Current Practice

MEDICINE IN THE TROPICS

Fever in Children in the Tropics

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Brit. med. J., 1969, 1, 761-765

Fever in a child in the tropics fills a mother with fear; so often she has seen it the herald of death, or of fits, or of slow, lingering illness and handicap. She knows that fever replaces health and happiness in her child by fretfulness, misery, burning heat, and screaming (partly no doubt the result of throbbing headache). Her fear is justified. Mortality and morbidity from infection in children in tropical regions is still extremely high, partly owing to as yet poorly developed control of environment and medical care and partly owing to the background of malnutrition still so frequent in many areas. The mother knows, too, that fever responds to the application of modern medicine. Many diseases are as yet not so affected, and for them traditional remedies still may hold some answer. Fever and its accompaniments, however, need the help of a doctor and hospital.

The purpose of this paper is to stress some of the difficulties which fever presents among children in the tropics, though many are common to those of temperate zones. No attempt is made to provide a glossary of all causes of fever in the tropics, reference to which can be found in many excellent textbooks of tropical medicine.

Clinical Features

"The fevered brow" is as familiar to the mother in the tropics as anywhere else. However, she can be easily misled by the feverish feel of her child's skin when it is hot through exercise or environment, when he still is maintaining a remarkably stable normal internal temperature, which only rarely breaks down in extremes of exposure to heat and cold. Doctors and others need to beware of this—and also the reverse situation, where the extremities of the collapsed child with a rectal temperature of 40° C. (104° F.) or more may be cold and sometimes oedematous. A cold, oedematous child may of course also be truly hypothermic, as happens in kwashiorkor, when the rectal temperature may be only 34.5° C. (90° F.) or even less.

Much is written in older textbooks of the characteristic pattern of some fevers, and this is still useful occasionally despite modern laboratory techniques. As a rule the younger the child the more atypical the fever. Nevertheless, the persistent high fever of Still's disease or typhoid, the swinging fever of a urinary infection, and the occasional flick upwards of bacterial endocarditis may be clues in the diagnosis. The patterns of fever so characteristic of the various forms of malaria in the adult are not necessarily true for the child.

Problems Associated with Fever

Convulsions or Disturbance of Consciousness.—Throughout the world the first sign of a febrile illness in a child is often a convulsion. The clumsy term "febrile encephalopathy" might be used to cover the whole spectrum of these disorders. This

term has the advantage of leaving open the relationship between the fever and the convulsions. While the majority of cases carry a relatively benign prognosis as in the so-called febrile convulsion due to a variety of infections—e.g., meningitis, otitis media, pyelitis, pneumonia, malaria—the syndrome is not without a mortality or sequela in the form of permanent brain damage. With good reason a convulsion is much feared in developing countries, and may be given special local names; for example, in Buganda, the area around Kampala, it is described as the "Ennyonyi" (bird) disease, partly perhaps because the suddenness of its onset resembles the swoop of a bird of prey on its victim, and partly because the child's eyes move upwards at the commencement of the convulsion just as if he was looking at a bird in the sky. Of 132 brain-damaged children seen at Mulago Hospital in 1966-7, 21 (15.9%) were apparently normally developed until they were struck by a catastrophic illness of this nature. Minimally brain-damaged children are more likely to develop these sequelae, and it is possible that these children belonged to this group, for accurate histories are notoriously difficult to obtain in countries where communication is a problem. All children with fever and convulsions occurring within the previous 12 hours with or without disturbed consciousness should have a lumbar puncture. This is the only way to exclude with certainty a pyogenic meningitis and to approach a more accurate diagnosis.

Patel¹ studied 109 children admitted over a nine-month period to the paediatric wards at Mulago Hospital with fever and convulsions; those with pyogenic meningitis were excluded. Twenty-nine died, 17 left hospital with residual neurological deficits, and the remainder appeared to recover completely. The diagnoses recorded on admission were most frequently "febrile convulsion," "cerebral malaria," and "encephalitis." "Encephalitis" was usually used to refer to those children who had no malarial parasites in the peripheral blood and a pleocytosis in the cerebrospinal fluid. An attempt was made to differentiate "cerebral malaria" from "febrile convulsions" according to whether or not malarial parasitaemia was present. However, such a simple division was made difficult because so many of the children had been given chloroquine before admission. Furthermore, the only two cases of cerebral malaria proved at necropsy had had a considerable cerebrospinal pleocytosis. Malaria may also cause febrile convulsions. A relationship was found between the clinical course of illness and the number of cells in the cerebrospinal fluid. In 80 of the children the cerebrospinal fluid had fewer than 5 cells/c.mm., while 29 had more than this number. The latter group, with a C.S.F. pleocytosis, had a longer stay in hospital, a longer period of fever, and a greater incidence of residual neurological signs. The incidence of malarial parasitaemia was not significantly different in the two groups.

The following conclusions were reached in an effort to differentiate these various groups of convulsions. If convulsions cease when the fever subsides, they are likely to have been

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febrile in origin whether or not malarial parasitaemia was present, though there is no doubt that a few of these children develop an "encephalopathy" secondary to anoxia; the C.S.F. is usually normal. If pleocytosis is present, then an encephalitis is probable and may or may not be malarial; in either case the course is likely to be longer and signs of focal or widespread cortical damage are more likely and may be permanent. If heavy malarial parasitaemia (*falciparum*) is present in such a case, then the diagnosis of "cerebral malaria" is more probable, but, as has been pointed out already, if chloroquine has previously been administered a definite diagnosis is more difficult. The study emphasized the vital importance of giving chloroquine to all children who are febrile in an endemic or sporadic malarial area and particularly to those who are convulsing or whose consciousness is disturbed.

Malaria Parasitaemia.—The relationship between this and fever is always a difficult problem. Much depends on the state of immunity of the child, on the virulence of the malaria parasite, and on the level of antimalarials in the blood. The most severe malarial infections in the wards of Mulago Hospital, itself in the centre of an endemic *falciparum* malarial area, are found in infants of non-immune mothers recently immigrated from the non-malarial highlands of neighbouring Rwanda. Occasionally European children, having omitted to take antimalarials during a carefree holiday on the East African coast, have returned to Kampala only to develop severe malaria associated with parasitaemia. Despite having lived in a malarious area for some time, they had not developed any immunity, because they had previously been taking regular antimalarials. By contrast, in a study of primary schools near Kampala 40% of apparently healthy children had some malarial parasitaemia. Hence malaria parasitaemia in a child with fever does not necessarily imply a straightforward causal relationship and therefore that chloroquine therapy is all that is required. Certainly this drug is required for reasons given already, but the doctor should remain alert for other causes of fever. An acute infection may sometimes light up a latent chronic malarial infection with consequent reappearance of the parasitaemia.

Splenomegaly.—Most acute infections in infants and children are associated with a palpable spleen persisting for one to two weeks. A greatly enlarged spleen suggests the presence of a chronic infection such as malaria or kala-azar, either in acute exacerbation or associated with a non-specific superimposed acute infection, to which such children may be particularly prone.

Meningism.—So often irritability accompanies fever, and this makes it very difficult to decide whether or not neck stiffness is present. In such instances lumbar puncture is mandatory; but, because a clear colourless fluid may contain an abnormal number of cells, a cell count should always be done. Provided a meningeal infection has been excluded, meningism is usually the result of general muscular tenderness associated with a viraemia or septicaemia secondary to Coxsackie infection, typhoid, leptospirosis, malaria, or to urinary or respiratory tract infections. Local inflammation can produce muscle spasm in conditions such as cervical adenitis, pyomyositis, osteitis of the cervical spine, or sickle-cell infarction or infection affecting the vertebrae.

Diarrhoea.—Fever is uncommon in the vast majority of the watery diarrhoeas seen in infants and children in the tropics. These diarrhoeas are usually caused by a complex combination of low-grade viral or bacterial infection, malnutrition, malabsorption, sugar intolerance, local herbal aperients, and dietary imbalance. When diarrhoea is accompanied by fever systemic infections such as malaria and measles are likely, though enteric infections—the salmonellosis, dysenteries, staphylococcal enteritis, and peritonitis—must also be considered.

Malnutrition.—Fever in the malnourished child is to be welcomed as an indication that the child's defences have not been overwhelmed, though by increasing metabolism fever in-

creases the negative nitrogen balance. The malnourished child whose temperature falls in response to an infection is, however, in far greater danger—a situation similar to that of the premature baby.

Sickle-cell Anaemia.—In many tropical areas this disease is common. The relationship between fever, intravascular sickling, and infection is often difficult to decide. It is probable that fever can both cause intravascular sickling and be produced by it. Infection can be suspected on the basis of the severity of toxæmia and the site of the infarct (dactylitis is mostly non-infected). Infection is confirmed by failure of rapid resolution, extension beyond the bounds of the original infarction, or culture of pathogenic organisms from the infarct or blood.

The predilection of salmonellae for this disease raises the problem of whether and how often in an undiagnosed severe infection chloramphenicol should be used. The newer penicillins, when ultimately cheap and available enough, will almost certainly replace chloramphenicol as a solution to this problem. There is also the question of whether or not prophylactic penicillin with or without chloroquine will in fact reduce the risk of infection, fever, and intravascular sickling.

From experience in East Africa, some of it documented, we have formulated a general policy for a child with sickle-cell anaemia who is admitted with fever.

First of all the haematological state should be assessed—the degree of anaemia and the degree of effective bone marrow response. On this will depend whether blood transfusion is necessary. Chloroquine should be given routinely (whether or not there are malarial parasites demonstrable in the peripheral blood). Though the heterozygote, and presumably therefore the homozygote, state may give rise to overall protection against malarial infection, there is no doubt that even a mild attack of malaria may induce a severe crisis in a homozygote.

The fever should be investigated as in any other child, and this will include a blood culture. Very often no cause is obvious. Any evidence of a possible infarction, such as acute abdominal pain, bone pain, haematuria, or neurological deficit should be treated symptomatically and with antibiotics, usually penicillin or sulphonamides or both. The exception to this is the infant or toddler in whom signs are confined to swelling of the hands and feet (the hand-foot syndrome); these patients are usually given chloroquine only. In the very few cases where the hand or foot continues to swell or become fluctuant for longer than a few days antibiotics should be given.

In older children the pattern of bone infarction or infection changes in a centripetal manner, and the long bones are often sites of painful swelling. If a limb is painful and swollen and there is bony tenderness, then aspiration of the bone may be attempted. The aspirate, however small, should be cultured, and the child treated with tetracycline or chloramphenicol as well as penicillin. Chloramphenicol should be used only if the child is seriously ill or a definite organism has been cultured and shown to be sensitive to the antibiotic, or if there is no response to penicillin or tetracycline.

Warley *et al.*² and later Mahmood³ have both shown from work done in this department that chloroquine is the only drug of proved prophylactic value, though a combination of an antimalarial and a long-acting sulphonamide drug may well prove of even greater prophylactic benefit.

Causes of Fever

Most fevers are caused by infections. The more obvious infections can be confirmed by the usual processes of history-taking and examination. At some stage by its resistance to inquiry the fever may earn the title "pyrexia of unknown origin" (P.U.O.).

P.U.O. may be labelled "a virus infection" in temperate zones or "malaria" in those areas of the world where the disease

is still endemic. Both agents are ubiquitous, and their responsibility for the fever—even if either is shown to be present—is often doubtful.

Each area will also have its own pattern of infection, and a particular fever seen in one area will be enough to suggest the diagnosis which in another area would remain unsuspected. It is as well therefore for the doctor new to an area to acquaint himself with the local disease pattern. However, among important causes of P.U.O. due to infection are the following:

Viral Disease.—Four or five days may elapse before the specific clinical features of the infection appear. In some mild infections this prodromal period may subside without the specific signs appearing, as in anicteric infectious hepatitis, non-paralytic poliomyelitis, etc.

Bacterial Disease.—The staphylococcal, enteric, and streptococcal infections, the spirochaetal infections of leptospirosis, relapsing fever, etc., or the acute miliary form of tuberculosis may present initially with a high fever and toxæmia only.

Skin rashes usually described as characteristic associations with these infections may be much modified by pigmentation of the skin, so that macular rashes in particular, such as those of rubella, meningococcal septicaemia, and typhoid, may not be visible at all on a very dark skin. Papular rashes, such as measles and syphilis, on the other hand, are often characteristic but different from their counterparts in white skins.

Occult Pyogenic Infections.—Abscesses, especially amoebic in the liver, as well as those under the diaphragm or in other intra-abdominal sites, may be difficult to detect. Pneumonia may also go unrecognized.

The fever usually subsides in response to the barrage of antibiotics which is given to most of these children, and the occult infections are either cured or attenuated. If the latter, then much harm may result from the smouldering infection, which becomes even more difficult to detect. This is particularly true of ear (chronic suppurative otitis media), pulmonary (empyema), and urinary infections (chronic pyelonephritis). Ear infections may go undiagnosed for the lack of an auriscope or care to examine the drums, or even the false assumption that if the drum cannot be visualized then it is probably normal. Urine is often difficult to collect, especially at a time when there is someone trained to examine it, and even then a microscope may not be available. Because urine deteriorates while standing for such an examination, suprapubic aspiration of the bladder overcomes this problem, especially in understaffed wards or out-patient departments. Matthews⁴ found this gave a more accurate idea of the true incidence of urinary infection in Mulago Hospital.

Other Causes of Fever

Acute Rheumatism.—This is as common in some parts of the tropics now as it was in Britain 30 years ago, and the clinical course is essentially the same—the onset is very acute and valvular lesions progress rapidly. The age of onset is often under 5 years, and may even be as early as 3 years.

Rheumatoid Arthritis.—This disease is common in the tropics and presents in the same way as in any other part of the world.

Environmental.—High environmental temperatures, especially when accompanied by high humidity, failure of adequate hydration, or dehydration due to any disease may all produce hyperthermia, particularly in newborn and premature babies.

Drugs and other Toxins.—The antibiotics and chemotherapeutic drugs, particularly sulphonamides, may produce in themselves a fever, inexplicable perhaps until their administration is stopped. Toxins, especially the iatrogenic antigens introduced to immunize the child against the effects of various infections such as the killed suspensions of whole bacteria (pertussis and typhoid), can produce a shortlived but occasionally high fever. Occasionally a parasiticide kills such a large number of

infecting organisms that a release of foreign toxins results in a Herxheimer type of reaction.

Anaphylactic Fever.—Serum sicknesses are still occasionally seen following the injection of repeated doses of antisera such as antitetanic serum or diphtheria antitoxin. The invasion phase of the lungs by *Ascaris lumbricoides* or the rupture of a hydatid cyst may be of this variety.

Tumours, Reticuloses, and Leukaemia are all well-known causes of fever, especially if there is rapid growth of the tumour. Fever from infections, often by organisms usually non-pathogenic to the healthy child, can supervene with tumours which interfere with the immune mechanism, such as Hodgkins disease. In this connexion it is worth noting that Hodgkins disease is considerably commoner in children in East Africa than in Britain and seems to occur at an earlier age.

Miscellaneous Rare Causes.—In any part of the world exotic causes of fever, such as inability to sweat due to the dyshydrotic ectodermal dysplasia and familial dysautonomia, may occur. Mucoviscidosis is strangely absent from the tropical East African scene.

Environmental Hypothermia

To cold-blooded temperate dwellers the tropics conjure up the terrible consequences of dehydration and heat or sun exposure, with high fever, vomiting, and delirium. While this can occur, the reverse is the more probable in the local population, who knew how to protect their babies and children from the sun and heat. In many tropical areas sudden drops of temperature may occur associated with violent thunderstorms at night. During these times infants (particularly prematures) and severely malnourished, often infected, children are laid open to the risk of cold injury. Furthermore, this hypothermia is often induced or increased by admission to a well-ventilated tropical hospital. The change from the warm back of mother to the cold sheets of a bed may drop the body temperatures of such children to the point of no return.⁵ Facilities for warming the environment should be available in every tropical hospital.

Complications of Fever

Fever in itself is a normal response of the body mechanisms to infection, toxæmia, or local inflammation. The effects and complications of fever are often those of its cause. In itself, however, fever has deleterious effects if extreme or long continued, though admittedly these are sometimes difficult to separate from its cause.

Mild Effects

No one who has a child of his own and has seen the dramatic effect of a dose of aspirin on a high fever will doubt that the benefit relates to the fall in temperature rather than to any effect the aspirin has on the infection itself. Irritability, misery, sleeplessness, and loss of appetite are largely the effect of fever.

Severe Effects

Precipitance or Aggravation of Malnutrition Syndromes.—The part which fever itself plays in the exacerbation of malnutrition is uncertain and undefined. The increase in metabolic activity occurring in fever gives rise to an increased demand for protein. This, combined with the loss of appetite and thus further reduction of the inadequate protein in the diet, produces increased breakdown of tissue protein. In a child balanced on the verge of nutritional breakdown a febrile illness can precipitate clinical malnutrition.

Effects of Hyperthermia on the Brain.—The clinical effects of fever on cerebral function in children are well known, and

on the whole they vary directly with the height of the fever and indirectly with the age of the child. They range from mild irritability to convulsions, mild and momentary to severe and intractable. In severe hyperthermia, death from cerebral oedema or permanent brain damage may ensue. Febrile convulsions tend to recur with each episode of fever, and are particularly likely to do so in the presence of mild, perhaps previously unnoticed, brain damage sustained in the perinatal period. They may also indicate a later predisposition to convulsions.

Treatment

The advances in therapy are outstripping the medical services of many countries. Powerful anti-infective agents are available to many medical and paramedical personnel who are working in an environment which precludes satisfactory examination and diagnostic investigation of patients and also their proper follow-up. Doctors must be aware of the results—the attenuated infection, the half-treated pyelitis or meningitis or gastrointestinal infection, the induction of resistant strains of organisms, the toxic effects of anti-infective agents themselves, and the risk of yeast or other antibiotic-resistant infections. All too often children survive the severest infections but are left in such a poor physical or mental state that return to a hostile environment may easily be the final arbiter of survival.

Specific Therapy

Aspirin.—This is the most commonly used and useful drug in the treatment of fever, but it is important to ensure that an adequate initial dose is given, which need be repeated only if the fever remains high. The large single or once repeated dose is usually not toxic; it is only the regularly repeated dose over several days which tends to produce "salicylism." The occasional risk of gastritis or gastric erosions from aspirin must be considered, especially if a child is already very anaemic from some other cause.

Chloroquine.—In areas where malaria is endemic it is right to give chloroquine to every feverish child. If the child is vomiting, convulsing, or unconscious, then it should be given subcutaneously—once it is clear that the child has not received a recent previous dose. The dose of 5 mg./kg. must be strictly adhered to, and a clear note made on the child's medical card of the dose and the time given. Chloroquine given parenterally is dangerous and can result in sudden death from cardiac depression. It is also wise to note the strength of the chloroquine in any particular solution, since this varies with different manufacturers.

Phenobarbitone.—Under the age of 5 there is always the risk of convulsions when fever is rising rapidly, especially when there has been a previous convulsion associated with fever or a family history of fits. There is a high tolerance for phenobarbitone in the first few years of life, so that an infant of 6 to 12 months should receive 15 mg. twice to three times daily, and the initial intramuscular dose necessary to control a convulsion may be at least twice this dose. Unroutable drowsiness is a sign of overdosage or accumulation of the drug. Sometimes a child is specifically intolerant to the drug and becomes irritable and restless. These symptoms, accompanied occasionally by drug rash, may be mistaken for the progress of the febrile illness. Changing from phenobarbitone to phenytoin will produce an immediate amelioration of these puzzling symptoms. If a child has repeated episodes of fever with convulsions it is wise if possible to give long-continued prophylactic therapy daily or twice daily for up to two years after the last convulsion.

Antibiotics.—The use of antibiotics introduces a difficult subject and one in which there is a great deal of difference between what is said and what is actually practised. The theorist correctly says that antibiotics should not be given until the cause

has been established. The practitioner realizes that very often the child is too ill to risk not giving treatment. In many areas he will not possess the tools or techniques required to identify the causal agent, while in developing countries there is the added complication of malnutrition or anaemia, so that the fever acts as the proverbial straw laid on the camel's back. An antibiotic in this situation may be regarded justifiably as a factor altering the balance in favour of the child. There is also the problem that because of lack of beds the child may have to return to a home many miles and often almost as many hours away from the hospital. Can the practitioner afford not to give such a child the benefit of a doubt? It is in such circumstances that the principle of "monodosage" may have to be considered, either "stoss" therapy or "depot" therapy, using either single large doses or long-acting preparations of the antibiotic respectively.⁶

The justifiable criticisms of all such blind treatment of fever with antibiotics are that the antibiotic is bound to be ill-aimed, that its use is bound to become more indiscriminate, and that, on the whole, thought over a correct diagnosis and effort to recover the causative agent will be suppressed by this easy short cut. Furthermore, large amounts of antibiotics will be wasted, such that the economy of a developing country can barely support. The compromise which so often has to be adopted in medicine all over the world lies in the balance of the theoretical and practical approaches.

If antibiotics are given in a blind manner as a therapeutic trial a reasonable course should be given, during which time the clinical course of the fever should be as carefully observed as time and distance allow. The antibiotic should not be changed unless in the meantime the organism and its sensitivity are identified and until at least three days have elapsed without any observable change in the fever. Even three days may be too short in such infections as typhoid, where the response to chloramphenicol may take more than five days—so long in fact that it is often doubtful whether the resolution of the fever is *post hoc* or *propter hoc*.

The choice of antibiotic in any fever depends on several factors:

(1) Toxicity by comparison with potency in the given situation: chloramphenicol and sulphonamides should be avoided in prematures. The former drug is not advisable unless the child is severely ill, rapidly deteriorating, or the infection is resistant to other antibiotics. Together with penicillin and sulphadimidine, chloramphenicol forms part of the "triple therapy" used at Mulago Hospital for a meningitis in which no organism has been identified.

(2) The "masking" effect of an antibiotic: streptomycin, for instance, should not be used as a broad-spectrum antibiotic in children over 3 to 6 months of age in areas where tuberculosis is endemic. If a urinary infection is possible, sulphonamides should not be used until this has been confirmed or refuted.

(3) The economic factor: several of the newer antibiotics, including the synthetic penicillins (resistant to penicillinase), are far too expensive to be contemplated yet for general use. The organisms in most tropical areas are unfortunately rapidly achieving resistance to the cheaper forms of antibiotics. Matthews⁷ studied the cost of and frequency of use of antibiotics in New Mulago Hospital, and noted that "stoss" therapy was one of the cheapest forms.

Steroids.—In the treatment of the fever itself the use of steroids is unjustifiable. Concomitant and severe collapse or a haemorrhagic condition suggesting a fulminating septicæmia may warrant "supportive" steroid therapy in addition to the appropriate antibiotic. The indication for steroids in inflammatory conditions cannot be dealt with here.

In areas where follow-up is difficult steroid therapy should be avoided unless considered to be life saving, and then only given in courses of high dosage and short duration.

Indigenous Therapy

As the power of the doctor's treatment increases so must the local unqualified practitioners become less sought after. However, local remedies are still much in use and individual medications may be known in some areas. These sometimes have a harmful effect and further confuse the diagnosis. Many of them, we suspect, are strong purgatives inducing a severe gastritis or gastroenteritis; some are central nervous system stimulants or depressants. Bizarre symptoms and signs should alert one to this suspicion.

This paper has been written in the hope that it will be a helpful introduction to the problems of the feverish child in the tropics. Some of it may even whet the appetite of a few who are wondering

whether to become involved in the difficult but stimulating task of solving one or two of them. I am grateful for the advice and constructive suggestions of Professor B. M. Laurance, of the Department of Paediatrics, Makerere Medical School.

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ANY QUESTIONS?

We publish below a selection of questions and answers of general interest.

Nitrofurantoin in Pregnancy

Q.—Is it safe to use nitrofurantoin in pregnancy in the first trimester or after the first trimester?

A.—Nitrofurantoin is not known to be teratogenic in man. Though it crosses the placenta cord blood levels are low and non-toxic.^{1, 2}

Reported adverse reactions include nausea, allergic rashes, blood dyscrasias, and peripheral neuritis—the last being associated particularly with excessively prolonged administration in the presence of impaired renal function. When clearly indicated, and with careful attention to the possible side-effects, nitrofurantoin would seem to be safe to use in pregnancy.³

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Phenylketonuria

Q.—What is the cost of detecting a case of phenylketonuria, the cost of maintaining treatment, and the number of children known to have this condition at present in the United Kingdom?

A.—The cost of detecting a case of phenylketonuria would depend on whether it presented as a mentally retarded child or was picked up on a screening programme. In the former the cost would be a fraction of a penny to cover the expense involved in examining the urine. Most would consider this too late.

Adequate screening procedures are available for the newborn infant.¹ Using an effective test such as the Guthrie test the cost per infant screened, covering test paper, the time of clinical staff in obtaining the specimen, postage, and the time of laboratory staff in processing the specimen, might be of the order of 2s. 6d. The cost of maintaining an infant on a controlled low phenylalanine diet would be of the order of £185 per annum, while that of maintaining a 7-year-old child

would be of the order of £470 per annum.

The incidence of phenylketonuria in newborn infants in the United Kingdom ranges from 1 in 5,000 to 1 in 15,000. This means that approximately 80 such infants are born per annum. The total number of survivors is not known.

The cost of detecting and maintaining a patient suffering from phenylketonuria, provided mental retardation is prevented, has to be balanced against the cost of the institutional care of a mentally defective phenylketonuric patient—quite apart from the value to the patient and his family.

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Borates in Detergents

Q.—Boron is now being included in detergents. Is there any danger in this practice to housewives from absorption from the skin of the hands, or of contamination of supplies obtained from rivers receiving domestic effluent?

A.—Sodium perborate has been used for several years in washing powders in many European countries in concentrations ranging from 0.5 to 27%. In the U.K. the usual concentration in which it is used lies between 8 and 10%. It is also included in certain "hair-brightening" rinses and shampoos for blonde hair, in bath salts and in so-called oxygenated foot-baths, in preparations for bromidrosis, in bleaching face-masks, and as an oxidant in hair dyes, dentifrices, etc.¹

Strong solutions of perborate, on account of their alkalinity, are irritant if allowed to remain in contact with the skin.¹ The systemic effects of perborate are said to be like those of boric acid.² Borates are rapidly absorbed from the mucous membranes and abraded skin, but toxic symptoms may be delayed for several hours. Absorption of borates can take place from unbroken skin after fairly prolonged contact.³ Excretion occurs mainly through the kidneys.

The W.H.O. Expert Committee in 1962 rejected boric acid as a food additive on the

grounds that no information was available on long-term tests in either animals or man and that there was some evidence that boric acid and related substances tended to accumulate in the body. However, it was recognized that such substances had been used as food additives for a considerable period, and no one had presented evidence of toxic effects resulting from their use for this purpose. From this evidence it seems that the use of perborate in detergents presents little hazard to health.

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Vibration Syndrome

Q.—Are forestry workers using power saws liable to develop the "vibration syndrome?" What are the features of this syndrome, and can it be prevented?

A.—Forestry workers are not any less liable to suffer from this syndrome than other workers who use tools that vibrate with a frequency of up to 2,000 or so per minute. The condition is a Raynaud-like phenomenon, and it is characterized by an uncomfortable disability of the hands due to vascular spasm brought on or aggravated by exposure to cold conditions. The bones, joints, muscles, and nerves of the hands, arms, and shoulders may also be affected. Recovery usually takes place after a change of occupation, and many men with a minor degree of the complaint continue to work, but as it becomes worse they experience discomfort to a degree which forces them to seek other work.

The Industrial Diseases Subcommittee of the Industrial Injuries Advisory Council is considering whether the vibration syndrome should be prescribed as an industrial disease under the National Insurance (Industrial Injury) Act, 1965, but considers that not enough is yet known about the incidence or severity of the disease to warrant prescription.¹ A survey is now being conducted on these two aspects of the condition.

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