubt that this was about the time when the disease first came under notice. One would be inclined to think that with all our improved ideas of hygiene Rickets would become less common as time went on but this is apparently not the case. It is probably increased by civilization and all artificial aids to existence.

This leads us to the consideration of the various causes which tend to produce Rickets. It cannot be said that any cause or causes can produce the disease. The only tend to produce it and great doubt exists as to the relative importance of the different causes.

"The essential cause of Rickets is dietetic although hygienic influences play a very important role in its production. While it
seems to be demonstrated that diet alone may produce rickets. Nevertheless this condition is much more easily produced when there are also unfavourable hygienic surrounding. "Holt's Diseases Children. "There seems to be a general ten-
dency to look upon the dietetic cause as the principal one but the more one studies the subject the more one is inclined to doubt this. I myself do not believe that diet alone can produce rickets in the human subject. So much has been said and written on the subject of rickets which has been passed on from one text book to another without being challenged that many ideas have come to be looked upon as settled facts which do not appear to me to have the slightest foundation. If my experiences seem to be different to those of others and to clash with various recognised ideas I can only say that I have
approached the subject in a totally unbiased manner and
if I seem to be cutting into
recognised authorities it is because
in the interests of truth I cannot
help it

"Rickets is not common in
nursing children unless lac-
tation be unduly prolonged
as for example where nursing
is continued for fifteen to eighteen
months without other food." Holt
This is not my experience. I
have found that as a rule
the artificially fed children
escape better. In my experience
the children of the rich are
more often artificially fed than
those of the poor, but they do not
so often suffer from Rickets. But
even excluding the children
of the rich I have found that
the artificially fed poor baby
has as a rule a better chance
of escaping Rickets than the
naturally fed poor baby.
"Artificially fed children are far
more prone to the disease especially those who are badly fed " Holt. The fact of the children being " badly fed" is the principal point and my opinion is that they are more often badly fed when nursed than when fed artificially.

With regard to the prolonged lactation I believe that Rickets almost always begins long before nine months and so I cannot accept prolonged lactation as a primary cause.

"It has been stated that infants nursed at the breast of a healthy mother rarely become rickets we may say never suffer from severe Rickets."

Ashley Wright, Diseases of Children, p. 395.

If this be true then there can be very few healthy mothers in existence. There are I suppose a few to be found but very few. By a healthy mother I mean one who is as healthy that he
milk is better for the child than artificial feeding. But how are we to tell when we see a healthy mother? Some of the most severe cases of Dicket I have met have been in children whose mothers seemed to me to be particularly healthy in every respect. My experience is that most of the children of the poor do have Dicket, more or less. It is not always noticed and does not comparatively often get bad enough to make the parents seek professional advice, but still if we examine the child carefully we find that it is almost always there although the parent may indignantly refuse to believe it.

"While infants which have been artificially fed from the first and who have suffered much from dyspeptic ailments are nearly always affected."

Ashley Wright

My experience is that it is as
a rule the artificially fed infants which do not have Rickets and this I believe is due partly to the superiority of artificial feeding over the feeding of most mothers and partly to the class to which the children belong. With regard to the dyspeptic ailments the question is are these the cause of Rickets or are they the sequelae or part of the disease or merely a coincidence. I think probably the latter. I know that most authorities consider the dyspeptic ailments to be the cause of Rickets but then these same authorities will say that Rickets usually begins later than six months of age and will put down a dyspeptic ailment which occurred say at three months as the cause of the Rickets. But on the other hand Rickets so often begins at from three to six weeks showing cranial tachy and the principal gastric symptoms following a
month or two afterwards and appearing to be rather the result than the cause. But still we have no indisputable evidence that they are more than coincidence. Overfeeding would seem to have some part in the causation of Rickets as well as dyspeptic ailments. It is the tendency of the British nation to eat far too much and to encourage the children to do the same. Taylor says that the majority of cases begin between twelve months and two and a half years and that some cases are seen even under six months. I should be inclined to reverse the statement and put it that the majority of cases occur under six months but that some cases are known to occur between twelve and thirty months. He gives as the principal cause defective hygienic conditions especially in the matter of food and air supply. He says “The natural food of the infant is
the mother's milk and a child should be nursed entirely until it is nine months old. "(1) A deficient quality of the milk from ill health or malnutrition of the mother or from lactation being continued far into the second year (2) The substitution for the mother's milk of various infant foods which the large number contain a high percentage of starch and the necessary elimination of the very essential fats and protein elements. (3) The ingestion through carelessness or ignorance of the parents of meat, bread, and potatoes either alone or in addition to the mother's milk or the artificial substitute. The natural food for the child certainly is the mother's milk, but it does not necessarily follow that it is best for the child and it is very doubtful whether a child ought to be nursed till it is nine months old. It does not require ill health or
malnutrition of the mother to make her milk deficient in quality. My opinion is that infant's foods have not so much to do with the causation of Rickets as they get the credit of. There is of course no doubt that meat potatoes do tend to produce Rickets but as a rule the disease has begun long before the child gets these.

"It appears however that the most important factor is a great deficiency of fat." Holt.

This is true to a certain extent but it is quite at variance with the idea that human milk is better than cows' milk as the cows' milk contains more fat than the ordinary human milk and very much more than the milk of the average woman.

"Rickets is exceedingly common in children reared upon the proprietary foods nearly all of which are very low in fat"
and contain an excess of carbohydrates.” Holt
I know that it is the practice of the medical profession to
sneer at “Infant foods” but I believe that this is to a great
extent the result of ignorance. It is all very well to take for
granted that because a food or a drug is patent it must be
a fraud. Doubtless they all are more or less but my experience
is that the average patent food is not half such a fraud
as the average placebo secretin.
Then it is all very well to say that because an analysis of a
patent food does not give the right proportion of fat therefore
it should be avoided. One
might just as well say that
because meat does not contain
vegetables it is bad. No sensible man would think
of feeding a child on Infant's
food alone. Before Nickels
can be successfully treated
medical men must look a little deeper than they do and must be more inclined to trust to facts than theories. I have often found great improvement in cases of rickety children of nine months and under due to no other cause than the substitution of infant's food for mother's milk. To give an example I had lately a case of a rickety child of six months old which was being nursed and fed with cow's milk from a bottle as well besides having cod liver oil and was getting steadily worse. I made her wean it and give infant's food with the cow's milk and it at once began to improve. That looks as if starch was not quite such a deadly poison as some would have us believe. I consider that up to six months old a child is better without infant's food at all but after that age and in
Some cases before, it very often
does an immense amount of
good.

"Although Rickets is essentially
a disease of cities being prin-
cipally seen in children living
in crowded tenements where the
effects of improper food are
most strikingly shown, yet
even here the disease is rare
in those who get a supply of
good breast milk." Holt.

If this is true then there must
be uncommonly little "good
breast milk" in Westminster
and Pimlicio.

Some authorities claim that
diet alone can produce Rickets
and give the experiments on
animals as a proof of this. It
has never been proved that
the complaint which they pro-
duced was really Rickets
and even if it was that is
no proof that the same would
follow if applied to the human
race. The disease is in some
very dependent on or at least intimately connected with the
nervous system and the
nervous system in animals
is not entirely similar to that
in human beings. My opinion
is that the children who have
a predisposition to Rickets have
as a rule a not very highly
organised nervous system.
In the Lancet March 7 1885 Dr.
Seymore Taylor reports a case
of Rickets supposed to have been
caused by a fall. He says
"as regards the causation of the
disease in this case there is a
remarkable absence of the re-
owned influences" I think
that the etiology of Rickets is
quite enough involved already
without suggesting falls as a
factor. Every child has falls
more or less, but supposing
that the fall was the cause
in this case surely it could
only be through some effect
on the nervous system.
"Infants suckled by healthy mothers or wet nurses who have an abundance of milk of good quality do not become rachitic as long as their nutrition is derived from this source.

Starr's Diseases of Children, p. 339

A statement like this would be difficult to disprove and quite impossible to prove. The symptoms usually manifest themselves between the sixth and fifteenth months." Yet although I do not agree with this still I am willing to admit that it is nearer the truth than any other estimate I have ever seen in print.

It is more difficult to believe that the general nutritive disturbances are the result of the bone changes than to regard both as having a common sign. Kassourly regards the bone changes as inflammatory excited by the presence of some irritant. The irritant has been
believed by many to be lactic acid originating in the digestive tract but the evidence in support of this is not very conclusive. Holt should say that both have a common origin viz. the nervous system. The sweating of the head is no doubt due to the nervous system in somewhat the same way as the unusual sweating of a nervous horse. The bone changes might be caused by an irritant and yet not be inflammatory but why should not the bone changes be due to the nervous system as the brittleness of lunatic's bones is supposed to be. With regard to the lactic acid theory I think that it is pretty certain that excess of any acid will help to promote rickets but not in the way that is suggested. We know that a too acid diet is quite as much a cause of rickets as a too starchy one, but it is not all
easy to see how the lactic acid can get at the proliferating cartilage cells for less cause sweating of the head. In the Lancet Jan 7 1871 we find some original remarks upon Richels by Dr C Currie Ritchie. He says "The four great deaths of childhood are the strumous the tubercular the rachitic and the syphilitic. Of these Richels is without question the most common the most important and in its effects the most fatal of the diseases which exclusively affect children." As the result of years observation at the Anlume Dispensary Manchester he gives the following table of ages.

<table>
<thead>
<tr>
<th>Age</th>
<th>Male</th>
<th>Female</th>
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<tbody>
<tr>
<td>Under 6 months</td>
<td>5</td>
<td>2</td>
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<tr>
<td>Between 6 and 9 months</td>
<td>8</td>
<td>10</td>
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<tr>
<td>&quot; 9 &quot; &quot; 12 &quot;</td>
<td>28</td>
<td>19</td>
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<tr>
<td>&quot; 12 &quot; &quot; 18 &quot;</td>
<td>36</td>
<td>24</td>
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<tr>
<td>&quot; 18 &quot; &quot; 24 &quot;</td>
<td>27</td>
<td>22</td>
</tr>
<tr>
<td>Third year</td>
<td>16</td>
<td>9</td>
</tr>
<tr>
<td>Fourth year</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Fifth year</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>
Total number of children under five years of age 219
Total number of children under five years under treatment 728
This gives about 30 per cent.
Those under five years 32.5 per cent.
Ritter found 31 per cent. of children under five years of age in the Medical Poliklinik at Prague.
Dr. Gie found 30.3 per cent. of children under 2 years at the Hospital for Sick Children in London during 1867.
Dr. C. Ritchie says "I think we have ample grounds for concluding with Vogel and Ritter thatrickets seldom begins later than the first year of life."
The General Tenderness and pains of Rickets are attributed by Ritter to the result of emaciation and Vogel considers them periorbital; my own experience points to their being most frequently muscular."
"Essentially a disease of infancy, rickets may overstep the border and on either side for while Boerhaave (Aphorisms 1841) wrote "Never congenital, rickets rare occurs before the ninth month scarcely ever after the second year." So William Jenner says he had some years since a girl aged nine years who was then only beginning to suffer."

H.C. Laurence Lanced Oct 2 1816

I have never had a case of congenital rickets myself and as I have attended a large number of confinements of women who had rickety children and have looked very carefully for any sign in the child, I think that this state cannot be very common. Still a number of cases have been reported, and I see no reason why the nourishment supplied to the child in utero should not cause rickets just as much
as that supplied to the child after birth; and most authorities seem to be agreed that there is something in the milk of a rickety woman which causes the disease in the child quite apart from the mere poorness of the nourishment. I think we may decide that the "new congenital" referred to above is incorrect. "Rarely occurs before the ninth month is also incorrect" "and scarcely ever after the second year" is probably quite true.

Numerous cases have been reported of children approaching puberty who have developed rickets but there seems to be some doubt as to whether the disease was true rickets.

"I have placed the term "infantile rickets" at the head of this communication to impress the fact that rickets develops earlier in life than is generally recognised. Taking
2018 cases including all
diseases observed at the North
West London Dispensary for
sick children I found 129
attributable to Rickets"

Lancet Oct 2 1880

This is quite in a far with
my own experience as regards
the age at which Rickets begins.
It is rather misleading to make
out a percentage of cases when
adults are included.
The researches of Sir William
Jenner led him to propound
the law that “Rickets being
a general disease the bones
are affected as one organ,
just as the arterial system
in the degeneration of old age;
the consequence of this is that
no one bone is ever affected
without all suffering”

This may or may not be true
but I cannot see how there
is any reason to suppose that
all the bones should suffer
in every case.
"Rickets not infrequently develops in syphilitic children; the connection, however, seems to be no closer than to any other cachexia. The relation of Rickets to other diseases, particularly to those of the digestive tract is very much less intimate than one would expect. Acute diseases of the stomach and intestines are very frequently followed by marasmus but only exceptionally by marked Rickets. There is no sufficient ground for believing that Rickets exerts any protective influence against tuberculosis as has been asserted. In fact the thoracic deformity may be a predisposing cause to that disease."

My opinion is that there is no connection at all between Syphilis and Rickets. It may be said that the weakening effect of Syphilis will
pre-dispose to Rickets but I do not believe that mere weak-
ening will tend to promote Rickets. They require to be
weakened in certain definite ways. I do not believe that
Rickets has any connection with diseases of the digestive
tract beyond the fact that
an improper diet and bad
hygiene will produce both.
I believe that there must be
some protective influence
against tuberculosis because
the two diseases do not ap-
pear often to attack the same
subjects. I have examined
a great many tubercular
children for Rickets and have
seldom found the two coexisting.
Now considering the very large
percentage of poor children in
London who have Rickets
more or less this seems to
point to the tuberculosis protecting
against Rickets. I do not
believe that the thoracic
deficiency of Rickets is a predisposing cause because if that were the case we should expect to find rickettsial children frequently tubercular. We know that anything which tends to make the blood venous tends to protect against tubercle and I think that there is not the least doubt that Rickets does this more or less in all cases. Some authorities (Marchand, Otto, Weber) believe that there is an excess of lactic acid in the bones and that this dissolves the phosphate of lime which is thus carried away and excreted. The bones of rickety patients have been found to contain lactates. It has been urged that to give phosphate of lime for Rickets is necessary, seeing that the want of it due to its being dissolved and carried away by the lactic acid must be replaced. It has also been
urged that we should not give it in the same plan that we exclude sugar from the diet of a diabetic patient. Whether the lactic acid dissolves the phosphate of lime or not I cannot say but from my own experience I am quite certain that phosphate of lime does little or no good in Rickets.

"Bone is composed of 67 per cent of earthy and 33 per cent of animal matter and in healthy children we find 37 per cent of organic and 63 per cent of inorganic matter; whereas in rickety children the proportion is 79 per cent of organic and 21 per cent of inorganic matter. Cholesterol and animals on food free from phosphate of lime and produced softening of the bones. Milne Edwards found that the bones of animals purposely fractured united much more rapidly in those animals to which phosphate of lime had been administered.
than to in times to which that remedy had not been given. Fractures during pregnancy unite much more slowly than at other times no doubt because a quantity of the phosphate of lime is diverted for the ossification of the foetus.”

Dr. Thomas Lancel March 8th 1846

There is no doubt that in the bones of rickety children there is a deficiency of phosphate of lime but still it does not follow that to give them phosphate of lime will increase the amount of it in the bones. We might as well say that to feed a thin man on fat meat would necessarily make him fat. The fault seems to lie more in the want of assimilation than in the want of the supply. The obvious treatment is to aim principally at improving the assimilation rather than supplying more of an element which is already being refused.
On the other hand it is evident that a deficient supply will weaken the bones even if the assimilation is all right. But this will not produce Rickets necessarily any more than weakening a muscle will necessarily produce cloudy swelling. Rickets means much more than a mere deficiency of phosphate of lime.

With regard to the relation of phosphate of lime to pregnancy, I have tried in a few cases to prevent Rickets in children by giving the mother an anti-rachitic treatment during the time that the child was developing in utero. These were cases where several rickety children had already been born and I thought that the predisposition might be prevented, in the treatment met with very little if any success. They all developed Rickets just the same as their brothers and sisters had done. None of them
suffered as badly but I think that this was entirely due to the fact that I was carelessly watching them and began to treat them as soon as the symptoms developed.

It is believed that because the milk sold in towns is not always fresh, that the lactic acid which forms in it is the cause of Rickets. I suppose it may be one of the many factors at work in the causation just as the want of lime salts in drinking water may have effect though probably not all that is claimed. Most authorities consider that the father has little if any influence in the production of Rickets in his children and certainly it would seem as if such a thing were hardly possible but I have met with several interesting cases of this kind which would rather indicate that it is possible for a father to hand down Rickets. One was a man who
showed very distinct signs of having had Rickets. His wife showed no signs whatever and was altogether a very strong and healthy woman. Their three children all developed Rickets in spite of being "fed at the breast of a healthy woman." A great deal has been said and written about the supposed connection between Rickets and Syphilis. Parrot's view was that Rickets was a result of Syphilis; a sort of sequella. He called the various evidences of Rickets the signs of an extinguished Syphilis. "Contrast Rickets with Syphilis as follows: In the former re- 
ification of tissue occurs in the latter condensation and softening. 
Sears and dental lesions are common in Syphilis rare in Rickets; corneal lesions are 
generally scrofulous. Cinqueal 
psoriasis is not peculiar to Syphilis. In infants which are 
impregnated with Syphilis are
provided in due course with suitable food they will not become rickety.
In the aetiology of Rickets syphilis holds the same position as measles,
variola scarlatina typhoid and diphtheria.

Lancet July 14, 1888

There are many reasons for believing that Rickets is not the result of Syphilis such as:

1) Rickets is common in country places where syphilis is not common.
2) Rickets is an infinitely more common disease than Syphilis.
   If Rickets were caused by Syphilis we should expect to find that
   Syphilis was more common.
3) Except in the case of some early stages the symptoms and
   course of each is so widely different and it is impossible
to believe that one disease could be the cause of another differing
   so totally from it.
4) If Syphilis were the cause of Rickets then there could not be
   such a thing as Morality in
   Great Britain. This I should be
even to believe
(5) Hereditary syphilis is more
masked in the elder members
of a family. Pickets in the
younger
(6) A child can have either one
or other or both either separately
or at the same time.
"Syphilis gave almost every disease
as a cause of Pickets. He also
said that wealth illness and
luxury were in his opinion
chiefly responsible for the malady.
He excludes those hereditary
diseases scrofula, tuberculosis, and
syphilis. He also excludes the
possible effects of peculiarities
of climate and locality."

Lancet Dec 1883

It is hard to imagine how syphilis
got the idea that wealth illness
and luxury would cause sickness.
Whatever effects these could have
upon adults would hardly apply
in the case of children. It is hard
to imagine that climate and
locality can fail to have a
great influence in the causation of Rickets.
Dr. Robert Lee believes that the most common cause is Bronchitis. He
looks upon Rickets "as a disease which is produced principally if
not entirely by any cause which
interferes with the functions of
respiration and that the foremost
cause of Rickets is generally some
form of pulmonary inflammation
such as Bronchitis, Broncho-pneumonia
or Pneumonia." He gives a table
of fifty cases in which the pre-
cedent causes were
Bronchitis 25
Cough from birth 4
Bronchitis and Colds 3
Measles and Bronchitis 3
Bronchitis Colds and Whooping Cough 2
Cough for several months 2
Cold and Whooping on the chest 1
Bronchial attack 1
Cough at birth, Measles and Broncho-
- pneumonia 1
Whooping Cough 1
Measles and Congestion 1
Measles Whooping Cough and Pneumonia!
Whopping cough and Mononchitis!
Bronchitis and Congestion!
Dentition and Cough!
Cough and Croup!
Dentition!

He has traced each of these
as the cause of the Rickets. I
think that one might just as
well make a table of fifty
cases of Diabetes or Gonorriphora
or Compound fracture of the
femur or any other disease
and say that because one
could obtain a history of cough
measles to in each case that
therefore it was the cause of the
complaint. No child that I
ever knew escaped coughs
completely and very few escape
measles whooping cough.

"Reduce the strength to a given
point and Rickets begins. Pro-
long this state of debility
sufficiently and the Characte-
ristic changes resulting from the
disease manifest themselves"

E. Smith's Writing Diseases of Children

I think that this statement is not justified by experience. I have seen many children whose strength has been reduced and the state of debility prolonged without producing rickets. Oeffler believes that the tendency to rickets is hereditary and the absence of phosphate in the milk the exciting cause. The following facts would rather tend to bear out this view:

(i) In many cases occur in which a large family are all affected with rickets and we find that some of them have been nursed and some brought up on a bottle. They all get rickets just the same as if it was born in them as an example of this I had a case where a poor woman died leaving a tenth baby a week old. All her children
had had diphtheria. This baby was adopted by a rich relative who had had six children of her own and only one baby and all free from diphtheria, and was brought up by her in the same way as her own had been but it began to show signs of diphtheria at three months. Now it is very hard to imagine that it got diphtheria during the first week of its life if it was not born with a tendency to it. In this clearly the hygienic conditions could have had nothing to do with the disease seeing that these six who were treated the same did not get it. This would rather tend to show that the predisposing cause was stronger than the exciting cause because it got it in spite of the absence of the latter. On the other hand given the absence of the predisposing cause will the virus of diphtheria produce the disease de novo? I think
probably not. There are a great many illegitimate children put out to nurse in Westminster. A number of them are the children of people in good position and are wanted out of the way and if they should die so much the better, so it is a very common thing to send them to be nursed in the Westminster slums. There they are in the very most favourable circumstances for Rickets to develop such as want of fresh air, relaxing climate near the river, improper diet and often not very much of it, and yet these children enjoy a wonderful immunity as regards Rickets although they seem to come off pretty badly with most other complaints. I have followed a number of these cases carefully and I have had every facility as the people are not too pleased to gossip about the parentage of the children. Then
again in some cases I have been asked to find a home for children which were not wanted. As I always have a number of poor women coming asking me to find them a nurse baby. Some of these have had ricketty children of their own and yet when I send them the nurse baby and they bring it up the same as they did their own it very often does not get Ricketts.

The hereditary influence may be compared to that of Tubercle in the following points; both are born in them and only need an exciting cause to set them in full activity, and the exciting cause in either case seems to be pretty much the same viz. anything which tends to weaken the system. I think that more children with hereditary Tubercle escape than with hereditary Ricketts. The difficulty of course is to
get a history of Rickets in the parents but still I think that
that can be dispensed with
seeing that the evidence in other
respects is so strong. It is not
easy to say that a rickety
child must have inherited
the disease but we can go the
length of saying "If that child
had been born in a different
household it would probably
not have had Rickets. Not
only does the actual hereditary
influence tend to Rickets but
also the fact if its being nursed
by the mother will help to increase
the effect of any taint that she
has already given it. If the
milk from the breast can pro-
duce Rickets why not the
monohem from the placenta
also? I do not recommend
mothers to adopt a bottle because
it is best for themselves that
they should nurse the child
for a few months both physi-
cally and mentally. It helps
to prevent future uterine troubles and makes them more fond of the children, and in all cases it is the mother whom we ought to consider first, but still the babies do not as a rule thrive as well when nursed as when artificially fed. I know that this is contrary to the opinion of most authorities but I am perfectly sure that I am correct.

A nursed baby gets the benefit of every bit of bad temper drunkenness and every other vice in which the mother happens to indulge. The fact that Pickett is principally met with among the poor among whom more children are nursed and nursed longer, and where bad temper, drink and other vices are more prominent rather indicates that the nursing has something to do with it. The way in which the mother takes care of herself during pregnancy seems to be an important
factor. In a case which I met with a woman had seven sickly children and I found that the two that had had it worst were those two which had been carried when her husband was out of work and she was going out churning. As to whether pre-mature children are more apt to get sickness my experience is quite the reverse. I have had eight cases of seven months children and three at eight months. One of each died but only one of the other developed sickness. Of the seven seven month children that lived four were first children so it was not easy to get a history of sickness but the other three had sickly elder brothers and sisters and yet only one of the three got it. Of course the treatment may have had something to do with it but still I think that if
a child is born to have Nicks
t no amount of care and codlin oil will prevent it entirely. This would rather indicate that if the mother imparts the predisposition to the child in utero then the last two months of the pregnancy is the time when the child gets it stronger and if Nicks were a more serious disease than it is one would be inclined to suggest premature labour as a preventive that is as long as the remedy was not worse than the disease.

The tendency is said to increase as the family becomes more numerous but I do not think that the number in itself is of much importance. I do not think that as a rule a woman is so very much weakened by having a large family. The probable causes are (1) Poverty—nine months to fill and less for each (2) More vice—people generally become more wicked as they grow
Older [3] Persistent amateur attempts at producing abortion. The child in utero must have rather a hard time in many cases, so many women up to three or four months do their best to bring on abortion rather than have another confinement and another month to fill. My experience is that the child in utero generally manages to resist the three months course of hierophierce but is a miserable little object when it does appear. The mother being very young at the time of marriage is said to be a cause of rickets and certainly this holds in the case of dogs. If a bitch is crossed at six months old the pups will be almost certain to have rickets, but I have never noticed it specially in the human subject.

The difference between town and country life in influencing rickets is not so marked as the difference in class but still is an important
factor. Riverside towns and country places usually have
more cases of Picket than those
remote from rivers. This is probably
due partly to the relaxing effect
which a river usually has on
the climate and partly due to the
drinking water being soft. Perhaps
also the height above the sea
level has something to do with it.
Picket is as a rule more frequent
the nearer one gets to the sea level
other things being equal.

"According to Palm the disease is
almost unknown in the extreme
north also very rare in China,
Japan, Greece, Turkey, and the
portions of Italy and Spain. Its
highest frequency is in the temperate
zone. The general immunity of
children in the southern climates
appears to be due to the outdoor
life and the almost universal
custom of maternal nursing. In
New York the greatest susceptibility
is among the negroes and Italians.
Extreme cases are almost invariably
in one of these nationalities. "Holt. The Italians are proverbially sick, probably from poverty, and among them the disease seems to have become very hereditary. It seems as if living in the temperate zone produces sickness in those who have been intended for a different climate.

In the Lancet Jan 19 1889 we have the report of the Collective Inves
gination committee upon the geographical distribution of sickness. "[2] That sickness though not un
common in rural districts was mainly a disease of town and industrial regions and especially large industrial towns, for it was rare in the rural districts of Scotland, the north of England, North Wales and Ireland, Ulster excepted. That it was more common in the rural districts of Ulster and of the rest of England and exceptionally prevalent in Cornwall, Kent and North Essex. D. Bailey.
alluded to the fact that when
the pure water from Loch Katrine
was brought into Glasgow the
increase of Ricketts was very marked.

Perhaps the classes who suffer
most in the world from Ricketts are
the working classes in England
and Italy. The English working
classes are probably about the
richest working classes in the
world that is as far as wages are
concerned but it is a question
whether in the end they feel any
better from a sanitary point of
view than the poorest stricken
Italian. It is quite the usual
thing here in London to find
the children eating off their
parent's plates as soon as they
have teeth to do it with. The
practice of giving them tea seems
to be almost universal. For a
long time I made a point of
asking everyone who had a
baby of six months and over
whether they gave it tea and I
found that the great majority did.
with regard to the age at which Dickels may begin, there are cases reported at puberty and at all ages up to puberty. I think we may discard these cases as peaks of nature just as cases which have been reported of cancer in young children.

The following are the aggregate statistics of Brunensische, von Ritterstein and Ritzche relating to the age at which rickets occurs:

During the first half year 88
During the second half of the first year 254

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If the word "year" were changed to "month" I think it would be nearer the mark. They give almost as many in the second year as in the first year; I am quite certain that this is not correct. They give a proportion of about two and a half times more in the second half year than in the first. This I am quite convinced is incorrect. It is very misleading to say that the disease occurs in a certain year or month unless we actually see it begin so there is no saying how long it has been going on. To merely take down the name and age of every child that comes in and then add up the ages at the end of a year and give so many to each year does not give a proper idea of the time when it really occurs. Then again some of the very early cases are very
wild cases and they do not seek professional advice at all and so their names and ages are not put down at all and this all helps to put the age up according to statistics. It would be more correct perhaps if we took these statistics to imply the age at which the child was brought to be treated but not necessarily the age at which it was first brought. It is difficult to get statistics of when the disease begins as we see them begin comparatively seldom. They very seldom seek advice at once and we can hardly expect it seeing that many cases begin with symptoms which only a medical man can appreciate.
The symptoms of Rickets may be divided into functional and organic. The principal organic symptoms consist of changes in the size, shape and consistence of the bones, changes in the shape and size of the chest and abdomen, and changes in the size of the liver and spleen. The functional symptoms consist of restlessness and sweating of the head and neck, with a great tendency to convulsions. The order of onset of the various symptoms varies somewhat in different patients, but the following is the usual order for the early symptoms to appear. Restlessness and sweating of the head, cranium-tubes, constipation, leading of the ribs. We are quite justified in diagnosing Rickets from restlessness and sweating of the head without anything else. In a few cases I have found that when these were the first symptoms to develop vigorous treatment has absolutely
presented any further symptoms. One might suggest that in these cases perhaps the sweating of the head and restlessness were not evidence of Rickets at all, but I am quite convinced that they were as these patients occurred in families where the other children were rickety. When I attend a confinement I look at the other children if there are any for signs of Rickets and if there are signs then I insist upon seeing the baby once a week until the Rickets begins and in that way I believe I have nipped in the bud many cases which would have developed severe Rickets. When the craniotubes appears first it is not certain that the case is one of Rickets, it may be congenital syphilis but there is no need to wait for further symptoms. The best thing is to start the treatment for Rickets at once and to give it some
calomel as well. There is no doubt that the calomel treatment will do it good whether the complaint is Nichols or Syphilis and the calomel will also do good whichever disease it is. I think that there is no doubt that a little calomel does good in Nichols. When the constipation is the first symptom to develop, and if the child has any appearance of Nichols about its general appearance, then it is best to give cod liver oil and cascara on the chance of Nichols because there is no doubt that the usual mixture given to constipated babies, viz. Alb. Salin. (usually a mixture of magnesia, ammonium, soda, bicarb, mag, sulph, and peppermint) does more harm than good if the case is one of constipation due to Nichols. Very often the leading of the ribs is the first thing that is noticed. These early symptoms occur long before any of the deformities in the limbs and my experience is
that if the case is met with in the early stage and properly treated, deformities hardly ever occur, that is deformities visible to the untrained eye.

It is a debated point whether there is any febrile stage connected with Rickets purely and simply. I think probably not. The temperature is often raised but as a rule there is something else to account for it. In some cases I have been unable to find any cause except the Rickets for the high temperature and in these cases I put it down to the pain and tenderness of the bones which is not in itself a necessary part of Rickets. I have much more often found the temperature in Rickets below the normal than above.

The general appearance of a child with severe Rickets is very characteristic. The skin has a peculiar pasty pallor probably not met with in any other complaints and
the skin has a dull look somewhat like a corpse. Nickel children are almost always anaemic to a certain extent but it is only the severe cases which have the characteristic appearance. This appearance is supposed to have connection with enlargement of the spleen and is said to occur specially in those cases in which the spleen is enlarged but I have not found any marked relation between the two myself. The blood is very poor in haemoglobin which is said to be sometimes down to 30 per cent. The number of the red corpuscles has not been found to vary as much as the amount of haemoglobin. In my experience the majority of nickel children are thin not fat and flabby as most authorities insist. A great deal has been written about the enlargement of the various glands in Nickel. We are told to examine the neck and groin and if they
are found enlarged then to con-
clude that the internal glands are also enlarged. I have not
found the glands so uniformly
enlarged as some authorities
would claim, and I am in-
clined to look upon them more
as a complication than a part
of the disease. They are most often
found in cases which have
not been treated early enough.

"The downward displacement of
the liver and spleen from con-
traction of the chest should not
be mistaken for enlargement of
these organs. Moderate enlargement
of the spleen is very common
during the stage of most active
symptoms that is from the sixth
to the twelfth month. Great en-
largement of either liver or
spleen is rare and in such
cases it is doubtful whether it
depends on the rachitic process.
It is rather to be connected with
the condition of the blood which
is developed during the disease

Pain and tenderness are rare. Rickets is essentially a chronic disease and its course is measured by months. The active symptoms in most cases continue from three to fifteen months although they occasionally last a much longer time. "Holt"

"In some children the beginning of the morbid change in the osseous structures is indicated by tenderness; but in an un-complicated case of rickets tenderness is never a marked symptom." E. Smith Hasting Diseases of Children p. 124

In the Lancet Jan 8 1887 Dr Goodhart gives some statistics of enlarged spleen. Out of 800-1000 cases of rickets children examined he gives the following table of results:

- Leukaemia 3
- Rickets (certainly) 16
- Rickets (doubtful) 7
- Cause undeterminable 14
- From Congenital Syphilis 9
- Tubercular 5
He points out that even including the Rachitic (doubtfully) and the cause unascertained under Rickets, the proportion of sick children with enlarged spleens is very small and that therefore it can hardly be looked upon as a very essential part of the disease, and he agrees with S. Gee and F. Hilton Fagg that when it occurs it is due to some cause which antedates both it and the bone enlargement. The histological change he describes as an interstitial fibrosis the new material being of a hyaline kind and not necessarily by any means the outcome of an inflammatory state. He says that the liver in Rickets is but seldom enlarged and when it is the increase is inconsiderable. He points out that the spleen is enlarged in some cases of Rickets by the following proofs
(1) By post mortem examinations
(2) Cases noted in which the spleen occupied one third of the abdominal cavity during life
(3) It is possible to separate these cases of Rickets during life with splenic enlargement from those without owing to the peculiar pallor that they present.
This proves that there really is an enlargement of the spleen in some cases of Rickets and that it is not merely pushed out of place.
He gives the following result of post mortem examination of four cases: Spleen large and firm with some slight thickening of its capsule; section homogeneous from pæricle of multiphigian corpuscles. Microscopically the change is one of hyaline fibroid thickening of the septa and stroma at the expense of the pulp and multiphigian sheaths. He has not
been able to satisfy himself that this material exists in the rachitic liver in an abnormal quantity.
Sir William Jenner found that the spleen and liver were found microscopically to be glie-like from the presence of a peculiar morbid deposit. This change & Goodhart considers represents an extreme case of hyaline fibrosis and he further states that the material is not different from that found in the spleen from chronic enlargement from ague and many other conditions.

Dr. Goodhart gives the following result of his examination of the blood in a number of rachitic cases. In some cases there was deficiency of colouring matter in others deficiency of corpuscles. A remarkable variety was exhibited by the corpuscles three for a few different sizes of red discs with a quantity of free granules beaded strings
and dumbbell aggregations — appearances which suggest both immaturity and poverty. He further considers that the histology of Ricketts points rather to improper development than to disease and compares the rachitic changes to a plant which treated otherwise than is natural to it develops in an unusual manner. His idea seems to be “feed a child on food that it should not have and the cartilage fat and connective tissue (that is, the lowest forms of tissue) will increase at the expense of the more highly organized forms such as brain, bones and muscle”; and he says let the child revert to its normal and it recovers.

I cannot understand why authorities should talk about the “stage of most active symptoms that is from the sixth to the twelfth month.” This same expression more or less varied has been used by so many that one would
be led to the conclusion that this stage was a regular part of the complaint. This is not my experience. I cannot see that there is any stage of Rickets particularly active. My experience is that the disease is active up to the time that treatment is begun or if it is a severe case for a short time after treatment has been begun, or in the event of there being no treatment, then the activity ceases usually about the age of three or four years. Of course after the disease has come to an end, has in fact "died a natural death," then there can be no activity; but this is not a part of the disease.

It is very comforting to be told that pain and tenderness are rare in Rickets but unfortunately one sees a good deal of them for all that.

The course of Rickets ought not to be measured by months if the case is taken early and treated
vigorously. I have never had a case in which the symptoms continued active for fifteen months.

My opinion is that there are plenty of uncomplicated cases in which tenderness is a marked symptom.

There seems to be some doubt whether it is possible to have pain and tenderness in a simple case of Rickets uncomplicated by infantile scurvy. I think that we can hardly diagnose infantile scurvy in every case of Rickets with pain and tenderness.

Dr. E. G. Hamilton divides Rickets into three stages (1) Incubation (2) Deformity (3) Restitution. In the first stage he gives malaise im|

paired digestion, abdomen swollen. In the second, changes in the bones. In the third ossification with unusual vigour

I should say that his first two stages run into each other and it is doubtful whether the third always exists.

Hamilton says "If the child rest continuously on the occiput or parietal bone, the bone is liable to become absorbed at places where the pressure is greatest and apertures are formed in it. The condition was called Cranio-tubes by Elsasser. This is an ingenious way of accounting for the presence of cranio-tubes but it is hardly possible to believe that it can be true. Can a child lie upon half a dozen different parts of its head continuously enough to produce the condition in a few weeks? Besides some of the patches are found in such positions that it can hardly be imagined that the child could or would lie upon them."
Almost every bone in the body has been known to be deformed by society. The bones of the head are very often among the first to suffer. The head is large to look at and square with open for-
tanelle but the bones of the body and hands vary in their deformities according to what forces have been at work.

"The spine also suffers curvature most, an exaggeration of the normal flexure but also in a lateral direction.

The deformities of the pelvis may become fixed and prove a serious complication in par-
turitum.

The ribs being insufficient to resist the negative pressure of the chest during inspiration tend to be driven in laterally, the sternum at the same time being protruded. The deformity is known as pigeon-breast a deformity which may become permanent."
The cranial vault is stretched and the capacity of the skull increased
as may be supposed rickety bones become unusually dense in later life and it happens frequently that if the permanent deformity be great the muscular system is correspondingly over-developed."

-Hamilton Text Book of Obstetrics, p. 831

In my experience the spine is usually either normal or else has a general dorsal curve from the middle of the dorsal spine to the sacrum.

I think that in this country it is rare for the pelvis to be affected sufficiently to cause any difficulty in labour. I have attended several hundred confinements and I have only met with one case where rickety deformity was sufficient to give any trouble. If we take into consideration that according to statistics at least 30 per cent of these women had had rickety
then it seems that not many cases of Pigeon-breast cause permanent deformity of the pelvis. Pigeon-breast is probably a rare recurrence. It is much more common to have a groove down each side of the sternum than to have the sternum much protruded. It is very doubtful whether the cranial vault is stretched or the capacity of the skull increased. It is quite certain that most of the enlargement of the head is due to thickening of the bones especially the parietals. Probably the capacity of the skull is more often diminished than increased. It is a common belief that new-born bones become very hard afterwards but I think that it is very doubtful. In a few cases which I have post-mortem the bones were certainly not harder than normal. The clavicle is said to suffer by an exaggeration of its curves.
In the upper extremity the humerus is supposed to have a forward and outward curve but I have never been able to verify this; nor is it very easy to make out enlargement of the ends of the humerus.

In the radius and ulna it is common enough to have a curve with the convexity on the extensor surface but it is not as a rule well-marked. The enlargement at the wrist is one of the most constant of all nicotine deformities probably owing to the large amount of movement of the hand. The metacarpals and phalanges are said to be sometimes affected in very extreme cases but I have never verified this.

It is doubtful whether the upper or lower extremity is most constantly affected. I think we may say that in every case of Richet's of more than six months duration the wrists and the
tibia and fibula are more or less affected. The most common deformity is that which comes from sitting cross-legged. Nickel's children seem to have a special fondness for this position. In most cases it is the right leg which is crossed over the left and it rests upon it a short distance above the ankle. In this way the bones of the two legs become moulded to one another, giving the right leg a curve forwards and inwards, the left backwards outwards. In most cases but the exact curve varying according to the exact position of crossed-leggedness which the child has taken up. These curves come long before the child begins to walk and if we put the two in opposition we see how they fit one another. The ankle is less often swollen than the wrist.

The femur is said to acquire a forward curve from sitting.
with the feet hanging down but I do not think that this is very common.

Holt gives the following statistics in 150 cases

10 per cent walked before the 15th month
47 " " were not walking at the 18th
20 " " 2 years
10 " " 23 years

This is due to weakness of the muscles as is also pot-belly and constipation.

In The Lancet Feb 24 '83 Mr Burwell reports two cases in which the right tibiae were more bent than the left and were bent forwards and were becoming more bent even though the patients were kept in bed. He looks upon them as hyperplasia affecting the front more than the back of the bone. I think this explanation is unlikely. Rickets is not a disease in which long bones are likely to alter their shape by addition of bone to one side
of the shaft. I think it is far more likely that the children were in the habit of sitting crossed-legged and the fact of their being kept in bed need not necessarily prevent this even supposing that they were kept lying down. The bending of the right leg is usually more than that of the left owing to the weight of the right foot.

"Following Kassowsitz the earliest indications of rickets are either trifling bending of the rib costo-chondral junctions or crano-tubes or a continuation of these. He considers that at least 80 per cent of children in Vienna under three years of age are rickety. In the question of some trifling bending of the ribs among the children of the London poor we should be prepared to go much further than he does and say that in a very large cut-patient experience
we have never yet failed to make out some very slight lassooing in this situation in the youngest infants and that if this be taken as sufficient evidence of Rickets then this disease is nearly ever present in the out-patient room to some extent." Lancet May 14, 1872.

Dr. G ee says "Unquestionable beading of the ribs may occasionally be found in infants of only three or four weeks old. Vol. IV of St. Bartholomew's Hospital Reports.

I do not think that this condition of beading at that age is so rare as the remark of Dr. G ee would lead one to believe. I have seen a large number of children I think I may say hundreds with distinct beading at the age of three and four weeks. I think that this beading may be taken as evidence of Rickets and if 80 per cent have it then I should say that 80 per cent have Rickets. This would rather lead
one to believe that Richet is the normal state of the British poor. If "normal" is taken to mean the "usual" state then I think there is very little doubt that is so.

"As Rousseau has shown, convulsions may be induced by some external irritant, such as a pin in the garments of a child transfusing the liver or anterior fontanelle, which being removed the convulsions ceased."

The Lancet Oct 2 1880

He omits to mention whether there cases recovered or whether the drawing out of the pin acted like the drawing out of the spear from the body of the Helen General. In either case the convulsions would stop.

"To Jacobi and Elsässer is attributed the theory that cranio-
tubes (which Elsässer maintains precedes in point of time beating of the ribs) itself, arising from undue pressure upon the
cranial bones by the brain substance from within or from without when the head rests upon the pillow, is intimately associated through the selfsame pressure with the production of laryngismus.“

The Lancet Oct 2 1870

I do not think that we have any good evidence that laryngismus is specially connected with cranio-taxis beyond the fact that they are both very common in Nicols.

"In conclusion I would remark...that in laryngismus as a neurosis we have probably one of the earliest evidences that Nicols has invaded the nervous system." H C Lawrence

The Lancet Oct 2 1870

I do not consider that Nicols "involves" the nervous system. I think that it originates there and as evidence of this we have the fact that the restlessness and sweating of the
head are so often the earliest signs.

"The conclusion at which they" (Dr. Lee and Barlow) "arrived was that syphilis was by far the largest factor in the causation of craniotubes. To determine whether it is the sole cause it would be necessary to examine a large number of infants in reference to whom the question of syphilis could be absolutely excluded. The authors strongly suspect that when this has been done it will be found that craniotubes is always a result of syphilis."

The Lancet Nov. 20th, 1875. Of course it is quite impossible to find a large number of children in whom the question of syphilis could be absolutely excluded especially among the class in which Ricketts most occurs but still by finding that a great many children, whom we are pretty certain have no syphilis, have craniotubes.
takes me come to be pretty certain that it can exist as a symptom of Rickets alone. "I think there can be no reasonable doubt that the swelling of the viscera is as much a part of the disease and as essentially belongs to it as that of the bones. It is however to be remarked that when the visceral change is most marked that in the bone is seldom extreme, as if its disease exhausted itself in one direction or the other."

Dr. Dickinson, Trenton Dec 11th 1836

I think that the swelling of the viscera which may be looked upon perhaps more as a complication than a symptom very often occurs in late cases compared with early cases, that in cases which show no signs till ten or eleven months. I found in one case the enlarged spleen preceded the symptoms of Rickets by several weeks.
Considerable doubt exists as to the exact pathology of Pielch's. There are many possibilities and it is not easy to say which is the more probable. It has been suggested that there is something wrong in the secretory activity of the osteoblasts. Hamilton considers this the most possible theory. He says, "The osteoblast is so closely related to the ordinary fibroblast that it is quite conceivable that it might lose its true bone forming propensities and revert to what has in all probability been its primitive type." Textbook of Pathology, 1885.

He also suggests that there may be a deficiency in the earthy salts and more particularly the phosphates contained in the food so that the essential salts are not absorbed from the digestive tract.

I think that there is no doubt that these last two theories are
both more or less true but still I do not believe that they are the only cause. Suppose the osteoblast theory to be true we have still to find what it is that makes the osteoblast do its work wrong.

A mere lack of the salts or a lack of assimilating them should not be enough to alter the growth of the bones or to make the cartilage cells proliferate as they do, if there were not some other factor at work.

Some regard the changes in the bones and viscera as inflammatory, some as merely perturbed nutrition. The principal fault lies in the production of cartilage at the epiphyses being greatly out of proportion to the production of bone. The normal proportion of 1/3 to 2/3 of organic to inorganic matter is reversed. It seems as if irritation had
something to do with it from the fact that the greater the amount of movement there is at a joint, the greater the amount of deformity of the epiphysis. The amount of use of the bone affects the amount of deformity as in the ribs which are the bones most frequently used we find that the seldom if ever escape.

It seems doubtful whether such a disease as poliomyelitis properly so-called exists. Mueller and Ethelst also in Parrot have shown that many of the specimens described although presenting a superficial likeness to Nielsen's are essentially different. In these cases there is no broad zone of proliferated cartilage at the junction of the epiphysis and the shaft as in true Nielsen's and the serial arrangement of the cartilage cells in the developing bone is defective.
so-called Ricketts depends on an altered pattern of bone development and finds its proper place amongst congenital malformations. August 5, 1921.

The bone is unquestionably softened and deformities and fractures can be produced but the spongy material characteristic of Ricketts is not produced. There is no zone of proliferated cartilage along the epiphyseal line.
There seems to be considerable difference of opinion as to what affect Rickets has upon the process of dentition.

"This influence over the teeth is peculiar to Rickets. In no other disease in which general nutrition is affected do we find any interference with the natural cause of dentition. Teeth which have already appeared speedily become black decayed and drop early from their sockets. This is due to insufficient development of the dental enamel." E. Smith Writing Diseases of Children

Pages 128-129

"Dentition is late and irregular. . . . The teeth themselves are imperfectly formed and their enamel is defective; in a year or two they turn black and break off or fall out." Trappe 3rd Edition Vol II p.136-7

"Dentition is much delayed in Rickets. . . . the enamel of rachitic teeth is bad, rooky, or pitted in disposition, the teeth are notched
or have horizontal ridges, and break away down to the gum where they appear as black jagged stumps. These conditions are not peculiar to Pritchets."

Goodhart 4th Edition p. 646

"Dentition is much delayed and the teeth when cut are deficient in dental enamel so that they decay rapidly. Quain's Dictionary of Medicine article Pritchets (E. Smith) p. 1373

"The teeth are late in appearing; the teeth moreover are specially apt to decay and become loose."

Bristowe 7th Edition p. 930

"The teeth appear very late ... while they also rapidly decay or fall out being deficient in enamel."

Roberts 7th Edition p. 285

"1 The teeth are late in their eruption 2 The teeth are cut cross that is they appear in wrong order 3 They soon become carious and are often shed early."

Kingsley Encyclopedia Diseases of Children article Pritchets Barlow and Perry Vol 11 p. 226
"The process of teething is generally delayed and the teeth that come are defective in enamel."

National Encyclopedia p 458

"The character of the teeth in Rickets in the great majority of cases is good."
Holt Diseases of Infancy and Childhood p 230

"We have examined the mouths of some 500 children with obvious Rickets, and find as we anticipated that the results are not confirmatory on the prevalent ideas on the subject. Briefly tabulated these results are as follows:

A. In the vast majority of patients the teeth are perfect in structure. There is no deficiency of enamel. The teeth do not become loose and rapidly fall out. There is no special proneness to decay.
B. In those rare cases where the teeth have been found defective a history of inherited syphilis has been obtained.
C. Dentition is undoubtedly delayed.

Carpenter and Bidle
The Lancet May 14 1892
My own experience is that sickly children have as a rule unusually beautiful teeth and I cannot think why so many authorities are of opinion that it is otherwise. I cannot say whether their teeth are made to last long as I have not been in practice long enough to have studied their whole career.

There seems to be no doubt the dentition is delayed byickets, though why, it is not easy to say. It has been suggested that the teeth are too large for the jaw and so take longer to come through, but probably they are not produced fast enough. Treatment has a great effect in hastening the eruption of the teeth in sickly children which would rather indicate that they are too slowly manufactured. "The delay is caused by abnormal thickness of the follicles." Bland and Sutton (Zontological Society Transactions)
“The fact that an infant has reached its ninth month without a tooth is regarded by Sir William Jenner as a reliable sign of rachitis. In order to determine to what extent dentition is retarded by rachitis—and retarded dentition may be considered a sign of rachitis—Dr. H.R. Purdy, physician to the outdoor department of Bellevue Hospital, made the following observations:

Table I showing at what age 200 infants exhibiting no signs of rachitis cut the first tooth—cases consecutive

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Table II Showing at What Date Age 50 Infants Exhibiting One or More Nuchitic Symptoms Cut the First Tooth. Cases Enumerated (18 Wet-nursed 32 Bottle Fed)

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Table II Thirty Infants Without Teeth But with Pronounced Nuchitic Symptoms (Bottle-fed 21 Wet-nursed 9) Age at Which They Cut the First Tooth.

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It is evident from these interesting statistics that dentition delayed until the ninth or even tenth or eleventh month is not a certain sign of rickets, but slow teething is common in the rachitic and therefore it aids in the diagnosis."

Starr's Diseases of Children
p. 337

In my opinion delayed dentition cannot be very often of importance as a diagnostic sign of rickets seeing that the great majority of cases of rickets show signs long before nine months. I do not consider that these tables are of very much value but I have quoted them in order to compare them with some similar statistics of my own. The difficulty in forming an opinion is increased by while those of the second table were being treated for rickets, those in the first table had not been under my care at
the time when they cut the first tooth, and so I cannot say whether they were being treated the same as I treated the others, and no doubt many were not treated at all.

In 100 consecutive cases of children who had teeth and who showed signs of Ritchies I made enquiries as to what age they were when they cut the first tooth. Of course I had only the mother's word for it but I fancy that that was pretty accurate as they generally seem to remember the cutting of the first tooth as rather a great event.

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2 cut the first tooth at 13 months
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In 22 cases which I treated for Nickels during the time that they cut their first tooth I had the following results. These were all early cases in which the treatment was begun between the third and eighth weeks and continued till after the time at which the first tooth was cut.

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I think that this second table shows that the effect of treatment on the cutting of Nickels teeth is very great indeed in fact it seems to bring them on faster than is usual with normal children, but
of course the number is too small to be of very great value.

"In some rare cases we find dentition unaffected and even particularly forward although the other symptoms of rickets are well marked." I. Smith Westing

Decaying Children p. 129

These cases are not by any means rare. Some medical men are put off the scent when they see plenty of teeth. The most unusual case I have had was a child of six months with very marked signs of rickets which had fourteen teeth.
The principal consideration in
rickets, as in every other disease
is the treatment. It is probably
the most amenable to treatment
of all diseases if taken in time.
If it gets a strong hold on
the patient before treatment is
begun then it is much more
obstinate but even then will
respond very quickly to treatment.
The disease as a rule runs itself
out by about the third or fourth
year if not treated before that
time, and of course it is no
good trying to prevent the defor-
mities after they have occurred
but the fact of their being
treated even at a late stage
always has more or less effect.
Considerable doubt exists as
to the time at which rickets
must often begin. My own
opinion is that most cases
begin very early from a
fortnight to six months. I
think that if a child gets
the length of six months
without any sign of Nickels, then the chances are very strong against its ever having it. But most authorities seem to be agreed that the time when treatment has most effect is up to one year old. After that, the mischief is worse less done and we cannot expect such good results. My own opinion is that there should be strict laws on the subject of Nickels just as in the case of Vaccination. I do not consider it right that mothers should be allowed to let their children grow into Nickels and continue in it without treatment. It seems to me like making away with the property of the nation. People say what poor miserable little creatures compose some of our regiments and the cause is not very far to seek. Most of them have had Nickels, most of them
have been rectified and the result is five feet six. While we might with proper treatment have had five feet ten.

In the Lancet June 13, 1885, we find the following interesting ideas on treatment. "Dr. Lembezende writes to a St. Petersburg journal that he was induced by the successful results obtained by Kassoritz in the treatment of孩子 by Phosphorus to make trial of it notwithstanding the adverse statements of Kersch and Schwechten. He gave it to fifteen children from eleven weeks to twenty-two months old, all other medicines being intermitted during the trial of the phosphorus which was prescribed in an emulsion with sugar and gum. It was only stopped when severe vomiting occurred. He came to the conclusion that it was an utterly useless mode of treating these cases and
reverted to his usual method of managing rickety children. (Which consists of giving salt baths daily, the head being washed with warm water and the whole body with brandy and water.) He may briefly summarise his internal treatment as follows: tannate of quinine, extract of secale, bouillon, boiled milk, lime water, cognac, glycerine, enemata of salicylate of soda, borax, or carbolic acid.

"I from one to two months the little patients invariably showed a marked improvement under this method."

Now to begin with phosphorus should not be given alone even with an emulsion of sugar and gum. Sugar and gum to not suspend phosphorus properly. When phosphorus is given dissolved in codliver oil it acts as a nerve tonic and a specific
in Rickets but when given alone or with sugar and gum emulsion it acts principally as an irritant. He does not say what dose he gave the fifteen children but I should think he probably gave far too large a dose as this is almost always done. No doubt the fancy that the phosphorus has something to do with the formation of the rickety bones and argue "the more phosphorus the more bone" and the result is more harm than good. The dose must be very small and the solution not too concentrated. One would be inclined to gather from the above that in the cases where mild vomiting occurred he continued the phosphorus and I can readily imagine that these cases would be speedily converted into cases of severe vomiting. Phosphorus
is no good at all unless it is given dissolved in oil and freshly prepared at that. This is the only method which prevents it oxidising in which case it is useless. The best way to give it is dissolved in cod-liver oil and the supply ordered should not be more than enough to last three days.

Dr. R. H. Sayre says “In my experience one of the best tonics for sickly children is phosphorus, and I prefer to give it in the form of the elixir of Phosphorus of the "National Formulary" a teaspoonful of which represents so of a grain of phosphorus and this amount three times a day I find well tolerated in children ten months to a year old.” International Clinics Vol IV 1896 p.13

I should think that the elixir of phosphorus of the National Formulary can not be a
very reliable preparation of phosphorus as I am quite sure that the great majority of children of ten months old cannot stand anything like \( \frac{1}{60} \) of a grain three times a day of pure freshly prepared phosphorus. I begin with \( \frac{1}{60} \) of a grain three times a day for children of ten to twelve months and sometimes increase it slightly as they grow older. The largest dose I have ever given three times a day is \( \frac{1}{60} \) of a grain, and I would not care to give as much as that to a ten months child. Even if the dose was not too much for it at the time, it would be too much to continue long. Then the degree of concentration is important. I find that \( \frac{1}{60} \) of a grain of phosphorus to a teaspoonful of cod-liver oil is about as strong as they can usually stand it.

As a rule it is not much good trying to improve the physic.
conditions of the patients as they usually occur among a class of people who have the greatest contempt for hygiene; but where they can be induced to take the children out in the sunshine in the parks it does a great deal of good. I think the reason why the earliest cases of all are so much more of a success to treat, is partly owing to the fact that these cases entail less trouble to the parents. When the deformities of bones have once begun I find the greatest difficulty in persuading the parents to take the trouble which is required to prevent them getting worse. It is very little good telling them that the child must not be allowed to sit cross-legged; they will not take the trouble to prevent it. In cases where we want the child to be kept lying flat, it is almost impossible to get them to do it.
Having compared and contrasted my opinions with those of others, I shall go on to give the results of my experience in the form of cases treated. I shall only give in detail a few of my best cases, that is, the most successful, those which I consider have been triumphs of science.

I Boy, aged 6 weeks; nursed at the breast of an apparently healthy woman, who nevertheless had had four rickety children. Brought to me on Aug. 20 for cough and sneezing. Showed very marked craniotabes, one patch as large as a penny. No other signs of either rickets or syphilis.

I prescribed what I may call my "usual treatment" in cases of this kind, viz. Codlin oil to be well rubbed into the whole surface of the body—head and all—twice daily morning and evening. Phosphorus and codlin oil R. Phosphori gr. ½
Oil, morrh. ad 3/4 S. sig 3/4 tinct.
This is the prescription I give when there are more than one children, and I make them all take it whether sickly or not, and the mother as well. When there is only one child I prescribe a smaller quantity, as it does not keep well. Lime water ad libitum: it does no good at all unless given in considerable quantity. A piece of warm mutton fat to be tied up in muslin, and given to the child to suck and chew. This is my standard treatment for early rickets: I add to it more or less in most cases but never deduct. I impress upon the mother the elements of massage, to be done when the oil is rubbed in.

Next seen Aug 27. The cranium-tubes had already begun to diminish—the places were slightly firmer. The cough and sneezing had quite
disappeared without special treatment. No fresh signs of either Pockels or syphilis.
Next seen Sept 6 Craniotomy completely gone. Cough and sneezing returned. No fresh symptoms.
Next seen Sept 7 Bronchitis (slight) Continued treatment, and gave Ammon. carb. Ipenc. and digitalis.
Next seen Sept 8 Improving no fresh symptoms.
Next seen Sept 10 ditto.
Next seen Sept 13 Chest all right no fresh symptoms. Continued "usual treatment."
Next seen Sept 25 no fresh symptoms discontinued "usual treatment" for two weeks.
Next seen Oct 10 Returned to usual treatment for a month.
Next seen Nov 12 No signs whatsoever of Pockels - not the slightest boiling of the ribs nor restlessness or sweating of the head. Told the mother to give
it "usual treatment" for four weeks in every six during the next three months, then for two weeks in every six, for next three months, and to bring it back to me if it showed any further symptoms. Never saw or heard of them again.

II Boy aged 8 weeks. Unbuck by drunken syphilitic mother. Sept 15

Reading of ribs, cranio-tubes, restlessness and sweating of head, and sickness. No other sign of syphilis. "Usual treatment" with in addition calomel ½ pill. ext. aromat ½ every night.

Next seen Sept 18 Improving. Same treatment.

Next seen Sept 22 all symptoms much better. Continued "usual treatment" and diminished the calomel to one grain each night.

Next seen Sept 30. Cranio-tubes almost disappeared as also restlessness and sweating of
head. Continued "usual treatment" and diminished colo.
to one grain every alternate
night.
Next seen Oct 16. All symptoms
gone except heaving of ribs.
No fresh symptoms. General
health excellent. Di continued
the colonel. Continued "usual
treatment." Never seen or heard
of again.

III. Girl: 3 weeks. Nursed by healthy
mother. Restlessness and two
slight convulsions on Nov 2.
Cause of the convulsions not
known — probably rachitic —
"usual treatment," with Ammon.
Brom ge v and syrup chloral. M 7
4 Dr. even.
Nov 3. Restlessness, no more
convulsions. Continued "usual
treatment" and diminished
mixture to every eight hours.
Colonel ge t.
Nov 4. Restlessness the same with
slight sweating of head no
other symptoms. Continued "usual"
treatment” and left off mixture. Nov 6 improving. Treatment as usual.
Nov 10 improving. Treatment as usual. No fresh symptoms.
Nov 16 all restlessness and sweating of head disappeared
no other symptoms. “Usual treatment” continued.

Dec 1 in status quo. Usual treatment continued. Not seen again.

Boy 4 weeks Nov 12 brought to me for sickness and cranio-
tabes. Nursed & drunk infusions. Vomiting. Vomous mother with
six sickly children. “Usual treatment” with pulse, cerat. armor-
acet. 3 fr every 3 hours and cal-
onel 3½ every night.

Nov 13 sickness stopped. Con-
tinued treatment the same.

Nov 20 Cranio-tabes improving.
Continued treatment the same.

Dec 5 Cranio-tabes improving.
Constipation. Increased colonel to 3½ each night. “Usual treat-
ment as before.”
Dec 8. Improving. Discontinued the calomel "usual treatment" as before.


1 Bay: 5 weeks: nursed by syphilis but otherwise healthy. Mother with two other children both sickly and both syphilitic. First seen May 12. Cranio-takes: bleeding of ribs; sweating of head and restlessness; rash on face and buttocks; snuffles; sickness. "Usual treatment" with calomel 3 g. 3 pulv. crb. aromat. 9 x 2 twice daily.

May 16. Sweating and restlessness slightly improved; other symptoms as before. Treatment continued the same.

May 21. All symptoms improving slightly. Purging. Calomel diminished to 2 1/2 x 2 twice daily. Treatment otherwise the same.

May 28. All symptoms rapidly.
disappearing except snuffles and
fevering in ribs. Same treatment.
June 10. Cramo takes quite dis-
appeared as also sweating and
restlessness, and rash. Slight
sickness and purging. Diminished
coloc to sit each night. Other
treatment the same. Not seen
again. I intended to go on treating
this case for some time but the
difficulty is to get them to come
after the pressing symptoms are
better. They come just when they
like and as soon as they are
a little better then they stop.
Some practitioners maintain that
unless coloc is given in sufficient
doses it will surely do good in
congenital syphilis. I do not
agree with this altogether. I think
that small doses do good but
not so much. I think it is best
to push it well. My experience
is that when a child has both
nickels and congenital syphilis
it can stand a large amount
of coloc without purging. If
seems to be that the colostrum does good to the Richels as well—perhaps by relieving congestion of the liver.

7th girl; aged 7 weeks. Nursed by very delicate mother showing hæmorrhage of ribs, restlessness and sweating of head; eighth child; all the others been nursed and all rickety. Brought to me Feb 3 for cough. "Usual treatment"; weaned and fed with cows milk; no special treatment for cough.

Feb 6 Symptons the same. Treatment the same.

Feb 9 Cough improving; other symp-
toms the same. Same treatment.

Feb 12 All symptoms improving.

Same treatment.

Feb 18 Restlessness preventing or cough completely disappeared. Ordered same treatment for four weeks in every six in next six months. Not seen again.

When I see no more of a patient I take for granted that there has been no return of the complaints.
but of course in many cases they
leave the district and so would
not come back to me in any
case. I cannot be certain there-
fore that these cases are com-
plete cures but I think most
of them are.

BoY 4 months: nursed by
tubercular mother. Rended ribs:
Rattlesnake sweating of head:
constipation: great pallor. Enlarged
lumps in neck: great tenderness:
Brought to me July 5. "Usual
treatment" with in addition phosphate
of iron & i three times daily and
elixir cascara two teaspoonful every
morning. In these cases where
there is much tenderness I do
not begin the rubbing till the
tenderness is better. Instead I have
them wrapped in flannel soaked
in codliveroil and kept on con-
tinually. I find the phosphate
of iron acts well in cases where
there is any enlargement of glands
and I find that as a rule it
is better given as powder than
as syrup ferri ph. 25. I know no drug which is better taken by young children than phosphate of iron and I think that it is the lightest of all forms of iron for the stomach.

July 10 Constipation and tenderness slightly improved other symptoms, other symptoms the same. Cannot persuade the mother to wean it. Continued treatment the same.

July 20 All symptoms improving treatment the same.

July 29 Tenderness quite gone as also restlessness. Sweating constipation: pull on and enlarged glands much improved. Treatment the same. Not seen again.

Jan 8 Girl aged 2 weeks: nursed by healthy mother with five other children all well. Slight restlessness and tenderness no other symptoms. Usual treatment in half teaspoonful doses.


Jan 20 Quite well. "Usual"
Treatment to be continued for six months. 4 weeks in every 8.

Girl: Aged 3 months; first seen Jan 22. Reading of ribs; restlessness and sweating of head. Slight curves on tibia and fibula when they had been crossed; wrists slightly enlarged. Raised by unhealthful mother who had three other children as extremely severe cases of rickets. "Usual treatment" and pillow to be kept between the legs to prevent crossing.


Boy: 3 weeks; fed on cows milk.

Boy born on March 10 into sickly family. Seven previous children all severely affected, two of them hopeless cripples. Started the usual treatment in half dose, the day it was born and kept it up for six weeks, then left off the phosphorus—just plain cod liver oil internally— for two months, then returned to the phosphorus for two months and so on. Last seen in bed, then seven months old and had never shown the slightest sign of sickness. This is one of those exceptional cases were sickness has been prevented in spite of its being born in them.

These cases are taken from a period of over ten years during which time I have treated between three and four hundred cases ofickets for that alone, besides many cases which were too late to do much good. I have always found that the earlier the case the greater the success. If they can be treated before the deformities begin then there is a very good chance of having no deformities.

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