

PROGRESS IN PEDIATRICS

REVIEW OF THE 1911 STUDIES IN THE NORMAL METABOLISM OF CHILDREN

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MINNEAPOLIS

Since this subject received its discussion by Langstein and Meyer¹ last year, advance has been made along various lines. Unfortunately this work is not accessible to all, but Grulee's² work, now in the press, devotes considerable space to metabolism, and in a measure makes up for this deficiency in our American literature.

Ott and Scott³ found that extract of the infundibulum starts the flow of milk in about one minute from the beginning of its intravenous injection, and that the excretion reaches its height in four minutes, after which it rapidly falls to normal. They found that the corpus luteum (10 grains), pineal body (5 grains) and the thymus (1 grain) increased the quantity of milk four-fold in five minutes. The ovary minus the corpus luteum had no effect. The amount of butter fat was about the same in the secretion, augmented by the thymus, corpus luteum and infundibulum.

Helbich⁴ demonstrated that lactation can be maintained by artificial evacuation of the breast-milk without the physical stimulus of the sucking child. This can be kept up for weeks and months. He showed, moreover, that a poorly secreting breast may have its milk production increased by artificial emptying with a breast-pump. The lactation curve varies very little from that obtained in normal breast feeding.

Studies on virginal lactation made by Pfaundler⁵ show the importance of irritation in producing a milk flow. An examination was made of the secretion of a 2-year-old calf which had not been covered or pregnant. The animal had been sucked by other calves, and Pfaundler considered it definitely proved that a fully normal, virginal animal subjected to the irritation of sucking may produce a proper and rather profuse milk

1. Langstein and Meyer: *Infant Feeding and Metabolism* (Sedgwick Ab.), 1910, Bergman, Wiesbaden.

2. Grulee: *Infant Feeding*, 1912, Saunders, Philadelphia.

3. Ott, I., and Scott, J. C.: *The Action of Animal Extracts upon the Secretion of the Mammary Gland*, *Arch. Pediat.*, xxviii, No. 10, p. 1029.

4. Helbich, H.: *Is the Physiological Stimulus Necessary for Starting and Maintaining Lactation?* *Monatschr. f. Kinderh.*, x, No. 8, p. 391.

5. Pfaundler, M.: *Virginal Lactation*, *Ztschr. f. Kinderh.*, iii, No. 3, p. 191.

secretion. He reviews the historical cases showing similar results in the human being. He therefore considers that the usual theories concerning normal, virginal lactation require revision.

Basch⁶ considers the activity of the breast of the new-born child to be an excellent indicator of the functional capacity of the mother's breast. He gives a very interesting résumé of the literature, as well as clinical and experimental work in supporting his position. He considers it probable that the activating bodies are carried to the fetus from the mother animal by way of the blood.

Talbot⁷ found in every instance that the milk-supply of the mothers at the hospital was in excess of the needs of their own babies. The women were paid at the rate of 60 cents a quart for breast-milk.

Frank and Unger⁸ give the following conclusions concerning the causes which produce the growth of the mammary gland:

1. Intra-uterine, prepuberty and puberty growth of the breasts are directly dependent on ovarian function (Tandler, Foges).

2. A cyclical change in the virgin breast occurs under the influence of the ovary.

3. Castration does not cause rapid regression of the cyclical breast hyperplasia.

4. No proof has been offered to show that the fetus or placenta directly produces growth of the breast in pregnancy.

5. Evidence points to the fact that the persistent corpus luteum of pregnancy may produce this breast growth.

6. The factors which favor or cause the persistence of the corpus luteum are unknown.

7. Certain evidence (increase of the breast produced by hydatid mole without fetus, chorio-epithelioma) makes it unlikely that the fetus is at any time the controlling factor.

8. Nature's process is more complicated than the simple chemical stimulus assumed by Starling. As yet hyperplasia of the breasts has not been experimentally produced except by parabiosis, which does not explain the stimulus. Possibly the influence of other glands of internal secretion complicates the problem.

9. Milk secretion is no index of quantitative increase in breast tissue.

10. Under physiologic conditions milk secretion sets in when the ovarian influence is removed in the new-born after birth; in the puerpera as the corpus luteum of pregnancy regresses; sometimes postoperatively

6. Basch, K.: *The Mammary Secretion of the Child as an Index of the Secretory Capability of the Mother*, München. med. Wehnschr., lviii, No. 43, p. 2266.

7. Talbot, Fritz B.: *Two Methods of Obtaining Human Milk for Hospital Use*, Boston Med. and Surg. Jour., 1911, clxiv, 304.

8. Frank, Robert T., and Unger, A.: *An Experimental Study of the Causes which Produce the Growth of the Mammary Gland*, Arch. Int. Med., 1911, vii, 812.

after castration in the virgin (if the breast has been activated by the corpus luteum of menstruation).

Knape⁹ found no bad results in feeding children with breast-milk preserved by the addition of perhydrol. Older children are sometimes disturbed by the taste.

Grulee¹⁰ concluded from clinical observations that sodium benzoate to the amount of $2\frac{1}{2}$ to 5 grains in twenty-four hours, given to artificially fed infants ranging in age from a few weeks to almost 2 years produces no recognizable symptoms, even though these children may be suffering from gastro-intestinal disturbances of a serious nature.

Kleinschmidt¹¹ found that the proteins of cow's milk, casein, albumin and globulin may be differentiated from each other by means of anaphylactic experiments. Albumin from cow's milk and serum from cattle appear to be identical. Casein appears to be more closely allied to the globulin than to the albumin.

A. Filia,¹² as the result of his researches on goats, stated that uric acid and purin bases in small quantity passed through the milk; the administration of food rich in nuclein, injections of lecithin, uric acid given by mouth and by injection, slightly increased the elimination of uric acid and purin bases. He found no difference in the quantity of uric acid and purin bases eliminated by the milk in uremic or healthy women.

Barbier's¹³ studies based on a dozen cases show a certain parallelism between the salts and the casein.

Schloss¹⁴ found that the composition of the milk bears no relation to the amount produced in early lactation. Early the amount of calcium is high. This is followed later in human milk by a fairly constant amount of calcium.

According to Plauchu and Rendu¹⁵ the influence of multiparity and age of the nurse, as well as the duration of the breast feeding is variable and not of great importance on the fat content of the milk. The alimentary regimen, as well as galactogogues and menstruation appear to have

9. Knape, Walter: Breast Milk Conserved by Perhydrol, *Monatschr. f. Kinderh.*, 1911, x, No. 6, p. 281.

10. Grulee, Clifford G. and Buhlig, Walter B.: Sodium Benzoate in Artificially-Fed Children, *Arch. Pediat.*, xxviii, No. 10, p. 869.

11. Kleinschmidt, Hans: The Biological Differentiations of the Proteins of Milk, *Monatschr. f. Kinderh.*, x, No. 8, p. 402.

12. Filia, A.: Elimination of Uric Acid by the Milk, *Brit. Jour. Child. Dis.*, 1911, viii, p. 463. Seventh Congress of the Italian Pediatric Society, held at Palermo, April, 1911.

13. Barbier, M.: Session Society of Pediatrics of June 20, 1911, *Arch. de méd. d. enf.*, 1911, xiv, p. 559.

14. Schloss, Ernst: The Chemical Composition of Human Milk, *Monatschr. f. Kinderh.*, x, No. 10, p. 500.

15. Plauchu, E., and Rendu, Robert: Study of Fat in Breast Milk, *Arch. de méd. d. enf.*, 1911, xiv, p. 601.

no effect. On the contrary the more milk a nurse has the less is the butter content. The butter content is higher in the morning than in the evening. The butter content at the beginning of the nursing is higher than at the end of nursing. The smaller of two breasts gives the higher butter content. Too much fat in the milk or too little fat is thought to produce digestive troubles, especially in premature infants.

Autenrieth and Mueller¹⁶ describe colorimetric methods for determination of kreatin and kreatinin based on the principle of the Folin method, and a colorimetric method for sugar, for which they claim the advantage of greater ease and rapidity.

Best¹⁷ found that in the normal person foods prepared in widely different ways were well digested. He considers the importance of the cooking, in as far as the digestion is concerned, to lie mainly in its effect on the appetite and the accompanying psychic secretion and stimulation to motility.

According to Allaria¹⁸ the importance of the chemical reaction of the mouth depends on its influence on the bacterial flora in the cavity, as well as its effect on the diastatic activity of the ferment. The mouth of the new-born is neutral (litmus) with frequent inclination to a slight acidity. In later infancy the contents of the mouth show various chemical reactions when examined with litmus paper. Usually blue litmus paper is turned red. The reaction is rarely neutral or alkaline. There seems to be no apparent relation between the chemical reaction of the contents of the mouth and the secretory irritation. Therefore the saliva may be considered as an almost neutral fluid. The saliva is less often and less actively acid immediately after its secretion than when it has remained in the mouth for some time. The saliva is acid to phenolphthalein.

In another communication¹⁹ he states also that isosmotic food solutions such as milk, or hyposmotic food solutions, arrive in the stomach in a very definite hyposmotic condition; hyperosmotic solutions, on the contrary, go into the stomach in a less hyperosmotic condition, so that the saliva may be considered in the earliest childhood to have an important physical-chemical effect; that is, the regulation, or better, the lowering of the molecular concentration of the food solutions and therefore a decreasing of the degree of osmotic pressure (osmo-regulating or osmoderating function of the saliva).

16. Autenrieth, W., and Funk, Albert: Concerning the Colorimetric Determination of Sugar, Creatin and Creatinin in the Urine, München. med. Wehnschr., vol. lviii, page 899.

17. Best, F.: Concerning the Influence of Preparation of the Food upon its Digestibility, Deutsch. Arch. f. klin. Med., civ, No. 1, 94.

18. Allaria, G. B.: The Chemical Reaction of the Infant's Saliva, Monatsschr. f. Kinderh., x, No. 4, p. 179.

19. Allaria, G. B.: Concerning the Action of Saliva in the Beginning of Digestion in the Infant, Jahrb. f. Kinderh., xxiv, No. 3, p. 252.

The arrival of the saliva food-mixture in the stomach causes the immediate secretion of gastric juice rich in hydrochloric acid and of a strong concentration, which has the effect of bringing about an osmotic equilibrium with the blood.

Salle²⁰ found it possible by means of raising the temperature beyond a certain boundary, in the case of young dogs, to bring about a disease picture characterized by great loss of weight, rise of temperature, diarrhea and vomiting. The examination of the excretory function showed a lessening of the gastric juice, a decrease of the digestive power of the ferment, a lowering of the total acidity and the content of free hydrochloric acid or even the disappearance of the latter.

Bahrtdt and Bamberg²¹ made examinations on dogs with high duodenal fistula in which the effect of acetic acid and butyric acid was tried on the peristalsis of the stomach and intestine. The quantitative relations were especially considered. It was shown that relatively small amounts of the lower acids, amounts which gradually came into the chyme, were able to hasten the peristalsis. Moreover, they brought about a lengthened closing of the pylorus, a reflex which is to be considered as a protective arrangement for the intestine against the acid-containing food coming out of the stomach. Small amounts which, fed by mouth, brought about no increased stomach peristalsis, increased the peristalsis and brought about vomiting and diarrhea when they passed into the duodenum.

They²² also found that acetic acid is the most active and the strongest among the substances examined. The higher the acid stands in the series the less active is it in causing peristalsis. It seems possible that the organic acids which are formed in the stomach normally may, in case of pathological increase of collection, be the cause of acute dyspepsia.

Huldschinsky²³ gives results which are to be considered in relation to normal digestion only:

1. In feeding with human milk the stomach contains only very small amounts of volatile acids. When cow's milk is fed it contains from three to six times as much.

2. The amounts of volatile fatty acids found in the stomach when cow's milk is fed corresponds with the amount of fat contained in the food. Protein and sugar, however, have no influence.

3. The formation of the volatile acids in the stomach of the normal infant can only be explained by the fermentative splitting of the glycerids

20. Salle, V.: The Effect of the Air Temperature upon the Secretory Activity of the Stomach, *Jahrb. f. Kinderh.*, xxiv, No. 6, p. 697.

21. Bahrtdt, H., and Bamberg, H.: Animal Experiments upon the Action of the Lower Fatty Acids upon Duodenal Peristalsis, *Ztschr. f. Kinderh.*, 1911, iii, 313.

22. Bahrtdt, H., and Bamberg, H.: Animal Experiments upon the Action of the Lower Fatty Acids upon Duodenal Peristalsis, *Ztschr. f. Kinderh.*, 1911, iii, 350.

23. Huldschinsky, K.: Concerning the Volatile Fatty Acids in the Stomach Content of Normal Infants, *Ztschr. f. Kinderh.*, 1911, iii, 366.

of these acids. The kind of lower fatty acid which is formed corresponds with the preformed acids in the milk fat.

Acetic acid is formed in small amounts only in the normal infant stomach. It appears possible that through a pathologic increase of the amount of cow's milk in the stomach there may arise acids which in themselves are less toxic; that is, butyric, caproic and caprylic acids, but which in greater amounts increase the peristalsis and cause acute dyspepsia.

According to Schmidt,²⁴ pieces of vegetable tissue which are left two to four hours in the incubator with a pepsin-hydrochloric acid solution and then placed in a solution of pancreatic ferments show marked softening so that a slight pressure of the finger or even a shaking of the test-tube change them into a gruel-like mass. This influence of the stomach on vegetables must be considered as a chemical action. In the past the breaking-up function of the stomach has been given too little attention in comparison with the dissolving function.

Davidsohn²⁵ states that pepsin is found in the infant stomach, but exerts no digestive action. He considers the coagulating ferment and the proteolytic ferment one.

Kleiner²⁶ found that the contents of the stomach and small intestine of normal rabbits, kept on a diet poor in easily convertible carbohydrates, when removed immediately after killing the animal, usually contain a very small but measurable amount of dextrose. A preceding nephrectomy does not increase the amounts of the dextrose in these viscera.

Sedgwick and Schlutz²⁷ found that a preliminary digestion of fat with gastric lipase increased the action of pancreatin on emulsified fat. Whether the effect shown was a summation or activation was not proved, but they concluded that the function of the gastric lipase does not end when the stomach contents pass the pylorus and are neutralized in the duodenum.

Cowie and Lyon²⁸ found that the pyloric opening and closing can be easily demonstrated in infants' stomachs. Evacuation of the stomach was delayed by experimental acidity (sustained duodenal closing reflex), as well as in experimental alkalinity (delayed pyloric opening reflex). Free acid was not found necessary for pyloric opening in the infant. In hyper-

24. Schmidt, Adolf: Concerning the Comminuting Function of the Stomach in the Normal and Diseased Stomach, *Deutsche med. Wchnschr.*, 1911, xxxvii, No. 10, 435.

25. Davidsohn, Heinrich: Contribution to the Chemistry of the Infant Stomach, *Ztschr. f. Kinderh.*, ii, No. 5, p. 420.

26. Kleiner, Israel: The Excretion of Dextrose in the Stomach and the Small Intestine, *Jour. Exper. Med.*, 1911, xiv, 274.

27. Sedgwick, J. P., and Schlutz, F. W.: Relationship of Gastric to Pancreatic Fat Digestion in Infants, *AM. JOUR. DIS. CHILD.*, 1911, ii, 243.

28. Cowie and Lyon: Further Observations of the Acid Control of the Pylorus in Infants, *AM. JOUR. DIS. CHILD.*, 1911, ii, 252.

secretion in infants, protein-containing food appeared to leave the stomach more readily than water because of its binding property for acid.

Klotz²⁹ finds the acid formation in pancreatic digestion weakest with wheat. It is increased with rye, still more with barley, and to the highest degree with oats.

His results show that the bacterial content in the stool of the breast-fed child corresponds in general to that which we find in the bottle-fed child which is receiving two carbohydrates. The different forms of sugar influence the fermentative process with different intensity. Especially aggravating in effect are the starches, and among them more noticeable energetically, barley and oatmeal. It is possible to increase the number of bacteria in the feces to a maximum by a pre-arranged variation of the carbohydrates. Bacteria appear in the infant to represent from 30 to 36 per cent. of the dry fecal substance. It seems, moreover, not improbable that when an increase of the bacteria is not found when we are ministering high molecular carbohydrates, that a disturbance in the working together of the intestinal enzymes and intestinal bacteria is indicated.

Edelstein³⁰ says:

1. Dyspeptic and normal stools of breast-fed children show acetic acid as the chief constituent among the volatile fatty acids. The amount of butyric acid may be as high as 0.06 per cent. in the normal stool from the breast-fed child. In dyspeptic cases the stools may show small quantities of caprylic and formic acid.

2. The volatile fatty acids in the stomach contents of children fed with full cow's milk consists of caprylic, caproic, butyric and a little acetic acids. Caprylic and butyric acids are present in like amounts.

3. In buttermilk, according to Koppe (Vibelmilch), and in sour milk which has stood for two days, the volatile fatty acids, principally acetic acid, are present. In the sour milk up to 0.05 per cent. and in the Vibelmilch up to 0.03 per cent.; that is, acetic acid with a little butyric acid.

Bauer³¹ confirms the work of Talbot on curds.

Brennemann³² says that in all his experience he has never seen a hard curd unless a considerable amount of raw milk casein was given, and has never seen hard curds persist or occur when boiled milk, no matter in what amount, was given. He considers the difference in the action of rennin on raw and boiled milk as significant in this connection.

29. Klotz, M.: Studies on Starch Digestion, *Jahrb. f. Kinderh.*, lxxiii, 391.

30. Edelstein, F., and Csonka, F.: The Qualitative (Quantitative) Determination of Volatile Fatty Acids, *Ztschr. f. Kinderh.*, 1911, iii, 321.

31. Bauer, J.: Concerning Casein Curds in Infants' Stools, *Monatsehr. f. Kinderh.*, 1911, x, No. 5, p. 239.

32. Brennemann, J.: Etiology and Nature of Hard Curds in Infants' Stools, *AM. JOUR. DIS. CHILD.*, 1911, i, 341.

While Ibrahim³³ confirms the findings of Wernstedt and Talbot, he also considers the casein "curds" more common in uncooked milk.

Pfaundler³⁴ calls attention to the fact that Talbot's biologic method does not show a protein body of definite chemical constitution, but only certain groups attached to the protein bodies. Therefore, strictly considered, the experiments of Uffenheimer and of Talbot and others show only the presence of such foreign radicals, not, however, the presence of casein or derivatives of the same in the infant's stool. He grants freely, however, that it is probably a casein derivative.

Stolte³⁵ considers that one common principle is fundamental in the methods of feeding which give good results, and that is the formation of soap or solid stools.

Saito³⁶ says the fat content of the feces of the infant is almost constant, either by natural or by artificial feeding; that is, it makes up about 20 per cent. of the salt constituent of the stools. Fat amounts to about 96 per cent. in the new-born child; especially in artificial feeding the fat content of the feces is usually higher and may go at times up to 40 per cent. or even more. In dyspepsia the fat content seems to be higher. Atrophic children always show a higher fat content, which becomes lower in convalescence. The feces of the new-born child, as in dyspepsia, are especially rich in oleic acid, which decreases in amount as the child grows, or in convalescence. The so-called "curds" in the feces are chiefly solid soap compounds of the fatty acids; 0.03 per cent. of the dried substance of the feces is made up of cholesterin and contains no saponifiable substances. In a rough manner the composition of the fat in the feces may be recognized by microchemical means. If a drop of concentrated sulphuric acid be put on a small piece of feces, numerous fatty acid crystals appear in the place of the soaps, and the individual fat drops are still plainer under the microscope.

Engel and Turnau³⁷ state that urines of breast-fed children react positively; that is, they show a black precipitate, while the urines of artificially fed children give a negative reaction when treated as follows: 15 or 20 drops (about 1 c.c.) of a 2 per cent. silver nitrate solution are added to 5 c.c. of urine. This is allowed to stand quietly for about ten minutes.

33. Ibrahim, J.: Curds in Connection with the Feeding of Raw Milk, *Monatschr. f. Kinderh.*, 1911, x, No. 2, p. 55.

34. Pfaundler: Discussion of Uffenheimer's Paper Before the *Münchener Gesellschaft für Kinderheilkunde*, *Jahrb. f. Kinderh.*, lxxiv, No. 1, p. 82.

35. Stolte, Karl: Concerning the Conditions Requisite for Formation of Solid Stools of Infants, *Jahrb. f. Kinderh.*, lxxiv, No. 4, p. 367.

36. Saito, Hideo: On the Fat Content of the Feces of Infants, *Jahrb. f. Kinderh.*, lxxviii, 222.

37. St. Engel and Turnau, L.: A Reaction Given by the Urines of Breast-Fed Children, *Berl. klin. Wehnschr.*, 1911, xviii, No. 1, p. 18.

Boschan³⁸ thinks that the Engel and Turnau urine reaction does not depend on whether the child is fed with breast or cow's milk, but on the chlorid, phosphate and carbonate content of the urine.

The discoverers of the reaction state, however, that they had recognized the fact all along that the chlorin is of great importance in this silver nitrate reaction. They state that on the basis of numerous chlorin determinations in the urine of breast-fed children, they have found that this amount of silver nitrate is sufficient to oversaturate the maximum chlorin content in 5 c.c. of the urine from breast-fed children. Naturally the key to the reaction lies in these quantitative data. If the amount of silver nitrate used with the urines of the infants fed with cow's milk is increased above the saturation point, a discoloration is also produced. This, however, is different from that of the urine of breast-fed children which shows from a yellowish to a reddish brown. If there is any doubt it is advisable to compare the color with the reaction from a breast-fed normal child.

Woodyatt³⁹ and Helmholtz found the losses in "The Use of Blood Charcoal as a Clearing Agent for Urine Containing Glucose" were not constant even in the same urines, but varied widely with the weight of charcoal used, the amount of shaking and the duration of contact.

Different samples, however, acting in divergently opposite ways, make it necessary that, before any conclusions be drawn from measurements made by the Bang and Bohmannsson method, the individual sample of charcoal which is used shall be thoroughly tested in control experiments.

Amberg⁴⁰ and Knox consider it probable that a very appreciable part of the nitrogen contained in the urine of the normal breast-fed infant is excreted in the form of hippuric acid.

Fleischner⁴¹ found that meat given twice daily to children of 6 years gives rise to a decided increase in the indicanuria and is a cause of pronounced intestinal putrefaction. This was found even more markedly the case in 3-year-old children. Meat given twice daily to 9- and 12-year-old children did not cause an increase of indicanuria. He concludes that the giving of meat more than once daily to children under 9 years of age is inadvisable.

Reuss⁴² states that indican is often found in the urine of breast-fed children during the first weeks of life, sometimes in large quantities,

38. Boschan, F.: The Character of the Engel-Turnau Reaction, *Berl. klin. Wehnschr.*, 1911, xviii, No. 7, p. 302.

39. Woodyatt, R. T., and Helmholtz, H. F.: The Use of Blood Charcoal as a Clearing Agent For Urine Containing Glucose, *Arch. Int. Med.*, 1911, vii, 598.

40. Amberg, Samuel, and Knox, J. H. Mason: Hippuric Acid in the Urine of Normal Breast-Fed Infants, *AM. JOUR. DIS. CHILD.*, 1911, ii, 248.

41. Fleischner, Charles: The Relationship of Meat Ingestion to Indicanuria in Children, *AM. JOUR. DIS. CHILD.*, 1911, ii, 262.

42. Reuss, A.: Indicanuria in the New-Born, *Ztschr. f. Kinderh.*, iii, No. 1, p. 12.

without its being possible to demonstrate chemically any pathologic phenomenon. It is found with good nutrition and with stationary weight, with frequent bowel movements and where there is an inclination to constipation. Indicanuria is usually lacking on the first day, is rare on the second day, and is found more commonly and intensively on the third and fourth days. Moreover, during the following days its appearance is not rare.

The summary of Hamill and Blackfan's study⁴³ of the albumin in the urines of normal children is too valuable to omit:

1. There has been no relationship between the specific gravity and the form or amount of albumin.

2. The reaction has had no influence on the production of albumin.

3. Sugar, acetone and diacetic acid were never found. They may, therefore, be considered as having no bearing on the production of albumin.

4. Indican, phenol and urobilinogen when present were usually associated with albumin, but albumin was sometimes absent when they were all present, and the amount was never greater when associated with them than it was in the cases in which they were absent.

5. Crystals, when present in amounts, such as are occasionally found in normal children, are in no way responsible for the associated albumin.

6. The milk disturbances of the intestinal digestion, as shown by the examination of the stools, were not sufficient to account for the occurrence of albumin.

7. The blood-pressure was within the normal range in all cases, and therefore did not influence the albumin output.

8. The albumin elimination was the same on mixed and exclusive milk diets.

9. They found no children in whom the albumin excretion corresponded to the requirements for postural or orthostatic albuminuria, a rather surprising result in view of the frequency with which this condition is supposed to occur.

10. Thirty-two and one-half per cent. of the children showed occasional hyaline casts and cylindroids in their urines. They do not consider their "occasional presence" as indicative of a lesion of the kidneys, but rather as suggesting a temporary overtaxation of the kidneys resulting from variations in the habits of life of the individuals which are too slight to be recognized.

11. Eighty-eight and seven-tenths per cent. of the urines of these 124 children showed albumin, 27.4 per cent. showing serum-albumin alone, and in combination; and 85.4 per cent. an albuminous body precip-

43. Hamill, Samuel McClintock, and Blackfan, Kenneth D.: *AM. JOUR. DIS. CHILD.*, 1911, i, 139.

itated by acetic acid in the cold. These two albumins were nearly always present in very slight traces, occasionally in slight traces and rarely in traces.

In thirty-eight children the twenty-four-hour specimens showed nucleo-albumin in all but one, and in this case samples examined over prolonged periods of time showed nucleo-albumin frequently.

In these thirty-eight children, the percentage of serum-albumin was very much higher (42.1 per cent.) than in the total number of cases examined. They believe therefore that it is possible to demonstrate in the urine of every presumably healthy child traces of an albuminous body precipitated by acetic acid. Consequently this substance must be regarded as an exceedingly common, if not constant manifestation in the urine of children up to 14 years of age, and as of no clinical significance.

They do not believe that serum-albumin in the amounts in which it appears in these children indicates a diseased condition of the kidneys any more than does the presence of occasional hyaline casts and cylindroids, and that its etiology may be considered the same as that given for these former elements.

Simon's⁴⁴ statement that the urines of new-born infants on which he worked did not give creatinin reactions at the dilutions recommended by Folin does not agree with the results of Sedgwick, who found reactions of 10-250 to 10-500 dilutions to be common. All of Sedgwick's infants were at the mothers' breasts and were usually given no other fluid, which could dilute the urine. Simon found that new-born infants have a high nitrogen excretion during the first week which sinks to the normal proportions later. He found that the new-born child (during the first few days of life) excretes unsplit polypeptids up to 12 per cent.

Hadlich⁴⁵ finds that the amino-acid content of the urine of older children corresponds to that in adults. Diseases with fever do not generally increase it. It is, however, increased by severe enteritis. In the infant the value is generally raised, but apparently is not dependent on the condition of the child or the food or character of the stool. There is one condition especially, however, in which this does not hold, and that is alimentary intoxication. This corresponds to the views of Finkelstein in that it is in this condition that the oxidation capability of the organism is disturbed. The presence of uric acid in the urine indicates an incapacity of the organism to catabolize the amino-acids brought to it from the intestine further, to the point of ammonia, and by this means prepare them for the formation of urea.

44. Simon, S.: The Nitrogen Partition in the Urine of the New-Born, *Ztschr. f. Kinderh.*, 1911, ii, 5.

45. Hadlich, Richard, and Grosser, Paul: The Amino-Acid Content of the Urine of Children and Infants, *Jahrb. f. Kinderh.*, lxxiii, 421.

Reuss⁴⁶ finds that the urines of newly born children contain glycocoll as a normal constituent.

According to Birk,⁴⁷ in the artificially fed new-born child about one-half of the nitrogen introduced is excreted in the urine. In the naturally fed child only one-sixth to one-seventh of the nitrogen is given off. From the above a fundamental difference between the artificial and natural feeding of the new-born child is shown. It is almost like a law to be observed that the longer the period of underfeeding continues, just so much more intensive are the symptoms of exudative diathesis which develop later.

The hypodermic injection of urine in the lower animals causes the appearance of hemolytic precipitates, and complement-binding antibodies in their serum. The precipitation is always stronger with normal than with protein-containing urine. On the contrary the protein-containing urine produces more complement binding.

The apparatus designed by Lawrence⁴⁸ for collecting urine in female infants, for use in the Boston Floating Hospital, has been found very valuable by the reviewer. It consists of an adhesive plaster strap one-half to 2 inches wide and 4 to 6 inches long, split at one end, thus forming two tails to be directed backward and outward over the buttocks. An elliptical opening is cut through the strap and through this opening the thumb of an old rubber glove is passed and turned down on the adhesive surface of the strap. The tip of the thumb is then cut out and a test-tube inserted in the opening. The test-tube may be wrapped with adhesive, if desired, to avoid slipping. The opening in the adhesive, armed with the rubber thumb, is placed with the adhesive portion toward the body so that the opening is over the vulva. The urine is then passed directly into the test-tube.

For collecting twenty-four-hour specimens the test-tube is replaced by a piece of glass tubing which is connected by a rubber piping with a bottle placed inside the bed.

Interesting apparatus for the collection of excreta is described by Dubois,⁴⁹ as well as by Howland and Cook.⁵⁰

The minimum, as well as the maximum, blood-pressure increases with the age of the child, according to Sahle,⁵¹ and is, moreover, dependent

46. Reuss, A.: Concerning the Presence of Glycocoll in the Urine of the New-Born Infant, *Ztschr. f. Kinderh.*, iii, No. 3, p. 286.

47. Birk, W.: Contribution to Physiology of the Newborn Child, *Monatschr. f. Kinderh.*, 1911, No. 1, p. 5.

48. Lawrence, Charles H.: A Method of Collecting Urine from Female Infants, *Boston Med. and Surg. Jour.*, 1911, clxiv, 309.

49. Dubois, Eugene F.: An Apparatus for the Collection of the Excreta of Infants, *AM. JOUR. DIS. CHILD.*, 1911, ii, 415.

50. Howland and Koch: A Metabolism Bed for Infants, *AM. JOUR. DIS. CHILD.*, 1911, ii, 419.

51. Salle, V.: Blood-Pressure in Children, *Jahrb. f. Kinderh.*, lxxiii, 273.

within certain boundaries, on the weight and size of the child; also the height of the amplitude becomes greater with increasing age. Deviations from the average are shown in lymphatism (lower), neuropathy and nephritis (higher).

Emerich Rusz⁵² finds the absolute values of the viscosity of the blood and refraction of the plasma to vary within wide boundaries according to the condition of the infant. The viscosity rises during the first days of life, then sinks sharply. This decrease then goes on more slowly through the whole first year. The refraction rises sharply also during the first days of life. There is then under normal conditions a decrease up to the fourth or eighth day after which it begins to rise again strongly. This rise continues then slower and slower through the whole first year of life. The day's variations of the refraction and viscosity of the blood are most marked from morning to midday. The decrease begins at mid-day and goes on until evening. The cause of the high morning value is the concentration of the blood during the eight hours of the night fast. The influence of the taking of food on the refraction and viscosity of the blood appears to differ with the condition of the child. The normal child does not seem to be affected by the food unless it causes a decrease. When the child is not progressing an increase occurs.

Miss Michael's⁵³ work confirms the blood-pressure results of Frau Wolfensohn-Kriss, as she found the pressure to increase apparently with height and weight, as well as age. She found, however, on application of Sallom's formula, thus obtaining the blood-pressure per square millimeter, that the actual blood-pressure of a 40-pound 5-year-old child and that of an 80-pound 15-year-old were practically the same.

Mills' ⁵⁴ summary and conclusions concerning the utilization of fats and oils given subcutaneously were as follows:

"1. Olive, peanut, cocoanut, sesame, cotton-seed, lard-oils, unsalted butter-fat and lard may be given hypodermically and over a considerable period without local irritation, provided aseptic care is used, and no constitutional disturbance occurs provided precautions are used to prevent injection into the blood-stream.

2. Emulsions of these oils made with 3 to 5 per cent. of egg lecithin and water are permanent, and cause no irritation if given subcutaneously.

3. Oils and fats given subcutaneously are absorbed by means of the lymphatic system and eventually reach the thoracic duct.

52. Rusz, Emerich: Physiological Variations in the Viscosity and Refraction of the Blood of Infants, *Monatschr. f. Kinderh.*, 1911, x, No. 7, p. 36.

53. Michael, May: A Study of Blood-Pressure in Normal Children, *AM. JOUR. DIS. CHILD.*, 1911, i, 272.

54. Mills, Lloyd, H.: The Utilization of Fats and Oils Given Subcutaneously, *Arch. Int. Med.*, 1911, vii, 694.

4. Lymphatic vessels and glands in contact with and transmitting oil for any length of time become hypertrophied and are thus better able to carry oil.

5. The amount of absorption of plain oil from the subcutaneous tissues after injection during starvation is so small as to be negligible. Emulsified oils and fats injected during starvation are absorbed in amounts sufficient to furnish from one-half to two-thirds of the full calorific requirement of the animals injected.

6. Oils and fats so injected and absorbed have no more influence on the destruction of protein in starvation than has fat given alone by mouth.

7. Plain oils injected subcutaneously under conditions of low protein ingestion are little, if any, better absorbed than when similarly given during starvation. Emulsified oils injected under these conditions are absorbed quite as well as similar oils given to starving animals.

8. Plain and emulsified oils are absorbed about equally well when the animals injected are given a plentiful supply of protein in their food. This probably furnishes the large quantity of lipolytic enzymes necessary for body action on plain oil.

9. The injection of oils subjected to lipolysis causes death, which is due apparently to the production of oleic or other acids, with the possible formation of toxic quantities of soaps.

10. Oil absorbed from the tissues after subcutaneous injection is (a) burned in the body for the production of heat and energy, thus sparing the body fat; (b) retained as such within the organism; or (c) possibly converted into body fat by reconstruction in the liver, from which it may be sent for storage to the various fat depositories, after which it is drawn on as needed. Proof of this last proposition is lacking.

11. It seems likely, from comparative examination of the iodine indices of the ether extracts of visceral and adipose tissue, that the actively functioning viscera use oil and fat absorbed after subcutaneous injection for the direct performance of their functions, and that the storage of the foreign fat given in excess of the nutritive requirement takes place principally in the subcutaneous tissue, liver and lungs, to a small extent in the kidneys and spleen, while the pancreas and stomach and intestines are practically uninfluenced.

12. This demonstration that after injection under suitable conditions oils can be absorbed to an amount capable of covering so large a proportion of the calorific requirement suggests the application of such injections to the treatment of wasting diseases, to the cachectic conditions associated with imperfect metabolic processes and especially to tuberculosis, in which the intolerance to fats is almost symptomatic."

The pediatricist will at once recognize the value of a perfected method of hypodermic feeding.

Carpenter⁵⁵ found the energy metabolism of the new-born child expressed per unit of weight, obtained by subtracting the metabolism of the mother alone from that of mother and child together, to be two and a half times that of the mother. Expressed per unit of surface, the energy metabolism of the new-born child was not found greater than that of the nursing mother, but higher than that of a woman in complete sexual rest.

The energy quotient among the new-born fluctuates within wide range according to Samelson⁵⁶ so that it would probably be well in place of the former ideas, to set it at from 115 to 150 calories.

Hess⁵⁷ says that the energy quotient needed by premature and under-weight infants averages between 115 and 170 calories when below 1,500 gm. in weight; when over 1,500 gm. the requirement is not so high—between 100 and 132 calories.

Niemann⁵⁸ considers the water balance the most important of his metabolism experiences. The question, "What does the difference in weight of the body on the scales mean? Is it body substances or is it water?" he believes one of greatest importance for the understanding of the condition of the child and for the condition of the metabolism processes of the infant. And this is one of the questions which we find most difficult. We have to consider the water introduced and the water formed by oxidation. Niemann believes that in weaker, normal infants, as one of his children was, water is lost with the taking on of body substance and also that when the child is brought under favorable conditions of nourishment and forced to oxidize body substance, its behavior toward the water does not change and at any rate no water is added. Under no conditions did there appear to be a tendency to putting on water in the case of simple body increase. In the case of very dry air much water was lost by the respiration. He found that with approximately the same body weight an artificially nourished child gives off considerably more carbon dioxide and water per square meter of surface than one naturally fed. On the contrary, two artificially fed children in spite of marked differences in weight gave off almost the same amount.

The daily capacity per square meter of surface was 1,347 calories. Four of his very interesting tables may be included:

55. Carpenter, Thorne M., and Murlin, John R.: The Energy Metabolism of Mother and Child Just Before and Just After Birth, *Arch. Int. Med.*, 1911, vii, 184.

56. Samelson, S.: The Contribution to the Physiology of the Feeding of Premature Infants, *Ztschr. f. Kinderh.*, 1911, ii, 31.

57. Hess, J. H.: A Study of the Pyloric Needs of Premature Infants, *AM. JOUR. DIS. CHILD.*, 1911, ii, 302.

58. Niemann, Albert: The Total Metabolism of an Artificially-Fed Infant, *Jahrb. f. Kinderh.*, 1911, lxxiv, No. 6, pp. 22, 650.

TABLE 1.—SHOWING WATER BALANCE IN AN INFANT DURING A SEVEN-DAY OBSERVATION

Water Excreted	1st Day	2nd Day	3rd Day	4th Day	5th Day	6th Day	7th Day
Through respiration ...	304.8	288.0	278.4	288.0	300.0	254.4	328.8
Through sweat	6.5	3.0	5.0	1.0	16.9
Through urine	500.0	470.0	490.0	445.0	510.0	460.0	405.0
Through feces	28.0	28.0	28.0	28.0	28.0	28.0	28.0
Total water excretion	839.3	786.0	796.4	744.0	843.0	743.4	778.7
Water given	693.8	693.8	693.8	668.0	668.0	689.0	745.0
Balance	—145.5	—92.2	—102.6	—76.0	—175.0	—54.4	—33.7

TABLE 2.—ESTIMATE OF CARBON BALANCE IN AN INFANT DURING A SIX-DAY OBSERVATION

Carbon Excretion	— Sum of Days — 1-3	4-6	24 Hr. Average for Days 1-6
Through respiration	151.3	148.0	49.9
Through urine	6.1	4.0	1.7
Through feces	8.1	8.0	2.7
Total C. excretion	165.5	160.1	54.3
Carbon taken in	224.7	168.8	68.6
Carbon balance	+59.2	+26.7	+14.3

TABLE 3.—NITROGEN BALANCE DURING A SIX-DAY OBSERVATION ON AN INFANT

Nitrogen Excretion	— Sum of Days — 1-3	4-6	24 Hr. Average for Days 1-6
In the urine	9.12	9.68	3.13
In the feces	1.20	1.20	0.40
Total Nitrogen excretion	10.32	10.88	3.53
Nitrogen taken in	13.25	14.19	4.57
Nitrogen balance	+2.93	+3.31	—1.04

Per kilogram of weight and day the following values are given:

Calorie intake (net).....	114 cal.
Taken on	29 cal.
Heat formation	85 cal.

In this case the daily production of heat per square meter of surface amounted to 1,297 calories.

Salge⁵⁹ believes it important for clinical purposes that the young infant can regulate the osmotic pressure, or better, the physiologic composition of its body fluids, but imperfectly. The physiologic insufficiency of regulation, as it is seen in the young infant, gives the basis for various pathologic conditions.

59. Salge, B.: Concerning the Physical Properties of the Blood of Infants, *Ztschr. f. Kinderh.*, 1911, ii, No. 5, p. 347.

Adler and Blake's⁶⁰ conclusions are as follows:

1. The amount of base excreted in the urine in acidosis, while following in general the variations in the amount of ammonia, may show differences which are of importance in estimating the power of the organism to resist intoxication.

2. Whether the amount of base excreted varies with the amount of ammonia or not, it is important to determine both quantities as they represent two distinct mechanisms of defense.

Rulon and Hawk⁶¹ found in their studies on water-drinking that in two of the experiments there was a pronounced increase in the output of chlorids on the days of added water intake with a return to normal during the final period. This augmented excretion of chlorids they interpreted as indicating that the large volume of water ingested during this period markedly stimulated the secretion of gastric juice. The excess hydrochloric acid, thus passed into the intestine, was reabsorbed and appeared, at least in part, in the urine as ammonium chlorid. The main bulk of the increase in the chlorid excretion they believe to have originated in this way. The flushing of the tissues and the stimulation of protein catabolism brought about by the copious water-drinking may have been contributing forces in causing the increased output of chlorid observed.

Mendelssohn⁶² states that the power of temperature regulation is usually insufficient in very small and weak children. The capacity of regulation is gradually acquired during the first months of life and may be again lost in severe diseases such as intoxication and atrophy.

Koepppe⁶³ says that marked increases of weight above the normal may owe their occurrence to restitution or water retention. The phosphate content of the urine he found dependent on the phosphate content of the food. When he gave salt in the infant's food he noticed a rise in temperature, increase of weight and a higher amount of phosphorus pentoxid excreted in the urine. He noticed also in the infant that when it had fever and at the same time was receiving the usual amount of food, the increase of weight which depended on the water retention, was accompanied with an increased excretion of phosphorus pentoxid in the urine. In analogy with the adult, he concludes that this is dependent on a chlorin retention.

60. Adler, Herman M., and Blake, Gerald: The Retention of Alkali by the Kidney with Special Reference to Acidosis, *Arch. Int. Med.*, 1911, vii, 479.

61. Rulon, S. A., Jr., and Hawk, P. B.: Studies on Water-Drinking, *Arch. Int. Med.*, 1911, vii, p. 536.

62. Mendelssohn, A.: Observations Concerning the Surface Temperature of Infants, *Ztschr. f. Kinderh.*, iii, No. 3, p. 292.

63. Koepppe, Hans: Studies in the Mineral Metabolism, *Jahrb. f. Kinderh.*, lxxiii, 9.

Those who are further interested in the important field of salt metabolism may read Schloss'⁶⁴ review with profit.

Wiggers⁶⁵ gives a résumé of the present understanding of the physiology of the pituitary gland.

Schloss⁶⁶ and Crawford found the uric acid output in new-born infants both absolutely and relatively high. In the case in which the umbilical cord was ligated late they found the output of uric acid greater during the second and third days than in those cases in which the cord was ligated immediately after birth. They found the total phosphorus excretion high during the first three days and then it showed a marked diminution. They found a marked retention of the phosphorus in the new-born infant, as well as a moderate nitrogen retention during the first three days. The results show an inverse ratio between the leukocyte count and the elimination of phosphorus and uric acid during the first few days of life. They believe that the parallelism between the excretion of uric acid and phosphorus during the first three days would seem to indicate a common origin from cell nuclei.

64. Schloss, Ernst: Progress in the Field of Mineral Metabolism of Infants During the Past Three Years, *Jahrb. f. Kinderh.*, xxiv, No. 1, p. 91.

65. Wiggers, Carl J.: The Physiology of the Pituitary Gland and the Actions of Its Extracts, *Am. Jour. Med. Sc.*, 1911, cixl, 502.

66. Schloss and Crawford: The Metabolism of Nitrogen, Phosphorus and the Purin Substances in the New-Born; With Special Reference to the Causation of the Uric Acid Infarcts of the Kidney, *AM. JOUR. DIS. CHILD.*, i, 203.