ANÆMIA IN INFANCY AND EARLY CHILDHOOD

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PATHOLOGICAL processes are but the utterances of physiological functions performed under abnormal circumstances. Those functions depend on the anatomical condition of the tissues or organs. While this relation has long been established in the minds of medical men, the former, though acknowledged theoretically, is frequently not heeded. As a rule, the pathological anatomy of a diseased organ is stated, in connection with the history of a case, or the description of a class of cases, but the reference of an anatomical predisposition of tissues or organs to special morbid processes is mostly neglected. It is mainly Beneke who has studied disease from this point of view, and it is from his various essays and works on kindred subjects that some of the exact data to be laid before you are taken.

By rights, every treatise, essay or paper on a pathological subject ought to commence with the normal anatomical condition of the organ or tissue to be dealt with. Thus,

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only, an intelligent appreciation of the facts becomes possible, and thus, only, when every case is viewed in this light, the practice of a medical man is raised above the level of routine and drudgery.

When some time ago, Mr. President, I had the honor of reading before our Society a paper on infant diarrhœa and dysentery, I emphasized the fact that healthy infants have a normal tendency to loose liquid or semi-fluid evacuations from the bowels. The causes I stated to lie partly in the conditions of the intestinal tract, and partly in the nature of the normal food, viz., breast-milk. The latter do not concern us now, but the former I repeat merely for the purpose of establishing, in a few examples, the close connection between anatomical structure and physiological and pathological conditions. The peristaltic movements in the infantile intestine are very active; the young blood-vessels very permeable; the transformation of surface cells is very rapid. The peripheric nerves lie very superficially, more so than in the adult, whose mucous membranes and submucous tissues have undergone thickening by both normal development and morbid processes. In the infant, the peripheric ends of the nerves are larger in proportion than in the adult, the anterior horns of the nerve centres more developed than the posterior ones. Thus, the greater reflex irritability of the young, under intestinal and other influences, is easily explained. Besides, the action of the sphincter ani is not quite powerful, the fæces are not retarded in the colon and rectum, and no time is afforded for the re-absorption of the liquid or dissolved constituents of the fæces. Moreover, the frequent occurrence of acids, sometimes in normal conditions, in the small intestines, gives rise to the formation of alkaline salts with purgative properties.

On the other hand, constipation in the very young is sometimes the result of grossly anatomical conditions of

the intestinal tract. I should not have to allude to the fact at the present time if it were not for the following reasons: Firstly, this form of constipation illustrates exceedingly well the connection between anatomy and function; secondly, the routine treatment of constipation by the administration of purgatives would be very dangerous in just such a case; and lastly, what I have published about the subject more than ten years ago, and repeated in the treatise on hygiene, edited by Dr. A. Buck, appears not to have been noticed to such an extent that the suffering infants can be sufficiently benefited. At least, in an essay on constipation, published but lately and presumably considered complete in its etiology, this important cause of the most obstinate form of constipation in the very young is not mentioned at all.

It therefore bears repetition; it is, in a few words, as follows: Until the fourth or fifth months of fœtal life, there is no colon ascendens, and it is still short at birth. Notwithstanding that fact, the large intestine at birth is comparatively longer than that of the adult. While in the infant it is nearly three times the length of the entire body, it is but twice that length in the adult. Now, the colon ascendens is very short in the newly-born, the transverse colon is not much longer; thus, the main part of the excessive length belongs to the colon descendens, and mainly to the sigmoid flexure, which Brandt found from fourteen to twenty centimetres, and myself in one case thirty cm. in length. This exorbitant length of the sigmoid flexure at the entrance of the narrow pelvis, gives rise to more than the simple curve found in the adult. Not infrequently the main curve is found on the right side instead of the left, and sometimes the repeated bending upon itself of the elongated gut is such as to seriously retard, and in a few instances, prevent, the passage of fæces.

The two instances hitherto spoken of illustrate the close connection of two conditions noticed in very early life depending upon the anatomical structure of the affected organ. In brief, I shall allude to two others which become manifest at a little later period of infant life. Thus, in rhachitis, while the heart is of average size, the arteries are abnormally large, the liver is of extraordinary volume, and the lungs are small. Great width of arteries lowers the pressure of the blood. One of the results of this physiological fact is the murmur audible in the brain of rhachiticial babies, which, by no means, as Jurasz explained it, results from the anomalies of the carotic canal. Another result of the low blood pressure is the retardation of the circulation in the muscles, and more yet about the epiphyses, which swell and soften. It is not the growth of the epiphyses alone which, by itself, results in general rhachitis, for the epiphyses are still in their cartilaginous condition up to adolescence, and some do not ossify until the twentieth year of life; but no rhachitis is met with at this advanced stage. Thus it is by no means the anatomical condition of the cartilaginous tissue which is one of the causes of rhachitis, but the condition of the arteries supplying the epiphyses. Besides, the large size and active condition of the liver give rise to a copious formation of cholestearin, the importance of which, in the establishment of a hyperplastic condition of cartilage cells and tissue elements in general, has long been recognized. Thus, ossification becomes irregular and defective, and the rhachiticial bone contains an abnormally large quantity of fat, in contrast with the deficient percentage of lime, which either is not introduced or not assimilated in consequence of the faulty nature of the preliminary stages of osseous development.

Some other peculiarities are found in the condition which has been called scrofula. The normal relation of the heart

to the lungs, between the second and twentieth years, is 1 : 5–7 ; in scrofula it is 1 : 8–10. This circumstance, coupled with an acquired debility of the nervous system, results in an insufficient supply of blood to both lungs and organism, and defective oxygenation, particularly in those cases which by common consent have been called torpid scrofula. It is mainly in these that the lymphatic system preëminently participates in the symptoms. The size and number of the lymphatics are very great in infancy. Sappey found that they could be more easily injected in the child than in the adult, and the intercommunication between them and the general system is more marked at that than any other period of life. These facts are but lately verified by S. L. Schenck who, moreover, found the network of the lymphatics in the skin of the newly-born endowed with open stomata, through which the lymph-ducts can communicate with the neighboring tissues and cells, and *vice versa* (Jacobi, "Treat. on Diphth.," p. 31).

The blood of the newly-born differs greatly from that of the infant at a period but little advanced. The hæmoglobulin in the umbilical artery amounts to 22.2 per cent. of the whole solid constituents, while in the venous blood of the mother it is but 13.99 per cent. The first to prove this high percentage was Denis, in 1830, who found the correct proportions by determining the quantity of iron contained therein. Poggiale found a similar proportion of the hæmoglobulin in the new-born and the fully-grown dog, viz.: 16.5 : 12.6 per cent., and Wiskeman's results are similar. The total amount of the blood contained in the newly-born is, however, smaller than in the adult. The relation of its weight to the total weight of the body being in the former, 1 : 19.5 ; in the latter, 1 : 13.

These conditions, however, are being changed soon. The high percentage of hæmoglobulin commences to decrease

instantly. Young animals have less than old ones; in the calf and oxen the proportion is 11.13 : 13.21.

Denis found it to diminish until the age of six months, and a very slow increase up to the thirtieth year. Leichtenstern found the following proportions: if the blood of the newly-born contains hæmoglobulin 100, that of a child of from six months to five years contains 55; of from five to fifteen years 58. At the age of from fifteen to twenty-five it is 64, 25–45=72, and 45–60 it is 63. Subotin also found less in young animals than in old ones; also less when the amount of nitrogenous food was reduced. Leichtenstern found the percentage of hæmoglobulin to decrease in the very first two weeks. It was lowest at the age of from six months to six years; after that time a slow increase takes place. But even in the very vigor of life, in the third and fourth decennia, the percentage of hæmoglobulin is smaller than in the newly-born.

There are some more differences in the composition of the blood of the young, more or less essential in character. The fœtal blood and that of the newly-born contains but little fibrine, but vigorous respiration works great changes in that respect. Nasse found the blood of young animals to coagulate but slowly. How this is in the infant cannot be determined until more and better observations will have been made. There are less salts in the blood of the young, and according to Moleschott, more leucocytes. Its specific gravity in the young is 1045–1049; in the adult, 1055. Thus, letting alone the newly-born, the result from the above figures is this: The infant and child has and requires more blood in proportion to its entire weight, but this blood has less fibrine, less salts, less hæmoglobulin, less soluble albumen, more white blood corpuscles, and less specific gravity.

The large arteries in the newly-born and the infant are

wide, and consequently the blood pressure is but low. This is mainly so in the first five years, in the subclavian and common carotid. Thus the brain has a chance to grow from 400 grammes to 800 in one year; after that period its growth becomes less. At seven, boys have brains of 1100, girls of 1000 grammes. In more advanced life its weight is relatively less; 1424 in the male, and 1272 in the female. At the same early period the whole body grows in both length and weight. The original 50 cm. of the newly-born increase up to 110 with the seventh year; the greatest increase after that time amounting to 60 (in the female, 50) centimetres only. In the same time the weight increases from 3.2 kilo. to 20.16 in the boy; from 2.9 to 18.45 in the girl; a proportion of 1 to 6 or 7, while after that time the increase is but three- or four-fold.

As the organs grow, so do the peripherous blood-vessels. Their size is in proportion to the large blood-vessels. Only the heart grows toward the seventh year, perhaps, only because it requires an over-exertion to overcome the sluggishness in the circulation of the large and small blood-vessels. It is smallest, with large arteries, in the first year (particularly in the second half) at the same time that the growth is most intense. Thus it appears that the growth and physiologically low blood pressure go hand in hand.

The sizes of the large blood-vessels do not grow equally, nor do they exhibit the relative proportions to each other of the normal development of the adult. The pulmonary artery is from two to four centimetres larger than the descending aorta. That means for the lungs more active work, but also more tendency to disease, particularly as, since the closure of the ductus Botalli, the aorta, from which the bronchial arteries are sent off, assumes considerable proportions within a short space of time.

At this time the lungs begin to rival the liver, which in

the first days of life was twice as large as both lungs combined. At this time, the amount of carbonic acid eliminated by the lungs is increasing steadily to relative proportions not known in the adult, in the same manner as the amount of urea eliminated is relatively larger than in the adult, in consequence of the size of the kidneys, which are proportionately larger than in the adult.

Water prevails in the organs, even to a greater extent than the smaller specific gravity of the blood appears to justify. The brain in all its parts, but not equally in all, contains a high percentage of water, the exact figures of which can be found in "Buck's Hygiene," 1st vol., p. 139. The muscular tissue has a percentage of 81.8 (E. Bischof) in the newly-born; of 78.7 in the adult. Schlossberger found the following figures: in a calf of four weeks, 79.7; the grown-up animal, 77; the young duck, 85.4; the old, 72.

The labor required of both heart and lungs is greater than in the adult; thus fatigue is more easily experienced, and the necessity of sleep, the interruption or absence of which adds to the exhaustion and waste, is readily explained. More physiological work is done by these two organs, and, moreover, in a manner somewhat different from what we notice in the fully developed individual. In him, nothing is required but the sustenance, or rather, constant reproduction of the bulk of the body; in the child, not only reproduction, but a new development of tissues, a constant growth, must go on.

Within one year after birth, the young creature attains three times its original weight. Thus we have to deal with a being whose organs are in constant exertion, or almost over-exertion. Now, metamorphosis of matter is not controlled by the inhaled oxygen alone, for the living organism is not only what Liebig took it to be, an oven; its in-

tensity depends certainly in part on nerve influences. As the nerve cells contain so much more water than in later periods of life, it is very probable that their electro-motor action differs from that exhibited later on. Besides, the predominating development of the medulla oblongata, the anterior horns and trophic nerves, points to the same conclusions. All this action and activity is at the expense of the system. But that is not all. Not only exertion and almost over-exertion, when compared with the efforts of the merely self-sustaining adult system, but constant production of new material, and all this at the expense of a blood which contains less solid constituents than the blood of the old. Thus the normal oligæmia of the child is in constant danger of increasing from normal physiological processes. The work before a baby has to be performed, under the most favorable circumstances, with, so to speak, a scarcely sufficient capital. The slightest mishap reduces the equilibrium between that capital and the labor to be performed, and the chances for the diminution of the amount of blood in possession of the child are very frequent indeed.

Thus, the vulnerability of the young being great, and diseases in early infancy and childhood so very frequent, cases of anæmia are met with in every day's practice, and in every form, complicated and uncomplicated, with great emaciation or without it, and either curable or not. A condition so frequent, so variable, so dangerous, deserved to be treated in monographs by the best men amongst practitioners and writers, and still there is scarcely any text-book, any journal, in which a competent and comprehensive view of the subject can be found. There is but one noteworthy exception to this fact. Dr. Förster, of Dresden, contributed two years ago a valuable essay on the subject in one of the most praiseworthy literary under-

takings of modern medical authorship. There are two great works in pædiatric literature recognizable as landmarks. The first were the three volumes of monographs published by Rilliet and Barthez. The second is the great manual on diseases of children, edited by C. Gerhardt. In its third volume, Dr. Förster's article has been published. Like others before him, he makes a distinction between idiopathic and symptomatic anæmia.

The former diagnosis is made when there is no tangible cause at all, or none which still persists; the latter when the change in the blood, with all its consequences, is attributable to a previous or present sickness. Perhaps it is idle to consider the question at all, whether there can be a genuine, primary idiopathic anæmia. When we sift the matter, we shall come to the simple conclusion that everything has its cause, is but a result, and secondary to something else. From this point of view, and strictly speaking, objection could be raised to the term of idiopathic pneumonia, peritonitis, or meningitis. When we make use of it, we mean to state only that the local affection is no longer complicated with any other that could be diagnosticated, and, possibly, removed.

In this sense there are cases of idiopathic anæmia, in which the original infant disposition to it, of physiological character, has been raised to a pathological dignity. But the large majority of cases are of markedly secondary character, and cannot be appreciated or treated rationally without the recognition of the original causes. They are of the most various character. In fact every disease occurring in infancy and childhood may give rise to anæmia. Very few diseases when they have run their full course and terminated in what we are pleased to call recovery, leave the organism or the affected organ, in as perfectly a normal condition as previously. The frequent recurrence of simple diseases such

as pneumonia points to the fact that changes have been worked which create a constant predisposition to pathological processes in the same organ. Thus, in most cases of anæmia the diagnosis of the whole case must extend to the organ first affected, and the treatment, while it may be directed against the result, is incomplete unless the causal indications be fulfilled.

Hemorrhages result in anæmia in a number of instances. They are of different character and importance. There is true melæna; umbilical hemorrhage; hemophilia; primary or secondary purpura; internal hemorrhages of the newly-born; cephalhæmatoma; hemorrhages from rectal polypi; epistaxis depending on coryza; epistaxis at a more advanced age from heart disease and abdominal stagnation; hemorrhages in diphtheritic angina; and such as take place during or in consequence of operations for hare-lip or ritual circumcision. Death may result from many of them, such as melæna, hemophilia, pharyngeal hemorrhages, or circumcision; others are of but little gravity, such as the sanguineous tumor of the newly-born; others are apt to result in permanent ailing. As a rule, however, an acute anæmia is more easily overcome than one that is of a more chronic nature, and thereby undermines the vitality and strength of the organs while it slowly robs them of their nutriment. Infants who are thus stricken recover but slowly or not at all. Young animals resist starvation to a less degree than old ones. A dog of two days bore starvation in Magendie's laboratory but two days; a dog of six years, thirty. Similar results were obtained by Chossat in his experiments on pigeons. Thoroughly anæmic and delicate babies seldom recover entirely, like starving young animals which never attained their normal condition though they were carefully fed afterward. The recruits of the Prussian army born in the starvation years of 1816 and 1817 were of a very inferior

character, physically. To this class also belong the children born prematurely and of delicate parentage, though there were no recognizable constitutional disease, and of mothers afflicted with a disease of the uterus or placenta, inflammatory, syphilitic, or otherwise; or of such as suffered much during pregnancy or lactation; also those born with congenital diseases, cyanosis, or neoplasms, which are by no means so rare as has often been believed and said, or the peculiar smallness of the heart, and principally the arteries, to which Virchow attributes many cases of chlorosis. I have met with half a dozen of such cases, in which the supply of blood to the body was diminished by this anomaly, and Dr. Skene reported a case of probably the same nature which was published in the *Journal of Obstetrics and Diseases of Women and Children*, Oct., 1876.

Besides the diseases and affections of the newly-born there are others which develop in later life and lead to the same results. It is often acquired in endocarditis, for instance; acute inflammatory rheumatism, which is very frequent, yields in most cases but little swelling of the joints, comprises most cases of so-called growing pain, and has a much more marked tendency to the production of an endocarditis than the same affection in the adult.

Protracted diarrhœa injures to a greater extent than constipation. It acts not only by the direct and immediate loss of serum, through which it can prove fatal in a short time, but more frequently by its consequences. The mucous membrane of the intestinal tract becomes thickened, the submucous tissue œdematous, the muscular layer œdematous or hyperplastic; the adventitia sometimes undergoes fatty degeneration. Erosions and ulcerations are apt to become chronic, and frequently the mesenteric glands are the seats of congestive and hyperplastic processes. An intestinal catarrh cannot last any

length of time without irritating, congesting, enlarging, and finally indurating, or provoking caseous degeneration of the neighboring lymphatic glands. The cause of the diarrhœa is indifferent in this respect. None can last without consecutive injury to the lymphatic glands which is apt to become permanent and deteriorate sanguification for the future. The unmistakable practical conclusion from this fact is that every diarrhœa must be stopped as soon as possible. Neither summer heat, nor that great scapegoat—dentition—must be permitted to yield a pretext for the continuation of a diarrhœa, no matter how innocent it may appear.

Malaria, which is too often diagnosticated when the real nature of the disease is not recognized, and frequently overlooked because of the irregularity and the little pronounced character of the attacks. The first stage of the attack is often not recognizable. The attacks are apt to come at irregular times; are more quotidian than tertian, often concealed by accompanying symptoms such as convulsions, and, therefore, sometimes not accessible to a ready diagnosis. On the other hand, the influence of malaria is apt to undermine the general health, render the child intensely anæmic, and swell the spleen considerably before ever giving rise to a real attack.

Nephritis, with albuminuria, not the acute cases, but those chronic ones which slowly undermine the nervous system and exhaust by direct loss; pernicious anæmia, with, it is true, as far as I know, but two cases occurring in children, recorded in the literature of this recent subject; leucocythæmia; sleeplessness from any cause such as malaria, hooping-cough, or indigestion; mercurial cachexia, rare though it be; congenital or hereditary syphilis; rhachitis, with its influence on blood, glands and bones, its shortening, flattening and even retraction of the thorax, its curvature of the

spine, and compression of the lungs and heart; fatty liver; enlargement of the lymphatic glands, mesenteric, bronchial or otherwise; the complex of symptoms comprehended under the general head of scrofula; diseases of the bones of the most various kinds, from the congenital or premature ossification of the costal cartilages, with its consecutive contraction of the chest and compression of its contents, to the chronic or subacute osteitis of the vertebral column or any of the other parts of the skeleton, with its final termination in amyloid degeneration of the viscera; and finally, to conclude with, diseases of the lungs and pleuræ, caseous deposits, cirrhotic induration, emphysema and empyematic deformity.

In anæmia both the skin and the mucous membranes are pale, of a yellowish hue, thin and flabby. A certain degree of apparent elasticity of the skin and subcutaneous tissue is noticed only in cases of œdematous effusion. Those organs or tissues which are least in use emaciate first; that is, in very young children, fat and muscle. But there are cases in which fat is persistently retained, and in which it is often increased in quantity. For, when the red blood globules are destroyed, there is scarcity of oxygen, and for that reason the combustion of the albuminous substances becomes incomplete, and fat, the physiological result of this incomplete combustion, is deposited in large masses. Particularly is this the case when anæmia is either complicated with or is the result of general rhachitis—when at the same time the glands and the chest are suffering from the results of the rhachitic processes. An illustration of this peculiar occurrence, which is by no means rare, is also seen in the peculiar appearance of acardiac or acephalic monsters, which contain a large amount of œdematous fat, in consequence of the exclusively venous character of their circulation.

In consequence of the ill nutrition and the emaciation of the muscular tissue these infants and children are easily fatigued. In general, the functions of all the organs suffer considerably. And with such debility, irritability goes hand-in-hand. The nervous system is less affected than any other, because of the rapid growth and development which it undergoes at that period of life. Not infrequently, babies who are anæmic and emaciated are in the very best of spirits, because their brains are comparatively in good condition. A certain amount of emaciation can be easily recognized by the depression of the fontanelles of babies under one year old or even later; but the emaciation of the brain does not increase at a rate which corresponds with the loss in weight of the other organs and tissues of the body. In addition, the very sinking in of the fontanelles, which allows us to estimate the amount of emaciation that has taken place inside of the cranial cavity, leads us to the fair conclusion that the emaciation of the rest of the body has taken place to an unusual extent; and any baby with considerable depression of the fontanelles must be considered in danger from the degree of inanition present.

Murmurs in the jugular veins are not very frequent in infancy and early childhood. Murmurs in the carotids and over the large fontanelles, however, are not at all rare. It is not true that these murmurs, audible over the brain, belong to rhachitis alone. They are found in every condition in which blood pressure in the large arteries of the cranial cavity is lessened.

The heart itself seldom exhibits functional murmurs. Whenever they are present, it is safer to attribute them to organic disease than to merely functional disorder. Besides, it is now well known that acquired endocarditis is by no means rare, and, moreover, that it occurs even more fre-

quently in the articular rheumatism of the young, be it ever so slight, than of the adult. Although the brain be not so liable to suffer from emaciation, dependent upon anæmia, as other organs, still there are a number of cases in which headaches, attacks of syncope, sleepiness, etc., or, on the contrary, sleeplessness and hysterical attacks, are the result of anæmia alone, and disappear when this condition is relieved. Not a few of the babies and children who cry the greater part of the night have no other ailment besides general anæmia, and such children are frequently relieved by a meal or some stimulant before they are put to bed, or given during the interruption of their sleep. The pulse of such children is sometimes very much accelerated; sometimes, however, it is slow, and sometimes irregular. I have known such children, in whom for months, and occasionally for years, I have feared the development of cerebral affections from the very fact that their pulse was both slow and weak; and yet, when their general condition was improved, both the regularity and frequency of the pulse were increased.

The pulse, however, is, perhaps, amongst the symptoms which are most unreliable at this age. In the baby it is best counted during sleep, and better over the fontanelle than upon the radial artery. It will change very frequently, not only with alternate sleeping and waking, with rest and restlessness, but sometimes without apparent provocation. A slight amount of muscular action will change its character more or less, and frequently considerably. Physiologically, the pulse is very apt to be more frequent at the age of two and a half or three months than earlier or later, because it is at about that age that muscular movements are actually developed.

Very few anæmic children have a good appetite except at the beginning. The influence of anæmia is general in

regard to all organs of the body. Circulation is deficient, and the normal secretions are defective or deficient in consequence. That is, both appetite and digestion are impaired, and sometimes destroyed, and cannot be restored until the general condition of the child is improved.

The slowness of the circulation and its insufficiency, and the watery condition of the blood, are apt to give rise to catarrh of the pharynx and larynx and the respiratory organs in general. Besides, the walls of the blood-vessels are known to suffer in anæmia. They become thin, and undergo fatty degeneration, which Ponfick has found in the heart, and in the intima of the larger blood-vessels and in the capillaries. In consequence of the thinness of the blood and the changed condition of the blood-vessels, serous transudation, and, now and then, extravasations will take place. The same occurrence is noticed in the adult in conditions of anæmia. It not infrequently occurs that those who have least blood lose it most easily. Anæmic women are very apt to have copious menstruation, and when their general condition has been improved, both blood and blood-vessels resist this tendency to hemorrhage.

There is one consequence of the anæmic condition which is of the utmost importance, and requires urgently that it should be removed in the shortest possible time.

Whenever a disease sets in it is more liable to result fatally in consequence of impaired powers of resistance, and where there is the slightest tendency to effusion or to exudation these processes will become more extensive and dangerous in less time than in the normal organism. A pneumonia, a peritonitis, a pleurisy, occurring in an anæmic child, is attended with a great deal more danger than when either of these affections occurs in a child enjoying good general health.

That epistaxis in a child 5, 6, or 8 years old should last

as long as the patient is in a generally impaired condition, is just as frequent an occurrence as it is a common experience to meet with almost constant improvement after a change of diet, change of air, and a few doses of iron.

The predisposition to anæmia in the child is very great, as proved before, and the causes of its development very numerous. These causes must be, according to circumstances, either prevented or remedied. For genuine cases of idiopathic anæmia are certainly very rare, and an accurate diagnosis will find it to be symptomatic in almost every case, and to depend on the lesion of some organ, or system of organs. The danger of anæmia is greatest at the time of the most rapid growth, still it is a cause of slow destruction in every age. The nursling is more exposed than the child, for the growth of all the organs, with very few exceptions, is most intense at the earliest period of life. At that time, besides actual disease, insufficient food, or improper food, are frequent causes, the latter a more frequent one than the former, and often the more dangerous one of the two. Infants whose mothers or nurses have not enough milk, simply starve; they lose weight, strength and color. As long as their lungs and muscles will hold out, they will scream. Some of the yelling heard in the night amongst the tenement-house population, and sometimes in the better-situated classes, too, comes from starving babies. After a while the yelling turns into a whining, and any slight disease terminates the baby's suffering. This condition is recognized by the absence of local disease anywhere, by the gradual emaciation, and is characterized by the paucity of otherwise normal fæces. Many a case of alleged constipation is one of starvation. Where there was no food, there are no evacuations, and when a baby is reported as having but one normal passage a day, or even less, the suspicion is that it has

not enough to eat. The remedy is easily recommended, for it consists in nothing but a sufficient quantity of proper food.

Improper food is a much more frequent cause. A few remarks must suffice here, for it is impossible to go over the whole ground of infant hygiene in a short paper which is more meant to suggest than to teach. A few points, however, I must not omit, because of the frequency of the sins committed. The contra-indications to a woman's nursing a baby must be obeyed. Nursing during pregnancy, or extended over too protracted a period, must be forbidden. The latter is, if possible, more serious than the former. Many a case of rhachitis or anæmia owes its origin to the baby being nursed into the second year. A baby whose development is not normal, for instance, whose first tooth does not appear at the regular age of seven or eight months, is either suffering from a previous disease or it has insufficient or improper food. If nursed, therefore, it ought to be weaned, or partially so. Many a flabby child at the breast will thrive when weaned at last, and good barley and cow's milk will make better muscle and teeth than poor mother's milk. An inherited or inheritable or communicable disease on the part of the mother or wet-nurse, such as consumption, rickets, syphilis, serious nervous diseases, intense anæmia, forbid nursing. In not a few cases the individual milk of mother or wet-nurse does not agree with the baby. When such is the case, unless the fault can be detected and remedied, weaning is required. In most cases it is possible to trace the indigestibility and insufficiency of a mother's milk to the absence or prevalence of a special constituent, mostly either sugar, or—and mainly so—casein. A beautiful illustration of this fact was but lately exhibited by a baby patient of Dr. A. N. Smith. The mother's milk was undoubtedly too white

and too caseinous. The baby's digestion was faulty, his assimilation quite defective. The addition of some farinaceous decoction to each meal from his mother's breast—a few teaspoonfuls given before each meal—remedied the evil somewhat, but the patient's life was finally saved by nothing but weaning and exclusive artificial feeding. It is impossible, however, to consider now the question of infant food to any extent. Such principles as I have laid down in Buck's Hygiene, and very briefly in my paper on infant diarrhœa and dysentery, have guided me through the better part of my life. I shall not, therefore, tire your patience by repeating them. There are, however, a few simple words which I cannot repeat too often. Avoid solid food in the care of an infant. Avoid cow's milk either undiluted or diluted with water only. Avoid condensed milk diluted with water only. Use no milk without the addition of some gelatinous or farinaceous decoction, barley, oatmeal, gum arabic, gelatine. In anæmia, add beef soup to the uniform infant food daily. Give solid food, that is a small piece of meat, a crust of bread, half an egg, about the end of the first year. Keep up this simple diet for another year, and add slowly such articles of food as physiology and experience permit. Prohibit bad habits, such as irregular and fast eating, cold feet and highland-fashion legs, and enforce out-door exercise; children before and after an out-door play are different beings. Avoid crowded school-rooms and the excess of private lessons. A child sleeping after a healthy exercise of his muscles and lungs will finally, besides being stronger and healthier, learn more than one who hangs his pale cheeks, sleeping over his books. We have laws to protect children from being sent to work in factories, or to be employed on the stage, but we have none to protect them from the equally destructive, incessant schooling in close

rooms, without air or exercise. There are too many books bought for Christmas and too few skates.

Amongst the medicinal agents iron has long been the main resort in anæmia and chlorosis. This was so even before the time when hemoglobin was isolated and found to contain all the iron of the blood. As it was found to benefit the cases of anæmia and chlorosis, in which the red blood corpuscles were undoubtedly diminished, it was believed that iron had the ability to directly increase the number and the quality of the red blood globules. But the question whether it is really the iron which produces this effect has not been answered to the satisfaction of all, for a great many of the cases get well while no iron whatever is given, and in consequence of change of diet and the securing of rest and a better general condition. Besides, there are a number of cases in which the administration of iron is absolutely unavailing. Moreover, there is plenty of iron in almost every article of food. Boussaingault found that thus eight or nine centigrammes (gr. iss) of iron are daily taken into the body. The same quantity has been found by Fleitmann to be eliminated by the kidneys and the intestinal canal. Thus, there certainly are cases of chlorosis which have not been caused by the absence of iron; and it cannot, therefore, be said that the iron, by supplying this lack or by removing this absence, cures chlorosis.

But it is still a question whether the iron thus given, under circumstances which are entirely abnormal, does not improve the chances of recovery in just these conditions. The doses given would certainly be too large, when compared with the iron contained in the food and with the amount of iron present in the whole quantity of circulating blood, three grammes and no more.

Compared with this small quantity, the doses we are accustomed to administer are certainly large. Speedy elimi-

nation, too, takes place, through which the whole or nearly the total amount of the ingested iron is removed. But it has not been found whether the iron does not act in some other way besides increasing the amount of the metal contained in the hemoglobin.

After iron has reached the stomach it is decomposed into an oxide, and is absorbed, probably in the form of an albuminate. There can be no doubt, according to Dietl and Heidler, that it is absorbed in the stomach, and very probably the upper part of the small intestine also. It reappears in the bile and the pancreatic juice. Not only is that the case after it has been introduced into the stomach, but it will also reappear in the bile secretions of the intestine and pancreatic juice, according to A. Mayer, after it has been injected into the veins. It is true that Quincke was sometimes unable to find iron in the intestinal secretions after it had been injected into the blood, but it seems to be well established, according to the experiments of Prokowski, that the temperature of the blood is elevated, the pulse accelerated, and the blood pressure increased after the use of iron. For this reason it ought not to be given during the height, or even during the course of inflammatory fevers. A number of its preparations are certainly vascular excitants. But for this very reason, while it is contraindicated in inflammatory fevers, it certainly is indicated and required in most cases of septic fevers.

The preparations most beneficial in anæmia of children are, in my opinion, the following: the lactate, the tincture of the pomate, the iodide, the pyrophosphate, the subcarbonate, and the tincture of the chloride.

The lactate and the pomate are very digestible, and may be given whenever the indication for the use of some mild preparation of iron is established.

The syrup of the iodide has an advantage over the other

preparations of iron, because by its use two indications may be met—that is, where the additional aid of an absorbent is desired. Therefore, it is the proper remedy in cases of slow convalescence after inflammations resulting in exudation, particularly in disease of the glands and the lungs. It has, moreover, one peculiarity which makes it much more desirable than many other preparations, and that is, it is easily decomposed in the stomach ; the iodine is set free, and acts as an antifermentative in the many cases of disturbed gastric digestion occurring even in normal children, and almost certain to take place in children whose circulation has been disturbed or whose gastric secretions are certainly below their normal amount in consequence of a deficient supply of blood.

The subcarbonate of iron is a very mild preparation, easily digested, and, properly combined with a number of drugs, such as bismuth or bicarbonate of soda, is of considerable value when, in slow convalescence or progressive anæmia, this gastric catarrh threatens to interfere with the improvement in the general condition. The doses may be larger than those of any of the other preparations. A child two years old will easily bear from 25 to 50 centigrammes daily. This quantity, combined with twice or three times as much subcarbonate of bismuth, and, if necessary, three or four times that amount of bicarbonate of soda, is a very proper remedy to be used in the conditions alluded to.

The tincture of the chloride of iron, when neutral, is a preparation which is also easily digested. Doses of a gramme daily, or more, are very readily digested, and prove beneficial. This can be easily combined with the bitter tinctures, stomachics, etc. The tincture of the muriate of iron is the one, amongst the ferruginous preparations, with the exception of those partly composed of ether, the acetate, for instance, which must be regarded as a vascular

irritant, and wherever the action of the heart is lowered and blood pressure is diminished, it is the preparation which will be found most beneficial.

In a number of cases, the choice among the several preparations of iron is an indifferent matter, at least, so it appears to be. Still it has seemed to me that, in those cases in which I have had to deal with anæmia attended by gastric catarrh and digestive incompetency in the upper portion of the small intestine, the pyrophosphate proved very satisfactory. I have employed the compound hypophosphites and phosphates a great deal, which combine iron, potassa, lime and soda, and, although it is well known that the elimination of these metals and metalloids is almost as rapid as their ingestion, still it appears that the effect produced by such combinations is a very happy one in just such conditions as those of which we have just spoken.

All these preparations are of special value in chronic anæmia, which is by far the most common affection. Acute impoverishment of the blood, such as that caused by severe puerperal hemorrhage or hemorrhage from the bowels, is fortunately very rare in infancy and childhood. Therefore, the opportunity for transfusion of human blood is seldom offered, even to those who are most fond of that particular operation.

The doubtful results of transfusion upon a large scale have induced a modern writer to make a number of small transfusions by means of the hypodermic syringe. He would withdraw blood from the vein of a healthy person and introduce it directly and immediately into the veins of the sick child, and he states that he has done so with favorable results. It seems to me that the plan is rational enough, but the future must decide whether the results will be as favorable as they have been reported, and whether

there will not be grave objections to what is described as a very trifling operation. If it be successful, it would certainly, under equal circumstances, have the preference over the slow process of gastric, or of rectal alimentation, no matter whether injections of defibrinated blood or other nutrients are used.

In cases of chronic anæmia I have frequently used arsenic; one or two minute doses daily, after meals and well diluted with water, and with benefit. Of one thing there is no doubt, and that is that arsenic does good in a peculiar torpid condition of the stomach which will not digest and assimilate in consequence of the absence of both nerve power and gastric juice. Both in adults and in children, I have given it for the purpose of improving general nutrition, and I have not seen in children what very frequently occurs in adults when arsenic is given for nervous disorders, namely, gastric derangement. With iron, with or without stomachics, I have seen the appetite improving, the mucous membrane filling with blood, and vigor returning under its restorative influence. Doses: from two to five drops daily, of Fowler's solution.

In this connection, I will state that strychnia, in my hands, has proved very beneficial as an adjuvant to either arsenic or iron. To a child two years old a dose of $\frac{1}{40}$ of a grain may be safely given daily, and this dose may be continued for a long time. Its action is well known in cases in which the digestion and the entire nervous power of the patient are simply lowered, and a few weeks' administration, together with proper food and either iron or arsenic, has changed the condition of the anæmic child considerably.

Phosphorus, in about the same doses as strychnia, has also produced very happy effects. They may be brought about by the influence of phosphorus upon the nervou

system, or they may be explained by the effect which the remedy produces when given in diseases of the bones. Some ten years ago, Georg Wegner found that the fractured bones of rabbits fed upon minute doses of phosphorus, would unite much more rapidly than the fractured bones of those animals which were left to themselves. Since that time I have been in the habit of giving phosphorus in cases of acute and chronic disease of the bones of an inflammatory character, and in caries particularly, and my impression is that the large majority of cases do very much better when small doses of phosphorus, say $\frac{1}{150}$ to $\frac{1}{100}$ of a grain daily, are given, than when the disease is left to pursue its course without the use of this remedy. It is true that the time required by such a process as caries is long under any circumstances, but it has seemed to me that even caries of the ankle joint and the metatarsus was apt to progress very favorably in the course of a number of months when phosphorus was used, whereas years were required in other cases which had not received the same treatment.

I do not know that it has been used extensively in rhachitis, but it is not improbable that the good effect which phosphorus produces in anæmia, mostly of rhachiticial children, is partly due to the fact that the bones especially show an increased tendency to normal development.

In many cases cod-liver oil is very serviceable; I need not speak of its effect, and shall only say that frequently the contra-indications to its use are overlooked. Most children do not bear it well in the summer, when it is apt to produce either gastric catarrh or diarrhœa. Some do not bear it at all at any season of the year. It is with cod-liver oil as with any other remedy, particularly iron, of which I have already spoken. There are children

who do not bear either, and therefore they must be treated without these remedies. At all events, it should not be forgotten, whenever digestion is impaired, whenever there is gastric catarrh, that these cases require preliminary treatment before the administration of either cod-liver oil or iron is resorted to.

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