CHILD HEALTH
IN WARM CLIMATES

W. K. BLACKIE

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BY

DR. W. K. BLACKIE

FOREWORD BY

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To My Wife

FOREWORD

In contributing a foreword to this small book I should first say that in my opinion the book is of far greater importance than its size may suggest.

The subject matter of the book is wrapped up with the problem of the preservation of the white races in tropical and sub-tropical areas, but even more important the preservation of the characteristics which they have derived from their European ancestors, such as energy, drive, activity, method and appreciation of time.

A great deal of the subject matter is applicable to the rearing of children in any part of the world. The chapter on sleep draws attention to the importance of sufficient sleep and rest during childhood if the finished product is to be a well-balanced normal man or woman.

The section on diet will be found most informative and the references to common diseases and symptoms which result from vitamin deficiency make this rather dry subject good reading and interesting.

In dealing with tropical heat and tropical sunshine, Dr. Blackie refers to housing shade and clothing. I consider this part of the book of outstanding importance. The question—which are the more harmful, the heat rays or the actinic rays of sun?—remains unanswered, but each is placed in its proper perspective. What is demonstrated, however, is that excessive heat is definitely detrimental and that to the European in the tropics and sub-tropics repeated overdoses of sunshine are definitely harmful. I consider

that the space devoted to this subject alone justifies the publication of the book.

The two chapters dealing with protection against disease will be found most helpful and the sections devoted to malaria and Bilharzia should be read by everyone in charge of children. The suffering and loss of efficiency due to these two diseases necessitate a more intelligent interest in this matter than has been shown in the past.

I am very pleased to have the opportunity of writing this brief foreword to a book which should be in the hands of every Child Welfare Worker, Hospital Nurse, Educationalist and Practitioner of Medicine who is new to practice in the tropics, and last, but by no means least, the more intelligent parent who has not received special training will find the book a mine of information and a useful guide to the successful bringing up of children.

G. M. HUGGINS.

SALISBURY,
SOUTHERN RHODESIA,
20th November, 1942

PREFACE

CONTINUED residence in the tropics and sub-tropics is not without its hazards and therefore demands a generous measure of vigilance and foresight in the maintenance of health and vitality.

This is especially true in the case of children, who because of their immaturity are less able to withstand the debilitating effects of heat and dietetic deficiencies or the devitalizing effects of parasitic infection.

This little book aims at conserving, under tropical conditions, the inherent vitality which may be regarded as the birthright of every child. By so doing the child is rendered more resistant to infection and at the same time more resilient in the presence of disease. There are, of course, exceptions to this broad generalization, but they do not invalidate it.

The principles which underlie any scheme which aims at maintaining and promoting the health of the child are fundamentally the same wherever the child may chance to spend his formative years. For this reason I have chosen to give due emphasis to the importance of sleep and diet and have attempted to show what modifications are desirable or necessary in relation to a tropical environment.

A chapter has also been devoted to the problem of the sun in the tropics. A newcomer will quickly become aware of the existence of two opposing schools of thought. On the one hand there are the ardent uninhibited sun-worshippers who preach the virtues of free and frequent exposure

to the life-giving sunshine and who claim immunity from each and all of the bogeys of over-exposure.

In the opposing school we have a small but select band who regard the sun as an unmitigated menace and who spend their days in evasive action.

I have therefore attempted to weigh up the pros and the cons of the situation in respect of those areas of the tropics where Europeans have already established themselves and have outlined what may be regarded as a reasonable approach to the problem by parents who hold themselves responsible for the welfare of their children.

In most tropical lands, even with European settlement well established, there is an ever-present risk of acquiring some parasitic infection, notably malaria, or some parasitic worm, or it may be one of the parasites of dysentery.

Fortunately a great deal of valuable information has been built up throughout the years on the biology of all the common parasites of man in the tropics and it is abundantly clear that a practical knowledge of the life history of these several parasites is essential to effective prophylaxis. Hence I have discussed the salient features in the life history of the common human parasites, especially those encountered in the African tropics, and have indicated how, by taking thought and applying this knowledge, much needless suffering can be avoided.

Then lest it be thought that the child of the tropics is spared the common infectious diseases of colder lands I have felt it necessary to discuss ways and means of protecting the child where possible against this group of conditions which prove as frequent in their incidence and as dangerous in their outcome in the tropics as elsewhere. But no matter how scientifically and comprehensively we protect our children from the more avoidable hazards of the tropics there still remain situations beyond our control capable of

upsetting the even tenor of the child's health and development. For this reason I have included a chapter on the more common disorders of child health in the tropics, and where possible have indicated the general procedure to follow until skilled medical attention becomes available.

It is hoped therefore that these pages will assist parents, nurses and even doctors new to the tropics in the upbringing of those children who, standing on the threshold of life, must run the hazard of climatic and parasitic influences which if left unchallenged may well cripple the health and break the spirit.

W. K. Blackie.

Salisbury,
Southern Rhodesia,
1949

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CHAPTER I

SLEEP

ALTHOUGH much study and deep thought have been devoted to the phenomenon of sleep, it cannot yet be said that we are fully aware of the sequence of events which culminate in the sleeping state. We do know, however, that during the formative years sleep is every bit as essential to normal growth and development as good food, fresh air and all the commonly accepted necessities of healthy childhood. A child who for one reason or another fails to obtain sufficient sleep will soon begin to look pale and tired and exhibit an irritability quite foreign to the happy spontaneity of healthy childhood. Yet it is a comfort to realize that the disturbances associated with lack of sleep are quickly abolished once the necessary adjustments in the hours of sleep have been put into practice.

The importance of sleep in childhood is strikingly exemplified in the infant who day and night virtually sleeps the clock round. As a sequel the brain and nervous system develop to a most astonishing degree. Without these long spells of uninterrupted sleep this amazing and harmonious development would be seriously retarded and what is true of early infancy is equally true of early childhood. In other words every child must have long hours of continued sleep, and once the importance of this biological fact is appreciated there should be no particular difficulty in arranging the sleeping hours in accordance with the age and temperament of the child. With the establishment of a good sleeping routine from earliest infancy, little difficulty will

be experienced in maintaining that routine suitably modified throughout the childhood years, both in sickness and in health.

Amount of Sleep.

The amount of sleep required by a child in the course of twenty-four hours is governed by a variety of factors including age, temperament, physical activity, atmospheric conditions, and so on. As already stated, young babies sleep the greater part of both day and night, but as infancy merges into early childhood and the child becomes aware of the fascinations of its new world there follows a natural reduction in the number of hours required for sleep.

The gradual modification in the sleep pattern of the child is shown in the following table which has been compiled from various sources:

NORMAL SLEEP REQUIREMENTS

Age	*Hours of sleep*
Early Infancy	20–22
Up to 2 years	15–16
2– 3 „	14
4– 7 „	12
8–11 „	11
12–14 „	10
Up to 16 „	9

This table gives no indication of the distribution of the hours of sleep over the twenty-four hours. Younger children must obviously make use of the day as well as the night to obtain their full quota of sleep, whereas in the later years of childhood all the sleep necessary can be obtained by a simple "early to bed" policy.

In the tropics most children wake early and in the first

eighteen months or so are usually ready for an hour's sleep by nine or ten in the morning and again during the heat of the afternoon, say between one and three or one-thirty and three-thirty. Thereafter they can be left to roam about until about six, after which they should be put to bed for their major sleep of the twenty-four hours.

The Day-time Sleep.

In Southern Africa the best nursery for the day-time sleep is out of doors in the open air. In this way the child gets the best out of the long hours of sunshine, so much a feature of this part of the world. Babies should therefore be accustomed to sleeping in the open air from the time they are born.

After the early morning feed the child is transferred to his cot and placed in some shady corner of the garden and left there to sleep until the next feed falls due. There is no particular need to worry about noise, as the healthy baby quickly accustoms himself to sleeping through all manner of sounds. After each of the day-time feeds the same procedure may be followed except that care must be taken to see that the cot is so placed that it is never exposed to the direct rays of the sun. A mosquito net, preferably green in colour, must always be used to prevent the child from being disturbed or bitten by flying and crawling insects.

There is always a tendency to overclothe the baby who sleeps out of doors. On the cool days a blanket will usually be necessary, but otherwise a single sheet is all that is required. If the baby's forehead feels cool to the touch, then it is obviously comfortable, but when the head and neck are wet with perspiration then the child is overburdened with clothes.

As the child grows older—that is to say after about a year or eighteen months—the day-time sleep may be con-

siderably curtailed and is usually restricted to the early afternoon when the heat is maximal and the sun's rays most intense. Even the animals of the veldt and the birds of the air fall quiet at this time. It is obviously an appropriate time to choose for resting the growing child.

With this object in view the child should finish his midday meal about half-past twelve and thereafter should be allowed to play about for twenty minutes to half an hour to allow his digestive processes to come into active operation. When a child lies down immediately after a meal, digestion is retarded and troublesome flatulence may be caused. Having played round for the prescribed period, the child is partially undressed, preferably clothed in cool, fresh sleeping garments and put to bed in a cool airy part of the house away from the glare and direct sunlight. On the hot days it will be perfectly safe to allow him to rest on top of his bed-clothes, but when the weather conditions are variable or when it is cool and cold, some form of covering becomes necessary. The child, of course, is allowed a book or some plaything with which to amuse himself, but it will usually be found that children in the younger age groups fall readily into a peaceful sleep. In this way they gain a valuable rest as a sequel to their activities of the morning. At the same time they are spared the exhausting heat of the early afternoon.

Perhaps it may not be amiss to point out that the practice of insisting on a rest for the child in the early afternoon affords the mother a welcome and well-deserved break from the exacting task she has on hand.

It is not always appreciated, not even by fathers, that the care of small children is a full-time job and, particularly in the tropics, imposes a heavy strain on the mother who assumes full responsibility for her children's upbringing, so that any scheme that benefits the child and at the same

time affords some respite for the mother is deserving of the fullest support.

The Night-time Sleep.

No matter how conscientiously the day-time rest is observed, the night sleep must always rank as the major sleeping period of the twenty-four hours. For this reason every effort must be made to ensure for the child a long, unbroken spell of sleep. As already stated, it is the uninterrupted nature of the sleep that enhances its tonic value. The bed-time routine, therefore, deserves special attention.

After a light supper the time that remains before bed-time should be a quiet, restful period—a true children's hour, given over to the reading aloud of some quiet story or to reasonably peaceful games. Undue excitement immediately before bed-time or the reading of frightening tales is apt to stimulate the imagination and so deprive the more nervous type of child of the quiet, restful sleep it so badly needs. A warm bath before retiring is particularly valuable. It removes the accumulated skin secretions of the day and encourages healthy skin activity during the hours of sleep. At the same time it promotes a sense of comfort and well-being and therefore prevents the child from being put to bed feeling cold and uncomfortable. One point, however, should be stressed, namely that once the bathing routine is over the child should be put to bed straight away and not allowed to run about rooms and passages, thereby risking chills and colds. One of the last acts before retiring should be to empty the urinary bladder. The child is then tucked in and after a brief but kindly "good night" routine, is left to fall asleep.

The bed should preferably be of the single type with a firm mattress. The coverings should be appropriate to the season, while a soft but firm pillow is desirable, especially

in infancy. With a pillow of the soft downy type there is always a risk that the young baby may bury its face in it and be unable to breathe. In the cold season it is perfectly reasonable to warm the bed with a hot water-bottle which, however, is better removed when the child lies down. Most children prefer to take some treasured toy or plaything to bed with them, and provided it has no sharp points or cutting edges, there is no reason why this habit should be discouraged. The child derives much comfort from the presence of some well-known friendly object when darkness is all around.

When the room has been darkened the child is left to fall quietly asleep. He may croon to himself for a time or where more than one child is sleeping in the same room, pleasant little conversations may be indulged in, but once the final good nights have been said, every child should appreciate the need to settle down quietly without further attention from the parents. It is a wise policy to train the child along these lines from earliest infancy. By so doing bed-time "scenes" will be quite unknown.

Once fully asleep it is as well to see that the child is lying in a reasonably graceful attitude and is adequately covered by the bed-clothes. Thereafter he may be left to sleep until morning except for a final glance when the parents retire for the night. It should perhaps be emphasized, however, that the child's bedroom should never be out of earshot of the parents. In other words the child must feel assured that there is someone to hear him when he calls out in the night, and must be spared the mental anguish of feeling utterly deserted and alone when frightened or distressed during the hours of darkness.

A healthy child soon learns to sleep the night through, although during the dentition period interruptions are more liable to occur. When the child does wake in the

night, as every child will from time to time, then it is important to see that his wants receive quiet, sympathetic but expeditious attention. It may be that he is thirsty or, on the hot nights, damp with perspiration or overburdened with clothes or just wet and uncomfortable. At any rate, whatever the cause, the necessary adjustments should be made, after which he is tucked in again and encouraged to settle down again right away. This the well-trained child will usually do without any fuss or trouble. A big yawn or a puckish grin will usually indicate that he is entirely satisfied with your administrations and a few seconds later will be sound asleep. It is by no means necessary to rush to the child's cot or bed the moment a whimpering cry is heard. Many children cry out in their sleep for a few seconds or even minutes at a stretch without even waking, and settle down again almost immediately. The sudden cry may have been conditioned by some fleeting cause such as a twinge of earache as a tooth erupts, a windy spasm or perhaps by some dreamland activity. However, it will soon be apparent whether or not the cry means more than a fleeting disturbance, and obviously a child in distress, whether fancied or real, must always be comforted immediately. Undue delay in responding to these calls may result in the child becoming a "bad sleeper."

A good deal of inconvenience and nervous tension in the home is sometimes caused by parents insisting on absolute silence once the children have been put to bed. There is no need for this at all. It is common knowledge that children will sleep soundly through all the unsubdued noises of the household provided raucous sounds and sudden bangs are eliminated.

In the pre-school years at least, every child should be allowed to sleep on until he wakes spontaneously. This is the only way we have of ensuring that a given child obtains

the amount of sleep he needs. It not infrequently happens in the tropics that the child wakes an hour or so before the household is ready to stir. In such circumstances he should be encouraged to amuse himself quietly in his cot with a toy or a picture book. Sometimes the child wakes early because he is being put to bed too early, so that once his sleep requirements have been assessed the necessary adjustments in the bed-time arrangements can be made. When feeding arrangements necessitate waking the child from his sleep, this should be gently and carefully done, so that the translation from a glorious sleep to the stern discipline of the nursery is carried out without engendering feelings of violent resentment.

Passing reference has already been made to the child's attitude when asleep, when it was suggested that ungainly dispositions of the limbs should be corrected. Some children, however, are individualistic, whether asleep or awake, but for the most part a common postural attitude prevails during sleep. Infants usually lie on one side or the other in an attitude of flexion. The fingers are closed and tucked beneath the chin, while the thighs and knees are bent. It is a useful plan to accustom the child to sleeping both on the right and on the left side. Where a child shows a tendency to sleep with his face well into the pillow, a soft pillow must never be used. Older children sooner or later adopt the method of sleeping on one side or the other.

Finally, all healthy children when asleep have the eyes and mouth closed so that any departure in this regard merits investigation.

The Function of Sleep.

The compelling power of sleep with its spontaneous daily rhythm is evidence of a function essential to life and health. Sleep is certainly a major consideration in infancy

and childhood, when the growth processes are so active and exhaustion so readily induced. Most healthy children expend their energies lavishly during the waking hours, and therefore require long spells of uninterrupted sleep to fit them for the day that lies ahead. The sleeping child is perhaps the most perfect example of spontaneous relaxation. All the basic bodily activities have slowed down. The heart beats less rapidly, the breathing is slower and the greater part of the brain is at rest. But it is now that the processes of growth come into their own. It would appear that during sleep the normal body pressures are diverted from the growing ends of the long bones, resulting in an immediate increase in activity leading to a steady increase in length. A similar acceleration of growth takes place throughout the body generally, so that not only does sleep make good the expenditure of energy but it indirectly promotes growth. In addition it gives the tissues time to eliminate all their waste products which in final analysis cause the mental and physical weariness that overtakes the healthy child at the end of the day.

Sleep is far and away the finest tonic the nervous system can have. The child who has slept well will always show a freshness and a spontaneity in sharp contrast to the sleep-starved child who is soon rendered pale and wan by the toxins of fatigue. We see too the great value of sleep in sickness. So long as a child sleeps well it will always be better fitted to combat an illness, and in this connection it may be said that the child who has been trained to sleep well in health will always feel the benefit of this training during times of sickness.

Restless Nights.

The causes of restless nights in childhood are many and varied. With small babies the possibility of under or over

feeding must be kept in mind, but this point can usually be settled by studying the weekly weight chart or more rapidly by carrying out a test-weighing at *all* the feeds over a twenty-four hour period.

The local irritation and discomfort from a wet napkin or the profuse sweating that comes from being over-burdened with bed-clothes will also render the child restless and wakeful at night. The sleeping garments must therefore be made of light material and should be loosely fitting, while the bed-clothes need consist of little more than a sheet and perhaps a single light blanket. At the same time the child must be protected against all forms of insect life by means of a good mosquito net, otherwise his sleep is likely to be disturbed. Because of the net it is important to make sure that the room or verandah is freely ventilated. The child will find it impossible to sleep restfully in a close room. As a result of the sweating induced by the hot night, the child is liable to become thirsty during the night, and in such circumstances may be allowed water freely, although the possibility of an over-full bladder later in the night has to be kept in mind.

During the dentition period, restless nights are a frequent occurrence, and at this period parents may be called upon to exercise a good deal of patient restraint. At this time the child is liable to bouts of earache and shooting pains in the gums sufficiently severe to wake him up. At the same time the nervous system is often unduly sensitive so that bouts of restlessness and crying are all the more difficult to control. Where the restlessness continues and threatens to become a nightly occurrence, it is as well to make use of a mild sedative, e.g. half an aspirin tablet for a night or two until the crisis has passed.

During the hot season especially, various irritable skin eruptions may appear and prove troublesome at night. A

dose of milk of magnesia with the free application of calamine lotion will often give a long spell of relief, but in some cases more elaborate measures may be called for.

With older children enlarged tonsils and masses of adenoid tissue constitute a common cause of restless nights, in that they interfere with free and effortless nasal breathing. In such circumstances the child breathes noisily with the mouth open and the head thrown back, and every now and then wakes with a sudden start, either through being overtaken by a choking sensation or by some disturbing dream. This type of breathing leads to defective aeration of the blood with all its attendant evils, while the constant mouth breathing confers on the child a characteristically dull and stupid expression. In these circumstances removal of the obstructing masses is obviously indicated.

Again, restlessness at night may be the result of intestinal irritation associated with constipation, fermentation due to an over-starchy diet or by intestinal worms, especially threadworms. A clue to the existence of intestinal irritation is sometimes to be found in the frequency with which the child grinds his teeth when asleep. This sign, though by no means constant, constitutes a valuable hint and should be followed up by the appropriate investigations.

Finally the sick or the feverish child will invariably be restless and wakeful at night. Special allowances will have to be made for him, and appropriate sedative treatment may have to be employed.

Disorders of Sleep.

Talking during sleep constitutes a very minor disorder and is a frequent occurrence in childhood. It often enough occurs in quite young children, but is most frequently encountered at the school-going age. It is sometimes possible to grasp the meaning of the words but more often they

are slurred, mumbled and apparently meaningless. As a general rule no special importance need be attached to the occasional occurrence of talking when asleep, but when it is repeated night after night, it usually implies some disturbance of the child's health, or more likely it indicates some psychical disturbance due to a spell of unusual excitement, worry or mental strain, especially in relation to school work. It is always more liable to occur in the nervous type of child.

A much more alarming and distressing form of sleep disorder is to be found in night terrors. These terrifying attacks occur for the most part between the ages of two and six years, and more than one attack may take place in a given night. Usually, however, a single attack develops once or twice a week, often for several weeks on end. At other times an isolated attack occurs in the presence of some intercurrent feverish ailment, and to all intents and purposes has been conditioned by the effect of the high temperature on the higher brain centres. The attack comes on after the child has been asleep for an hour or two. Then suddenly, without warning, he starts up in a wild screaming terror, staring ahead with unseeing horror-stricken gaze as he crouches trembling and terrified against the end of the bed or in a corner of the room. Nor does he glean comfort from the proximity of well-known objects, or even from the presence and voices of the parents, since the gaze holds no recognition. The visionary hallucinations assume many forms, always alarming and threatening. It may be a ferocious animal, some diabolical human shape, an impending collision with a run-away car, or just fantastic frightening shapes dancing in the shadows of the room.

One curious feature always associated with night terrors is the unusual depth of the sleep. So much so that it is with the greatest difficulty that the child can be roused to

a recognition of his surroundings, but once roused the terrors melt away and in due course the child falls into a natural sleep (henceforth usually peaceful) and awakes next day with no recollection of the events of the night.

The causes of night terrors are many and varied. Not infrequently the precipitating factor can be traced to some emotional experience of the preceding day, such as the sudden fright of an accident or the shock and alarm of an anæsthetic. Again, excessive anxiety concerning home-work or an impending examination may be responsible for an attack, while in the case of younger children, bed-time tales of dragons or witches may have a like effect on highly strung, imaginative types.

Other possible causes of night terrors include indigestion from over-feeding at bed-time, constipation, threadworms and other intestinal parasites, while obstructed breathing from enlarged tonsils and adenoids may also be responsible.

When night terrors occur, they obviously call for a careful investigation of the cause, followed by whatever adjustments and treatment may be deemed necessary. Even after the cause of the disorder has been removed some time may elapse before the night terrors disappear, hence a short period of sedative treatment is usually necessary. At the same time it is probably advisable for one of the parents to sleep in the same room as the child for a night or two, to enable him to have a sense of security and safety, while subsequently he must sleep well within earshot of his parents, so that he may fall asleep secure in the belief that his slightest call will be heard at once.

Finally, there is the disorder known as sleep-walking or somnambulism, which differs from the other disorders already discussed in that there is the added risk of bodily harm.

In the somnambulistic state the child moves about with

his eyes open and the pupils dilated. He frequently talks or mumbles to himself and often appears to comprehend dimly what is said to him. The pattern of these attacks, though constant as to its main features, shows considerable variation in scope and duration. Thus an attack may consist merely in getting up and standing beside the bed in a dazed manner for a few minutes, then getting back in again. At other times the sleep-walker moves from room to room avoiding objects with considerable success. He may descend the stairs or may attempt some clambering feat at considerable risk, and in some cases may carry out some purposive destructive act. In childhood this may take the form of an attack upon some toy and is of no particular consequence, but obviously the situation holds serious medico-legal potentialities in adult life.

Some sleep-walkers have no recollection of their activities during sleep, while others retain a vague impression which may in time cause them to dread the night. Somnambulism, however, is usually an isolated event which may not be repeated for weeks, months or even years, and in a proportion of cases ceases at puberty. The background to the condition is essentially some psychical disturbance such as worry concerning work at school. But it also seems to be the case that behind these psychological factors lies a highly nervous temperament often manifested in an excitable type of child who is prone to headaches or habit spasms.

The treatment of somnambulism necessitates a tactful investigation and adjustment of the psychical background combined as a rule with a brief course of sedative treatment. In the more stubborn cases it may be necessary to accustom the child to sleep in some form of restraining apparatus which must be so designed as to permit of freedom of movement in bed.

There are other pathological forms of sleep which scarcely fall within the scope of this discussion, but enough has been said to illustrate the point that any departure from the healthy, restful sleep of childhood merits careful and painstaking study.

CHAPTER II

DIET IN CHILDHOOD

THE CHEMICAL COMPONENTS OF THE DIET

The importance of diet in childhood can hardly be overstated. It not only determines the child's development but in large measure conditions his resistance to infection and disease. While many of the fundamental facts of dietetics have long been known to medical science and have received ample confirmation from present-day workers on nutrition, it is doubtful if enough has been done towards translating these important nutritional findings into the language of everyday life and correlating them with the various nutritional disorders of childhood. A simple knowledge of the main physiological principles underlying nutrition is very desirable to enable the mother to plan her children's diet to the best advantage and at the same time to remain secure in the knowledge that her dietary scheme has the full support of carefully sifted scientific data.

Childhood is so very much a period of active growth and intense physical activity that the food requirements at this period are relatively much greater than for the grown-up. At the same time children are particularly susceptible to vitamin deficiencies, so that from every biological viewpoint it is necessary to maintain a simple but balanced diet arranged in such a way that the needs of the growing body are at all times adequately met.

In this chapter, therefore, it is proposed to deal in broad outline with the components of the diet and to show how the various food deficiencies may affect the health of the child.

Every normal diet is made up of protein, fat, carbohydrate, vitamins, minerals and water. The distribution and concentration of these various components varies with the age and general metabolic pattern of the child, but they all subserve a common purpose in that they supply energy, promote growth and repair according to a well-ordered plan.

Protein.

Protein is a complex substance which enters into the basic structure of all protoplasm. Chemically it is made up of a series of smaller units termed amino-acids which combine to form a wide range of protein molecules. The value of protein in relation to health appears to have been over-shadowed in recent years by what a distinguished medical writer has termed the "vitamin ramp," but the carefully controlled studies of the physiology and treatment of starvation amongst prisoners of war and the victims of the concentration camps have brought to light the disastrous effects of sustained protein deficiency. This can be readily understood when it is realized that (as already stated) protein is the basis of all protoplasm. In addition it constitutes an essential component of all the glandular secretions so necessary to health, and plays a fundamental role in the resistance of the body to infection. Protein is therefore a biological necessity in the fullest sense of the term.

When protein is taken into the body as food the molecules are broken up by the digestive juices into their component amino-acids and absorbed as such from the gut. From the bowel they pass into the circulation and are distributed over the whole of the body. In this way they are brought into contact with all the cells of the body and so contribute to the life and function of each and every living cell. In other words amino-acids constitute the "bricks"

or "building stones" on which the stability of the body structure depends. Any shortfall in the amino-acid content of the circulation is fraught with far-reaching consequences in that it disrupts the normal function of all the essential organs such as the heart, brain, kidneys and liver. It is not proposed to discuss the effects of protein deficiency further except to say that not only is protein essential to positive health but it also plays an important role in the treatment of certain diseases of the heart, kidney, liver and intestinal tract.

The vast range of protein which abounds in nature renders it difficult to conceive of gross protein deficiency developing apart from war or famine, until one realizes that all proteins have not the same biological value. In the case of human beings, for example, certain amino-acids are essential to life and unless the protein composing the diets contains these amino-acids in high concentration serious deterioration in health will follow. The biological value of protein is therefore a very important consideration when deciding on suitable dietary schemes for the growing child. With this as our yardstick we find that good quality protein includes milk, eggs, meat and fish with plant protein appreciably lower in the biological scale. When suitable helpings of these several proteins are included in the child's dietary from day to day, there will be little risk of failing to meet the heavy demands of tissue-growth and repair.

Fats.

Fats consist of glycerine in organic combination with fatty acids. During the process of digestion these two components are split off by means of a fat-splitting enzyme secreted by the pancreas and released into the duodenum. The facility with which the fat molecule is disintegrated is appreciably enhanced by the emulsifying power of the bile

which reaches the duodenum in the company of the pancreatic secretions. Following upon the disintegration of the fat molecule the glycerine and fatty acids are absorbed by the cells of the small intestine and are immediately reconverted into neutral fat which in due course reaches the blood stream and is either used up at once with the production of heat and energy or is stored in the fat depots until required.

The fats constitute a particularly concentrated source of heat and energy and are especially valuable in cold climates. In the hot countries, therefore, fats are chiefly valuable as a source of the fat-soluble Vitamins A and D, upon which depends the structure of the bones and resistance to infections.

Fat is best given as butter, cream and egg yolk, but it must always be kept in mind that in the tropics there is often a significant reduction in the child's fat tolerance. This point will be discussed in greater detail later, but for the present it should be remembered that under tropical conditions fat is given more from the point of view of its vitamin content than for its more strictly physical attributes.

Carbohydrates.

The carbohydrates, which are represented by the sugars and starches, constitute an important and relatively cheap source of energy and thereby reduce the call on the protein supplies which, in childhood, are so essential to orderly growth and development. Thus from the viewpoint of human metabolism, carbohydrates are said to have a protein-sparing action. At the same time their presence is essential to the complete combustion or oxidation of fat, so that should the carbohydrate intake fall below a certain level, poisonous bodies are released during the process of fat metabolism and give rise to severe disorders of health.

The relation between the fat and carbohydrate metabolism has been described by Macleod in the following words:

> "If the carbohydrate fires do not burn briskly enough, the fat is incompletely consumed; it smokes, as it were, and the smoke is represented in metabolism by the ketones and derived acids."

During digestion the carbohydrates are disintegrated in the intestine and subsequently absorbed into the blood stream. After conversion into a starch called glycogen they are stored in the liver and elsewhere, to be released in due course to meet the demands of the tissues. During the final oxidation process which leads ultimately to the liberation of water and carbonic acid, heat and energy are evolved.

While it is clear that the carbohydrates must bulk largely in the child's diet, care must be taken to see that they are not given in excess to the exclusion of adequate amounts of protein and fat. Excess carbohydrate in the diet leads to intestinal fermentation which usually manifests itself in the form of a frothy diarrhœa. At the same time any superfluous carbohydrate in the tissues is converted into soft body fat which in due course gives the child a flabby, unhealthy appearance. It is also claimed that an excess of carbohydrate in the diet is a potent cause of dental caries. The carbohydrates recommended in childhood include cereals, potatoes, vegetables and fruit. While jam and sweets are allowed they should be given sparingly and only at the end of a meal.

Vitamins.

It is difficult in the present state of our knowledge to give a concise and comprehensive definition of the highly important food factors now termed vitamins. They occur

in varying proportions in all natural foods, and in many instances have been isolated as pure chemical substances. Yet it is a strange, almost paradoxical fact, that these vital factors are, with one important exception, rarely manufactured by the body itself but are elaborated elsewhere amongst the plants and lower animals. Some knowledge of the distribution of the vitamins in the natural world is of importance if the requirements of the growing child are to be met.

By vitamins we mean those substances which, occurring in natural foods, are essential to normal health and growth. Broadly speaking all vitamins may be divided into two great categories based on the physical property of solubility in water or in fat. Hence we have *(a)* the water-soluble and (*b*) the fat-soluble vitamins.

While it is not intended to discuss the chemistry of the vitamins it is however proposed to outline the main sources of supply of the more important vitamins and at the same time to indicate the salient features of vitamin deficiency.

The Water-Soluble Vitamins.

This group contains Vitamin C or ascorbic acid and the Vitamin B complex which is now known to consist of at least ten components. Some of these factors are of academic interest only and do not call for more than passing mention.

Vitamin B Complex.

The Vitamin B complex includes a group of water-soluble vitamins formerly regarded as a single entity and commonly referred to as Vitamin B. The complex is made up of at least a dozen water-soluble fractions, but the discussion will be restricted to the three of established importance in relation to the health of the child. These are:

Vitamin B_1 or Thiamine
Riboflavin
Nicotinic acid

Vitamin B1 (Thiamine).

This vitamin occurs in most natural foods, but the richest sources are yeast, wheat germ and rice bran. Considerable quantities are found in fresh egg-yolk, liver, pork, wholemeal bread, cereals, peas, beans, nuts, beef and poultry. Unfortunately the milling processes at present employed remove both the germ and the husk of the cereal, thereby enhancing the keeping properties of the grain at the expense of two most valuable factors, namely thiamine and certain important minerals. It is obvious, therefore, that both white flour and polished rice are practically devoid of thiamine, whereas wholemeal flour and unpolished rice contain valuable quantities.

Symptoms associated with Vitamin B_1 Deficiency: The classical manifestations of gross Vitamin B_1 deficiency are found in relation to a disease known as Beri-beri. This disease is especially common in the Far East and Eastern Archipelago, but in more recent years a number of minor disorders attributable to minor degrees of thiamine deficiency have been described.

Beri-beri: It is now accepted that beri-beri is due to prolonged thiamine deficiency and it will usually be found that in the adult the presenting symptoms can be grouped under one of three headings:

(1) peripheral neuritis or dry beri-beri;
(2) gross fluid accumulations (œdema) in the loose tissue spaces and various body cavities—wet beri-beri; and
(3) acute cardiac failure.

In dry beri-beri the legs are more severely affected than the arms. The symptoms range from mild "pins and needles" sensations in the limbs to gross muscle weakness with wasting and numbness and an unsteady, drunken gait. The calf muscles are usually very tender on pressure and as a rule some measure of swelling is present over the shins or ankle regions. The œdema, however, does not constitute a dominant feature in this type of case, and so long as the symptoms are not too advanced a satisfactory response will be obtained to Vitamin B1 therapy.

In wet beri-beri dropsy or œdema constitutes the outstanding feature. Swelling develops over the shins and round the ankle-joints and gradually extends upwards until in advanced cases the entire body is bloated and waterlogged. At the same time fluid accumulates in the pleural and abdominal cavities and around the heart, thereby causing grave mechanical embarrassment to the heart's action and to the efficient aeration of the blood.

Finally there is the acute cardiac type in which rapid failure of the heart may set in with pain across the chest and in the upper abdomen, difficulty in breathing, rapid feeble pulse and ultimately death within a few hours or days. This type of case usually occurs in association with epidemic outbreaks rather than with sporadic cases.

An infantile form of the disease is also recognized and occurs with greatest frequency amongst the poverty-stricken peoples of the Far East. It occurs usually under the age of two, and is especially common amongst breast-fed infants of mothers already suffering from gross Vitamin B1 deficiency. In the acute form the infant rapidly succumbs to a series of convulsive attacks of sudden onset. In the less acute forms the child steadily loses condition and soon becomes weak, emaciated and restless; shortness of breath sets in and is soon followed by complete loss of voice.

In the absence of treatment the heart fails either gradually or abruptly.

Treatment in such cases consists in rapidly improving the mother's reserves of Vitamin B1 in the case of breast-fed infants or in giving yeast or Marmite or the pure vitamin either orally or by injections to the child.

Signs of Minor degrees of Vitamin B1 deficiency: This group contains a number of less well-defined signs and symptoms which may be grouped under two headings:

(*a*) symptoms involving the nervous system;
(*b*) symptoms involving the heart and blood vessels.

Symptoms relating to the nervous system include the following conditions:

tenderness of the calf muscles;
abnormal sensations in the hands and feet;
increased sensitivity to noise;
easily induced fatigue, irritability, depression, insomnia, uncertain memory and poor concentration together with sundry aches and pains and general inefficiency in connection with the daily tasks.

Symptoms due to inefficiency of the heart and blood vessels include:

low blood pressure;
instability of the blood vessels giving rise to giddiness on suddenly changing posture, poor cardiac response to effort and irregular cardiac rhythms.

These various symptoms may suggest a state of neurasthenia, and although confirmatory laboratory tests are available the most practical approach to the problem is to administer Vitamin B1 in adequate dosage and study the effects so obtained. Thereafter the diet is adjusted and any

predisposing cause removed so that there is no further risk of thiamine deficiency.

Nicotinic Acid.

The nicotinic acid fraction of the Vitamin B complex has a distribution in nature very similar to thiamine, the main sources being:

yeast, whole wheat, liver, pork, beef, poultry, ground nuts, potatoes and carrots.

The signs and symptoms of nicotinic acid deficiency are seldom encountered amongst European children enjoying a diet of the usual mixed type, but a well-defined disorder attributable to gross nicotinic acid deficiency is recognized in the adult and appears to occur with greatest frequency amongst the maize-eating communities of the world and is therefore prevalent throughout Africa.

In African children—but never so far seen in European —a condition known as Kwashiorkor or Proctor Williams disease is encountered and may represent an acute nicotinic acid deficiency, but other possible causes such as liver poisoning or an actual virus infection have not been entirely excluded.

The onset of the attack is usually abrupt, in that the child, previously enjoying good health, suddenly develops a type of diarrhœa in which the stools are loose, pale and frothy. There is a rapid deterioration in the general health and very soon the child becomes abnormally swollen (œdematous) about the eyes, wrists, legs and genitalia. At the same time the normal black pigmented skin becomes paler and a form of dermatitis develops over the forearms, legs, thighs and buttocks where the skin becomes thickened and tends to crack and peel off, exposing pale pink areas. The hair too undergoes depigmentation and shows a ten-

dency to straighten and fall out. Accompanying these changes the child becomes thoroughly miserable and resents bright daylight and any form of handling.

Treatment is not entirely satisfactory and in spite of administering the Vitamin B1 fractions together with other essential dietary factors such as first-class protein, iron, etc., the mortality rate still remains high, so much so as to throw considerable doubt on the primary role of nicotinic acid in the genesis of this interesting disorder of childhood amongst Africans.

In the adult—either African or European—a more sharply defined clinical picture emerges in the presence of a gross deficiency in nicotinic acid, and when fully developed constitutes the disease pellagra which is characterized by a triad of symptoms relating to the skin, alimentary tract and the nervous system.

The skin shows a symmetrically disposed dermatitis involving the exposed parts of the body and those parts exposed to friction. Thus it is seen on the forearms and backs of the hands, on the legs and on the face where it often extends as a butterfly patch from one cheek across the bridge of the nose to the other. The affected areas become dry, rough, scaly and deeply pigmented. The skin tends to crack and peel off, leaving a raw-looking glistening surface.

The symptoms relating to the alimentary tract include soreness of the mouth and tongue which tends to become glazed, smooth and often fissured, while the gums may become inflamed and even ulcerated. The appetite goes and abdominal pains are often experienced, together with varying degrees of looseness of the bowels.

Finally the nervous changes which develop are more in the nature of mental changes which begin with mental dullness and in some cases progress to serious mental dis-

order in the form of melancholia, mania or incoherent delirium. In some cases a form of neuritis may constitute the main feature in which disturbances of sensation occur in the lower limbs. For example a subjective sensation of heat constitutes a common feature.

Treatment consists in administering nicotinic acid in adequate dosage either orally or by injection, or brewer's yeast may be given as a syrup and any co-existing parasitic infection removed.

Riboflavin.

This vitamin is found with the other fractions of the Vitamin B complex in yeast, milk, cheese, eggs, liver, beef, pork, ground nuts and spinach. Deficiency of riboflavin gives rise to a condition known as ariboflavinosis in which the tongue, mouth, skin and eyes are the main areas of disturbance. The tongue becomes glazed, painful, reddish purple in colour and abnormally clean, while the lips become shiny and the corners of the mouth show radiating cracks or fissures which fail to heal with local applications. The skin changes consist in the development of fine papules on various parts of the skin surface occurring first beside the naso-labial folds and then extending to the chin, cheek and forehead.

Finally the eyes at first begin to burn and itch and later conjunctivitis and inflammation of the cornea (keratitis) occur. At the same time the eyes become hypersensitive to light.

In such cases a good response is obtained from administering riboflavin by mouth and by ensuring a liberal diet.

Vitamin C (Ascorbic Acid).

The main sources of Vitamin C in nature include oranges, grape fruit, limes, tomatoes and tomato juice, guavas, raw

cabbage and strawberries, while small amounts are found in potato, fresh milk and raw meat juice. Pasteurized milk is of course practically devoid of this particular vitamin, the amount of which in fresh milk is largely determined by the diet of the cow. It is rapidly destroyed by heat and by drying, hence it is usually absent from dried, canned and preserved foods. On the other hand where food is canned by a process which excludes oxygen the vitamin content is retained and remains potent for approximately nine months.

The partial or complete exclusion of ascorbic acid from the diet leads to the onset of a condition known as scurvy which is by no means rare in infants fed exclusively on artificial foods unsupported by orange or tomato juice. Infantile scurvy is therefore rarely encountered in breast-fed infants. The symptoms seldom appear before the sixth month and although they usually develop about the ninth month no significant features may be noted until eighteen months.

Symptoms of Infantile Scurvy: The child gradually becomes pale and increasingly fretful and appears to dread being handled. For example it becomes acutely distressed the moment any attempt is made at undressing as in preparation for a bath. Indeed the pain and tenderness may be so pronounced that the child appears to lose the use of its limbs.

When the attack is fully developed the child tends to assume a characteristic attitude in that it lies on its back with the legs drawn up and the thighs everted in what has been described as "a frog-like attitude." The limbs are seldom moved so that the poverty of movement suggests a state of actual paralysis, but this is not so, as gentle stimulation of the feet will soon show.

The pain and tenderness in the limbs is essentially due to bleeding under the fibrous covering of the long bones and into the muscles of the limbs. In many cases the bleeding is sufficiently extensive to give rise to visible swellings, usually just above the knee or ankle-joint, or just above the wrist. Where the teeth have erupted, bleeding may take place into the gums, giving rise to areas of purplish discolouration or localized swellings which bleed readily when touched. At the same time the teeth already erupted may loosen and fall out. Then again, the breast-bone or sternum tends to be displaced backwards in such a way as to give rise to a beaded appearance of the ribs at the junction with the costal cartilages.

In many cases bleeding occurs into the renal tract, so that blood appears in the urine, although in many cases it can only be detected microscopically. Blood in the urine is always an important confirmatory finding in a suspected case of infantile scurvy. Bleeding may also take place into the skin or from the bowel.

The continued loss of blood, but more especially the gross lack of ascorbic acid, leads to a state of anæmia in which both the red blood cells and the hæmoglobin are reduced. Bony growth is either retarded or arrested, so that characteristic changes appear in the X-ray pictures. At the same time, by virtue of the loss of appetite, the child fails to thrive and put on weight.

However, once the cause of the symptom-complex has been determined, the response to appropriate treatment is truly remarkable.

Treatment: The child has to be handled with the greatest care and gentleness and disturbed as little as possible. Routine bathing is suspended temporarily.

In the case of older children, the diet consists in unboiled

milk from a reliable source, fresh fruit juice and potatoes given in the form of potato cream—that is to say a teaspoonful of potato is mixed with an ounce of milk.

In the tropics it is usually wiser to boil the milk as usual and give Vitamin C in the form of pure ascorbic acid until there is evidence of improvement, after which the usual fruit juices may be employed.

Prevention: The breast-fed baby never suffers from scurvy, whereas babies brought up on artificial feeding may do so. Therefore in the latter circumstance Vitamin C must be added to the child's diet in the form of fresh fruit juice from the age of two months. Although lemon juice is particularly rich in Vitamin C it is too acid for routine purposes, whereas orange juice is usually well tolerated and yields a satisfactory concentration of Vitamin C. It should be given daily diluted with warm water and suitably sweetened. From an initial teaspoonful of the solution the dose is gradually increased until by the time the child is six months old it is taking the juice of a whole orange. In some cases orange juice gives rise to looseness of the bowels or to a diffuse irritable rash, and in such circumstances recourse may be had to grape juice, tomato juice or guava juice.

The Fat-Soluble Vitamins.

This group comprises the Vitamins A, D, E and K. Vitamin E is concerned in maintaining the normal function of the reproductive system and is sometimes referred to as the anti-sterility factor. It need not be discussed further. The same remark applies to Vitamin K which plays an important part in the phenomenon of clothing. It maintains an adequate supply of prothrombin in the blood.

Vitamin A.

Vitamin A occurs in fish-liver oils and their concentrates. It is present also in butter, eggs, unskimmed milk, cream, cheese, liver, green leafy vegetables, carrots, sweet potatoes and apricots. In vegetables and fruits it appears in the form of a pro-vitamin which takes the form of an orange-red vegetable pigment. This pigment, known as carotene, is converted into the fat-soluble Vitamin A in the animal body.

Vitamin A Deficiency: Since Vitamin A is concerned in the production of visual purple, any deficiency of the vitamin leads to a progressive inability to adapt the vision to the dark, and in due course a state of true night blindness supervenes in which the patient is quite unable to see in the dark. Night blindness may also be found in the presence of gross Vitamin C deficiency.

Another expression of Vitamin A deficiency is found in relation to the eyes. The secretion of the tear or lachrymal glands gradually dries up, and the cornea becomes dry and opaque and may subsequently ulcerate.

Finally the skin becomes rough and dry, and covered by fine papules especially on the back of the (upper) arms, buttocks, thighs and legs.

It is probable that Vitamin A enhances the resistance of the lining membranes of the respiratory tract to bacterial infection and probably plays a part in the prevention of bronchitis and pneumonia and nasopharyngeal catarrhs.

Vitamin D.

Vitamin D might be described more accurately as the Vitamin D complex since it is now known to consist of several entities which vary in their practical importance and in their mode of production.

The richest natural sources of Vitamin D are the fish-liver oils with halibut liver oil about ten times as rich in the vitamin as the best cod liver oil. Other sources include egg yolk, butter, cream, liver and fish such as herring, sardine and salmon. Other foodstuffs furnish very little in the way of Vitamin D. A valuable and highly important source of Vitamin D for human beings is obtained through the action of the sun's rays on the skin. The rays interact with certain substances of the provitamin class, especially ergosterol normally present in the skin, and convert it into calciferol or Vitamin D, which is subsequently utilized by the tissues. In high latitudes and in smoky towns where very little ultra-violet succeeds in reaching the earth's surface, there is a great tendency for both children and adults to show evidence of Vitamin D deficiency. Fortunately deficiencies of this type are rarely seen in Africa, either amongst the European or indigenous races where the long hours of continuous sunshine go a long way towards building up adequate tissue reserves of Vitamin D.

Calciferol, identical with naturally occurring Vitamin D, can also be prepared in the laboratory by irradiating a substance known as ergosterol with ultra-violet light.

In the case of infants Vitamin D from the fish liver oils and irradiated ergosterol (calciferol) are entirely satisfactory for routine use in the prophylactic sense.

Vitamin D Deficiency: There is no doubt that Vitamin D plays an important rôle in human physiology in that it controls the calcium and phosphorus metabolism of the body, even though the precise manner in which it acts is not fully understood. It is probable, however, that in the presence of a Vitamin D deficiency the bowel contents become abnormally alkaline, thereby retarding the absorption of calcium. Vitamin D is therefore vitally important

in childhood, so much so that any deficiency in the diet or any shortcoming in its production in the skin leads to a serious derangement in the growth and development of the bony skeleton. The bones formed in such circumstances are soft, spongy and easily deformed, while the teeth are defective in enamel and dentine and a condition known as rickets is the eventual outcome of Vitamin D deficiency.

Rickets: Rickets, fortunately, is a rare disease in the tropics, mainly because the long hours of sunshine enable both mothers and children to build up adequate reserves of Vitamin D.

Rickets develop gradually with restlessness and a tendency to excessive sweating constituting the initial features, but in due course the classical skeletal changes become apparent. Thus the configuration of the skull becomes modified and the fontanelles or soft areas not only remain larger than is in keeping with the child's age but may remain open up to or beyond the second year. At the same time the skull bones become abnormally thin in a patchy manner. As a result of these several changes the skull has a "square" appearance, and looks larger than it should be. Dentition is usually delayed—although it must be stressed that delayed dentition alone does not constitute evidence of rickets. Not only is the eruption delayed but the teeth are of poor quality and because of the imperfect growth of the jaw they are usually overcrowded. Premature decay is the usual outcome and unless steps have been taken to correct the vitamin deficiency, the second dentition may also be damaged. The long bones also show characteristic changes, especially in the vicinity of the ankle and wrist where the growing end of the bone becomes swollen. At the same time the softened bones not only of the arms and legs but also in relation to the spine and pelvis become moulded

into abnormal curves and greenstick fractures are a frequent occurrence. Then, too, the ribs tend to yield to the negative pressures within the chest so that the sides of the chest become flattened and the breast-bone is pushed forward to give rise to the so-called "pigeon breast" while a horizontal groove appears in the lower chest and small nodules known as the "rickety rosary" develop alongside the sternum. Finally there is an abnormal laxity of muscles and ligaments, so that the limbs may be placed in fantastic attitudes, while sitting and walking are inevitably delayed. At the same time the lax abdominal wall predisposes to ventral hernia. In addition the child is pale and anæmic, soft and flabby, development generally is retarded and there is a special susceptibility to infections of the chest and bowel.

The main complications of rickets include (*a*) a persistent diarrhœa which is usually badly tolerated, and (*b*) infections of the respiratory tract such as bronchitis and broncho-pneumonia.

Prevention: Since the incidence of rickets is highest in artificially fed infants it is clear that breast-feeding for the first six to nine months affords sound protection against the disease.

In the tropics the long hours of sunshine constitute a further protection and every child should be judiciously exposed to the sun's rays in the morning and afternoon.

Treatment: In the remote possibility of rickets developing under tropical conditions it will usually suffice to ensure adequate exposure to the sun's rays to correct the tendency, although in the presence of a well-established attack more specific measures may be necessary. This includes giving Vitamin D in the form of cod-liver oil, halibut liver oil or

irradiated ergosterol. The fish-liver oil emulsions may be given in the form of an emulsion—four teaspoonsful daily —but it will be seldom that this dosage will be tolerated for long by a child living in the tropics. Hence, under tropical conditions it is more usual to give Vitamin D in a more concentrated form, so that the total daily dosage amounts to not more than about three drops.

In the case of children over nine months old the diet should be rich in phosphorus and calcium and should include butter, eggs and green vegetables. Iron will usually be required separately as a mixture. The child will have to be kept off his legs until the bones and muscles have firmed up. Splinting may be necessary to correct and prevent deformities.

The Minerals.

The mineral content of the diet has a profound influence on the growth and development of the child, so that any dietary scheme which lacks certain biologically important mineral elements must be considered inadequate. The elements present in the body include calcium, sodium, magnesium, potassium, iron and copper together with sulphur, phosphorus, chlorine and iodine. Fortunately most of these elements are present in adequate amounts in the ordinary mixed dietary of the European child, but in certain circumstances a mineral deficiency of one kind or another exists and in due course gives rise to certain well-defined clinical disorders. The importance of minerals in the diet is readily apparent from the part they play in the structure of the bony skeleton, in the composition of the blood and in determining the quality of certain internal secretions. Indeed, the fundamental chemical interchanges that take place within the body can only do so provided a precise constancy is maintained in the chemistry of the tissue fluids. For

these various reasons brief reference will be made to the parts played by the more important of these tissue elements and to the disorders that accompany deficiency states.

Calcium.

Calcium plays an important part in building up the bony framework of the body, and in addition insures the smooth functioning of the muscles and nerves. It is also possible that the calcium content of the tissues enhances their resistance to certain bacterial infections. The main sources of calcium include milk, cheese and eggs. Calcium is also present in green vegetables but in a less available form. In Africa, however, the soil is often poor in calcium with a corresponding reduction in the calcium content of these main sources of supply. In childhood milk will always provide a high proportion (about two-thirds) of the body's calcium requirements so long as it is available in amounts of not less than a pint to one-and-a-half pints daily, depending on the age of the child.

A calcium deficiency state will develop not only when the intake of calcium is deficient but also when any condition exists which interferes with the absorption of calcium from the bowel. Such conditions include a deficiency of Vitamin D or of phosphorus or certain intestinal disorders.

Calcium Deficiency: Calcium deficiency in childhood soon leads to serious deformities in the bony skeleton which may be perpetuated throughout life. Calcium, therefore, is particularly essential to the maintenance of orderly bony growth during childhood and adolescence. Although we are well aware of the calcium-containing foods, there are so many factors affecting the absorption of calcium from the gut that not more than about 60 per cent is absorbed in health. Apart from a number of intricate physical reasons

which may conspire to retard or inhibit calcium absorption it can definitely be stated that normal calcium absorption will only occur in the presence of an adequate supply of Vitamin D. Vitamin D deficiency gives rise to excessive alkalinity of the bowel contents with the precipitation of calcium in the form of an insoluble and unabsorbable salt.

Apart from its importance in the building of the bony architecture of the body, calcium determines the easy functioning of the muscles and nerves, so that whenever the calcium of the blood falls below a certain critical level a state of spasmophilia supervenes.

Spasmophilia: The term spasmophilia covers a group of neuro-muscular disorders which have a common denominator in the shape of an abnormally low blood calcium. These disorders include (1) tetany, (2) laryngismus stridulus and (3) convulsions.

Tetany: This condition is characterized by painful spasms of the muscles of the hands and feet. During a spasm the thumb is pulled across the palm, the hand is flexed at the wrists and the fingers are rendered rigid and tense. At the same time the feet are turned downwards and inwards and the toes are tightly contracted. An attack may last for several hours and any attempt to undo the spasm leads to sharp aggravation of the pain.

Laryngismus Stridulus: This alarming condition is characterized by sudden spasm of the glottis or opening between the vocal cords. Breathing is suddenly arrested and the child rapidly becomes blue in the face—a most alarming spectacle. After about half a minute the spasm passes off and air is drawn into the lungs with a crowing sound. The attacks show a remarkable tendency to occur at night, and

the emergency treatment of the condition consists in passing a finger behind the tongue and drawing it forward while cold water is sprinkled over the head and chest.

Convulsions: The convulsions which may occur in relation to spasmophilia present no specific characteristics. They merely indicate that a low blood calcium must be considered along with other causes as the background. Sedative drugs in such circumstances constitute a temporary measure, but restoration of the blood calcium is essential to cure.

Prevention and treatment is essentially the same as for rickets.

Phosphorus.

The phosphorus content of the average diet which includes a generous milk ration together with foods of animal origin is sufficient to prevent a state of phosphorus deficiency. Furthermore it is generally accepted that a diet rich in calcium implies an adequate supply of phosphorus.

Phosphorus enters into the development of the skeleton and is widely distributed in the tissue fluids, but it must be admitted that little is known about the signs and symptoms of phosphorus deficiency in man.

Iron.

Iron ranks as one of the most important of the mineral elements in the child's diet by reason of the fundamental part it plays in the formation of the red colouring matter of the blood (the hæmoglobin). This complex substance is entirely responsible for the oxygenation of the tissues, and in final analysis controls the vitality of every cell in the body. Consequently any falling off on the part of the

hæmoglobin content of the blood leads to serious derangements in the health and development of the growing child. A rich red blood, therefore, is a prerequisite of robust health. In other words a diet deficient in iron inevitably gives rise to anæmia.

During the gestation period the infant usually succeeds in accumulating a large reserve of iron in the liver substance sufficient to see it through the first few weeks of life when milk constitutes its sole source of food. As the months go by the iron reserves diminish so that a state of anæmia can only be averted by transferring the child to a mixed dietary which includes the iron containing foods. So far as the child is concerned the important iron containing foods include eggs, cereals, fruit and vegetables. Theoretically, therefore, a mixed dietary which includes these various food factors will prevent the onset of anæmia.

Causes of Anæmia in Childhood: There may be many causes of anæmia in childhood, but these several causes imply either a lack of available iron in the tissues themselves or in the diet.

Wherever the iron content of the tissues falls below a certain value there is a failure on the part of the bone marrow to produce red blood cells either in sufficient numbers or sufficiently rich in red colouring matter, and so a state of anæmia supervenes. There may be many causes for the marrow failure.

The child may have been born prematurely or may have been the weaker of twins, or the mother herself may have suffered from an iron deficiency anæmia during her pregnancy. In such circumstances the reserves of iron in the liver substance are inadequate and are used up before the child is mature enough for mixed feeding. Any undue delay in transferring the child to a mixed dietary of egg,

vegetables and meat broth will also predispose to the anæmic state.

Infections, whether bacterial or parasitic, are frequently responsible for the onset of anæmia. This is well illustrated in the case of the child who suffers from recurrent bouts of malaria and is especially frequent in relation to another protozoal disease known as Kala Azar. Worm infections may also lead to severe degrees of anæmia, especially hook-worm and round-worm infections, but bilharzia disease and tape-worm infection may also give rise to an anæmic state. The chief bacterial infections associated with the anæmic state include infections of the tonsils, teeth, sinuses, bladder and urinary tract. Again, lack of essential vitamins such as C and D lead to anæmia in relation to scurvy and rickets, while chronic diarrhœas, such as cœliac disease or a chronic nephritis will often be responsible for a refractory anæmia in childhood.

Finally the tendency for some children in the tropics to develop a stubborn loss of appetite inevitably leads to minor degrees of nutritional anæmia which invariably retards the child's development.

The Anæmic State in Childhood: The anæmia develops so insidiously that some time may elapse before it is recognized, but in its fully developed form there are several characteristic features.

The outstanding sign is usually pallor which is best seen in relation to the gums and the lining membranes of the eyelids and the lips, while in some cases the skin acquires a faint lemon tint. At the same time the child is listless, disinclined to exert himself physically or mentally and is easily fatigued. Temperamentally he tends to be fretful, whiny and difficult, more especially in the hot summer months. The pulse rate is usually rapid, even at rest, and

the child is sometimes troubled by attacks of giddiness or fainting. Furthermore, the anæmic child is especially susceptible to colds, bronchitis, infections of the middle ear and attacks of diarrhœa or dysentery.

While the signs and symptoms already enumerated provide valuable evidence of anæmia, the true state of affairs can always be assessed with accuracy by means of a few simple laboratory tests. These tests not only establish the existence of the anæmic state but indicate its true nature, and in due course enable one to assess the response to treatment.

Treatment: Once it has been established that the child suffers from anæmia a careful review of the dietary is necessary so that the iron-containing foods may be introduced in keeping with the child's age group. In the case of red meat, for example, only some 10 to 25 per cent of the iron content is available to the body, whereas almost the entire iron content of liver can be utilized. That is to say liver constitutes a particularly rich source of iron in the treatment of anæmia. Again, the iron content of legumes (either fresh or dried) is present in a readily available inorganic form, so that weight for weight legumes actually constitute a better source of iron than meat. In the case of green vegetables from 60 to 70 per cent of their iron is available even though it is not present in a high concentration.

Apart from reviewing and adjusting the diet the treatment of the anæmic state necessitates the administration of iron medicinally in generous doses, and it will usually be found advisable to continue the iron for a period of two to three months.

Finally it is always necessary to determine the primary cause of the anæmia, and deal with it wherever possible.

This may consist in removing septic tonsils, clearing up a latent malaria, removing an intestinal parasite, making good some vitamin defect, and so on. But once these adjustments have been made and the treatment well established, a steady and gratifying improvement in the child's whole disposition and physical well-being soon becomes apparent.

Iodine.

Only minute amounts of iodine are required by the body, yet even this small amount is of vital importance to the growing child, both before and after birth. Iodine is found in greatest concentration in the thyroid gland where it forms an integral component of thyroid secretion. Any deficiency of thyroid secretion inevitably leads to a gross caricature of normal development which culminates in a condition known as cretinism. Cretinism, or more correctly endemic cretinism, is found only in those areas where goitre prevails, and although several factors may be responsible for the goitrous state, lack of iodine in the food and water supplies undoubtedly constitutes the major cause.

The main sources of iodine in the diet are fish, vegetables (especially when grown in the proximity of the sea) and drinking water. It is well known that in some parts of the world the water supplies are so deficient in iodine that the goitrous state can only be avoided by supplying both children and adults with iodized salt or by deliberately administering potassium iodine over a period of ten days twice a year.

Goitre: By goitre we mean a simple enlargement of the thyroid gland. The condition is met with in many parts of the world including certain parts of Africa, where it shows a remarkably high incidence amongst the indigenous

peoples. While there may be many contributory causes of the goitrous state, the most important factor is undoubtedly a lack of iodine in food and water. This deficiency leads to diffuse swelling of the thyroid gland which soon becomes visible as a smooth, soft, rounded swelling in the middle line of the neck in front, and in some cases may cause considerable disfigurement. Although the general health is not usually upset to any extent the goitrous swelling may cause compression of the wind-pipe and so give rise to shortness of breath. In other cases the compression may be such as to cause a noisy type of breathing known as stridor. In some cases operative measures may be necessary, but in the early stages the cautious administration of iodine will usually suffice.

Cretinism: It is now recognized that the incidence of cretinism is highest in areas of endemic goitre, so that it is reasonable to postulate a close relationship between the two conditions. That is to say the conditions causing goitre are also responsible for cretinism. Goitre therefore is almost always a feature of endemic cretinism, but in sporadic cases atrophy of the thyroid has occurred from unknown causes.

The characteristic features of cretinism seldom appear before the child is about three months old, but thereafter it becomes increasingly obvious that the child is failing to develop along normal lines. The facial characteristics of cretinism are remarkably constant. The expression is dull, cross and disinterested. The face is broad and flat with a squat nose, narrow heavy eyes set well apart and a wide coarse mouth with protruding tongue. The skin is dry and sallow with heavy pads of fat round the root of the neck and above the collar-bones, while the hair is scanty and what there is is dry and brittle due to lack of natural fat.

There is also a general lack of muscle tone so that all the limb joints can be over-extended and the abdomen is permitted to protrude in an ungainly fashion. A hernia of varying size is usually present at the umbilicus. The poor tone of the intestinal muscles inevitably leads to obstinate constipation so that cretinism has always to be kept in mind when investigating chronic constipation in childhood. The circulation is invariably sluggish so that the hands and feet have a cold clammy feel, even in hot weather, and in addition the temperature is usually subnormal.

Retardation of normal development is seen in a variety of ways. Thus the teeth are slow to erupt, the fontanelles are late in closing, while crawling, walking and talking are all delayed to an abnormal degree.

The sustained delay in development of the mental faculties is soon reflected in the general apathy and unresponsiveness of the child to its environment. Finally growth, especially growth of the long bones, is so retarded that some measure of dwarfism inevitably follows.

Treatment of Cretinism: Treatment consists in administering thyroid extract by the mouth in the appropriate dosage. The amount taken has to be increased steadily as the years go by and must be continued throughout life.

Provided treatment is begun early enough the child's whole appearance becomes steadily more normal, the growth processes are resumed, and in some but not in all mental development follows the usual pattern. The general rule, however, is that improvement is greater on the physical than on the mental side.

Sodium and Chlorine.

Sodium and Chlorine are normally present in adequate amounts in all ordinary mixed diets, so that gross deficien-

cies of these elements are extremely unlikely. Chlorine is present in the body in inorganic combination as chloride. Both sodium and the various chlorides share in maintaining the delicate balance of the tissue fluids and glandular secretions.

In the presence of excessive vomiting, excessive diarrhœa and excessive sweating, there may be a serious loss of tissue chloride which can only be made good by the deliberate administration of saline solutions either orally or by injection. The steady sweating that occurs under tropical conditions leads to a heavy loss of sodium and chloride ions, which gives rise to varying degrees of salt deficiency.

The commonly accepted indications of a tissue salt deficiency include loss of appetite, impaired sense of taste, an aching tiredness in the limb muscles and a sense of exhaustion, while in the more severe forms of salt deficiency, severe muscle cramps and spasms constitute the dominant features.

For these various reasons it is important to see that the active child is given every opportunity to maintain the salt content of his tissues at a satisfactory level, and to this end he should be permitted to indulge his natural cravings for salt and salty food. In this way a good deal of restlessness and irritability will be obviated.

Water.

It may appear unnecessary to make particular reference to water in discussing the composition of the child's diet, but in the tropics water-intake assumes special significance.

In the first place the water content of the human body is between 70 and 75 per cent, but the mechanism determining the distribution of water between the tissues and the blood stream is still very imperfectly understood. None the less, we do know that large volumes of fluid enter and

leave the circulation in the course of the twenty-four hours, and we are also aware that from the purely practical standpoint there is a close relationship between the water-balance of the tissues and physiological thirst. Again, it is well known that depletion of the body's water reserves produces death much more rapidly than does starvation. In the tropics a very large volume of fluid is lost by the skin, particularly when free sweating occurs in a dry, hot atmosphere, hence in the case of young children who are accustomed to disport themselves with unrestrained vigour, care must be taken to compensate this loss.

Apart from maintaining the tissue fluids in a state of optimum dilution, water is essential to normal digestion in that it facilitates the complete breakdown of the individual molecules of the food, and so prevents the products of incomplete digestion from reaching the circulation, where they may give rise to a variety of disturbances.

The intake of water in adequate amounts also promotes the free action of the bowels and in so doing facilitates the elimination of waste products and minimizes the risk of constipation.

Finally, whenever the water-intake falls below a certain critical level, fluid is immediately withdrawn from the blood stream, a process which renders the blood more concentrated and this in turn leads to a highly concentrated urine which cannot flush out the waste products with that degree of efficiency so essential to the maintenance of good health.

Water should always be readily available, but as will be seen later, great care must be exercised to insure its purity and freedom from bacterial contaminations.

CHAPTER III

DIET IN CHILDHOOD

THE ARRANGEMENT OF THE DIET: APPETITE

HAVING discussed the more academic aspects of the dietetics of childhood, it is now necessary to apply this information to the preparation of the daily menus for all age groups. It must be accounted no mean feat to arrange the dietary schemes in such a way from day to day that they escape the criticism and condemnation of the youthful gourmet.

In the early months of infancy the choice of diet is simple and straightforward. The mother's milk is still and always will be the ideal method of feeding a young baby, and except in the presence of certain well-defined contra-indications should always be encouraged.

Later, with the advent of mixed feeding, careful selection and graduation of the dietary is necessary, but here again fresh foods should always be used in preference to food that has been preserved or put up in tins.

Finally, by the end of the first year, when the diet is no longer based on a series of feeds but on the usual set meals, a wide variety of foods can be introduced until a full and varied diet has been built up.

Milk.

Milk, however, should always constitute a dominant feature of the diet during childhood and adolescence. Not only does it provide good protein but it constitutes a rich and valuable source of calcium and riboflavin. Up to the age of five years it is usually recommended that the child should take a pint of milk a day. Some of this may be

used in the preparation of custard, junket, cocoa and so on, especially when the child finds it difficult to consume a full pint of milk day after day. After the age of five years, from three-quarters to half a pint is recommended daily throughout the growing years, provided the diet contains other sources of protein and calcium. Not only does milk protein contain a high concentration of amino-acids or biological building stones but fat is present in the form of a fine emulsion which is easily digested and assimilated. At the same time milk is rich in all the essential minerals with the important exception of iron, while in addition to carbohydrate it contains a variable concentration of Vitamins B and C and a certain amount of D. As will be seen later it is seldom advisable to drink milk in its raw state in the tropics; some form of sterilization must always be adopted. Indeed it may be said that unless milk can be boiled or pasteurized, then some form of dried milk should always be used, in view of the risks inherent in drinking raw milk in the tropics.

The other varieties of milk which may be made use of from time to time include skimmed milk, buttermilk, curds and whey.

Butter.

Butter constitutes a valuable component of the diet in that it provides fat in an easily digested form. At the same time it contains all the vitamins present in milk and is therefore a valuable source of Vitamin A and to a less extent Vitamin D.

Chemically, good butter contains about 90 per cent of fat, the rest being made up of water and minerals. Most children tolerate butter in reasonable amounts very well indeed, but in the presence of a low fat tolerance it may be necessary to restrict the butter intake, especially in very hot

weather. In some parts of the world an emulsion of milk, vegetable or animal fat has to be used as a substitute for butter. This product, known as "margarine," constitutes an effective substitute for butter in regard to its fuel or caloric value, but it is completely lacking in vitamins. However, since the introduction of "vitaminized" margarine it is now claimed that it constitutes a satisfactory and economical substitute for butter.

Cheese.

Cheese has a remarkably high nutritive value. Not only is it rich in good protein and in milk fat but it constitutes a valuable source of calcium, phosphorus, iron and Vitamin A. Children between one and two years of age may be given cream cheese thinly spread on a slice of bread and butter. Over eight a portion of hard cheese may be allowed but it must always be eaten as part of a meal and not as a special tit-bit at the end. Furthermore the digestibility of cheese should never be impaired by any form of cooking or seasoning.

Egg.

The egg is another example of a good natural food of high nutritive value. The protein content ranks high on the biological scale, while the yolk contains fat, which like the fat of milk, is finely emulsified and easily assimilated. In addition the yolk is rich in calcium, phosphorus and iron and in the Vitamins A, D and B. As will be seen later, egg yolk may be cautiously introduced into the child's diet from an early age and then as tolerance is built up the amount given is gradually increased.

But as with all foods rich in fat, care must be taken to see that the child's tolerance is not exceeded. It will usually be found that most children in the tropics do better on an

average of about four eggs a week, while some will scarcely tolerate one. The mother will seldom experience any real difficulty in determining her child's tolerance in this connection.

Meat.

Meat consists of protein of high biological value, but has a variable fat content depending on the source. Phosphorus and iron are present in high concentration, but the calcium content of meat is very low. The iron fraction, however, is present in the form of a complex organic compound which disintegrates with difficulty in the digestive tract, with the result that only a relatively small proportion of the iron is absorbed. The vitamin content of meat is relatively low apart from an appreciable amount of Vitamin B. Meat, therefore, does not add materially to the total vitamin content of the diet. Meat in the form of liver, kidney, pancreas (sweetbread) or brains is biologically similar to muscle meat except that the proteins have a still higher biological value, while the Vitamins A, B and C are present in rich concentrations. Another point of importance is that the rich iron content of these various organs is almost 100 per cent available to the body in contrast to the low availability of iron in relation to muscle meat. The various organs are not equally digestible. Kidney on the whole is rather indigestible, and is scarcely suitable for regular inclusion in the child's diet. Sweetbreads, on the other hand, are readily digestible but liver is probably best suited for children's menus. It may be given as well fried or well stewed ox or sheep's liver once a week. Not only is it valuable from the nutritional viewpoint but it appears to exert a stimulating effect on the child's appetite.

For the most part, however, the child's meat ration is made up of muscle meat, and this being so it is important

to appreciate the differences that exist in the digestibility of the different types of meat.

Mutton and beef are about equally digestible, whereas veal, by reason of its immaturity, is very much less so. Pork is relatively indigestible whereas bacon is easy to digest. The breast of chicken or game is perhaps the most digestible of all meats.

Apart from this variation in digestibility there is no fundamental difference between red meat (such as beef and mutton) and white meat (such as poultry). They are alike in their nutritive value, although the looser texture and lower fat content of white meat may render it more digestible than red.

The portion of meat selected for the child's ration should be tender, simply cooked and served in small amounts in a finely divided form. In Southern Africa a dried meat preparation known as biltong constitutes a highly nutritious food and is enjoyed by children of all ages.

Fish compares favourably with meat from the viewpoint of biological value; not only does it provide good protein and calcium together with the Vitamins A and D in high concentration, but it constitutes a most valuable source of iodine. Fish, therefore, should appear twice a week in the child's diet and when given in the form of fish cakes is usually well received.

Cereals.

The cereals or starchy foods depend in large measure for their nutritive value on their high carbohydrate content. Not only is cereal protein present in small amounts but it is low in biological value. There is at the same time a gross lack of minerals and vitamins. None the less, the cereals are of dietetic importance in that they provide a high proportion of the energy value of the diet, and as already

pointed out, they play a valuable part in metabolism.

In the process of milling, the cereals are still further depleted of those nutritive properties contained in the germ and the husk, consequently it follows that wholemeal bread is preferable to white bread, although on a good mixed dietary the differences are not of great significance. What is of importance, however, is that the cellulose of the wholemeal flour is not absorbed so that the greater bulk of the intestinal residues offsets any tendency to constipation. For this reason alone wholemeal cereals should be preferred to the more refined products, but since calcium absorption may be partially retarded an additional supply of calcium may be advisable where a natural soil deficiency exists. Wholemeal cereals also contain more protein, minerals and vitamins and are therefore preferable for children.

Cereals play an important part in the diet of infancy and childhood in the tropics where the intake of fats has usually to be curtailed; this loss has got to be made good by a generous intake of cereals.

In infancy the cereals most frequently employed include cream of wheat, groats and cream of rice. In all cases the cereal requires to be well cooked to ensure adequate splitting of the starch granule and so avoid troublesome indigestion. It will usually be found that most cereals require thirty minutes direct cooking or from one to two hours in a double saucepan. A well prepared cereal is a most valuable addition in artificial feeding in that it prevents excessive curd formation and can usually be added to the diet once the child has reached the age of five or six months. In the case of older children a wide range of cereals is available such as oatmeal porridge, corn flakes, grapenuts, shredded wheat, puffed rice, cream of wheat, groats and so on. As will be seen later, cereals figure at breakfast and supper but only as part of a meal, as it has long been appre-

ciated that an over-abundance of starch in the diet has a disturbing effect on the calcium balance in the growing tissues.

Vegetables and Fruits.

No dietary scheme can be regarded as complete without the inclusion of vegetables and fruit in at least one meal of the day. Vegetables are of value mainly on account of their high mineral and vitamin content, but from the physiological viewpoint they acquire additional value by reason of the stimulant action their residues exert on the wall of the colon. As in the case of the cereals the cellulose component of the vegetable structure is resistant to the digestive juices, and so passes unchanged into the large gut where it absorbs water and forms a bulky semi-solid mass which usually undergoes some measure of bacterial fermentation, thereby facilitating easy evacuation of the bowel.

The green vegetables are rich in Vitamins B and C and in a substance called carotene which is a precursor of the important Vitamin A. Fortunately carotene is but little affected by the ordinary temperatures employed in cooking, but the same cannot be said of B and C, both of which undergo considerable destruction, especially when bicarbonate of soda has been added in an attempt to preserve the green colour of the vegetables. The loss in carbohydrate, protein and salts brought about by boiling can be eliminated in large measure by steaming the vegetables with a small quantity of fluid just sufficiently long to soften them thoroughly.

The legumes (peas, beans and lentils) are a source of protein of low biological value, but to the child in the tropics they constitute a valuable source of iron. As already mentioned the iron of legumes is present in an inorganic

form which is readily available to the body, so that weight for weight they contain more iron than meat. Fresh green peas contain in addition good supplies of Vitamin B and C. Potatoes, beetroots, carrots and also parsnips provide a valuable supply of carbohydrate, while the Vitamins B and C are present together with a small amount of protein, but in the case of potatoes, unless they are cooked in their skins, the vitamin content is almost entirely eliminated.

Peas, beans, lentils and monkey-nuts constitute a useful addition to the dietaries of older children. They contain protein, fat and Vitamin B_1 while germinating and fresh peas and beans provide an additional source of Vitamin C. Most children enjoy monkey-nuts when served as "peanut butter."

The value of fruit and fruit juice in the child's dietary is widely recognized and, as will be seen later, it is a wise plan to introduce fruit juice and fruit pulp at an early age —that is to say between the fourth and fifth month, irrespective of whether the child is breast or bottle fed. Raw fruit is a valuable source of carbohydrate, vitamins and certain salts, while in the case of certain fruits the high cellulose content encourages easy movement of the bowels.

In spite of these several virtues raw fruit must always be given with restraint since an excessive intake may give rise to a distressing diarrhœa which weakens the child and may render the bowel unduly susceptible to more serious bacterial infections. It is also a common experience to find that various rashes and urticarial eruptions can be traced to the excessive use of raw tropical fruit.

Finally, all fruit offered to the child must be scrupulously clean.

Bearing these simple precautionary measures in mind, every child should be encouraged to eat fruit daily, and in most parts of the tropics a wide selection of fruit is

available for the greater part of the year. These include paw-paw, mangoes, guavas, granadilla, together with the more traditional fruits such as apple, orange, banana and grapes.

Fresh fruit, of course, is always to be preferred, but when not available canned products are entirely suitable now that a more conservative canning technique has been adopted.

The method of introducing fruit and vegetables into the dietary scheme will be discussed later.

Breast Feeding

It is not proposed to discuss breast feeding in detail, as this subject is fully dealt with in all text-books on infant feeding. However, one would like to stress the point that breast feeding is far and away superior to all other methods of infant feeding. It provides the infant with the most perfectly balanced form of nourishment under the happiest conditions. It minimizes the risk of gastro-intestinal infections which are all too common in the artificially fed baby, and for the mother there is the feeling of satisfaction and confidence in her capacity to nourish her child. Clearly, therefore, every effort should be made to give every child the incalculable benefits of its mother's milk.

It is generally better to abandon any ideas of fixed feeding times for the first ten days of the baby's life and simply feed the baby whenever it is hungry. By the end of this period a rough feeding pattern will have emerged and more often than not the infant will be beginning to sleep for four hours between an increasing proportion of the feeds. During the stage of frequent feeding only one breast should be used at a time, but with the development of a four-hourly rhythm the child should be put to each breast for ten minutes at a stretch. If a given feed starts with the right

breast then the subsequent feed should start with the left. Once a regular four-hourly system has been established, the times usually adopted are 6 a.m., 10 a.m., 2 p.m., 6 p.m., 10 p.m., and 2 a.m., but sooner or later the question arises as to when the 2 a.m. feed can be discontinued. It is not possible to give a categorical reply to this question, but with the child thriving well it is quite a sound plan to leave him to wake for his night feed. This usually means that he rapidly acquires the art of sleeping first six and soon approximately eight hours at a stretch, thereby giving the mother (and the father) a long spell of uninterrupted sleep.

Artificial Feeding

There will always be a proportion of mothers who, with the best will in the world, will fail to satisfy the baby. Apart from this there are certain maternal disorders which constitute a contra-indication to breast feeding. Included in this category are advanced cardiac disease, pulmonary tuberculosis and insanity. Syphilis acquired after the birth of the child absolutely negatives breast feeding, but if acquired before delivery no further damage will be caused the child by breast feeding. In these various circumstances artificial feeding becomes necessary.

There has been a tendency in recent years to render the subject of artificial feeding both complex and difficult, but most mothers will be pleasantly surprised at the ease with which the child adapts himself to the new regime provided certain fundamental rules are adhered to faithfully and conscientiously.

In regard to the choice of a food for artificial feeding, there is, strictly speaking, no choice. Where the mother's milk is not available for one reason or another, then the child should always be given fresh cow's milk. It has been pointed out over and over again that the virtues inherent

in fresh milk will always outweigh any apparent advantages claimed for the dried or humanized forms.

Only where fresh milk is unobtainable, or where storage conditions are unsatisfactory, or where a long journey is contemplated can the use of dried-milk products be justified.

Cow's milk, however, is not perfectly adapted to the child's digestion, mainly because of the larger and tougher curds that form in the stomach. Modification is therefore necessary, and aims at reducing the size of the curds, rendering them more friable and at the same time enhancing the carbohydrate value of the feed. These modifications are effected by diluting the milk with boiled water and by adding cane sugar. This procedure will have to be followed for the first five to six months of life.

In the tropics the choice will usually lie between raw or pasteurized milk, although in most places only raw milk will be available. But whether raw or pasteurized, milk used for feeding babies should always be boiled. This may be done by one of two methods:

(1) The milk is boiled in an open saucepan until the bubbles begin to rise and break the surface. The heating is then interrupted and the milk allowed to cool.

(2) The milk is boiled in a double saucepan and allowed to cook for half an hour after the water in the outer jacket has come to the boil. It is then cooled rapidly.

The milk is now ready to be modified. Dilution is effected by means of boiled water. Neither barley water nor lime water is regarded as having any special virtues as diluents and so are seldom used to-day.

The carbohydrate value of the milk is enhanced by means of cane sugar. When available brown Demerara

sugar is the sugar of choice and most babies thrive well on it. Where the baby is small or ill and underweight dextri-maltose is preferable until the infant has been restored to normal health, but neither lactose nor glucose are advised as they often seem to constipate the child.

The Milk Mixtures: During the first four weeks of life the following mixture is recommended for a healthy baby:

Boiled milk	10 oz.
Boiled water	10 oz.
Cane sugar	2 level dessertspoons

After one to two weeks on this mixture or when the baby is more than a month old when artificial feeding is instituted, the milk mixture is strengthened as follows:

Boiled milk	14 oz.
Boiled water	7 oz.
Cane sugar	2 level dessertspoons

The simplest arrangement in artificial feeding is to prepare the total feed for the twenty-four hours. It is then distributed in a set of five bottles which are covered and stored in a cool place or preferably in a refrigerator until required.

The next problem is to decide how much the child needs at each feed, and in the case of a healthy child the rule is 2½ oz. of the mixture for each pound of body weight. Thus a child weighing 8 lb. requires 8 × 2½ oz., i.e. 20 oz. daily. This amount, distributed over five feeds, equals 4 oz. per feed.

It must be emphasized, however, that these figures should not be regarded as part of an immutable law in infant feeding. Each baby is a study unto itself, and where there is evidence either in the weight, general behaviour or

general condition that the child is being underfed, then the feed must be gradually improved, both in quality and quantity. The feed may have to be modified in the course of a feverish ailment, either by increasing the dilution or offering water at more frequent intervals. It is certainly very important to maintain an adequate intake of water during the course of a fever. The same advice applies to very hot weather when the child may have difficulty with the standard dilutions.

One last point in regard to artificial feeding in the tropics: there is undoubtedly an ever-present risk of infections, especially gastro-intestinal infections, being transmitted by contamination of either the feed or the teat. Consequently the bottles must be kept scrupulously clean, and it is strongly advised that this cleansing and sterilization be carried out by the mother herself and not delegated to the coloured nannie.

In all cases, artificial feeding has to be supplemented by means of the Vitamins A, D and C. Vitamin C is readily available in the form of fresh orange juice, tomato juice, or guava juice. The juice is diluted with warm boiled water and sweetened with sugar. Two or three teaspoonfuls are given daily straight off the spoon.

The Vitamins A and D are contained in cod-liver oil and halibut. They may be administered as a few drops of an emulsion of these oils or as a drop of concentrates such as ostelin or radiostoleum. The concentrates are certainly more suitable in hot countries.

Mixed Feeding

The present-day tendency is to introduce mixed feeding when the child weighs 14 to 15 lb.—that is to say when the child is four to five months old. The early introduction of mixed feeding offsets the tendency to anæmia which

inevitably develops in the presence of a pure milk dietary, since milk is poor in iron. Furthermore, the risk of a vitamin deficiency is lessened and the final transition from the breast or the bottle is rendered infinitely easier.

The addition of fresh fruit juice to the diet in the event of artificial feeding has already been mentioned, but by the fourth or fifth month fruit pulp may also be added with advantage. The fruit is pulped and is passed through a sieve and after the addition of sugar a teaspoonful is given, preferably before the 2 p.m. feed and then gradually increased until two or three tablespoonfuls are being taken in the course of the day. Tolerance for fruit pulp varies considerably, hence the amount of fruit pulp administered will vary for each child. The fruits that can be administered in this way include oranges, apples, grapes, tomatoes, bananas, peaches, plums, apricots and guavas.

Once a tolerance for fruit juice and fruit pulp has been established, the vegetable purées should be introduced. Purées may be prepared from a wide range of vegetables which include carrots, turnips, parsnips, asparagus, potatoes, cabbage, cauliflower, spinach and peas. When appropriately cooked in a minimum of water and without soda the vegetables should be strained and puréed. Only a teaspoonful should be offered the first day and continued until the child has grown accustomed to the taste, and thereafter the dose is gradually increased, taking care to avoid indigestion and watery motions.

The puréed vegetables should in due course be followed by egg-yolk. The egg is lightly boiled and one teaspoonful of yolk is added to the vegetables. This procedure is repeated daily and then a whole yolk is given twice a week.

Bone and vegetable broth is frequently advised in the early stages of mixed feeding. The preparation is a lengthy process, but most children soon learn to enjoy the flavour.

The usual procedure consists in giving two teaspoonfuls of the broth immediately before the two o'clock feed, and increasing the amount gradually until the child is having from three to four ounces a day. The volume of the subsequent milk feed will fall proportionately.

However, the introduction of bone and vegetable broth need not be regarded as an essential step in the mixed feeding programme, when raw fruit pulp and vegetable purées can be prepared so easily and at the same time contain all and more of the virtues inherent in soup.

The diet for a healthy infant from six to seven months and weighing 15 to 18 lb. would be as follows (After Gibbins):

FEEDING TIMES: 6 a.m., 10 a.m., 2 p.m., 6 p.m., 10 p.m.

6 a.m.: Milk mixture or breast feed. 6 oz.

10 a.m.: Egg yolk, 1-2 teaspoonfuls twice a week.
Cereals such as Robinson's Patent Groats or barley, 3 days.
Hard-baked crust or rusks twice a week with butter and honey or jelly.
Milk mixture or breast.

2 p.m.: Puréed vegetables.
Bone broth, 2-4 oz. twice or thrice a week.
Egg custard, junket, milk pudding.
Sieved stewed fruit.
Milk mixture or breast.

6 p.m.: As at 10 a.m.

10 p.m.: Breast or milk mixture—6-8 oz.

In the tropics a thirsty child will require, in addition to the above, fresh fruit drinks or plain boiled water freely between meals.

From seven months onwards, the time of the feeds is

altered so that they coincide with breakfast, dinner and tea with a final night feed at 10 p.m.

Diet for Babies aged Seven to Eight months:

On waking:	Fresh fruit juice.
Breakfast: (8-8.30)	Hard-baked crust or rusk with butter. Egg yolk three times a week. Cereal or porridge on other days. Occasionally a little stewed fruit. Milk mixture, 7-8 oz.
Dinner: (12.30-1 p.m.)	Sieved vegetables. Broth or soup. Custard, junket, milk pudding with a little sieved stewed fruit.
"Tea": (4.30-5 p.m.)	Crusts, hard toast, stale bread or rusks with butter. Sandwiches (thin) with Marmite, honey or any jelly. Sponge fingers occasionally.
10 p.m.:	Milk mixture, 7-8 oz.

The diet is gradually increased by the addition of new foods and by increasing the amounts given.

The milk feed is gradually strengthened so that by nine months the child is taking whole milk thrice a day.

The following, therefore, constitutes a suitable dietary scheme for babies eight to twelve months:

Diet for Babies aged Eight to Twelve months:

On waking:	Fresh fruit juice.
Breakfast:	Crust, rusk with butter. Egg, lightly boiled, poached or coddled or scrambled, three times a week. Cereal on other days. Stewed fruit. Milk, 7-8 oz.

Dinner: Sieved vegetables, broth or soup, boiled or steamed fish, twice a week.
Small amounts of meat—mutton, beef, liver, chicken, brains, finely cut up, three times a week.
Custard, junket, milk puddings, blancmange, milk jellies, stewed fruit, light steamed castle pudding or lemon sponge.
Water to drink.

"Tea": Sweetened and diluted orange juice with a rusk or biscuit.

Supper: Crusts, hard toast, stale bread or rusks with butter.
Thin sandwiches with Marmite, honey or jelly or with egg and tomato.
Plain sponge cake or sponge fingers.
Milk, 7-8 oz.

10 p.m.: Milk, 7-8 oz.

Diet from One to Two years:

On Waking: A drink of orange juice and water.

Breakfast: Porridge or other suitable cereal.
Egg—lightly cooked—with a slice of fried bread three days a week with fried tomato and a small rasher of bacon or a little fish on the other days.
A slice of bread and butter.
Milk, about 8 oz.

Dinner: A small helping (e.g. 1½ oz.) of finely chopped meat, liver, chicken or a similar amount of fish.
Vegetables including potato with meat juice or gravy.

Milk pudding, custard or light steamed pudding with a small helping (about 1 oz.) of mashed stewed fruit or mashed banana.
Milk, about 5 oz.
Water to drink.

"Tea": A cup of milk or fruit juice.
Thin bread and butter sandwiches with Marmite, honey or jelly.
A piece of plain cake.

Supper: Cereal or macaroni cheese or a milk pudding.
Bread and butter and milk.

Add sugar to all helpings of cereal and fruit up to about 1 oz. a day, and always remember to encourage the child to drink freely of plain water throughout the day.

By the time the child is two years old, his diet should be similar in all essential respects to that of the more grown-up section of the family. That is to say, the diet should include milk, butter, cheese, eggs, meat, fruit and vegetables, and at the same time the child should be encouraged to drink freely of fresh (boiled) water at intervals throughout the day.

Milk continues to be an important component of the child's diet, and up to the age of five years his daily consumption should be not less than one pint. Thereafter the amount consumed may be reduced somewhat provided the diet contains adequate amounts of first-class protein and calcium containing foods.

Sea fish should figure in the diet at least twice a week, since it constitutes a valuable source of iodine as well as first-class protein.

Doubt is sometimes expressed concerning the advisability of allowing cheese to the young child. As already men-

tioned, cheese is rich in both protein and milk fat, and provided it is properly chewed it may be given to children without disturbing the digestion. In the case of very young children, small helpings may be given in the form of cream cheese or ordinary cheese may be grated and given in the form of white sauce with macaroni or sprinkled on vegetables or on bread and butter.

The daily bread ration may usefully include a few portions of wholemeal bread, but a little white bread may also be allowed.

Once the child has reached school-going age, weak, milky tea may be given, but coffee is better avoided altogether.

Sweets are best given after a meal and then only in moderation.

Finally, it is well to remember that eating between meals should always be discouraged, as it impairs the appetite for the major meals of the day and so disturbs the balance of the diet.

Appetite.

Since appetite, or from the infant's viewpoint, hunger, is a primitive and urgent instinct its gratification leads to a state of happy contentment, and at the same time forges a link between mother and child. Yet as every mother knows, as the child grows older and reaches the stage of mixed feeding her most praiseworthy efforts to present the right kind of food in the most attractive form are liable to frustration by unheralded, often unpredictable fluctuations in the child's appetite. Indeed this fickleness of appetite may constitute a fruitful cause of disharmony, so that both mother and child come to dread the approach of meal-times.

It follows, therefore, that in every feeding régime the mother or the nurse must obtain the willing co-operation

of the child. When it is appreciated that the imposition of a dietary régime with its particular types of foods and its regular time for meals does in fact constitute interference with a primitive instinct, it may appear that the prospects of gaining the child's co-operation are prejudiced from the very outset. However, as has been pointed out in the section on breast feeding, if during the first ten days or so of the baby's life it is fed whenever it is hungry, it will gradually fall into a regular three or four hourly rhythm, and with the introduction of mixed feeding, the transfer to regular set meals should take place smoothly and with a minimum of resentment on the part of the child. In other words the child should be unaware of anything approaching gross interference with the gratification of its primitive instinct for food. At the same time uncompromising rigidity on the part of the mother as to what and when the child must eat will sooner or later lead to friction over meals. Thus the mother must allow her child some measure of choice, so that the various instinctive cravings may be satisfied. Indeed it is highly probable that children have a greater capacity for selecting the food best adapted to their needs than was hitherto believed possible, and where this innate faculty is given reasonable play, not only does the child eat more but is undoubtedly happier at meal-times, and it is highly probable that in such circumstances the food is digested and utilized to greater advantage.

Factors which upset Appetite: Children vary widely in their attitude to meals. Some are always ready to enjoy their food, while others, often in the same family, need continual coaxing. The reason for this lack of interest in food is by no means clear, but there can be no doubt that some children are born without a normal healthy appetite, and little or nothing can be done to encourage them to feed.

Dentition: It not infrequently happens that a healthy, vigorous child begins to show a progressive deterioration in appetite round about the age of eighteen months to two years, or possibly considerably earlier. In these circumstances the loss of appetite is almost certainly associated with the eruption of the canine or second molar teeth, and it is worth bearing in mind that the impairment of appetite will probably persist until the first set of teeth have all erupted. So far no satisfactory reason has been postulated to explain the association between loss of appetite and dentition, but it is generally agreed that it does not appear to prejudice the child's health to any significant degree.

A similar phase of fickle or indifferent appetite is frequently encountered between the ages of five and seven, that is to say during the stage of the second dentition. Here again the mother will tend to become distressed and worried, especially when the child fails to increase in weight, so that she usually makes the mistake of trying to force the child to consume his full allowance of food. To do this is merely to precipitate rebellious reactions on the part of the child and strained relations between mother and child at meal-times. There is nothing for it but to exercise considerable restraint at this time, and just make sure that what the child does take has a high nutritive value and is not just "trash."

Fever: There are many causes outside the sphere of physiological dentition capable of exerting an adverse effect on the child's appetite, and amongst these many causes any fever occupies a prominent position.

One of the earliest accompaniments of a feverish state is loss of appetite. It is important to appreciate this and remove all solid food from the diet. As will be seen in a later

section of the book the diet in the fevered state is built up round fluids and some easily assimilated carbohydrate such as glucose. The digestive secretions flow less freely at this time, so that to force solid food upon the child merely leads to vomiting and a further rise in temperature. So long as the child is given fluids and glucose freely and frequently, no harm will come to him, and in the case of a short fever, no further dietary measures need be considered. In the case of a protracted fever, e.g. enteric, then a more elaborate dietary programme is necessary, to include purées as well as fluids.

"*Liver Upset*": This rather vague term is a frequent cause of loss of appetite amongst children in the tropics. It is not always easy to say why it occurs, but in many cases it can be ascribed to excess cream in the diet or to the injudicious administration of the cod-liver oil emulsions in the hot season, or to some emotional upset or excitement.

The child is not only disinclined for food but may even show a revulsion at the prospect. The tongue is heavily coated, the breath is heavy and may smell of acetone, while the stools are paler than normal and the urine pigmented and concentrated. At the same time the child is irritable and fractious and there may be a sharp rise of temperature in association with ketosis.

In these circumstances the child should be given fluids only—including fruit drinks, and a dose of milk of magnesia at night for a few nights until liver function has been restored.

This subject will be discussed in greater detail later in the book.

Constipation: By constipation is meant the infrequent evacuation of the bowel, although the passage of a dry,

hard motion is sometimes regarded as an indication of constipation, even though the bowel is evacuated daily. Although babies are seldom upset in any way when they are constipated, it is important to correct the tendency as speedily as possible in order to obviate the unpleasant consequences that gradually emerge as the child grows older.

The usual background to chronic constipation in children is that insufficient care has been given to the training of the bowel reflex in early infancy. In some cases the infrequent motions or the hard motions have been disregarded with resultant blunting of the reflexes which set in motion the bowel movements, or the bowel is overstimulated by laxatives and comes to rely on them.

In the case of the older child, strict supervision is equally necessary to ensure that the child goes regularly to stool. There can be little doubt that most children will pay little heed to the need for attention to the bowels when there are games to be played and toys to be examined as soon as breakfast is over. Or again the rush and bustle that so often occurs in poorly organized households to enable the child to get off in time for school may encourage the child to suppress the urge to evacuate and so a state of chronic constipation is brought about.

Finally, the diet may be too concentrated or the fluid intake inadequate.

Whatever the primary cause of the constipation, it sooner or later exerts an adverse effect on the child's health and one of the first indications is loss of appetite. This in itself aggravates the constipation. In addition the tongue becomes coated with a brownish fur, and the skin acquires a sallow, unhealthy appearance. There is a failure to gain in weight and in some cases the child runs a slight temperature which may greatly puzzle both the parents and the

doctor. The child often complains of headache, is restless at night and often irritable in the day-time.

The treatment of the condition calls for a careful investigation of the cause. In the case of young babies it will always be advisable to increase the fluid intake in breast-fed babies, and to increase the amount of sugar in the milk mixture in the case of bottle-fed babies. Brown sugar is certainly preferable in this connection. Where the stools are small, hard and dry and can only be passed after much painful straining, it is desirable to give a teaspoonful of liquid paraffin or plain liquid paraffin emulsion twice a day for a few days until the stools are being passed without undue effort. Thereafter the dose is reduced and attention focussed on increasing the fluid intake, and seeing that the child gets plenty of exercise. It is especially important in the tropics to see that the child is not overburdened with clothes, whether awake or asleep, as the heavy fluid loss in the sweat will undoubtedly predispose to constipation. Once the child has reached the stage of mixed feeding with meal-times arranged in terms of breakfast, dinner, tea and supper, a time for evacuating the bowel should be set apart each day immediately after breakfast and after a later meal if necessary. This arrangement should never be departed from, and in this way a conditioned reflex will soon be established and once established will go a long way towards the prevention of constipation in the future. At the same time it should be emphasized that the child must always respond to any desire to empty the bowel whenever it occurs.

In addition, the child must have plenty of exercise. The danger is not so great in the early years but in the later years at school, with examinations ahead, there is always the risk that the child will lead a sedentary life and so begin to show indications of constipation.

The dietary control of constipation is certainly important, but the indiscriminate addition of roughage to the diet in the form of fibrous vegetables, raw fruit, nuts and so on may set up a catarrhal state of the bowel or lead to abnormal degrees of distension which may actually aggravate the constipation. The fluid intake must always be augmented either by means of plain water between meals or by the addition of fresh orange juice. The juice or pulp of stewed prunes also constitutes a valuable natural laxative, and should always be tried. The diet should follow the lines already laid down for the different age groups.

In spite of these measures it is usually necessary to make use of a laxative preparation to assist in re-establishing a rhythmical evacuation of the bowel, but care in the selection of a laxative is highly important. In the first place, castor oil should never be employed. Indeed all mothers should be advised to get rid of the castor oil bottle for all time, and the same applies to enemas and suppositories. The only preparations recommended as laxatives are liquid paraffin, milk of magnesia and syrup of figs. The dose will vary with the age of the child, but should always aim at producing the desired result. Thereafter the dose should be gradually reduced until eventually the laxative can be discontinued. Once a regular rhythm has been established it will usually be maintained and with it there will be a general improvement in the child's sense of well-being together with a return of normal appetite.

Chronic Infection of the Tonsils and Adenoids: Another important cause of loss of appetite in childhood is to be found in unhealthy conditions of the throat and nose, more particularly in the form of septic infections of the tonsils and adenoids. These infected tissues discharge a muco-pus

which is swallowed and in due course sets up a low-grade catarrh of the stomach with the inevitable loss of appetite.

Apart from impairing the appetite a chronic infection of the tonsillar and adenoid tissue leads to a state of indifferent health in which the child becomes anæmic and subject to repeated attacks of colds and bronchitis, while mental development is usually retarded. When the infected adenoid tissue becomes grossly swollen, mouth breathing becomes persistent and the child's whole expression becomes dull and vacant. The voice acquires a nasal intonation, and during sleep the breathing is noisy and snoring. Indeed, sleep is usually restless and is frequently interrupted by nightmares or night terrors.

Many complications have been ascribed to "tonsils and adenoids," but the chief of these include conditions such as enlarged glands in the neck, middle ear infections, sometimes with deafness and recurrent joint pains.

The presence of tonsillar sepsis can be ascertained readily enough, but it does not necessarily follow that removal of the tonsils is indicated. Each case has to be assessed on its merits but in the presence of any of the complications listed above conservative measures will usually be disappointing and only by removal will the appetite return and with it a steady improvement in the child's health.

Chronic Parasitic Infections: When a child's appetite begins to fail the question of a parasitic infection must also be considered.

Under tropical conditions the main possibilities include infection with a parasitic worm such as threadworms, roundworms, hookworm, or the bilharzia parasite, or the basic cause may be a recurrent malaria infection. These various possibilities necessitate detailed laboratory investigation and even after treatment has been carried out

repeated examinations will be necessary to establish cure.

Elimination of the parasite concerned is invariably followed by a steady improvement in appetite.

Psychological Causes: Finally, loss of appetite may be a purely psychological phenomenon. Most children are quick to sense any atmosphere of anxiety that may attend meals, and soon become aware that he (or perhaps more often she) can occupy the centre of the stage and so monopolize the attention of all around by the simple expedient of displaying a fickleness of appetite. This behaviour is often enough unwittingly encouraged by the mother's tendency to discuss her child's likes and dislikes in the child's hearing, and he may subsequently derive great satisfaction and a feeling of exalted prestige through being able to discourse upon his impressive array of dietetic inhibitions.

In other cases the child may have a horror of growing fat or be anxious to remain small and puny or have a complex that food is dangerous. These various neurotic inhibitions, rooted as they are in the phantasy life of early childhood, are gradually replaced by more balanced and enlightened ideas.

While a reasonable distaste for certain articles of diet may have to be recognized, all unreasonable fickleness must be tactfully and firmly overcome. Here again, however, many of the expedients employed by parents to induce their child to eat are to be vigorously deplored. Thus to play with the child at meal-times with the object of creating fantastic diversions so that he may be fed "off his guard," as it were, is merely evading the real issue and wasting valuable time. As already mentioned, the meal should be attractively served with the actual helpings commensurate with the child's usual capacity. A modicum of initial coaxing may be necessary to induce the child to

give his full attention to the meal and, of course, all toys should be placed out of reach, though preferably out of sight. If, however, the child persists in his refractory attitude then the plate should be quietly removed while the mother maintains an attitude of placid unconcern. Anything in the nature of a "scene" must be avoided.

The child, of course, may have to go hungry for a few hours, or even for a whole day, but apart from a feeling of injured innocence no ill-effects need be anticipated. At the end of it all he will have realized that it is more profitable, more comforting and more satisfying to eat what is placed before him than to attempt to give rein to his temperamental proclivities.

CHAPTER IV

PROTECTION AGAINST THE TROPICAL SUN

To maintain a reasonable measure of good health in the tropics we have to concern ourselves with anything capable of sapping the energies and vitality of the white races.

In regard to parasitic disease, the careful and devoted work of the medical scientist has gone a long way towards holding at bay the dangers inherent in many of the parasitic infections. At the same time the hygienists have erected effective barriers against many dangerous bacterial infections, while individually most people appreciate the necessity for good clean food and drink with plenty of fresh air and exercise, and so make their own contribution to fitness of body and mind. But it cannot yet be claimed that the white man has succeeded in subduing the tropics, so that he must still be on guard against the more insidious "climatic" influences.

There is still, I think, a widespread tendency to underrate the several dangers inherent in over-exposure to the tropical sun.

The benefits accruing from the all-pervading, life-giving sunshine of the tropics are so many and so fundamental to human existence that it almost savours of irreverence to probe the potential dangers. But because the white man has made a home for himself and his children in the tropics, it is more than ever necessary that we should know the answer to the question:

> Is the white child in any danger from the tropical sun?

The same question has been asked many times before, and always when asked evokes considerable controversy and divergence of opinion. There are grown-ups who, having spent the best years of their lives in the tropics and having grown thoroughly acclimatized to local conditions, tend to decry the potential dangers of the tropical sun in relation to child health. These views, however, are nothing more than matters of opinion and cannot be regarded as constituting valid scientific opinion. Indeed, in our search for carefully sifted scientific data upon which to base our discussion concerning the tropical sun, we find that a great deal of investigational work has yet to be carried out before we can arrive at conclusions capable of withstanding the onslaught of the "salted" sceptic.

However, it is the welfare of the white child in the tropics that we have at heart, and therefore we consider we cannot afford to take risks so far as the tropical sun is concerned. If in time to come it can be proved beyond all reasonable doubt that the powerful rays are devoid of all harmful action on the delicate tissues of childhood, then we can but accept the evidence and modify our precautionary measures accordingly.

Until then, however, it is more logical to accept the risks so far as we know them, and take whatever precautionary measures we have at our disposal.

The Sun's Rays

For the purpose of our discussion we may group the sun's rays in three categories:

(1) The chemical or short rays made up of blue, indigo, violet and ultra-violet radiations.
(2) The luminous or medium length rays which include orange, yellow and green radiations.

(3) The long heat rays comprising the red and infra-red emanations.

THE CHEMICAL RAYS.

These rays exert a tonic or stimulating influence on all forms of life and probably account for the sense of well-being experienced by ordinary human beings on a bright sunny day. They also play an important part in the elaboration of Vitamin D in the skin, and so constitute a powerful safeguard against all forms of Vitamin D deficiency, especially rickets.

It is also possible that these rays assist the immunity mechanism of the body in that they are believed to stimulate the production of antibodies which serve to neutralize the effects of parasitic infection. It can also be shown, however, that these rays are capable of destroying certain parasites in the free-living phase, so that we may justifiably look for certain reactions in human beings when exposed to an over-dosage.

The Harmful Effects of Chemical Rays

Sunburn.

This well-known condition develops in those parts of the body exposed to an overdose of strong sunlight. It is more common in fair-skinned children than in brunettes, but it is sometimes met with in the non-pigmented (Albino) African native.

The condition constitutes a direct reaction to the chemical rays of the sun, and consists essentially of an acute inflammation of the deeper layers of the skin, which becomes visibly swollen and congested. The reaction is largely dependent on the duration of the exposure and the intensity of the rays. A moderate exposure will result in a sharp inflammatory reaction in the skin, which gradually

dies away after about twenty-four hours leaving a slightly pigmented area. With subsequent exposures the reaction becomes progressively less severe until in due course a protective bronzing of the skin develops.

Prolonged exposure of the unprotected skin, however, gives rise to most alarming reactions. The skin becomes intensely red, hot and swollen. Blisters form all over the affected area, which discharges a watery, serous fluid. Pain is severe so that the child is restless and ill.

The condition may persist in an acute form for several days, after which it subsides, leaving the usual pigmented areas.

Treatment: This consists in keeping out of the sun during the acute phase of the reaction and applying some soothing cream or lotion in the milder cases, or some tannic acid preparation in the more violent reactions. A simple sedative may be required at night when the pain is severe and renders the child sleepless.

Children who are highly susceptible to the sun's rays may have to make use of some protective cream containing tannic acid, ichthyol or quinine before going out in the sun, but carefully graduated doses of the rays will usually pigment the skin sufficiently to render it immune to sunburn from ordinary exposures.

Chronic Skin Changes.

(*a*) *Freckling:* This consists in the appearance of small, rounded yellowish-brown or even black spots on the face or upper part of the trunk, in response to exposure to the chemical rays of the sun. They are especially common in blonde or red-haired children. In temperate regions they frequently fade or even disappear during the winter season

but in the tropics they are more persistent and are not subject to seasonal variations.

No special treatment is called for as a rule, although there are measures available in special circumstances.

Prevention consists in providing adequate shade for the face when out of doors.

(*b*) *Chronic Dermatitis:* When exposed to the tropical sun over a long period of time the skin becomes darkly pigmented and significantly altered in texture. The outer horny layer becomes appreciably thicker and denser, so that the affected surface becomes coarse and more deeply patterned.

The pigmentation, of course, is not in itself harmful, and can best be regarded as a protective response on the part of the skin to the solar rays. The presence of this pigment holds back the rays and so screens the deeper tissues. Furthermore, rays held back in this way are converted into heat, which is not only radiated from the skin surface but plays a part in activating the sweat glands.

It is certainly of interest to note that the most highly pigmented races in the world are found in the tropical belt, a fact which may be said to afford additional support for the view that skin pigment has an important screening function in respect of the sun's rays. It is also the experience of many workers in the tropics that succeeding generations of white people there become progressively darker. The increase in the horny layer of the skin may, however, give rise to troublesome reactions, mainly in the shape of some low-grade inflammation or dermatitis which proves extremely resistant to treatment.

(*c*) *Urticaria:* In a few instances an intense urticarial reaction develops on exposure to the sun. This can prove

extremely troublesome and usually means that the sufferer has to spend most of his time indoors in the day-time.

THE LIGHT OR LUMINOUS RAYS.

As the name implies, these rays comprise the light-giving component of the solar radiations. Their inestimable value to mankind is beyond question, but what we are concerned with at present is to what extent may they cause harm to the white child in the tropics. In this regard it must be admitted that there is some divergence of opinion, and although many disorders of the central nervous system in particular have been attributed to the light rays, it is only proposed to discuss those for which there is a good measure of supporting evidence.

Glare Conjunctivitis: It is now held that this condition is due to the action of the luminous rays on the delicate coverings of the eyes.

The condition arises after prolonged exposure to glare from road surfaces, from a sandy beach or from the sea, and is essentially the same as the glare conjunctivitis that develops in relation to snow-covered surfaces, showing that the heat rays at least play no part in its production.

Once established, the child develops an acute aversion for the light. The eyelids swell up and the eyes stream with tears. A burning pain in the eyes is very distressing, while a persistent spasm makes it practically impossible to open the lids.

Treatment necessitates keeping the child in a darkened room until the inflammation has subsided, while bathing with warm boracic solution or the instillation of a few drops of castor oil has a soothing effect. In cases accompanied by severe pain novocaine drops may be necessary for a day or two.

To prevent recurrences, it will be necessary to wear dark glasses and a wide-brimmed hat out of doors for some time to come.

Glare Headache: This condition usually develops gradually. When taken out repeatedly in the bright sunlight, the child first of all complains vaguely of some discomfort which in due course assumes the features of a headache, usually sited over the back of the head and often accompanied by tenderness of the scalp in this region. The headache or discomfort may persist long after sunset and may render the child restless and irritable. The eyes soon begin to look heavy, tired and red, and the child may say that they feel hot and burning. They are often very tender on pressure.

When exposed to the glare of the sun for weeks on end the recurrent headache renders the child nervous and irritable and devoid of all the happy *joie de vivre* of healthy childhood. Indeed, it is probable that the whole nervous system is being irritated.

At any rate, it is always important to take particular note of headaches in childhood, as it is highly probable that a review of the child's daily routine will show that the primary cause of his trouble is excessive exposure to glare. When that is the obvious cause, the child should be kept indoors when the glare is at its maximum, and made to wear tinted glasses with good lenses when outside, until all signs of headache have disappeared.

Many other symptoms have been attributed to the luminous rays of the run, but the supporting evidence is still unsatisfactory, so that it is not proposed to include them in this discussion.

Enough has been said, however, to show that the light rays in excess are capable of irritating the nervous system

sufficiently to give rise to various groups of symptoms, and therefore appropriate preventive measures should always be part and parcel of every white child's routine in the tropics. The specific nature of these preventive measures will be discussed later in this chapter.

THE HEAT RAYS.

The heat rays exert a powerful heating action on the tissues in certain circumstances and are capable of giving rise to a group of disorders which may be grouped under the general heading of Heat Stroke.

This condition is so intimately linked up with the heat-regulating mechanism of the body that it is necessary to give some consideration to this important function before going on to discuss the indications of a breakdown in its efficiency.

Regulation of Body Temperature: It is a well-known fact that the temperature of the healthy body is maintained at a remarkably constant level, wherever the individual happens to be. In the tropics, with its high atmospheric temperatures, the temperature-regulating mechanism must be maintained at a high level of efficiency if serious and dangerous crises are to be avoided.

It is now accepted that the central nervous system is the headquarters of the temperature-regulating mechanism. Tucked away in the depths of the brain is a small nerve centre which, after the manner of a highly sensitive thermostat, regulates heat production and heat elimination in such a way that the temperature of the body remains approximately constant at about 98·4°F. with small fluctuations throughout the twenty-four hours. The figure given represents an average but there will be those whose "normal" is set either a little above or a little below 98·4°F. We are

not at the moment, however, concerned with the regulation of heat production but more particularly with the mechanism of heat elimination in the presence of a hot environment.

For all practical purposes, heat loss takes place mainly through two channels—(*a*) through the lungs and (*b*) from the skin.

There are, of course, secondary chemical reactions in the tissues and organs of the body whereby heat production through chemical activity is reduced, but those processes are not particularly well understood, and in any case have little bearing on the fact that the main heat loss takes place through the lungs and skin. The loss of heat from the lungs, however, is only of importance when a significant disparity exists between the atmospheric and body temperatures. This is, relatively speaking, so seldom the case under tropical conditions that the main burden of cooling the body rests with the skin.

The actual process of cooling is based on the simple physical fact that the transformation of water into vapour at the body surface results in the rapid removal of a great quantity of heat from the body when conditions favour evaporation. A homely illustration of the cooling power of water evaporation is inherent in the common practice of cooling a water-bottle by wrapping it in a damp cloth and leaving it to hang in the breeze. So long as the cloth remains damp and evaporation continues the contents of the bottle remain cool, even on a hot day.

In the case of the human body, water for vaporizing at the body surface is made available in the sweat. Sweat or perspiration is being produced continuously by the sweat glands, sometimes in visible amounts but sometimes invisibly, so that an evaporation process is in action almost continuously. Thus sweat glands are widely but not uni-

formly distributed over the body surface, being more concentrated in some areas than others. They can be stimulated either through direct heating of the skin or through the medium of the nervous system, which is highly sensitive to any rise in the temperature of the circulating blood. Although our knowledge of the mechanism of sweating is still incomplete, it is reasonably certain that the sweat glands are also stimulated by heating of the skin pigment (melanin). This explains an apparent paradox in that although the highly pigmented skin of the African native heats more rapidly than the average blonde skin, it also sweats more promptly, and as it is more generously supplied with sweat glands it also sweats more profusely.

Clearly, therefore, sweating with subsequent evaporation constitutes a vital element in the body cooling mechanism, so much so that the indigenous races of the tropical belts are biologically better adapted to the prevailing conditions than the white-skinned peoples.

However, so long as the skin functions efficiently, even white-skinned people can adapt themselves to high atmospheric temperatures with remarkable degrees of success. That is to say, the efficiency of the heat-regulating mechanism plays no small part in the health of the European in the tropics. It cannot entirely negative the exhausting effects of the heat, however, so that additional steps to assist in cooling the body will always be necessary.

These measures will be discussed in due course and are especially necessary when the atmosphere is both hot and moist as it is in these circumstances that a serious breakdown in the heat-regulating mechanism may occur, giving rise to conditions such as heat stroke or heat exhaustion.

Heat Stroke or Heat Hyperpyrexia.

This condition is met with all over tropical Africa, but is

definitely more common in localities such as India, the Persian Gulf, the Red Sea, the Straits Settlements and Southern China.

It constitutes a reaction to the heat rays and implies a breakdown in the heat-regulating mechanism. Once the temperature of the atmosphere exceeds that of the body, heat loss by the vaporization of sweat is the only remaining physical means of controlling the body temperature. When, therefore, the sweat glands fail to function efficiently in these circumstances, the body temperature begins to rise and sets in train a symptom-complex to which the name heat stroke or heat hyperpyrexia is given.

All Europeans are not equally susceptible to this condition. Children are definitely more liable than adults, and in the same way newcomers are more likely to suffer than older residents. It is probably true also that old people coming to the tropics for the first time are less well able to adapt themselves to the heat than the younger age groups, and so, like children, are relatively more susceptible to heat stroke.

Finally, anything which lowers the general health and well-being may be regarded as a predisposing factor in relation to heat stroke.

Symptoms: An attack usually develops gradually, following upon the cessation of free sweating. A feeling of lethargy and general weakness sets in, together with headache and drowsiness. At the same time there is an intolerance for bright light and in some instances the patient complains of seeing coloured lights before his eyes. Occasionally the main presenting symptoms include nausea, vomiting, severe abdominal pains and even diarrhœa.

As the attack develops, the temperature rises rapidly and may race up to quite alarming levels. Figures

between 104°F. and 107°F. are quite usual, while temperatures ranging between 110°F. and 114°F. are also on record.

With the attack at its height, the face is flushed, the skin dry and burning and the eyes congested. The pulse is rapid and full, and although regular at first it frequently becomes intermittent and irregular in the later phases of the attack. Headache is always intense. The sustained high fever is soon associated with a rambling delirium which may quite rapidly give way to a state of unconsciousness. Muscular twitchings develop early in the attack, and with children convulsions are a frequent occurrence during an attack. The urinary output is always low.

The patient suffering from heat stroke is obviously acutely ill. The hazard to life is considerable, and unless treatment is instituted promptly there is a grave risk of the attack terminating fatally. The duration of an attack is variable, but in favourable cases the temperature falls in response to treatment, leaving the patient in a very exhausted state.

After-effects are by no means uncommon in relation to heat stroke, and include conditions such as headaches, giddiness, intolerance of light and a state of nervous irritability, or even more profound psychological changes which may persist for several months.

Treatment: The treatment programme aims at reducing the temperature to a reasonable level (between 101°F. and 102°F.) without precipitating a dangerous collapse. Emergency treatment, therefore, consists in loosening all tight clothing and transferring the patient immediately to as cool and shady a spot as possible. When the patient can be taken indoors, he should be stripped of all clothing and placed on a bed which has been covered with mackintosh

sheeting. Where ice is available an ice-bag is applied to the head and the whole body is rubbed over with ice.

While this is being done, a sheet is wrung out in ice-cold water and then wrapped round the patient. The sheet is kept damp and air is directed over it either from the windows or by means of a fan. A cooling mixture of salt and water containing a dash of lemon, vinegar and eau-de-Cologne can be prepared and sponged all over the patient from time to time. Throughout the whole of the treatment a strict watch must be kept on the rectal temperature. As soon as it is found to have fallen to between 101°F. and 102°F., all cooling procedures must be stopped. The patient is then wrapped in a blanket and put to bed. The temperature should still be closely watched, and should there be evidence of a rise, the cold sponging will have to be repeated, until the temperature remains steady at or near normal levels.

These emergency measures will as a rule suffice to ward off danger to life, but medical advice will usually be advisable to make sure that the heart and nervous system have escaped serious damage.

The after-treatment will probably necessitate a mild nerve sedative and a light diet for a day or two, and for long afterwards it will be necessary to avoid over-exertion and over-exposure to heat.

Heat Exhaustion or Heat Syncope.

Heat exhaustion is essentially a state of collapse which develops in the presence of high atmospheric temperatures, especially when associated with high humidities. That is to say, heat exhaustion is especially common in the presence of moist heat.

It most often occurs in people who for one reason or another are in a poor state of health or in whom there is

some pre-existing evidence of weakness of the heart muscle accompanied by low blood pressure. Again, it will often be found amongst those who over-indulge in violent exercise during the hottest part of the day, or amongst those who go about overburdened with clothes. Amongst adults, alcoholism is also a predisposing cause of heat exhaustion.

Symptoms: The attack usually sets in abruptly with a feeling of giddiness and utter exhaustion. Nausea and even vomiting may occur at the same time. If overtaken by the attack when standing, the patient may simply crumple up and fall to the ground without warning, or if walking, may suddenly begin to sway and stagger and then collapse.

In contrast to heat stroke, these patients are pale and cold. The pulse is small, rapid and difficult to feel. The blood pressure is very low and the pupils dilated. The skin is covered in a cold sweat which gives it a clammy feel. At the time of the collapse the patient's temperature is usually subnormal, but a fleeting rise will usually have occurred immediately before the collapse.

Consciousness is usually lost for a longer or shorter period. Fortunately recovery follows in the majority of cases, but there are occasions when the unconscious phase persists and deepens and terminates fatally. Oral temperature readings taken during the attack are usually subnormal, whereas rectal temperatures may be raised a few degrees.

As the attack passes off, consciousness returns, while headaches and muscle cramps are often experienced at this stage.

Treatment: Treatment consists in loosening the clothes and transferring the patient to a cool, airy place. If he can swallow, a little brandy and water or sal volatile should be

given immediately and followed up with a copious intake of fluid containing glucose and salt (one teaspoonful and half a teaspoonful respectively to the pint). In severe cases medical attention will be necessary so that the necessary cardiac stimulation may be given by injection and the fluid administered intravenously.

Heat Cramp.

This condition is more in the nature of an indirect effect of exposure to the heat rays in that it follows the excessive sweating induced by the rays. It is now considered that the heavy loss of salt in the sweat constitutes the immediate cause of an attack.

These attacks, therefore, are especially common in relation to sustained muscular effort in severe heat, and are seen with greatest frequency amongst miners and stokers in coal-burning ships in the tropics.

In an acute attack, the patient falls to the ground in an agony of pain with the face flushed and the pupils dilated, while every few moments a fresh wave of cramp sweeps over the calves, thighs or abdomen until the victim is almost demented with pain.

Fortunately these attacks can be brought under control fairly rapidly by means of salt and glucose drinks, and can be prevented by sucking glucose sweets and drinking a weak salt and water solution when at work.

While attacks of this severity are seldom encountered in the ordinary course of events, it is highly probable that the heaviness of the limbs and the aching sensations in the thighs so commonly experienced in very hot weather are related to a similar cause. In the same way the tendency for children to get restless and irritable in very hot weather may be due in part at least to the diffuse muscular discomforts associated with excessive sweating.

In these circumstances the thirsty child would derive more benefit from weak glucose and salt solutions than from plain water.

PREVENTIVE MEASURES.

It has been necessary in this chapter to examine the dangers inherent in the tropical sun. These have now been discussed in terms of the various radiations which enter into the composition of the sun's rays, and we have seen that real and serious damage may arise from over-exposure both in a direct and an indirect sense to the heat and the sun.

It now remains to study ways and means of protecting the white child against the sun in the tropics without at the same time depriving him of its essential virtues, and in the present state of our knowledge, preventive measures can be discussed most usefully under two headings:

(1) Housing
and (2) Clothing.

Housing: The child's home should take a big share in protecting the child from the sun, and for this reason every house in the tropics should be designed to provide a maximum of coolness and shade. This probably means that the whole subject of house construction in the tropics merits careful review in the light of recent studies in air-conditioning, refrigeration and the value of aluminium foil in roofing. Wide verandah space is always desirable in that it provides a cool, shady and airy part of the house where children can play in safety with a minimum of restriction and yet get plenty of fresh air.

Assuming that the child lives in a well-designed house, it is strongly recommended that during the pre-school and early school years he be kept inside during the hottest part

of the day. The duration of this indoor phase will be determined by a number of factors, such as the region of the tropics concerned, the season of the year, the age of the child, and so on. For example, on or near the equator it will often be advisable to remain indoors from about ten in the morning until as late as four in the afternoon. In Southern Africa, on the other hand, it will usually suffice during the hot season to remain indoors from about midday until three or three-thirty in the afternoon. In the case of young children, a portion of this period can be spent resting on a bed or couch or even asleep. Older children may be less disposed to rest at this time, but are certainly better to remain indoors engaged in some quiet occupation. With babies it should usually be possible to leave them out of doors all day long, provided their cot or pram is kept in dense shade; otherwise they too will have to spend the hottest hours of the day indoors.

Finally, there is the problem of children at school, either as boarders or those who spend most of the day there. It is considered equally important that the school routine should permit of the child remaining inside at the hottest part of the day. Indeed in the writer's opinion the time has come when the distribution of the school hours calls for careful scrutiny and revision. Most school teachers in Southern Africa agree that the receptive power of the child is at low ebb in the afternoon, and many feel that teaching between two and three o'clock is virtually a waste of time and effort.

If that is so, then it seems logical to make fuller use of the early part of the day when, in the cool of the morning hours, sustained effort and concentration become possible. That is to say by starting school an hour or so earlier the important part of each day's study programme could be completed by midday, leaving the late afternoon for games

and special subjects. At any rate, an arrangement of this nature would do away with the necessity for arranging classes or games in the early afternoon, and would make it possible for the child to remain indoors at this time engaged in some of the lighter activities of the school curriculum.

The tendency to get the child out of doors in the daylight hours probably represents a genuine desire on the part of parents and teachers alike to ensure the maximum benefit from the open air and inviting sunshine of the tropics, but this commendable point of view must be tempered by the knowledge that in the tropics the midday sun is dangerous and the associated heat exhausting.

The unfortunate child of pre-school age especially when left to languish in the hot sunshine day after day will soon become a fretful, whiny, rather apathetic individual, sadly lacking in all the irresponsible *joie de vivre* of healthy childhood.

There is also a deeper psychological aspect to the child's out-of-doors programme. The child who spends practically the whole of his waking hours away from home in the company of someone of a different race will gradually come to regard his favourite playground as the main scene and centre of all the interesting activities of his life. Home for him will be a place where he fights a losing battle against organized authority, where he must feed whether he wants to or not, and where he must go to bed just when he is beginning to feel more energetic and full of new and interesting ideas.

Nor must it be forgotten that the traditional home influence must always constitute the dominant theme in the formative years of every child's life. The child brought up in continuous contact with an alien race will readily acquire habits, modes of speech and a sense of values often very

much at variance with all that is best in European tradition and culture.

While these undesirable traits may undergo some measure of modification in later years, they constitute a handicap which can seldom be entirely eradicated.

And so it becomes apparent that the indoor phase of the child's life is not only beneficial in the purely physical sense, but helps to bring the child into closer contact with the life of his parents and his family generally.

Clothing: The question of clothing for the white child in the tropics has also to be considered in terms of the heat and the sun.

It was said by Sir Andrew Balfour (quoting Gibbs) that the ideal "costume" for the tropics consists in a large white umbrella which shades the body and reflects the heat without in any way retarding evaporation and radiation from the body surface or interfering with the free movement of the air. The idyllic simplicity of this costume has much to commend it, but there are certain obvious difficulties in the way of its acceptance as a routine of childhood. None the less, it emphasizes two basic facts which should govern the selection and design of clothing intended for white children in the tropics, namely (1) the provision of adequate protection against the sun with (2) a minimum of interference with the free circulation of air over the body's surface.

Clothing, therefore, is designed to protect as well as adorn, consequently the tendency to shed or shorten the child's garments is not likely to receive the support of responsible scientific opinion. It does seem, however, that the design of tropical garments still awaits the master touch of one fully aware of the combined claims of protection and coolness, but it is not my intention to venture opinions

upon such a controversial subject, but rather to deal with a few general principles which may assist the mother in her choice of suitable garments for her children.

Clothing for tropical wear should be light in texture, while the colour should reflect more heat than it absorbs without being too glary or too easily soiled. White, of course, has the property of filtering out heat rays better than any other colour, and is certainly popular for special occasions, but it has the disadvantage that it is easily soiled and is trying to the eyes in bright light. Pale blue, light green and light yellow come next in their ability to reflect the heat rays, while dark yellow, dark green, red and light brown are rather more absorptive. Khaki is a useful and practical colour with a relatively low heat absorption and is particularly suitable as a routine colour for small boys. Black, on the other hand, is badly suited for tropical wear in view of its high absorptive index.

With boys, the problem of what to wear is relatively straightforward. The undergarments should consist of a vest and small underpants made of aertex cellular material. These should be worn consistently throughout the year, using garments made from slightly heavier material in the colder winter months. A simple cotton shirt of an appropriate colour is worn over the vest. This should fit loosely and should be open at the neck. The sleeves are probably better to be long, but there is no real objection to wearing them short or rolled up. Some mothers incorporate a spinal pad in the make-up of the shirt. That is to say a broad strip of some coloured material is sewn inside the back of the shirt in such a way as to overlie the spine. There does not appear to be any special advantage in this, but it can do no harm, and there is no need to condemn it so long as it is supplemented by a more comprehensive protective routine.

The shorts require to be well fitting, and for ordinary wear, khaki or grey flannel will be found most practicable. Belts, of course, are always popular with small boys, but actually aeration of the body is better served by means of braces. Alternatively the trousers can be designed to fit snugly at the waist without the need for either belt or braces.

It is always advisable to make the child wear socks, but they will have to be changed and washed daily.

Shoes should be worn, and must always be selected with care right from the start. They should have a well-defined low heel, should be well fitting and must allow for expansion of the foot in the heat of the tropics. When fitting a child for new shoes, therefore, full use should be made of the pedascope which most outfitters have to-day. In this way a correct fitting can be obtained, while re-examination from time to time will enable the mother to keep a check on the size of the shoes in relation to the growth of the feet.

In the case of small girls, a much wider choice of colour and material is available, with correspondingly pleasing effects to mother and child, but here again the same broad principles should be followed in regard to selection and design.

Undergarments should be made of soft material, such as a mixture of cotton and silk, while in cold weather some form of bodice will also be required.

The frock should be loose-fitting and made of some brightly coloured washable material. The sleeves should preferably be long, but here again short sleeves are permissible. As to length, the frock should come at least two-thirds of the way down the thighs. Shoes and socks should be selected as already discussed.

It is always wiser to insist on the child wearing socks and shoes in the tropics. Running barefoot, especially in the

country districts, increases the risk of acquiring some parasitic infection such as hookworm disease, sandworm and certain troublesome fungal infections of the feet.

In view of the low early morning and sundown temperatures which prevail in so many parts of the tropics, it will usually be advisable to supplement every child's "basic" clothing by means of a warm cardigan, pullover or jersey. These can be removed without risk as the temperature rises during the day. They should also be employed to prevent chilling after vigorous exercise.

Finally, in many parts of Southern Africa, an overcoat is also necessary during the cold season.

It is also very important to protect the child's head from the sun. Therefore, no child should be allowed out "in the midday sun" without a hat, and provided training in this regard is conscientiously carried out from an early age, no serious lapses need be anticipated as the child grows up.

The pith-helmet undoubtedly provides the most complete protection against the sun, especially when reinforced with aluminium foil, but except in regions directly on the equator or in close proximity to it, the helmet is not absolutely essential. In Southern Africa, for instance, a wide-brimmed felt hat will provide the child with adequate protection against the sun. The crown may be lined with red or green material as desired, but the important thing is to see that the brim is sufficiently wide to give shade to the eyes, face and neck. At the same time the crown of the hat should be well ventilated—a point that usually receives scant attention from hat-makers.

Where young children and girls are concerned, there will always be the temptation to dress them in some picturesque headdress which may be æsthetically highly attractive, but of little value as a protection against the tropical sun. The mother must simply resolve to harden her heart against

such temptation and do what she can to modify the austerity of the more practical felt.

There is no need to wear a hat at all in the early morning or late afternoon, but as the morning advances and the rays become more direct and intense, then a hat must always be worn out of doors. We already know enough about the evils of over-exposure to the tropical sun to justify this simple precautionary measure.

Such, then, is an outline of those measures which in the present state of our knowledge afford the child a fair measure of protection against "the heat and the sun." As time goes on and developments take place in the cooling of houses and classrooms, some of the foregoing suggestions may have to be modified, but for the present it is safer to recognize the dangers inherent in over-exposure to the sun in the tropics, and to do what we can to avoid them.

This does not mean that every white child in the tropics must be shut away from the sun from dawn to dusk. It simply means that they must and should be kept out of the direct sunshine when the day is at its height, and spared the exhausting heat in every way possible. In this way they stand to gain in health and in happiness in spite of the tropics.

CHAPTER V

PROTECTION AGAINST DISEASE

GENERAL MEASURES

In this chapter it is proposed to discuss those general measures which in the aggregate serve to maintain the health of the child, and at the same time to discuss the various procedures now available in the prophylaxis of certain specific diseases.

The well-rested, well-fed child stands the best chance of being fit, and in this connection the whole question of sleep and rest has already been discussed in some detail. All that remains to be said is that sleep should be regarded as the finest natural tonic to the nervous system, and therefore long and uninterrupted spells are absolutely essential throughout childhood. During this period the brain grows and develops with amazing rapidity, and in consequence is especially susceptible to the poisons of fatigue. Therefore make sure the child is given the opportunity of plenty of sleep; late nights must be few and far between.

Just as sleep is vital to the growth and development of the nervous system, in the same way good food and regular meals play a big part in the growth of the body generally. Nor is this all, for it is now appreciated that the quality of the tissues is also dependent on the nature of the diet. In other words, good food means better resistance to infection and disease. For these several reasons the whole question of diet has already been discussed in the preceding chapters.

Again it has been urged that every child should be spared the exhausting effects of the heat and the dangers of over-

exposure to the sun. This calls for a certain amount of thought and common sense. No one need deprive the child of the joys of playing in the sun; all we ask is that the time of his exposure be selected with care along the lines already suggested, and that he be appropriately protected and clothed.

Consistent care and attention to these major issues will play a big part in conserving the health and vigour of the child, but many minor discomforts and disorders will also be avoided by attention to a variety of additional measures.

Care of the Skin.

While the skin has many functions, not the least of these is the part it plays in regulating the body temperature. It does so largely through the reaction of its capillaries and the free action of the sweat glands, so that in the tropics a sluggish skin will have unpleasant consequences both in health and disease.

The first principle in the care of the skin is to keep it clean, and the second aims at maintaining good "tone" in the cutaneous capillaries. Cleanliness calls for a daily bath. In this way sweat and sebaceous material which are secreted freely are removed so that decomposition and irritation are avoided. The bath is best given in the evening, so that the child may be put to bed fresh and clean. In regard to the temperature of the water it is advantageous in the hot months at least to bath in tepid water ranging between 80-85°F., depending on the health and vigour of the child. The puny type of child will undoubtedly require a hot bath during the early weeks of life, but in the case of healthy babies and older children the temperature of the bath should be lowered to the 80-85°F. level. By so doing the tepid water exerts a tonic and bracing effect on the skin capillaries. Babies should be allowed to splash about freely

and to this end they should be bathed in a big bath as soon as possible. The child must never be left in too long, and shivering means that the water is too cold or that the child is developing some feverish illness.

Apart from the tepid bath at night, it is a good policy to train the child to start off the day with a cold shower, and wherever possible this should be kept up the whole year round.

A good fatty soap should be used in bathing, but there appears to be no special advantage in using so-called antiseptic soaps which not infrequently irritate the child's skin. After a bath the skin must be dried vigorously and thoroughly. Failure to do so renders the skin rough and damp areas may afford entry to fungal spores with subsequent dermatitis. It is also advisable to make free use of a soft, non-irritating dusting powder between the legs and buttocks, under the arms and round the neck under the chin. This is especially necessary in the case of fat children in whom there is a greater tendency for skin irritations to develop.

Care of the Hair and Scalp.

The care of the scalp begins in infancy when the head should be washed with warm water daily, but soap is not applied oftener than once a week. The overzealous application of soap and water depletes the scalp of its natural fats and renders the skin dry and scaly. So that after every washing the scalp should be well dried and brushed with a soft hairbrush. From time to time a few drops of castor oil or almond oil may be applied when signs of overdryness become apparent. In washing a baby's scalp there is no justification for avoiding the skin over the anterior fontanelle. There is not the slightest danger in touching this soft part of the scalp. Indeed when this area is left un-

washed a quantity of dirty brown scales accumulate and may be difficult to remove.

Older children should have the scalp washed once every week, using a good shampoo or a good fatty soap with plenty of hot water, and all children should be taught to brush the hair vigorously at least twice a day. They must therefore be provided with a good brush for the purpose.

In the case of boys the hair should be kept short; not only does it look neat but is the more easily kept clean. Girls with long hair will find it cooler to wear their hair in plaits, but some may prefer to keep it short.

Care of the Mouth and Teeth.

The hygiene of the mouth is especially important in early infancy, so that in the case of artificially fed babies the teats employed must be scrupulously clean. After use the teats should be turned outside in and well rinsed in cold water, while immediately before use, boiling water is poured over them. With older children gargling seems to be widely practised as a means of maintaining the mouth and throat germ free, but it is extremely doubtful if the virtues claimed for gargling can be fully substantiated. Nature has seen to it that the composition of the normal secretions of the mouth are unfavourable to the untrammelled growth of invading organisms, so that any fluid that dilutes these natural secretions is actually impairing the bactericidal properties of the saliva. Nor is it possible to claim that the ordinary gargling fluids when diluted sufficiently to be tolerated in the mouth are capable of exerting a highly destructive action on bacteria, hence the case for the prophylactic value of gargling appears to have been built up on very insecure premises. This is not to decry the value of gargling in acute infections of the throat where the warm fluids have an undoubted soothing effect.

Care of the teeth implies a good deal more than simply brushing them regularly with a suitable dentifrice. Brushing the teeth is, however, important and should be instituted as soon as the teeth erupt. Using a soft toothbrush dipped in an alkaline mouth-wash such as milk of magnesia, the teeth should be cleaned twice a day, say after breakfast and after supper. As the child grows older a brush with a small head but with slightly stiffer bristles should be used, and brushing should always take place in an axis running from the gum margin to the crowns of the teeth. A horizontal movement is restricted to the biting surface. The tooth powder employed must be of fine quality, otherwise damage is caused to the dental enamel. The mouth must be well rinsed afterwards, as one of the main functions of the toothbrush is to dislodge food residues which otherwise stagnate and decompose between the teeth and so predispose to dental sepsis and decay.

But as already stated, care of the teeth goes far beyond these laudable local measures. Unless the teeth are well and soundly formed from the earliest phases of development, they will always be prone to infection and decay.

If, then, we accept the view that sound teeth can only be built up in the presence of an adequate supply of building materials, it follows that the first step in the care of teeth necessitates an adequate supply of foods rich in Vitamin D for the mother during pregnancy—that is to say butter, milk and eggs. During infancy and early childhood the teeth continue to develop, so that during this period every care should be taken to see that the child receives at least a pint of milk a day, half an ounce of butter a day and three eggs a week. This will ensure an adequate intake of Vitamin D which in the tropics can be still further augmented by making judicious use of sun-baths. It is important to see that cereals do not bulk too largely in the diet,

as they have been shown to interfere with the normal process of dental calcification. Where there is any reason to suppose that the Vitamin D intake is inadequate it can readily be augmented by a teaspoonful of cod-liver oil emulsion twice a day in the cold weather or by a few drops of some Vitamin D concentrates in the hot season.

Thus, care and attention to the diet along these lines will ensure healthy milk teeth and at the same time will lay the foundations for sound permanent teeth. Neglect of these elementary rules can never be undone.

The milk or deciduous teeth erupt in various ways and at various times, but the following table gives the average pattern of the dentition:

Central incisors: lower, upper	8 months
Lateral incisors: lower, upper	10 months
First molars	12 months
Canines	18 months
Second molars	24 months

The roots are not fully formed until two to three years after eruption.

Great care should be exercised over the milk teeth, as it is well known that neglect will prejudice the development of the jaw and the structure of the permanent teeth. So whether the baby cuts his teeth early or late is of little importance so long as the teeth are sound and, being sound, are well cared for.

The Regulation of the Bowels.

Reference has already been made to the importance of a rhythmical evacuation of the bowel, but it may be useful to recapitulate the main points.

The bowel is not difficult to regulate, provided the training process is begun in early infancy. It is therefore a sound plan to accustom the child to associate the feel of the chamber pot with evacuation of the bowel from the earliest days of infancy. After each feed the child is held on the chamber pot until the customary reflex emptying of the bowel occurs, and provided this procedure is carried out consistently and conscientiously the mother will be pleasantly surprised to find how rapidly the reflex becomes an established practice.

As the child grows older the bowel movements become less frequent and in due course settle down to once, or it may be twice, a day. Hence a definite time must be set apart each day for the evacuation of the bowel, and furthermore the mother must satisfy herself that the evacuation is complete. A suitable time is immediately after breakfast, but a second bowel movement may occur after some later meal in the course of the day. At any rate, it is important to ensure that the same time is observed day by day and that nothing is allowed to interfere with the routine. At the same time it must be appreciated that the urge to evacuate the bowel should never be suppressed no matter when it occurs. With the advent of school days particular care must be taken to ensure that the child is allowed ample time for the evacuation of the bowel after breakfast. "Rush tactics" in this connection are to be deplored. One further point may be mentioned. It is important to see that when the child is promoted to the lavatory seat his feet are able to reach the floor. If this is temporarily impossible of achievement then he must be provided with a flat box or footstool on which his feet may be firmly planted. Failure in this regard upsets the dynamics of defæcation.

In addition to the simple matters of routine, the diet has to be carefully supervised from day to day. With the child

on a well-balanced dietary the only point that calls for special mention is the need for a free intake of water and fruit juices. This is especially important in the tropics where the fluid loss from the skin is so considerable. In the case of young artificially fed babies the main point to observe is an adequate concentration of sugar in the feeds, roughly one teaspoonful of sugar to each pound of body weight. The tendency to incorporate large quantities of roughage in the diet is to be deplored as the resultant over-stimulation of the bowel may cause irritation and even inflammation of the delicate bowel lining.

Finally, the child, even the baby, must have plenty of physical exercise. In the case of young healthy children, there is seldom any particular need to encourage them in this respect, but with older children it may sometimes be necessary to exercise some direction, especially when they are concentrating on examinations.

Care of Food and Drink.

A considerable number of dangerous infections are transmitted by contaminated food and drink, so that in the tropics it is vitally important to maintain a careful watch over the cleanliness of both. The list of diseases transmitted in this way includes many formidable conditions such as enteric fever, dysentery, undulant (Malta) fever, abdominal tuberculosis and certain streptococcal infections of the throat including scarlet fever. As will be seen later the dangerous parasitic infection known as bilharzia disease may also be contracted through drinking contaminated water.

In discussing the child's diet the importance of milk was stressed repeatedly, but at the same time it must be emphasized that raw milk may be the vehicle of several dangerous infections, and this is especially so in the tropics where flies

abound and where the hygiene of the native inhabitant is often primitive in the extreme. Thus the child should never be given raw milk to drink. It must either be boiled or pasteurized. Indeed in some parts of the tropics reconstituted dried milk is to be preferred. Most children object to boiled milk, although some acquire a taste for it. The boiling may be effected in one of two ways:

(1) The milk is boiled in an open saucepan for five minutes. The maximum temperature in these circumstances is 213·8°F. and all organisms are destroyed. The vitamin content is also destroyed but provided the milk is then kept in covered sterile containers it is perfectly safe to drink. It is, however, unpalatable.

(2) As an alternative the milk may be boiled in a double saucepan. The water jacket in the outer section of the pan is brought to the boil from cold and kept boiling for thirty minutes. The milk is thereby heated to 210·2°F. and is rendered free of bacteria. Provided it is cooled rapidly with the aid of iced water, the taste is not materially altered.

In the process of pasteurization milk is heated to not less than 145°F. and not more than 150°F. for thirty minutes, and is then quickly cooled. When properly carried out this procedure either destroys or renders harmless all the dangerous organisms without producing any significant change in the physical or chemical character of the milk. Thus at 145°F. the "cream line" remains unaffected, nor is there any outfall of soluble calcium or phosphates. The Vitamins A and B remain intact, but Vitamin C is destroyed; the taste is not affected. The position, therefore, is that there is no significant impairment of the nutritive qualities of milk in the process of pasteurization except in

regard to the Vitamin C content, which can be readily replaced by the inclusion of citrus fruits in the diet. On the other hand the elimination of dangerous bacteria from the milk far outweighs any demonstrable or hypothetical deterioration in its nutritive value.

Drinking water, like milk, may also contribute to the transmission of certain infectious diseases such as dysentery, enteric fever and, in some parts of the tropics, cholera. Everything must be done, therefore, to render the child's drinking water safe. In the home the simplest way of doing this consists in boiling the water for about five minutes, and after cooling, transferring it to a sterile container which is covered and kept in a cool place, preferably a refrigerator. The boiling process should always be supervised by the mother. In towns where the water supply is subjected to strict laboratory control the necessity for boiling may appear redundant, none the less it is an added precaution which is always well worth observing.

Finally food which is eaten raw must be scrupulously clean. Fruit should be dipped in boiling water and skinned when necessary or in some cases rinsing in a weak solution of potassium permanganate is preferable.

Vegetables about to be used in the preparation of salads should be well washed in running water and the leaves separated. They are then immersed in a strong salt solution (one part salt to six parts water) for about an hour and finally washed and soaked in fresh water before use. This procedure facilitates the removal of larval pests from the leafy vegetables. It is also necessary to see to it that whoever is responsible for the preparation of vegetables for the table has well-washed hands.

Such then is an outline of various simple ways and means which combine to maintain the child's resistance at a high level and at the same time reduce the hazard of bacterial

infections. The procedures are simple and straightforward and should be so much part of the daily routine that they need be neither irksome nor unpleasant.

PROTECTIVE INOCULATIONS

It is possible nowadays to build up an effective immunity against a number of dangerous and debilitating diseases by means of protective inoculations, whereas in the past it was only through an actual attack of the disease that a similar measure of immunity could be established. Unfortunately there are still many disorders against which no specific protection is available, apart from the natural resistance to all infections inherent in the vigorously healthy child, but where protective measures of established efficacy are available then it is logical to make full use of them. In this connection two points should be emphasized.

Firstly the immunity conferred by a given injection or series of injections may have a limited period of effectiveness so that periodic "boosting" inoculations will be necessary. This point will be discussed in a more specific sense later.

Secondly full use should always be made of any test which gives a measure of the effectiveness of the immunity conferred by the injections. Thus the Schick test in relation to diphtheria prophylaxis is a case in point.

Diphtheria.

Diphtheria is a highly infectious disease caused by a specific organism against which a high measure of immunity can be established by means of protective inoculations. The organism responsible for the disease is known as the Klebs-Loeffler bacillus. Any person suffering from diphtheria will readily infect others by coughing, sneezing or

kissing or by contaminating books, toys, feeding utensils and so on. The disease is also spread by carriers who harbour the organism in the throat without themselves showing evidence of infection. Finally the disease may be transmitted by contaminated milk. Infants up to the age of six months are usually immune to the disease, by reason of the protective antibodies acquired from the mother.

The incubation period ranges from one to five days, usually three to four.

The Signs and Symptoms of Diphtheria: An attack of diphtheria usually develops insidiously with a sore throat and difficulty in swallowing, but it must never be forgotten that younger children may develop diphtheria without once complaining of the throat. The child becomes listless, irritable and feverish with little or no interest in food. When the throat is examined it is seen to be red and spotted with foci of a greyish-white exudate on one or both tonsils. As the hours pass the greyish exudate spreads rapidly and very soon the tonsils are covered by a greyish-white membrane which continues to extend further and will eventually involve the uvula, soft palate and pharynx unless vigorous steps are taken to control the infection. The throat becomes swollen and painful and the glands below the jaw become enlarged and tender. The breath and odour from the throat is heavy and offensive.

The child looks pale and ill but in spite of the extensive involvement of the throat the temperature may not be more than 100 or 101 °F. In other words the height of the temperature in diphtheria is no index of the severity of the attack. The pulse is always soft and rapid. Both these points are usually in sharp contrast to an attack of acute tonsillitis, in which the child develops a raging temperature accompanied by a full and bounding pulse. In the

untreated case of diphtheria the membrane reaches its maximum development in four or five days. By this time the child is desperately ill and unconscious. Only in a very few cases does the membrane begin to shrivel and recovery set in.

In some cases the infection develops primarily in the nose, giving rise to what is termed nasal diphtheria. In such circumstances one or both nostrils is blocked and the discharge consists of a blood-stained watery pus which causes excoriations round and below the nose.

As there may be little in the way of general disturbance to the child's health the true nature of the infection may be overlooked and so a dangerous carrier state may remain undiscovered.

Finally, diphtheria may develop in the larynx, giving rise to the highly dangerous variety known as diphtheritic laryngitis or laryngeal diphtheria. In this variety the first indication is the onset of hoarseness accompanied by a good deal of noisy coughing. Then the voice goes, or practically goes, and the temperature and pulse rate rise, while the breathing quickens. As the membrane spreads in the narrow larynx, breathing becomes more and more laboured and more and more noisy, while suffocative attacks set in and become more numerous. Meanwhile the child is blue and livid in appearance—while every muscle in the body is straining to get air into the chest. When this stage is reached, unless tracheotomy is carried out with expedition, the child dies of asphyxia.

Complications: The natural history of diphtheria does not end with the attack on the throat, nose or larynx. In all types of infection the body is flooded to a greater or lesser degree with powerful toxins which frequently cause serious damage to the heart and the nervous system.

While the heart is always involved to some extent in diphtheria, the extent of the damage varies considerably. In some cases the heart muscle or its nervous control is so overwhelmed with toxin that death may occur suddenly and dramatically. In other cases the cardiac muscle, though not overwhelmed by the diphtheria toxins, is gravely weakened. In such circumstances the pulse rate rises and a distressing shortness of breath sets in. Finally a serious disturbance of the cardiac rhythm may develop and this may render the patient a cardiac cripple for years to come.

The toxins of diphtheria may also inflict serious damage on the nervous system, particularly in relation to the peripheral nerves, causing various types of paralysis, usually during the second or third week of the attack. The main varieties of paralysis include (1) paralysis of the palate in which the voice acquires a nasal twang and fluid regurgitates down the nose; (2) paralysis of the nerves to the eye muscles with failure of accommodation, squints and so on; (3) paralysis of the nerves to the limbs, with difficulty in walking.

But these by no means exhaust the possible forms of paralysis which may occur in diphtheria. Practically any part of the body may be involved, including important muscles such as the diaphragm.

Prevention: Diphtheria is obviously a highly dangerous disease, but now that the causal agent has been identified a high order of immunity can be built up against the disease by means of preventive inoculations.

The two preparations at present employed to build up immunity against diphtheria are alum precipitated toxoid (A.P.T.) and toxoid antitoxin floccules (T.A.F.). Both these preparations may be administered to infants and young

children without causing serious reactions. At the same time they confer an effective immunity against diphtheria.

The immunizing process is usually started when the child is between six months and a year old. By this time the child has begun to lose its natural immunity to diphtheria.

To obtain the best results from these protective inoculations a period of several weeks should elapse between the first and the second injections. The advantages inherent in this delay have been very convincingly demonstrated.

When using A.P.T. the usual procedure consists in injecting 0·1 cc. subcutaneously followed by 0·5 cc. four weeks later. In the majority of cases an effective immunity is gradually built up in the next few months, and is maintained over a period of several years. The actual period of effective immunity is variable, and for that reason it is considered advisable to give the child a further "boosting" injection between two and three years and again when he goes to school at the age of five or six. Immunologists are now advocating an increase in the initial dose to 0·5 cc. and an increase in the interval between the first and the second injection from four weeks to three or even six months, the second dose again being 0·5 cc.

It is now possible by means of a simple skin test to assess the efficacy of the protective inoculations. That is to say it tests the child's susceptibility to diphtheria. The test was introduced by Professor B. Schick in 1913 and is now known as the Schick test. The test consists in the injection of a standard dose of diphtheria toxin into the skin of the forearm, while a control injection of heated toxin is inserted into a similar site on the other arm. Where a child's blood contains a high content of diphtheria antitoxin, no reaction develops in either arm, so that the child is said to be Schick negative, which implies immunity to diphtheria.

Therefore every child who has been successfully inoculated with one or other of the diphtheria prophylactics should be Schick negative about three months after the last injection. On the other hand where the child's blood is deficient in protective antibodies a red zone develops at the site of the toxin injection (but not at the control site) after an interval of 48 to 72 hours and persists for a week or ten days, then gradually fades, leaving a brown pigmented patch. In such circumstances the child is regarded as Schick positive, that is to say he is susceptible to diphtheria. The Schick test is thus essentially a test of susceptibility.

Smallpox.

Smallpox is a dangerous and disfiguring disease with a widespread distribution throughout the tropics and sub-tropical belts of Africa. There are two varieties of the disease—a virulent and often deadly major form, and a relatively mild or minor form sometimes known as Alastrim or Amaas.

The disease is caused by an ultra-microscopic virus which can be demonstrated in the skin eruptions. It is transmitted from one person to another by direct contact and through the agency of infected articles. Smallpox must therefore be regarded as a highly contagious disease capable of infecting all age groups, although it is probable that children relatively speaking show a greater degree of susceptibility to the disease than adults.

The incubation period is usually twelve to fourteen days. The patient then becomes suddenly ill and feverish with a severe frontal headache and, characteristically, acute pain in the back. After three days of severe constitutional disturbance the temperature falls and an eruption appears which rapidly develops the characteristics of a true smallpox rash. The eruption consists initially of a crop of small

hard papules which can be felt as small shot beneath the skin. They first appear and attain their maximum concentration over the head, face, scalp and wrists, and then spread to the trunk, legs and arms, but the entire eruption develops rapidly as a single crop. In chicken-pox, on the other hand, the eruption is concentrated on the trunk and emerges as a succession of crops.

About the third day the smallpox papules fill with clear fluid, a process known as vesiculation, and about two days later they become pustular. At the same time the patient's condition deterioriates as a result of a secondary fever which may be severe and prostrating. Gradually the pustules become dry and crusted and after two to three weeks the temperature subsides and the patient recovers, but the deeply placed pustules may cause gross facial disfigurement by reason of the terminal scarring.

While the mild varieties of smallpox run an uncomplicated course, the virulent types are frequently accompanied by dangerous infections of the chest, middle ear, eye, kidneys, bone and so on.

From this brief sketch it is clear that apart from the many dangerous complications smallpox is capable of causing grave facial disfigurement, so that no one is justified in withholding from any child the protection inherent in vaccination, even though the parents themselves may entertain personal scruples concerning its virtues.

Vaccination: The Jennerian method of vaccination which dates from the year 1796 consists in inoculating the human subject with the virus of cowpox. This simple procedure confers a highly effective immunity against smallpox without causing more than a local reaction at the site of the inoculation, and at the same time a variable but always fleeting degree of constitutional disturbance. Primary vac-

cination should be performed between the second and the sixth month but only if the child is thriving satisfactorily and is free of any skin disease or feverish ailment. Where the child is vaccinated within the first two months, negative reactions are more likely to be obtained on account of the transference of a temporary immunity from mother to child. The sites usually selected for vaccination are (1) the upper arm on the side away from the mother when the child is being carried in her arms, and (2) the outer aspect of the thigh just above the knee. The method of vaccination recommended by the Committee of Vaccination consists in making a single linear scarification through each of four droplets of lymph. More recently, however, two alternative methods have been introduced. In the one a small volume of diluted lymph is injected directly into (not under) the skin and in the other the virus is inoculated by pressing a needle point through the lymph at thirty or so points. After application the lymph is allowed to dry and is then covered with a sterile dressing.

When the child has been successfully vaccinated a fairly well-defined series of events ensues. On the third day a small papule appears at the site of the vaccination and goes on to form a bleb or vesicle which reaches its maximum by the seventh day. By this time the contents of the vesicle have become purulent and the surrounding skin is red and swollen. At the same time the regional lymph glands are enlarged and tender and usually the temperature is two or three degrees above normal. By the end of the first week the child is fretful and definitely out of sorts. He is disinclined for food and often sleeps badly for a night or two. However, during the second week the vesicle dries up to form a scab and at the same time the constitutional upset rapidly subsides. Finally between the fourteenth and the twenty-first day the scab separates and falls off, leaving

a permanent scar known as the vaccination mark. During the acute stage when the vaccination is angry and painful a protective dressing should be placed over the vaccination site which should be treated at frequent intervals with a cooling dusting powder. Fomentations should not be employed. At the same time restlessness or sleeplessness caused by the fevered state can usually be controlled by half an aspirin tablet given at bed-time and repeated if necessary during the night.

A high degree of protection against the ravages of smallpox is conferred upon the child by means of a primary vaccination, but as the duration of the immunity is not lifelong the principle has now been laid down that re-vaccination should be carried out on two occasions at roughly seven-year intervals. Little or no constitutional upset occurs with re-vaccination, and the resultant scarring is usually quite insignificant. This procedure, however, ensures that a solid immunity against smallpox will be built up and maintained.

Complications: It is only fair to state that certain complications may be associated with vaccination, but they are very infrequent.

(1) On rare occasions vaccination is complicated by a generalized vaccinia which develops towards the end of the first week and consists in crops of papules which spread over the face, trunk and limbs. These papules form vesicles which pustulate and dry up to form crusts in the same way as the original lesion. There is usually very little in the way of constitutional upset and recovery is the rule.

(2) Secondary vaccinia consists in the appearance of daughter vesicles near the site of the original vaccina-

tion and are invariably caused by scratching and breaking the primary vesicle.

(3) Very rarely vaccination is followed by a post-vaccinal encephalitis in which cerebral symptoms with fever, headache and vomiting set in about the second week after vaccination. The majority of cases recover.

It may be said that the risks inherent in vaccination have been so greatly minimized in recent years that no parent is justified in withholding from his child the protec-- tion which vaccination affords against a dangerous and disfiguring disease.

Whooping Cough.

Whooping cough is generally regarded as one of the more serious infectious diseases of childhood, and is responsible for a high mortality, especially amongst very young infants or weakly children. It is a highly infectious disease caused by a small organism (the *H. pertussis* of Bordet and Gengou) which has been transmitted experimentally to human volunteers.

Infection is transmitted in the "droplets" projected from the mouth in the act of coughing and sneezing, and unfortunately the period of maximum infectivity coincides with the initial catarrhal stage when the true nature of the illness may still be in doubt.

The incubation period ranges from one to three weeks, with an average period of fourteen days.

The initial symptoms of whooping cough resemble those of a severe cold in the head with sneezing, coughing, running nose and eyes and a slight rise of temperature. After a few days it becomes apparent that the cough is assuming a paroxysmal character with intervals of freedom, and by the end of the first week or ten days the characteristic

whoop has appeared. The paroxysms of coughing tend to increase in severity and in frequency and are usually more troublesome at night. Each paroxysm consists of a series of rapidly repeated expiratory coughs which cause the eyes to run with tears and the face to become suffused and bloated. At the same time the tongue protrudes, saliva runs from the mouth and the veins of the neck distend. Then just as the child appears about to suffocate and collapse from sheer exhaustion the spasm of the glottis relaxes and air is drawn into the chest with a long-drawn crowing sound or whoop. Very frequently vomiting occurs at the termination of the attack. The paroxysms may be repeated several times and in severe cases may occur almost hourly day and night. The child very soon comes to dread the attacks and at the first sign will run to seek protection from the mother or clutch on to something solid.

As the disease runs its course the child begins to look thin and tired, while the features look puffy and swollen. After about three weeks the paroxysms begin to lessen both in severity and in frequency and by the end of the sixth week the whoop has usually disappeared, although the cough may persist and retain its paroxysmal character long afterwards. By this time the child has usually lost weight, is disinclined for food and is obviously "nervy" and debilitated.

Complications: As might be expected, a disease of such severity is not without its dangerous complications.

The devastating paroxysms throw a heavy strain on the delicate blood vessels so that hæmorrhages may occur from the nose and lungs, into the eyes or, rarely, into the brain. In addition the heart muscle may be strained. The most frequent complication, however, is broncho-pneumonia, which is especially liable to occur in very young children and leads to a protracted convalescence.

Finally, convulsions are frequently seen in infants suffering from whooping cough, and may prove fatal.

Protection: A great deal of interesting work has been carried out in recent years in an attempt to evolve an effective means of building up an immunity to whooping cough, but the results so far have been only partially successful. It appears that when the causal organism is cultivated on artificial media as is necessary in the preparation of a prophylactic vaccine, it shows an instability which affects the potency of the resulting vaccine. In spite of this, however, it is claimed that vaccines capable of stimulating an active immunity response can now be prepared, and in view of the potential dangers inherent in an attack of whooping cough, every effort should be made to lessen the child's susceptibility to infection.

To this end a specially prepared vaccine is employed and is given by injection. The appropriate dose is given once a week on three consecutive weeks and then a final dose is given a month after the last injection. These injections should be given before the end of the first year of life, so that a basal immunity may be built up during those first two years when whooping cough is especially dangerous.

The immunity acquired in this way is not lasting, so that a "boosting" dose will be required every two years or so, or at any time when it is known that the child has been exposed to infection.

Measles.

Measles is a highly infectious disease of virus origin. It occurs with greatest frequency between the ages of two and seven, and it is by no means uncommon to find whooping cough and measles occurring within a few weeks of each

other. The infectivity is greatest in the first few days of the attack, when the virus is transmitted in the discharges from the nose, throat and eyes.

The incubation period varies from seven to twenty-one days, with ten days as the average.

The initial symptoms in measles consist in a feverish cold. The eyes become congested and watery and a watery, turbid secretion runs from the nose. The throat is diffusely red, some degree of cough is usually present, and in some cases the child becomes quite hoarse.

At this stage the child looks thoroughly miserable and lies with its face away from the light. In this early phase the appearance of a few minute bluish-white spots on the inner surface of the cheek opposite the premolar or molar teeth is diagnostic of measles. These spots, known as Koplik's spots, are not always easy to see, and should always be looked for in daylight. The temperature may fall a little on the third day, but on the fourth day it rises again abruptly and the characteristic measles rash appears. It consists in a blotchy red eruption which develops behind the ears and spreads rapidly over the face, trunk and limbs. At the same time the individual blotches increase in size and frequently coalesce. The rash usually reaches its maximum intensity in forty-eight hours and in some cases becomes very itchy. Thereafter it begins to fade in the same order as it appeared, and leaves a brownish stain which disappears in turn. As the rash fades the temperature falls away and with it go all the other distressing features of the attack.

The main complications include bronchitis (which is virtually part and parcel of the disease), broncho-pneumonia, which is always a dangerous complication, and otitis media (middle ear disease) which may lead to dangerous involvement of the mastoid.

Protection: The risks inherent in an attack of measles stimulated the study of preventive measures as far back as 1918. The first attempts at prophylaxis were made with serum obtained from patients recently recovered from an attack of measles. The serum is given by intra-muscular injections, using 2·0 c.c. for each year of life up to a maximum of 10·0 cc. If the injection is made within the first five or six days of the incubation period the measles attack will be averted. If made between the sixth and the ninth day of the incubation period the attack will be mild and a lasting immunity will follow.

In view of the difficulty of obtaining convalescent measles serum just when it is needed, pooled serum from adults who have had measles some time previously has been employed, but this not infrequently fails to protect against an attack or even to modify the attack when it does occur.

More recently the discovery that the immunizing property of the serum is practically confined to the globulin fraction of the plasma protein has led to the preparation of "gamma-globulins" from pooled human plasma. This preparation is about twice as potent as convalescent serum, and is therefore of considerable value in building a passive immunity to measles. In view of the risk of infectious hepatitis from the use of crude serum, the "gamma-globulins" are to be preferred and should be encouraged to prevent outbreaks in a community or to protect the weaker type of child from a potentially dangerous disease.

It is possible that vaccines prepared from the measles virus will be available in due course, so that the building up of an active as opposed to a passive immunity will become a practicable measure in the near future.

Scarlet Fever.

Scarlet fever is an acute infectious disease which appears

in recent years to have lost some of its original virulence, although when it assumes an epidemic form severe types are liable to occur. It is caused by the *Streptococcus scarlatinæ* which is transmitted by droplet infection from patients already suffering from the disease. Discharges from the ear or nose may also convey the infection, and it is possible that toys and books and clothing contaminated by such discharges may play a small part in the spread of the disease. There are also instances on record of epidemics of scarlet fever having been caused by infected milk.

The disease rarely attacks infants but is especially common between the ages of five and ten years.

The incubation period ranges from one to seven days but the usual period is two to four days.

The attack of scarlet fever sets in suddenly with a sharp rise of temperature, sore throat, vomiting and headache. Although at this stage no rash has appeared, the skin is hot and dry and the pulse full and rapid. It is important to realize that very young children may say nothing about the throat being sore, but the abrupt onset of the high temperature, the vomiting and the rapid pulse should always make one keep in mind the possibility of scarlet fever. Within a few hours of the onset of the attack the temperature reaches 102 to 104°F. and the throat is intensely red, the tonsils swollen and later patches of exudate appear while the glands below the jaw become swollen and tender. The characteristic rash appears after twenty-four to forty-eight hours, first on the front of the chest, after which it spreads rapidly to the trunk and the limbs. It consists of small closely packed bright red spots on a flushed background and is densest over the lower abdomen and inner aspects of the thighs. The face is flushed except around the mouth and nose, but remains free of the characteristic rash. The tongue is heavily furred at first

but gradually clears and by the fourth day or so is usually bright red.

After a variable period of time ranging from two to three days up to a week, the temperature begins to fall slowly but steadily, the rash fades and the throat clears. Soon after the rash goes the skin begins to "peel" or desquamate, first on the face, then on the trunk and finally on the hands and feet where the skin may be shed in the form of large flakes. This process may continue for several weeks but the scales are no longer regarded as infectious, unless of course they happen to be contaminated by any coincident nasal or aural discharge.

Complications: The infection may cause suppuration in the neck glands or involvement of the middle ear (otitis media), but the two most important complications are acute nephritis and acute joint rheumatism.

When acute nephritis occurs it does so usually during the second and third week of the illness. The face becomes puffy, vomiting occurs and the urine acquires a dark, smoky appearance and there is a significant reduction in the output. Although recovery is the rule the child has to be kept in bed until all signs of kidney involvement have disappeared.

The onset of joint rheumatism as a complication occurs about the end of the first week of the illness, and although the joint inflammation always clears and never becomes chronic it may pave the way for other less favourable types of joint rheumatism, and in some cases may be accompanied by cardiac involvement. So that here again the child must be kept at rest and in bed until the joint symptoms have subsided.

Protection: Before deciding to immunize a child against

scarlet fever it is necessary to determine whether or not he is susceptible to the disease. This can be ascertained by means of the Dick test which stands in the same relation to scarlet fever as the Schick test to diphtheria. The test consists in injecting a small dose (0·2 cc.) of diluted scarlatinal toxin into the skin of the forearm, while a control injection of heated (i.e. inactivated) toxin is similarly injected into the opposite arm. In a child susceptible to scarlet fever a red zone about one centimetre in diameter develops at the site of the test twelve hours later and reaches its maximum in twenty-four hours. No reaction develops at the site of the control injection. These findings indicate a Dick positive test and, as already mentioned, indicate susceptibility to scarlet fever. Most children are Dick negative during the first year of life but become rapidly positive thereafter.

Having ascertained that the child is susceptible to scarlet fever, the next question to settle is whether or not immunization should be carried out. In the first place the use of scarlet fever toxin as the immunizing agent has variable and entirely unpredictable power. That is to say it is difficult to be certain in any given case just how effective or how enduring the immunity will be. In the second place, with scarlet fever in its present relatively mild phase, most normal and healthy children are well able to deal with the infection. On the other hand, where there is a history of damage to the heart, kidney, joints or middle ear it is probably wiser to protect the child as far as possible from further damage. In such circumstances immunization against scarlet fever is justified. An active immunity can be built up by means of graduated doses of scarlet fever toxin given in a series of four or five subcutaneous or intramuscular injections at intervals of a week. An effective immunity takes several weeks to develop and persists for approximately a year. Where emergency immunization is

necessary this can be conferred in a passive form by means of anti-scarlatinal serum given intramuscularly, but in such circumstances the protection lasts two to three weeks only.

Enteric Fever.

The enteric fevers constitute a group of infectious diseases caused by a specific organism and characterized by a primary invasion of the blood stream with subsequent involvement of the lower end of the small intestine. The two main varieties of enteric fever are (1) typhoid fever and (2) paratyphoid fever, but as they resemble each other in all essential particulars a separate description is unnecessary.

Typhoid fever results from infection with *Bact. typhosum* which in the majority of instances is transmitted by contaminated water or food, especially through the medium of milk or milk products, uncooked vegetables, fruits and in certain instances by oysters and shellfish. Human carriers play an important part in the transmission of the disease, especially when concerned with the handling and preparation of food. Carriers can now be detected with greater accuracy by means of a highly specialized blood test, but treatment of such cases continues to be unsatisfactory.

The incubation period ranges from five to twenty-one days, usually ten to fourteen days.

An attack of typhoid usually sets in gradually with headache, loss of appetite, general listlessness and a rising temperature. Bleeding from the nose very frequently occurs at the beginning of the attack. The temperature rises a degree or so each day, so that by the end of a week it has reached 103 or 104°F. As the pulse fails to rise *pari passu* with the temperature it remains relatively slow throughout the attack unless disturbed by some sudden complication. Although the bowel may be constipated at first, the

tendency is for the stools to become loose and frequent. At the same time the abdomen appears diffusely distended and is usually a little tender, especially in the right flank. Towards the end of the first week a faint eruption of "rose-spots" may develop over the front of the abdomen flanks or back. The rash is seldom profuse and consists of small, slightly raised rose-pink spots which come out in crops but only last a day or two. For these various reasons they may be completely overlooked.

During the second week of the attack the temperature remains consistently high in the neighbourhood of 103°F. By this time the child has obviously lost condition and looks wasted and ill. The face is flushed and the eyes heavy, and the tongue heavily coated with dry whitish-brown fur, while the expression becomes characteristically apathetic, denoting a state of complete lethargy. The abdomen continues to be distended and tender and the stools remain loose and frequent.

Then towards the end of the third week the temperature gradually subsides, the stools become less frequent, the tongue clears and the child slowly becomes more alert and responsive, so that in an uncomplicated case the convalescence has usually begun by the fourth week of the illness. In many cases, however, convalescence sets in much sooner as typhoid in childhood is usually less severe than in the adult.

Complications: The two important complications are (1) intestinal hæmorrhage and (2) perforation of the bowel.

Hæmorrhage is most liable to occur in the third week of the illness and is due to separation of the sloughs from the ulcers in the lower segment of the small gut. When free bleeding occurs the temperature falls abruptly and the pulse rate rises steadily and the patient is collapsed.

Perforation of the bowel may also occur in the third week at an ulcer site. This catastrophe is indicated by the sudden onset of severe abdominal pain with a state of overall collapse in which the temperature falls and the pulse accelerates. In such circumstances an immediate operation is necessary to save life.

Protection: It is now possible to build up a high-grade immunity against the enteric group of fevers by means of the T.A.B. vaccine. Therefore every European child (and every adult) in the tropics should be immunized against the disease. Two types of vaccine are available. The one consists of a killed suspension of the enteric group of organisms and is administered by subcutaneous injection in two doses separated by an interval of seven to ten days. (Some prefer to give three injections at fortnightly intervals.)

The other vaccine consists of the immunity-producing fraction of the bacterial suspension and is prepared in a concentrated soluble form, to which the term endotoxoid vaccine is applied. The endotoxoid vaccine is given in a series of three subcutaneous injections at intervals of about a week. This procedure confers a high degree of immunity, and as the vaccine has been subjected to a detoxicating process the reaction to the injection is seldom severe.

With both vaccines a certain amount of redness, swelling and tenderness develops at the injection site, and after a few hours a feeling of shiveriness, malaise and headache may set in and the temperature may rise a degree or two. These reactions, however, are short-lived and seldom persist for more than twenty-four hours. An effective immunity develops about two weeks later and remains at a high level for at least six months, then gradually wanes. However, it is generally agreed that the immunity remains effective for eighteen months to two years.

It follows from this that a " boosting " dose of the vaccine will be required every two years to restore the immunity to its original high level.

GENERAL COMMENTARY

Having dealt with the protective measures at present available in relation to various important infectious diseases, it is now proposed to discuss the extent to which they should be employed as a routine procedure in childhood.

The natural immunity of early infancy against the common infectious diseases is short-lived, so that by the end of the first year of life most children are in a state of heightened susceptibility as their own tissues are still untrained in the production of immune antibodies. It is logical, therefore, to consider to what extent the child can be given reasonable protection against the more dangerous infections. So far as the child living in the African tropics is concerned, the choice is straightforward. It is my opinion that every European child without exception should be immunized against the following infections:

(1) Diphtheria,
(2) Smallpox
and (3) Enteric fever.

The methods of doing so have already been discussed. It just remains to be said that these various immunizations should be completed by the end of the first year of life. At the same time it must be emphasized that the immunity resulting from these primary inoculations is not lifelong, consequently full use must be made of the " boosting " dose from time to time. In the case of diphtheria the " boosting " dose should be given between two and three years after the first, again on beginning school, and finally at

eight or nine years. Further injections will then only be necessary in the presence of a positive Schick test.

With smallpox a satisfactory primary vaccination reaction will normally afford protection for the next seven years. Normally, therefore, re-vaccination need only be carried out on two additional occasions at an interval of seven years. However, the tendency for smallpox to flare up amongst the indigenous inhabitants of the tropics from time to time may render more frequent vaccination advisable. It is certainly wise to follow the recommendations of the Public Health authorities in such matters.

Finally, with enteric fever so widespread in the tropics and with the risk of infection from carriers so liable to occur, protective inoculation should be repeated every two years. This will ensure a solid immunity against the whole enteric group of fevers.

We come now to the question of immunizing the child against whooping cough, scarlet fever and measles.

There can be no gainsaying the fact that whooping cough is a dangerous disease and therefore justifies the use of prophylactic measures. On the other hand the vaccines at present available show a variable immunizing power, but in spite of this the writer considers that every child should be given a course of protective vaccine with a "boosting" dose at least every two years or whenever the child has been exposed to infection.

In the case of measles and scarlet fever it seems that further progress will be necessary in the production of an effective and stable vaccine before immunization need be considered as a routine procedure in either of these diseases. In the case of sickly children, however, the current protective measures should be employed and repeated as the need arises.

Finally, in special circumstances the child may be im-

munized against yellow fever, typhus, tetanus, cholera, rabies and so on, but as these infections do not normally menace the child, no further reference will be made to them.

It is clear from the above that the child is being subjected to a considerable number of injections, even when the minimum is employed, so that steps are being taken to combine the vaccines in such a way that a single injection will cover a group of infections such as diphtheria, typhoid, whooping cough and tetanus. This is undoubtedly an important development from which much is expected in the next few years.

CHAPTER VI

PROTECTION AGAINST DISEASE

PARASITIC DISEASE

Malaria.

This disease, which has been known to afflict the human race for thousands of years, is everywhere regarded as the commonest of all the tropical diseases, and in relation to our present study, malaria must rank as one of the most serious afflictions of childhood.

For many centuries malaria remained a baffling mystery evoking theories which in the light of present-day knowledge appear fantastic but ingenious. The mists, or miasmata, that rose from the tropical swamps were long regarded as the source of the dreaded ague, but with the coming of the science of bacteriology attention first became focussed on certain algæ and later on actual bacteria as the likely causal agent. But it was not until the year 1880 that Laveran, while examining the blood from a malaria patient, saw for the first time certain pigmented bodies which we now know are the true cause of malaria fever in man. In this way a corner of the curtain of mystery had been lifted, yet nearly twenty years were to pass before the discovery was made that the malaria parasite is transmitted from one human being to another through the agency of the female anopheline mosquito. In 1898 Sir Ronald Ross, working in India, demonstrated the mosquito transmission of a malaria-like parasite in sparrows, and in 1898-99 three Italian workers, Bignami, Grassi and Bastianelli, finally proved the truth of the theory as applied to human malaria. Much detail has been added to our knowledge of malaria

since then, and many important advances in treatment have been made, yet malaria still "holds the initiative," as it were, except in a few favoured regions of the tropics. That being so every parent should have a sound basic knowledge of the life cycle of the malaria parasite so that an intelligent domestic control over the transmission of the disease may be exercised, particularly in rural areas where systematized mosquito-control measures on a big scale are unlikely to prevail.

The Life Cycle of the Malaria Parasite: When the life cycle of the malaria parasite was finally elucidated a new doctrine was established in relation to the transmission of disease. For the first time it was clearly demonstrated that under natural conditions malaria could only be transmitted from one human being to another through the bite of an infected anopheline mosquito. In other words the life cycle of the malaria parasite is represented by the sum of two distinct phases, one of which is passed in the human host, and the other in the mosquito or intermediate host.

During the act of feeding the infected anopheline injects the malarial spores into the human tissues where they are temporarily lost to view but eventually appear in the red blood cells. Once established in the substance of the red cells, each spore begins to enlarge and mature at the expense of the red colouring matter of the cell, and in due course undergoes a process of division which leads to the formation of several daughter spores. Finally, the red cell ruptures and the contained spores escape into the blood stream where they rapidly re-enter other red cells and repeat the cycle of development, multiplication and escape. The speed of this phenomenon varies with the species of malaria parasite, but as each shower of spores is released into the blood stream a sharp rise of temperature occurs

along with associated symptoms, thereby accounting for the paroxysmal character of malarial attacks. While the vast majority of the spores contained in the blood stream are destined to repeat this remarkable cycle with unfaltering regularity, a few are set apart for a totally different type of development. It is clear that the biphasic nature of the life cycle demands that due provision must be made to ensure transmission of the parasite from man to mosquito. To achieve this end certain spores are set apart for a particular form of development which renders them capable of infecting the anopheline mosquito as it draws up blood from a malarial patient. Once these specialized spores have entered the mosquito's stomach they fuse together in a particular way to form a new body which buries itself in the delicate stomach wall and forms a cyst within which anything from one to ten thousand new needle-like spores are developed. In due course the cyst wall ruptures and vast numbers of spores are released into the body cavity, many of them passing to a definitive site in the salivary glands, whence they are readily expressed into the human tissues in the process of biting. These in turn reach the red blood cells and so the cycle of man-mosquito-man is completed.

Since the anopheline mosquito plays such an important role in the transmission of malaria, it may be of interest to define the salient features of the adult forms.

The male forms can be readily distinguished by reason of their feathery or plumose antennæ and large club-shaped palpi, whereas the female antennæ, though long, are sparsely covered with short hairs.

The anopheline mosquito also adopts a characteristic attitude when at rest on a surface. The whole body forms a straight line which projects freely outwards at a variable angle, whereas those species of mosquito not concerned in

malarial transmission rest in a hunch-back fashion.

Finally, most tropical anophelines show spotting of the wings, usually in the form of dark markings on a light background. In addition to these elementary distinguishing features in the adult forms, the eggs, larvæ and to a lesser extent the pupæ of anopheline mosquitoes also present well-defined differential characteristics.

Acute Malaria in Childhood: Malaria in childhood is invariably an acute disease and in certain types of infection may rapidly assume highly dangerous features. While several species of malaria parasite exist in Africa, the prevailing infection amongst European children is *Plasmodium falciparum*, the parasite of malignant tertian malaria. As the name implies, this is a highly dangerous infection in that there is an ever-present risk that a given attack may suddenly present certain dangerous complications.

The incubation period of malaria averages from eight to ten days, but may occasionally extend to twelve days.

An acute attack of malaria always sets in abruptly. The child may complain of feeling cold and shivery and almost immediately the temperature races up to 103 or 104°F. and within a remarkably short space of time the child is very obviously acutely ill. The skin is hot and burning to the touch, while the face is flushed and the eyes red and congested. Vomiting sets in early in the attack and when at all severe is responsible for the rapid onset of prostration and exhaustion.

As the fever increases in severity the child becomes more and more restless and very soon is mentally confused and even delirious. Occasionally a convulsion occurs at the height of the attack.

After a period ranging from twelve to eighteen hours the

temperature falls abruptly and the hot, dry, restless phase is relieved by the onset of a drenching sweat. The sweating continues for half an hour or more, soaking both clothes and bedclothes, but in spite of this the patient enjoys a sensation of pleasant relief after the discomforts of the preceding phase, and once the sweating is over the child will be both limp and exhausted but quite happy in his dry cool bed.

After a few hours respite the attack recurs, probably with increased severity, and with each succeeding paroxysm the child becomes more obviously jaundiced and will often complain of an ache or pain in the left side below the rib margin as the spleen begins to enlarge.

It is clear that delay in recognizing and treating an attack of acute malignant malaria in childhood exposes the child to grave risks.

Cerebral Malaria: Cerebral malaria constitutes one of the gravest forms of acute malignant malaria. It may express itself in several ways. A child previously fit and well may suddenly complain of feeling tired and lethargic, and prefer to lie about on its bed rather than play with its toys. It will soon be apparent that the child is feverish and is becoming increasingly drowsy and unresponsive. It lies with its head turned away from the light, while jerky movements develop in the limbs and in the facial muscles. Mentally the child is confused and very soon becomes delirious, and it is at this stage that convulsions are very apt to occur. The convulsion may occur as an isolated event or as a series of attacks, but with the onset of generalized convulsions the child lapses into a state of unconsciousness from which it rarely emerges.

In some cases an attack of cerebral malaria sets in with a violent convulsion and the child is precipitated into a state

of deep and fatal coma. In these fulminating cases death may occur within six hours.

For this reason convulsions in childhood acquire an added significance when occurring in a malarious area in the malarial season, because failure to recognize them as an expression of cerebral malaria will inevitably mean the loss of a child's life.

Other forms of acute malignant malaria: It is not proposed to discuss these other forms in detail but merely to draw attention to the fact that acute malignant malaria may simulate almost any acute disease—an acute dysentery, an acute abdomen, e.g. acute appendicitis, "sunstroke," middle ear disease and so on.

In other words malaria must always be kept in mind when dealing with an acute fever in childhood. Only in this way will serious mistakes and grave tragedies be avoided.

Chronic Malaria in Childhood: Where a child is the subject of recurrent bouts of malaria the disease enters upon a chronic phase which has far-reaching effects upon growth and development.

In chronic malaria the parasite persists in the tissues of the host, and although it no longer gives rise to violent paroxysms of temperature it continues to cause a steady destruction of the red blood cells and to saturate the tissues with malarial toxin.

These two factors gradually bring about a state of anæmia and general debility. The child grows languid and tires easily. The appetite is poor, headaches are frequent, while sweating and shivering attacks occur from time to time, often accompanied by a fleeting rise of temperature. The skin and whites of the eyes acquire a yellow-

ish tinge, giving the child a sickly, unhealthy appearance. The abdomen often appears unduly distended, especially in the upper half, largely because of the swollen spleen and to a lesser extent the liver, whereas the chest and limbs seem spare and thin by comparison.

In the presence of a well-established malarial infection the growth processes are retarded and it is soon apparent that the child is mentally backward, while not infrequently he is unstable and unreliable as well.

Blackwater Fever.

One of the most dramatic complications of malaria is undoubtedly blackwater fever. A full and convincing demonstration of the cause is still awaited, but it is now generally accepted that blackwater fever is the outcome of recurrent attacks of malaria, especially malignant tertian malaria. The essential feature of an attack consists in a sudden massive breaking down of the red blood cells within the circulation, with the release of a large volume of red colouring matter or hæmoglobin, and its escape in the urine where it appears as a red-brown or even black pigment—hence the name blackwater fever.

An attack sets in abruptly with shivering and fever and soon afterwards the patient passes a dark brown or black urine. Vomiting occurs early in the attack and may be severe and prostrating. Backache is common and in addition pain occurs in relation to the pit of the stomach and over the spleen, while headache may be severe. Jaundice develops in most cases and deepens gradually throughout the attack.

The duration of the attack is extremely variable, but in a favourable case the urine gradually clears and all the acute symptoms subside.

In less favourable cases the urine fails to clear and the

patient's condition deteriorates rapidly. In such circumstances systematic transfusion of healthy blood becomes necessary. Sometimes, too, the kidneys may be so damaged by the malarial toxins, or so silted up with blood pigments, that they cease to function.

Blackwater fever is potentially a highly dangerous disease, but the point to keep in mind is that it never occurs apart from malaria. Therefore measures designed to protect the child from malaria will at the same time preclude blackwater fever.

Prevention: While the general strategy of mosquito and malaria control is essentially a matter for the public health authorities, the contribution of the individual will always constitute an intrinsic factor in any programme designed to minimize or eliminate malarial infection. Consequently it is with what may be termed domestic control measures that we are mainly concerned, and there can be little doubt that consistent and intelligent care in this regard will be reflected and rewarded in the well-being of the child.

Elimination of Mosquito Breeding Grounds from the Immediate Neighbourhood of the Home: The elimination of anopheline breeding places is a problem of much greater complexity than may at first sight appear in that it presupposes an acquaintance with the biology of the malaria-transmitting mosquitoes of the locality concerned. It may be said, however, that water is an essential component of all mosquito breeding grounds, consequently the elimination of all unnecessary collections will serve to reduce the amount of breeding, especially if at the same time the destruction of mosquito larvæ is consistently carried out in relation to all essential or permanent waterways. A survey of the neighbourhood of the homestead will frequently

reveal a surprising collection of unsuspected breeding places. For example, the hoof-marks of cattle, the wheel-tracks of wagons, the pits from which the soil has been dug to repair a roadway, or the erosion gullies may all harbour sufficient water sufficiently long to enable mosquito larvæ to complete their development. Such foci can be eliminated readily enough by filling up the depressions, but at the same time every effort must be made to prevent their recurrence.

The problem of drainage generally will have to be faced, but in this regard it will be as well to secure expert advice so that a maximum efficiency may be obtained with a minimum of drains.

Permanent waterways or water collections will inevitably constitute an attractive breeding place for certain species of anophelines, so that attempts at larval destruction may have to be undertaken in certain circumstances.

Oiling is one of the commonest procedures employed. The oil is applied in the form of a spray once a week, and in some cases it may be necessary to divide the area to be treated into a number of sectors so that systematic spraying may be carried out efficiently at regular weekly intervals. The oil kills the larvæ either mechanically or by a direct toxic action. Other preparations used in the destruction of mosquito larvæ include cresol compounds and Paris Green, a mixture of arsenic and copper, but advice as to the best preparations to be employed in a given set of circumstances should always be sought from the health authorities.

Control of Adult Mosquitoes in the Home: A second line of defence consists in excluding mosquitoes from the house, destroying any that may gain access to the rooms, and at the same time taking the additional precaution of eliminating the risk of being bitten whilst asleep by the systematic

use of a mosquito bed-net. The mosquito proofing of houses requires to be carried out with care and thoroughness, so that it is usually advisable to secure expert advice on the material to be used, the mesh of the gauze, the design of the screens, and so on. In this way it will be possible to be reasonably confident of the efficacy of the screening, provided it is subjected to constant supervision. In most households the destruction of adult mosquitoes is most conveniently effected by means of D.D.T. and pyrethrum extracts which are sprayed into the rooms in the form of a fine mist, the finer the better. When spraying the room special attention should be paid to the dark hiding-places favoured by mosquitoes, such as the space behind pictures or in relation to pieces of furniture. Once the room has been sprayed it should be shut up for half an hour to ensure the complete destruction of all the contained mosquitoes. At the same time it should be fully appreciated that spraying does not prevent the subsequent entry of further contingents of adult mosquitoes.

This second line of defence also includes the systematic use of the mosquito bed-net, and where children are concerned any laxity in the use of nets can only be regarded as a form of gross negligence. The contention that is sometimes heard, to the effect that the child is unable to sleep under a net, is invalid and merely proclaims a defect in parental discipline.

The net should be of good material with a mesh of at least sixteen holes to the inch, and should be reinforced by a calico border about two feet in depth. With the net in position there is then no risk of the child's arm coming into contact with the mesh-work of the net, through which it could be bitten. The net should be tucked in under the mattress and never allowed to hang down on to the floor. and, of course, it must be carefully searched for mosquitoes

both when it has been arranged for the night and again when being rolled up next morning.

Repellent oils and creams are sometimes advocated, but the volatile nature of their essential components renders them of temporary value only.

Treatment of Malaria in Native Employees: A third and very important prophylactic measure takes cognizance of the fact that the reservoir of malarial infection is the native community and especially the native children. It has been pointed out in the section dealing with the life cycle of the malaria parasite that the mosquito derives its infection from a human being suffering from the disease. From this it follows that the more efficiently we treat malaria in the native communities, the less risk will there be to the European residents. Therefore, in a given household, any native servant who succumbs to an attack of malaria should receive an adequate course of treatment, with one of the recognized anti-malarial drugs. While this procedure undoubtedly lessens the risk of reservoirs of infection existing within the zone of action of the domestic anophelines, it does not entirely remove the risk. Ideally, therefore, it becomes necessary to use some preparation which will destroy or inactivate these particular forms of the malaria parasite, and in plasmoquine and paludrine we have drugs possessed of such properties. In actual practice the prophylactic value of plasmoquine has fallen short of expectation except in the most carefully controlled experiments, so that it should never be used except under strict medical supervision. Paludrine, it is hoped, will prove a safe and effective means of interrupting the transmission of infection from man to mosquito.

Chemical Prophylaxis: In spite of all the prophylactic pro-

cedures available in relation to mosquito control, the European in the tropics still finds it necessary to utilize some anti-malarial drug to ensure the maximum protection against the disease. In some parts of the tropics it may be necessary to use drugs in the prophylactic sense throughout the entire year, but in most parts of Africa malaria has a distinct seasonal incidence, so that a more restricted prophylactic course becomes possible. It must be emphasized, however, that the course must be started approximately a month ahead of the "season" and continued for a like period after the risk of infection has passed. Furthermore the dosage scheme adopted must be conscientiously followed without interruption throughout the period concerned.

Three drugs are now available in the prevention of malaria. These are Quinine, Mepacrine and Paludrine. At the same time it should be appreciated that neither quinine nor mepacrine when taken prophylactically will necessarily ensure complete freedom from attacks. They undoubtedly prevent the untrammelled development and accumulation of parasites in the blood stream, but in certain circumstances the infection seems capable of breaking through the restraining barrier and so gives rise to a malarial attack, but in the presence of quinine and mepacrine the infection will seldom or never assume the dangerous features which prove so fatal in childhood. Therefore the case for drug prophylaxis in malaria can still be upheld.

Quinine Prophylaxis: The usual method of quinine prophylaxis consists in taking a single dose at sunset, but experience of most workers in the tropics supports the taking of a dose both morning and night. In the case of adults the dose recommended is 5 grains night and morning. Children from four to twelve years should be given

a total of 3 grains daily, while under four years a dose of ¾ grain for each year of life is recommended.

Mepacrine Prophylaxis: The outstanding value of mepacrine prophylaxis was amply demonstrated during the war years, so that there need be no hesitation about putting these lessons into practice in relation to civilian populations.

The daily dosage scheme for children is as follows:

Up to 2 years	0·05 g. (½ tablet)
2–4 years	0·75 g. (¾ tablet)
5–8 years	0·1 g. (1 tablet)
8 and over	0·2 g. (2 tablets)

Very rarely indeed does the foregoing dosage scheme give rise to any toxic symptoms, apart from transient abdominal discomfort at the very beginning of the course. The skin usually acquires a variable degree of yellow staining but this is not permanent and has no relation to jaundice—it is caused by the yellow acridine component of the mepacrine tablet.

Paludrine Prophylaxis: The results obtained with paludrine prophylaxis in relation to African malaria have been so variable that it is not yet possible to give a dogmatic statement on its reliability in this regard. It is clear, however, that the original dosage scheme of 0·1 g. twice a week is entirely inadequate. Therefore this dosage requires modification. It is tentatively suggested that the prophylactic dosage scheme should be 0·1 g. daily for adults and 0·05 g. (½ tablet) for children.

Bilharzia Disease.

The disease which now goes by the name of bilharzia disease has a long history, which stretches back to at

least 3,000 B.C., as shown by the recovery of bilharzia eggs from Egyptian mummies. From the Nile Valley, which is generally regarded as the original home of the disease, dissemination has occurred throughout the greater part of Africa, while extension to the New World coincided with the export of negro slaves to the American plantations. A similar parasitic infection exists in the Far East, but both the parasite and the disease it causes present certain characteristic features which serve to distinguish it from the African forms.

The first real addition to our knowledge of the disease occurred in comparatively recent times when Bilharz, working in Egypt, demonstrated the parasite in the tissues of the human host. This discovery took place in the year 1851, and the name Bilharzia was conferred upon the parasite in honour of its discoverer. Some fifty years later a similar parasite was demonstrated amongst the indigenous inhabitants of the Far East. For many years considerable uncertainty and controversy centred round the life history of the bilharzia parasites, but in 1913 two Japanese observers claimed to have traced the parasite through a fresh-water snail back to the human host. Two years later, a distinguished British scientist, R. T. Leiper, finally established the bilharzia life cycle in a series of masterly experiments carried out in Egypt, and in due course he differentiated the bladder and the intestinal forms of the parasite. He showed that in both species an intermediate host in the form of a particular species of fresh-water snail constituted a vital link in the life cycle, just as the anopheline mosquito constitutes an essential element in the life of the malaria parasite. Since then, investigators all over the world have identified the intermediate snail hosts with great accuracy, so that the stage is now set for an intensive study of those methods best calculated to exterminate the

snail, thereby eliminating the risk of bilharzial infection and providing yet another triumph for the science of preventive medicine.

The first great advance in treatment occurred in 1918 when McDonogh demonstrated the curative value of antimony (when given intravenously) in the form of tartar-emetic, and shortly afterwards Christopherson worked out a suitable dosage scheme which enabled the drug to be used to the best advantage. Christopherson's treatment scheme has been modified in recent years with appreciable shortening of the period of treatment. At the same time new drugs such as fouadin and anthiomaline have been introduced and have the advantage of being given intramuscularly.

The Life Cycle of the Bilharzia Parasite: The bilharzia worms belong to the family of flukes, several of which parasitize man. While most flukes are flat, leaf-like structures, the bilharzia worms have a cylindrical appearance, and in addition the sexes are separate. The male parasite is a white cylindrical-looking worm measuring about 1 to 1·5 cm. by 1 mm., and is provided with two well-defined suckers which enable it to maintain its position in the blood stream of the host. The female parasite is more hair-like in appearance, and is considerably longer and narrower than the male, measuring about 2 cm. The parasites live in pairs within the abdominal veins of the host, the distribution being determined by the species of the parasite. Thus *Bilharzia mansoni* and *Bilharzia japonica* (the bilharzia parasite of the Far East) live in the veins of the large gut, while the *Bilharzia hæmatobium* is distributed in relation to the veins of the urinary bladder and other pelvic organs. The life cycle, however, is essentially the same for all the bilharzial species. The species is propagated by

means of eggs discharged by the female worms which make their way into the fine venous tributaries, so that the eggs may be deposited as near the interior of the bowel or bladder as possible. These eggs contain a small living larva which produces a powerful secretion capable of percolating through the egg shell and dissolving the tissues in the immediate vicinity. In this way the egg works its way through the tissues and eventually finds itself in the bowel or bladder, and in due course is passed out in the stool or is voided in the urine.

The next stage of development will only take place in the presence of fresh water containing the appropriate snail host. In such circumstances the larva escapes from the egg and rapidly enters the snail, penetrating deeply into the snail's liver. Thereafter it undergoes a complicated process of multiplication, so that in due course the liver swarms with dozens of new larval forms, all of which have been derived from the single larva which emerged from the egg. These new larvæ, which by this time have acquired a characteristically forked tail, escape from the snail and swim about vigorously in the surrounding water. At this stage of their development the larvæ are capable of infecting human beings, and it is important to realize that *they can gain entrance to the human host through any part of the skin surface*. Thus they may penetrate the skin of the hands or wrists when these are dipped in an infected stream. Alternatively they readily pass through the delicate lining of the lips and mouth, so that drinking infected water is every bit as dangerous as bathing or paddling in it. It should perhaps be stressed that the danger of infection is enhanced by the fact that the larvæ are drawn to the human body by some form of biological attraction designed to facilitate the survival of the bilharzial species.

Once the larvæ have penetrated the skin they enter upon

a complicated migratory phase which carries them through the body and brings them eventually to the liver. In the meantime the parasites have grown and developed so that soon after reaching the liver they pair off and set out on the last stage of their journey, which brings them to their definitive sites, either in the veins of the gut or urinary bladder. In due course the process of egg-laying begins and so the cycle is completed. The whole process from the penetration of the skin to the passage of eggs occupies some six to eight weeks.

The Snail Hosts of the Bilharzia Parasites: The recognition of the snail hosts of the bilharzia parasite is a simple and interesting exercise in natural history, and those who live in bilharzia localities should acquaint themselves with their distinguishing features.

The snails are always found in fresh water, commonly in relation to calm, sluggishly moving stretches of river or stream, or in still pools or waterways where they live on decaying vegetation. Where lotus plants abound the snails tend to take advantage of the shade afforded by the broad, heart-shaped leaves, so that in searching for specimens it is always necessary to examine the under surface of the leaves. It is here, too, that the snails deposit their eggs in nests of clear, jelly-like material. The recognition of the carriers of the bilharzia parasite presents no great difficulties, hence a brief reference will be made to their main distinguishing features.

In Africa snails concerned in the life cycle of the urinary form of the bilharzia parasite (*Bilharzia hæmatobium*) belong to the genus Physopsis. The members of this genus have a squat shell with a low whorled turret, and when held with the apex directed away from the observer and the opening looking upwards, the opening or operculum is

seen to be on the left-hand side of the shell. In Africa snails with a right-hand opening are not normally associated with the bilharzia life cycle.

The snail host of the intestinal bilharzia worm (*Bilharzia mansoni*) has an easily recognized flat or discoid type of shell rather reminiscent of the whorled type of squib that figures in juvenile fireworks. To this type of snail the name Planorbis has been given.

In the Far East the snail host of *Bilharzia japonica* is distinguished by its tall, whorled, turreted shell with its opening on the right-hand side. The generic name of this molluscan group is Oncomelania. All these snails appear to possess remarkable powers of resistance to adverse environmental changes, so that unless destroyed by some reliable method they tend to persist in any given river or pool for long periods of time. There is also reason to believe that once infected with bilharzia larvæ the snail retains its infection for the remainder of its life span.

Signs and Symptoms of Bilharzia Disease: The signs and symptoms that constitute bilharzia disease or bilharziasis are the outcome of a group of factors.

Firstly, the parasite throws off certain excretory products or toxin which affect the general health of the patient, and set up a train of constitutional symptoms. Secondly, reactions occur around the egg deposits in the bowel and bladder wall, giving rise to certain characteristic local symptoms. Thirdly, late tissue changes occur in an attempt to shut off or localize the areas damaged by the parasite or its eggs, and so give rise to a complex group of symptoms.

The primary signs of bilharzia disease may be said to occur when the larvæ penetrate the skin. In many cases this takes place without the patient's knowledge, but where heavy infections occur a transient irritation and redness of

the skin occurs at the site of penetration. In the weeks that follow, the parasites, having entered the blood vessels of the host, are carried round in the circulation until they eventually reach the liver. In so doing they cause widespread constitutional disturbance, the main features of which include a low-grade temperature reaction, loss of weight, vague abdominal pains, a dry, persistent, troublesome cough and very frequently urticaria. At the same time characteristic changes occur in relation to the distribution of the white cells of the blood.

The diagnosis may be very difficult to establish at this stage, so much so that the disease is liable to be confused with Malta fever, typhoid fever or even tuberculosis.

Once the parasites have reached maturity they leave the shelter of the liver and move out along the blood vessels to reach their definitive sites in the wall of the gut or urinary bladder. With the completion of this last phase of the journey, the female parasites begin depositing their eggs, and soon afterwards the characteristic localizing symptoms of bilharzia disease appear.

In the urinary form of bilharziasis the presenting feature is the presence of visible blood in the urine. This striking feature occurs in a high proportion of European children afflicted with the disease, although in many cases it may be a very transitory phenomenon. Furthermore the blood is most likely to be noticed with the last few drops of urine to be passed.

Not only is urine passed more frequently in these circumstances, but a variable degree of discomfort is experienced in the lower abdomen each time the bladder is emptied. When the urine is examined microscopically the characteristic eggs of *Bilharzia hæmatobium* can usually be demonstrated together with red blood cells.

In the case of intestinal bilharzia disease there are fre-

quently no localizing symptoms whatever. In heavier infections, however, the patient may suffer from recurrent bouts of diarrhœa accompanied by some measure of abdominal pain or discomfort. In other cases the infection may present the features of a frank dysentery with blood and mucus in the stools, griping abdominal pains and considerable straining. These attacks tend to occur intermittently and in the untreated cases the tendency is for the attacks to become less severe as the months go by. The point to bear in mind, however, is that in many cases intestinal bilharzia disease exists without causing any apparent bowel disturbance, none the less in such circumstances some measure of constitutional upset usually occurs. In many instances, especially in Southern Africa, the local features of bilharziasis are so insignificant that they virtually escape notice. That is to say, the patient may have no recollection of having passed blood in the urine or having suffered from bouts of diarrhœa or dysentery, in spite of having had ample opportunity of acquiring a bilharzial infection. In such cases a group of constitutional symptoms usually preponderate. In children the outstanding feature is generally lassitude. That is to say, the child is easily tired both physically and mentally, and is for the most part disinterested in all the usual activities of childhood, so that in the classroom, for example, he will usually be looked upon as thoroughly lazy or even backward. The appetite is usually poor, consequently there is failure to gain in weight if not an actual loss of weight. In grown-ups rather than in children there is usually a considerable measure of dyspepsia, which may lead one to suspect a peptic ulcer, a chronic appendicitis or even chronic gall-bladder disease.

Some children suffer from a dry and troublesome cough at this stage, probably due to bilharzia eggs depositing out

in the lung substance. In addition it will often be found that the child runs a mild temperature from time to time.

We see, therefore, that bilharzia disease in childhood may lead to a state of chronic ill-health, in which the outstanding features are lassitude, retarded mental development and a general loss of physical condition.

It is not proposed to deal at length with the manifold features of the late stages of bilharziasis. As already stated, these features are conditioned by the scar tissue formations that develop in relation to the egg deposits all over the body.

The areas most liable to be involved in these late changes include the urinary bladder, the lower ends of the ureters (or ducts that connect the kidneys and urinary bladder), the appendix and the liver. The local damage arising out of these changes may be severe, but the chief danger to the health and life of the victims rests with the scarring of the ureters, since obstruction to these ducts may seriously disorganize either one or both kidneys. While these later changes are met with most frequently in relation to adult life, they may on occasion develop in childhood, the commonest being chronic bilharzial appendicitis.

Finally, bilharzial disease in all its phases lowers the patient's powers of resistance, thereby rendering him more vulnerable to intercurrent infections such as bronchitis, pneumonia, dysentery and so on.

Prevention: As in the case of malaria prophylaxis, the prevention of bilharzia disease will be discussed from the domestic point of view. The treatment of infected cases and measures adopted to prevent the contamination of streams by the products of excretion are matters for the public health authorities and need not concern us here. Thus from the viewpoint of the individual the problem

of prevention resolves itself into (*a*) the avoidance of all infected water; (*b*) the destruction of snail hosts; (*c*) the destruction of infective larvæ. In other words these simple measures aim at interrupting the life cycle of the bilharzia parasite between the snail and human hosts.

Avoidance of Infected Water: The avoidance of infected water would appear to present no major difficulties, but the sight of a clear, cool pool on a hot, sunny day will always exert an almost irresistible appeal to the unsuspecting child. But in any locality where bilharziasis exists, bathing in such pools must be forbidden and the child must also be denied the simple joys of paddling. Nor must he be allowed to drink untreated water from the streams, in view of the ease with which the bilharzia larvæ penetrate the delicate linings of the lips and mouth.

Destruction of Snails: The destruction of snails in all collections of water in the immediate neighbourhood of the home constitutes a valuable means of prophylaxis. Pools and waterways should be made as uncongenial as possible for the snails by such simple expedients as removing all vegetation from which they derive nourishment or obtain shade. Where practicable, it is useful to keep ducks and geese, which include the freshwater snail in their multifarious dietary, thereby playing their part in keeping down the snail population. It is usually necessary, however, to supplement these procedures by some measure of chemical control, and for this purpose lime and chemical manure may be sprinkled round the smaller pools, or copper sulphate (bluestone) may be added to small pools or sluggish small streams in a strength of 1/500,000. More recently the chemical malachite has been used, but appears to have no special advantages over copper sulphate.

Destruction of Infective Larvæ: Finally, there is the destruction of the infective larvæ to be considered. So far as drinking water is concerned it can be rendered perfectly safe by boiling, and, as mentioned in a previous chapter, boiling of the child's drinking water is a valuable routine measure in the tropics.

The free living larvæ of the bilharzia worm have, however, a very limited life span unless they succeed in gaining access to human beings, hence water used in washing or bathing may be regarded as safe when it has been stored for at least three days. By this time the larvæ are either dead or so devitalized as to be incapable of penetrating the skin. Where storage for this period of time cannot be effected the bath water can be rendered safe by the addition of a tablespoonful and a half of lysol or cresol to the volume ordinarily used in a bath.

It is also possible by means of copper sulphate to eliminate larvæ from a swimming-bath provided the water volume can be retained and emptied at will. For this purpose copper sulphate is used in the ratio of 1 ounce to 7,000 gallons of water, and as one cubic foot of water equals 6·25 gallons the volume of water in a bath can thus be calculated and the amount of copper sulphate readily determined.

Hookworm Disease.

Hookworm disease is another example of a parasitic disease which has probably afflicted mankind for thousands of years. A papyrus dated 1550 B.C. almost certainly refers to the condition, while Hippocrates in 440 B.C. and again Lucretius in 50 B.C. noted symptoms which we now regard as evidence of hookworm infestation. With the coming of the Christian era references to the condition become more numerous, and Avicenna (A.D. 98-1037) is probably the first of the early writers to describe true hookworm disease.

The discovery of the worm was deferred until 1843, when it was demonstrated by the Italian, Angelo Dubini, in the intestine of a woman who had died of pneumonia in the City of Milan in 1838. Yet it was not until 1853 that the causal relationship between the parasite and the symptoms was recognized, and it is to Bilharz—already mentioned in connection with bilharzia disease—that much of the credit is due, although Griesinger in 1854 established the relationship with convincing scientific accuracy. For the next twenty years or so little interest appears to have been taken in the disease outside Egypt until attention was sharply focussed on its occurrence in the form of a localized epidemic. During the building of the St. Gothard tunnel in 1880 the workmen, mainly Italians, suffered from an outbreak of severe anæmia, at first ascribed to bad hygienic conditions, but eventually proved to be due to massive infestation with hookworms. After the completion of the tunnel in 1882, the workmen scattered all over Europe in search of work, with the result that hookworm disease became disseminated widely throughout the continent with far-reaching consequences.

The disease was also prevalent in certain regions of America, whither it had been carried in the days of the slave trade.

Until 1898 it was generally held that hookworm infection was acquired through the mouth, but in that year a curious incident lead up to the elucidation of the life cycle. While experimenting with suspensions of hookworm larvæ Arthur Looss, a professor of parasitology in Cairo, accidentally allowed a drop of fluid-containing larvæ to fall on his hand. He was too busy to remove the drop and experienced a feeling of itchiness as it dried. Gradually it dawned on him that the hookworm larvæ had gained access to his system through the unbroken skin, and some weeks later

the presence of hookworm eggs in his stool confirmed his hypothesis. As will be seen later these findings of Looss have been amply confirmed.

Various methods of treatment were tried once the significance of hookworm infestations had been appreciated. Amongst the earlier drugs used were thymol and male fern (*Felix mas*), and after initial disappointments thymol was regarded as an effective cure right up until the year 1917. From then onwards various preparations have been employed, the most successful being oil of chenopodium, carbon tetrachloride, and, more recently, hexylresorcinol, so that at the present time the drug treatment of hookworm has reached a high order of efficiency.

The Hookworm Life Cycle: The adult hookworms are cylindrical parasites, white or grey in colour, except when reddish-brown from the presence of engorged blood. The male measures 8 to 11 mm. in length, while the female, which is both longer and stouter, measures between 10 and 13 mm. They live in the upper reaches of the small intestine, where they cling to the delicate mucous membrane by means of their hook-like teeth. Once maturity has been reached the female parasite deposits her eggs, which are passed in the stools in great numbers, and under favourable conditions of moisture and temperature a worm-like larva develops in the egg. The larva eventually escapes from the egg and lives free in the moist fæcal culture medium on which it feeds voraciously until, after a series of moults, it reaches the stage of development at which it is infective to man. At this stage development is at a standstill, and can only proceed provided the larva succeeds in entering the human host. In the meantime the larva moves about languidly in the damp earth, mud or muddy water, until it comes into contact with warm human skin, to which it is

powerfully attracted. It may be pointed out at this stage that larval development occurs in the absence of any intermediate host, so that once the larva has emerged from the egg it does not multiply, but rapidly reaches the stage when it can infect the human host. Infection takes place through the unbroken skin anywhere on the body, but in view of the distribution of the hookworm larvæ in the soil a common site of infection is through the skin of the ankle region. Thus any child who runs barefoot in hookworm areas is very liable to infection.

After penetrating the skin, the larvæ gain access to the veins and are carried round in the blood stream to the lungs, where they break through into the air spaces and are carried upwards to the back of the throat. They are then automatically swallowed, and, after traversing the stomach, come to rest finally in the upper reaches of the small intestine, where they mature and lay their eggs in an unending stream.

Signs and Symptoms of Hookworm Disease: The manifestation of hookworm disease depends very largely on the severity and duration of the infection, so that it is sometimes claimed that light infections are relatively unimportant. However, it is doubtful if a parasitic worm can ever be completely ignored.

In the presence of a hookworm infection the factors responsible for the signs and symptoms that characterize hookworm disease are:

(1) Chronic loss of blood from the bowel wall.
In the act of feeding the hookworms suck blood and tissue fluid from the delicate mucous membrane of the gut and at the same time secrete an anti-coagulant which leads to prolonged oozing from the abandoned bites. And as the hookworm parasite is a prodigal

feeder a steady loss of blood occurs from day to day, with the result that a state of anæmia supervenes.

(2) Absorption of poisons.
Various toxic substances are secreted and excreted by the parasites, and their absorption into the blood stream gives rise to various constitutional disturbances.

(3) Finally the presence of the parasites sets up irritations in the bowel.

The cardinal signs of hookworm disease will therefore fall under three headings corresponding to these three factors:

(1) Anæmia.
The anæmia belongs essentially to the iron-deficiency type, and is mainly responsible for symptoms such as pallor of the skin and mucous membranes, palpitation, shortness of breath, dizziness, lassitude and so on.

(2) Toxic symptoms.
These include a low-grade fever, and a disturbance of the white cell count. In addition it is reasonably certain that these toxic bodies contribute to the lassitude and general debility that characterize the disease of long standing.

(3) Irritative symptoms.
Vague abdominal pains occur from time to time, together with periodic bouts of diarrhœa. Loss of appetite is common, but in some cases the appetite may be ravenous, and in still other cases may be perverted. That is to say the child may eat strange and indigestible things, but more especially earth. In some African tribes, however, earth eating or geophagy may have a deep ceremonial significance.

While in the case of a well-established hookworm infection

an obvious state of debility prevails, there are lesser degrees of infection in which there appears to be an indefinable deterioration in the child's health. While there may be many possible causes for this it is obvious that in the tropics the possibility of hookworm infection has always to be borne in mind. Fortunately once the presence of infection has been established, it can practically always be successfully eliminated by means of the appropriate drugs.

Prevention: A study of the debilitating effects of hookworm disease makes it clear that every precaution should be taken to prevent the child from acquiring the infection. The basic fact to keep in mind is that the main preventive measures consist in preventing fæcal contamination of the soil, water supplies and all vegetables which are eaten raw as in salads.

Where the sanitary arrangements available to both African and European embody the flush-system, there is little risk of acquiring hookworm infection. In areas where this is not possible the deep bore-hole latrine with a concrete top offers a satisfactory substitute. Where localized areas of soil are believed to be contaminated the development of hookworm larvæ can be prevented by spreading coarse salt in sufficient quantity to form a brine.

Finally, the child must never be allowed to run barefoot in the veld, since hookworm larvæ rapidly attack the warm foot and rapidly penetrate the thin skin of the ankle region.

"Creeping Eruption" or "Sandworm."

This peculiar infection occurs in many parts of the tropics, including Southern Africa. It is caused by various parasitic larvæ, more especially by the larval stages of a hookworm which normally infects dogs and cats and by

the larvæ of certain warble flies. These larvæ penetrate the human skin, but because they have erred biologically they are incapable of establishing themselves in what is a wrong host and they fail to carry out their normal migratory cycle. Instead they wander aimlessly about in the deeper layers of the skin, giving rise to a characteristic eruption.

Their progress beneath the skin surface is reflected in the red zigzag line or ridge which appears. In addition the affected area is intensely itchy, thereby provoking vigorous scratching, as a result of which septic infections may develop. At the same time the itching may be responsible for considerable loss of sleep.

As the parasite moves on (usually at the rate of several millimetres each day) the original track becomes dry and crusty as a new serpiginous tunnel is in process of being thrown up—a state of affairs which may last for weeks on end. The areas most frequently affected include the feet, legs and buttocks.

The usual method of treating the condition consists in repeatedly freezing the skin with an ethyl-chloride spray immediately ahead of the advancing track, but in some cases a few injections of anthiomaline may be required.

In regard to prevention, nothing much can be said except that children should be discouraged from sitting about on sandy beaches just above the high-water mark, and from playing on dumps of builder's sand.

Skin Infection with the Maggot Fly.

The invasion of the human skin by certain species of fly larvæ is a not uncommon occurrence in the tropics, particularly the African tropics, and is responsible for the production of inflammatory boil-like reactions which cause considerable distress, especially in children.

In the African tropics the skin maggot fly is yellowish

in colour, with various dark markings, and is roughly about the size of a "blue-bottle." It is an inactive type of fly and is usually to be found in dark places, where it lives on decaying vegetable and animal matter.

The eggs are usually laid in shady and sandy soil or on clothing which has been contaminated by urine or fæces, and after two or three days the eggs hatch and the larvæ or maggots are released. They crawl about vigorously in search of a host, which may be a dog or rat as well as a human being. After coming into contact with the skin, they penetrate beneath the surface, and in due course produce localized inflammatory swellings which give rise to acute discomfort. On the summit of each swelling a small aperture can be seen, usually covered with a light crust, which, when removed, reveals the tip of the larva, and once the swelling has ripened the larva can be expressed through the aperture, leaving a short vertical tunnel. Thereafter the swelling and inflammation rapidly subside, but it is always possible that the original lesion may be a prelude to septic infection of a serious nature.

Fortunately the risk of infection from fly larvæ can be lessened very materially by giving attention to a fairly simple routine.

Since the fly tends to deposit its eggs wherever urine or fæcal contamination occurs, it is important to see that the child's clothing, together with all blankets and sheets, are freed of all traces of contamination by adequate washing with soap and water. After washing, the garments should by hung out to dry on a line, never spread out on the grass. Thereafter they are carefully ironed and put away without further exposure in the open.

By consistently using a mosquito net for the perambulator as well as the cot the fly will be prevented from depositing its eggs in the immediate proximity of the child.

CHAPTER VII

COMMON EPISODES IN CHILDHOOD

The Fevered State.

Before discussing some of the common causes of acute fever in childhood it is proposed to say a word or two about taking temperatures.

The thermometer in the home, like castor oil, is not entirely an unmixed blessing. In the first place it should always be used sparingly. In older children the temperature may be taken in the mouth, in young children in the groin or rectum. The normal temperature of the body ranges between 97·8 and 99°F. with an average of 98·4°F. The lowest figures are usually obtained in the early hours of the morning and the highest about eight o'clock at night. The rectal temperature may be ½ to 1° higher than the mouth temperature, and mouth temperatures are usually slightly higher than those obtained from the groin. The time taken to register a temperature varies with the thermometer but usually two to three minutes are required in the groin and one or two in the mouth or rectum. In the case of oral temperatures nothing either hot or cold should have been taken for at least thirty minutes before the reading. It is always important to see that the mercury column in the thermometer has been shaken down to well below the normality line before taking the reading. Finally, once the reading has been taken, it is helpful to jot it down together with the time of reading.

The body temperature is easily disturbed in childhood, and this appears to apply with even greater force to young

European children in the tropics. It is also true that children vary widely in their reaction to temperatures. Whereas some appear to be scarcely disturbed, others become restless and irritable and complain of headache, while others again show a strong tendency to delirium and convulsions. In many cases the feverish child will sleep most of the day and be restless most of the night.

Some of the commonest causes of the sudden onset of fever in a previously healthy child are:

> feverish colds, influenza, acute tonsillitis, the so-called acidosis attack, urinary tract infections in female children, and the onset of some infectious disease.

But in every case of fever the possibility of an acute malarial attack must be kept in mind and steps taken to establish the diagnosis. However, we are not so much concerned with the possible explanation of the fever as to how to set about the routine treatment of the attack, no matter what the primary cause may be. Our main concern should be

(1) to put the child to bed;
(2) to ensure an adequate intake of fluid;
(3) to keep the child as cool as possible and maintain fresh air;
(4) to relieve symptoms.

The feverish child should be put to bed in a quiet room in a cool part of the house and suitably protected from the glare of the brilliant tropical sunshine. Fresh air should be admitted freely and in very hot weather it will be advantageous to use a fan provided it does not play directly on the patient. In the hot weather a single sheet will be necessary by way of covering, but it will usually be desirable to

make use of blankets towards sunset when the atmospheric temperatures begin to fall. The child should be lightly clad so that the skin may benefit from the cool air. The tendency to wrap the child in warm cardigans or jerseys during the fever is to be deplored.

The diet should be restricted to fluids such as fruit drinks, home-made lemonade, milky tea and diluted milk. Neither very hot nor very cold drinks should be given. It is always very useful to add glucose to the various feeds, about two teaspoonfuls to a feed, but ordinary sugar is an entirely satisfactory substitute. Water should always be available and the child should be encouraged to drink freely at all times. The diet may also include jellies, junket, custards, strained soup. The feeds should be given two-hourly and a feed may be given during the night as well should the child be restless and wakeful. It is important to realize that the child is not interested in food—during the feverish state, therefore, it is wrong to force the child to eat. He will come to no harm even should the temperature run on as long as a week.

It should never be forgotten that a brisk temperature reaction is never harmful (except when abnormally high temperature levels are reached), therefore the aim of treatment is not to eliminate the fever but rather to remove the discomforts that accompany it—namely the headaches, the nausea or vomiting, the insomnia and all the sundry aches and pains. One of the safest and most refreshing ways of combating the discomforts of a fever is the tepid sponge. Not only does it soothe the fevered body but it has a tonic effect on the skin and the blood vessels. Indeed, in the warm countries there is no reason why the child should not be placed in a tepid (80°F.) bath once the cause of the fever has been determined. If this is carried out during a warm part of the day and all draughts carefully excluded, there

is no risk of chill. The child is usually pleasantly tired and tends to drop off into a restful sleep.

To combat the headaches, restlessness, insomnia, etc., aspirin is invaluable provided it is used with discretion and restraint. Young children may be given half a tablet two or even three times a day, while older children—from about the age of five or six—may have a whole tablet about twice in the twenty-four hours. In some cases a simple bromide mixture may be necessary for a night or two to ensure a restful sleep.

Nausea or vomiting will usually be relieved by glucose drinks or if it continues by a solution of sodium bicarbonate in water.

Finally a good bowel action should be obtained at the onset of the illness, but drastic purgatives should never be employed at any stage. The laxatives advised are milk of magnesia, syrup of figs, liquid paraffin emulsion or liquorice powder. Calomel, Grey powder and castor oil should all be discouraged unless for some reason the doctor in charge considers their use desirable.

Convulsions.

Convulsions constitute a frequent occurrence in childhood, and cause considerable alarm and anxiety with parents. They are especially common in early childhood when the nervous system is still relatively unstable and easily stimulated. Convulsions in childhood fall for the most part into two categories:

(1) those due to organic disease of the brain or its coverings such as meningitis, cerebral abscess, cerebral tumour, injury to the brain substance and so on;
(2) those due to some reflex cause such as the toxins absorbed from some infective condition, e.g. acute tonsillitis, gastro-enteritis, etc.

When occurring soon after birth the fit is usually due to some birth injury causing bleeding into or on to the brain surface, or swelling of the brain from fluid exudates. In such circumstances fits have a serious significance and call for careful study.

During the first year of life certain types of children tend to develop convulsions with particular ease at the onset of some infectious disease such as measles, scarlet fever or some bacterial infection such as bacillary dysentery, gastro-enteritis, pneumonia, pyelitis, middle ear disease and so on. There can be little doubt that constipation may also constitute a precipitating factor, in the same way as the irritations associated with dentition.

In temperate climates rickets has always to be kept in mind as a cause of convulsions, but this is rarely the case in the tropics. On the other hand, there are two important causes that must never be forgotten in the tropics.

The first is malaria. It has already been pointed out that cerebral malaria in childhood may be heralded by a convulsion or series of convulsions; therefore malaria must always be looked for as a possible cause of the fit. Disregard of this simple rule will lead sooner or later to the tragic loss of a young life.

The second cause is worms. The worm infection most frequently associated with fits in childhood is the round-worm (*Ascaris lumbricoides*), but other worm infections include tape-worm, hookworm and heavy threadworm infections. Their discovery and elimination will rapidly clear up the fits.

Finally, of course, there is always the possibility that the fits are an expression of epilepsy or of some serious organic disorder of the brain, but fortunately such causes are relatively uncommon.

The Convulsion: The fit sets in abruptly, although the mother may have noticed a preliminary restless twitching of the limbs or facial muscles. When the attack comes on the child suddenly stiffens and becomes unconscious. The eyes roll upwards so that only the "whites" are seen, the colour rapidly passes from dusky to blue or blue-black, while the hands and jaw are tightly clenched. After a few moments the limbs take on a jerky movement, the eyes twitch and at this stage the bladder and even the bowel may be evacuated.

As the attack passes off the jerky movements cease, the muscles relax and the child either wakes up feeling dazed and confused or drops off into a deep sleep.

The actual duration of a fit is variable, ranging from less than a minute to half an hour. In some cases one fit may follow another in quick succession, or it may occur as a single isolated event.

Treatment: While most convulsions are over before much can be done in the way of emergency treatment, it does sometimes happen that the fits are protracted. In such circumstances the method usually adopted to arrest the attack consists in holding the child in a hot bath (a teaspoonful of mustard may be added) until the attack passes off. Should the attacks persist, the services of a medical man will be necessary, so that the necessary sedative measures may be applied. Having gained control of an attack the next step consists in preventing recurrences by means of

(*a*) a small dose of sedative for the next few days (chloral hydrate being the drug of choice);
(*b*) the systematic administration of calcium and Vitamin D (in view of the frequency with which a low serum calcium is found in relation to convulsions);

(*c*) investigating and if possible removing the probable precipitating cause of the attacks.

Croup.

The term croup refers to a type of noisy crowing breathing, and constitutes a frequent occurrence in childhood. Anything affecting the child's larynx and causing swelling of the vocal cords is liable to precipitate an attack of croup, and although the usual cause is a simple inflammation or laryngitis, two more serious conditions must always be considered. These are (1) laryngeal diphtheria and (2) a foreign body in the larynx.

Whatever the cause, the signs are usually the same, namely (1) crowing respiration and (2) hoarseness or loss of voice.

A common cause is a simple acute laryngitis which has developed in association with a spreading "cold in the head" or as a prelude to an attack of measles or whooping cough. As the laryngitis develops there is first hoarseness and then commonly loss of voice. At the same time the swollen larynx gives rise to the typical crowing breathing. Associated symptoms include a rise of temperature and a certain amount of soreness of the throat.

In such circumstances the child must be kept in bed and great relief will be obtained from the steam kettle. Friar's Balsam may with advantage be added to the water. Warm fomentations or a light anti-phlogistine plaster to the neck are very soothing, while a simple sedative cough mixture will delay the persistent cough and so help to rest the larynx. An old-fashioned remedy which still has a place in the treatment of croup consists in giving the child a teaspoonful of Ipecacuanha wine to induce vomiting.

There is also a peculiar form of croup which goes by

the name of laryngitis stridulosa, and attacks the child at night. The child goes to bed apparently perfectly fit and well, but after a few hours' sleep wakes up fighting for breath. Something throws the larynx into spasm, so that air entry becomes difficult and noisy—that is to say, inspiration gives rise to a long-drawn-out, high-pitched stridor which can be heard all over the house. At the same time the face becomes dusky and congested and by this time the child is thoroughly terrified and will often be drenched in sweat. The attack gradually passes off after an hour or so, but further attacks may occur during the night. In the morning, however, the terrors of the night appear to have been forgotten, but unless some preventive measures are adopted further attacks may occur for a night or two.

The immediate treatment of an attack consists in applying hot fomentations to the neck and in persuading the child to take a hot drink. The relief is usually immediate, but at the same time the child has to be comforted and reassured that all is well.

A review of the child's general health will be advisable, while a simple sedative should be given for a week or two.

Croup in relation to Diphtheria: It sometimes happens that the membrane that forms in the throat during an attack of diphtheria extends downwards to involve the larynx and vocal cords, giving rise to what is termed diphtheritic laryngitis or laryngeal diphtheria. In such circumstances the child is obviously gravely ill. The breathing becomes increasingly difficult, noisy and croupy, while the bloated face and evil-smelling breath all point to grave interference with the narrow airway. A careful inspection of the throat will usually reveal patches of diphtheritic membrane in the tonsillar area. But where the infection constitutes a

primary laryngeal diphtheria, no evidence of throat infection will be apparent.

Where diphtheria is the cause of the croup, prompt medical attention is immediately necessary, if the child is to live. Tragedies of this type, however, can always be prevented by having the child immunized and re-immunized at the appropriate times.

Croup due to a Foreign Body: Apart from the spasmodic croup that accompanies rickets (a condition rarely or never seen in the tropics) the only other form of croup that need be discussed is that which develops when a foreign body enters the larynx. This is by no means an uncommon occurrence in childhood.

In the case of a small foreign body, although it is firmly trapped in the larynx, air is still able to pass into the lung, and in so doing gives rise to a noisy stridor or croup which can often be heard some distance away.

The foreign body may be demonstrable on X-ray examination, but its immediate removal will be necessary by a skilled operator.

Vomiting.

There are many causes of vomiting in childhood, and it is always important, especially in the case of persistent vomiting, to elucidate the reason if at all possible.

During the early months of infancy, vomiting is almost an every-day event, due mostly to overfilling. This phenomenon is known as posseting rather than vomiting, and does not interfere in any way with the child's progress. A reduction in the volume of the feed is all that is necessary.

Sometimes, however, persistent vomiting develops, after the baby is a few weeks old. This is of much greater sig-

nificance in that the underlying reason may be enlargement and spasm of the circular muscle fibres which guard the exit from the stomach—a condition referred to as hypertrophic pyloric stenosis. The cardinal features of this condition include:

(1) Projectile vomiting: That is to say, the vomited material spurts from the infant's mouth and nose, sometimes after every feed but eventually about twice a day.

(2) Constipation: This feature is very nearly as constant as the vomiting. Constipation alone does not imply pyloric stenosis, but when it occurs in association with projectile vomiting there is every likelihood of stenosis being the cause.

(3) Wasting: The constant vomiting leads to a steady loss of weight with wasting, and as the disease progresses the child becomes more and more wizened and shrunken.

(4) Finally, the enlarged and thickened pylorus can sometimes be felt through the thin abdominal wall, while it is usually possible to see waves of contraction passing over the surface of the stomach from left to right.

The cause of this condition is still not known, but its early recognition is important, so that the necessary curative measures can be undertaken before the child's condition deteriorates too far. Although medical measures are available, these have largely been abandoned in favour of surgical treatment.

Errors of Feeding: When the feeds are unsuitable for any reason, then vomiting occurs with great regularity. In some cases the vomiting is accompanied by diarrhœa with

undigested food residues in the stool. This is always a certain sign of indigestion, and in such circumstances a careful review of the child's diet is indicated.

Sometimes a certain amount of effortless vomiting occurs when the child has developed the tendency to gulp down quantities of air during the act of feeding. This tendency is fostered by a faulty teat which has either too large or too small a hole and is aggravated by the use of a "dummy" or even by thumb-sucking.

Every effort must be made to stop the habit by correcting the teat and by giving smaller feeds more frequently, or by giving the child a little plain water just before the milk feed begins, so that the actual feed is taken more slowly.

"*Acute Liver Upset*": Not a great deal is understood about the underlying cause of this condition, but there is no doubt that it is a common cause of vomiting amongst European children in the tropics. It is commonly associated with the highly strung nervous type of child who works and plays very intensely.

So far as we can see in these cases the main underlying cause consists in an abrupt fall in the starch reserves in the liver, and as soon as this happens there is an immediate disruption in the metabolism of fat, so that the blood is flooded with the imperfectly oxidized products of fat metabolism known as ketones. These ketones appear in the breath, giving it a sweetish odour, and in the urine where they can be demonstrated chemically. This condition of "ketosis" is popularly but erroneously referred to as "acidosis."

Attacks of this nature commonly set in by the time the child is two years old, and are especially common in the hot season. They are especially liable to occur when the child is being served with too much cream, ice-cream, cod-

liver oil emulsions and with too many eggs. They are frequently precipitated by the anxious mother, going all out to fatten her child with these rich, fatty foods. Other factors precipitating an attack include intense excitement, e.g. a party, an examination, or any emotional upset, or some relatively trifling ailment.

The presenting symptom of this condition is usually vomiting, which sets in abruptly, although in some cases there may have been a few warning signs such as loss of appetite, furred tongue, heavy breath and a state of irritability for a day or two beforehand. The vomiting soon becomes severe and persistent, and the child rapidly becomes dehydrated, so that the face looks pinched and dark shadows develop under the eyes. The child looks drowsy and ill as the temperature rises abruptly to 103 or 104°F. Next to vomiting an extremely common symptom is acute abdominal pain and tenderness. This may be so pronounced as to suggest an acute appendicitis, and some difficulty may be experienced in eliminating the possibility. The vomiting usually leads to constipation, but the stool when passed is invariably pale due to the presence of undigested fat. At the same time the urine is scanty, concentrated and highly pigmented, while the breath is heavily charged with sweet-smelling acetone.

The attack may last for several days, but as soon as it subsides the child convalesces with amazing rapidity; one day the child is prostrated and almost semi-conscious, the next he is up and racing round with his pals.

It is, however, an alarming condition while it lasts, and therefore steps should always be taken to prevent recurrences as far as possible.

The immediate treatment of the condition consists in putting the child to bed and restricting the diet to fluids only, while glucose and sodium bicarbonate should be

given as follows: one teaspoonful of sodium bicarbonate and two teaspoonfuls of glucose are dissolved in a glass of water. The child should be given the solution a few sips at a time. Any attempt to gulp down a glass full of fluid will simply precipitate a fresh bout of vomiting. From three to four glasses of this solution should be taken in the course of twenty-four hours.

Other fluids that may be given at this time include plain water, sweetened lemonade and fruit drinks.

Where these simple procedures fail to control the attack, then more elaborate measures will be necessary under medical supervision.

The distressing nature of these liver attacks renders it necessary to give considerable attention to their prevention, and in the present state of our knowledge a carefully controlled diet is the keynote of prophylaxis. All available evidence points to the fact that the child subject to these attacks has a poor tolerance for fats. Therefore the greatest care should be taken to see that the child's diet is low in fats. It does not mean, however, that fats must be entirely excluded from the diet. Such a step would lead in due course to a serious lack of Vitamins A and D. A reduction in fat can readily be effected by excluding cream, ice-cream, chocolate, fish-liver oil emulsions, cocoa and cocoa-like products entirely, while the egg intake is reduced to three a week and in cases where the milk yields a rich cream it may have to be skimmed. To make up for the loss of fat the diet should be rich in carbohydrates such as bread, potatoes, cereals and boiled sweets, jams, sugar and honey. Cane sugar is perfectly well tolerated, so that there is no particular need to take glucose. Fruit and vegetables should bulk largely in the diet, while lean meat and fish are always well tolerated.

A regular action of the bowel is important, so that a dose

of some simple laxative may be desirable from time to time, e.g. milk of magnesia or syrup of figs.

At the same time it is necessary to review the child's routine, so that fatigue, excitement and heat exhaustion may be eliminated as far as possible, as we know that such factors will readily precipitate an acute liver upset.

Vomiting in relation to certain fevers: Both in childhood and in adult life vomiting constitutes a prominent sign in an acute attack of malaria. In these circumstances it is a recurring rather than an isolated event, and is accompanied by other indications of acute malaria, such as a raging temperature, hot burning skin and intense headache, all of which give way after a few hours to intense sweating together with a sharp fall in the temperature. In such circumstances the only way to stop the vomiting is to control the malaria.

Of the infectious diseases, vomiting is especially common as an opening sign in scarlet fever. Here, however, it is a more isolated event than in malaria; the throat is inflamed and sore, the temperature is high, while the characteristic rash of scarlet fever appears within twenty-four hours of the onset of the attack.

Vomiting is very common at the onset of an attack of pneumonia in childhood, but it does not as a rule persist beyond the early stages. Vomiting is also a constant feature of the paroxysms of whooping cough. The violence of the spasms, together with the accumulation of mucus in the back of the throat, usually lead to vomiting as a climax to the paroxysm. The constant vomiting leads to steady loss of weight, especially where the paroxysms are frequent and food is seldom left long enough in the stomach to be digested. The rule, therefore, should be to ignore regular meal-times altogether in whooping cough and feed the

child immediately after a paroxysm with a few ounces of milk, Benger's, beef tea, etc. Glucose and amino acid preparations are especially valuable at this time.

Vomiting and abdominal pain: Where a colicky abdominal pain precedes the vomiting then an inflammatory state of the appendix is a possible explanation. In rare cases the presenting symptoms in acute tonsillitis in very young children may also be abdominal pain and vomiting.

Finally, in what we term the highly strung type of child, vomiting may occur in relation to some emotional experience. In this same category we have the child who consistently feels sick on schooldays but makes a miraculous recovery at the week-ends. In fairness to the child, however, it should be pointed out that in the case of very young children especially, the sickness may be due every bit as much to pleasurable excitement as to actual dread of school.

As stated above, vomiting in childhood may have many causes, some of little significance, but others fraught with more serious consequences, so that in any case of continued vomiting it is always important to ascertain the cause.

Loose and Frequent Motions (Diarrhœa.)

By diarrhœa we mean the frequent passage of loose, watery stools in a previously healthy child. Primary gastro-enteritic infection of the gastro-intestinal tract constitutes one of the commonest causes of diarrhœa in infancy and childhood. In the case of breast-fed infants the infection takes place through the medium of the contaminated dummy; with bottle-fed babies, on the other hand, the milk mixture itself constitutes an additional source of infection. This is especially so in the tropics, where the

bacterial content of the milk increases with great rapidity.

This infective type of diarrhœa is sometimes referred to as gastro-enteritis or summer diarrhœa, and in Southern Africa is most prevalent during the hot rainy summer months.

Symptomatic Gastro-enteritis: There is a further type of enteritis in childhood which may conveniently be regarded as symptomatic gastro-enteritis. That is to say, it is secondary to an infection elsewhere in the body. The most important conditions capable of setting up diarrhœa in this way include: chest infections such as bronchitis and pneumonia, middle ear disease, a bad "cold," tonsillitis, acute malaria, inflammation of the kidneys or the onset of an infectious fever, e.g. measles.

Diarrhœa may also be the result not of infection but of faulty feeding. In the case of the breast-fed baby, the feeding is spasmodic, being frequently interrupted by bouts of crying in which the baby draws up his legs in pain and twists and squirms in his mother's arms. Several thin, watery, greenish motions are passed daily and as a result the buttocks become red and sore. At the same time the child sleeps badly both during the day and at night. The fault here is underfeeding—a fact which can be readily ascertained by test weighing. In the same way diarrhœa may set in on account of unsuitable milk mixtures in the case of the bottle-fed baby, and in such circumstances it is obvious that the child is unhappy and restless both during and after the feed.

It is always a wise step to obtain medical advice if the diarrhœa fails to improve after twenty-four hours.

Other causes of symptomatic diarrhœa of childhood such as cœliac disease, dysentery, etc., scarcely fall within the scope of this section, and will not be discussed.

Symptoms of Acute Gastro-enteritis: The attack may consist of little more than a few relaxed stools over a period of two or three days, together with loss of appetite and a certain amount of vomiting.

In the more severe type of case a previously healthy child begins to pass frequent loose, watery stools. Vomiting sets in about the same time, while the temperature may be raised. The stools are discoloured and offensive and after the first few, contain little in the way of actual fæcal matter. The rapid loss of fluid leads to an alarming deterioration in the child's condition. The face becomes small and pinched, the eyes sunken and expressionless, while the skin hangs loosely on the shrunken body. The child is soon completely prostrated and lies in a collapsed, semi-comatose state, probably whimpering a little from time to time, and unless the dehydration is rapidly corrected the child may succumb to the attack.

This alarming and distressing state of affairs can usually be averted provided skilled medical attention is obtained if the diarrhœa fails to improve within the first twelve to twenty-four hours.

The scheme of treatment will obviously depend on the age of the child and on the amount of vomiting, but the first step in all cases consists in putting the child on fluids only for twenty-four hours. The fluids consist of plain boiled water or preferably a weak solution of salt and water containing a teaspoonful of glucose. Diluted orange juice may be used as an alternative to the glucose saline mixture. Never allow the child to take more than about a couple of teaspoonfuls of the fluid at first. When this is safely down, double the dose after about fifteen minutes and gradually build up the child's intake in this way.

The subsequent dietary programme will depend on the age of the child. Breast-fed babies can be returned to

the breast after an interval of eight to twelve hours on the fluid programme outlined above, but nothing should be given in addition to the breast milk until the diarrhœa has cleared up. With bottle-fed babies, after the twelve-hour rest period, the milk feeds are resumed in a dilution of equal parts of milk and water and continued thus for the next two days. Thereafter the feeds are strengthened until normal feeds are being taken, provided the state of the bowel permits.

With older children jellies, junkets, purées and mashed potatoes may be introduced as the diarrhœa subsides. Only soft non-fibrous food must be taken for at least a week afterwards.

These simple measures will cover the first twenty-four hours or so, but should there be no sign of improvement by the end of this period then medical advice must be sought at once and more elaborate measures taken.

At any rate, diarrhœa should never be neglected, no matter what the age of the child, and when blood and mucus appear it is evident that a true dysentery has set in.

In the case of symptomatic diarrhœa, removal or control of the primary cause is essential to recovery.

Bed-wetting.

This is a distressing condition which calls for careful and sympathetic investigation. In the majority of cases enuresis is a purely functional phenomenon connected with a hypersensitive nervous mechanism in the bladder. But since bed-wetting may be due to many possible causes, a full survey of each case is necessary.

Possible causes include diabetes, chronic disease of the kidneys, septic tonsils, carious teeth, an overloaded bowel, threadworm infection, urinary bilharziasis, inflammation

of the bladder, pyelitis, phimosis, spina bifidia and allergy. In the presence of mental deficiency bed-wetting is very common, while even in the absence of mental defect faulty training in infancy may be the underlying cause.

At any rate it is usually the case that the child achieves control of the urinary bladder by the age of two years, certainly by the age of three, but any delay beyond this period merits investigation. At the same time it should be remembered that to fuss the child unduly about bed-wetting at the critical period when control is about to be achieved may cause lasting harm in that it creates a feeling of anxiety in the child's mind and may grievously retard the acquisition of bladder control. No idea of guilt or unworthiness must be allowed to creep into the child's mind in connection with the problem of bladder control. Nor must the training be either over-zealous or over-casual. A good common-sense attitude must be maintained. It is well to look into the possibility of some psychological disturbance, e.g. the arrival of a new baby with a corresponding deflection of attention from the ex-baby, and so on. Any fright or emotional disturbances may lie behind the bed-wetting.

Boys are more often affected than girls, in a proportion of about three to two. In the functional type of enuresis the urine passed by the bed-wetter seldom shows any abnormalities on analysis, but the volume passed at night is usually considerable, so much so that the mother often volunteers the information that her child appears to pass more by night than by day. Normally, of course, the reverse is the case. The bed-wetting very often takes place in the early part of the night.

Treatment: The medical man's approach to the problem of bed-wetting will include a full review of possible local or

general causes, and in appropriate circumstances the cause will be removed.

In the home, however, we are concerned more with the emotional and psychological causes. In the first place the child should sleep on a firm mattress, in a well-ventilated room or verandah, and the bed-clothes must be suited to the time of the year—neither too many nor too few. Meals must be so arranged that the fluid intake for the day should be reduced to a minimum after afternoon tea, and where the urine is known to be highly acid, fruit drinks should be encouraged at the appropriate time. The child should also be encouraged to follow a well-regulated daily routine with plenty of recreation and plenty of contact with congenial friends in the appropriate age group. At the same time the parents must make the firm resolve never to punish or harangue the child for any bed-wetting lapse. The whole incident, trying though it may be, must never call forth a storm of parental protest but must be treated quite casually. This is very important in that the afflicted child is often mentally very alert, and in spite of an outward show of bravado and nonchalance, will suffer acutely when he is made to feel a sense of guilt. It is far more profitable to institute a system of rewards for success than to stigmatize the failures. During the day the child should be encouraged to hold the water as long as possible and so promote a more efficient control of the bladder.

Finally, sensitivity to the bedding must be excluded. Drugs are used in a restricted sense and only under medical supervision.

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