lower fragments of the tibia and fibula are carried back with the displaced foot, both fragments forming a large open angle with their corresponding shafts. (See Fig. 3.)

Disastrous Third Degree.

This last is the fracture to which I now wish to call particular attention. My experience of the treatment of this fracture, of which very many cases have passed through my hands since I first recognised it early in my career, is that it is very often impossible to replace and retain the fragments in accurate apposition by means of manipulation and splinting alone. That this is certainly the experience of others is fair to assume

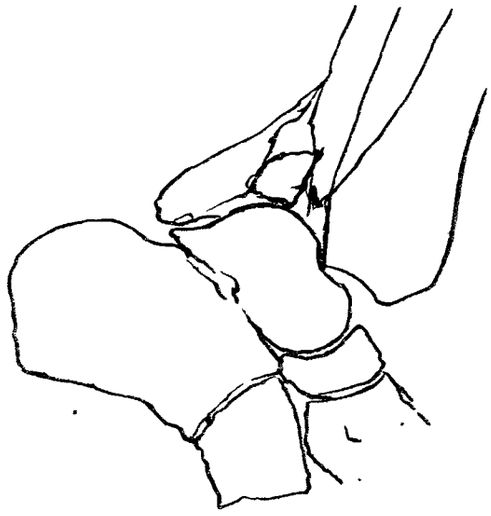

FIG. 3 represents diagrammatically the relations of the broken bones to the foot at time of receipt of the injury.

from the conditions presented by those cases which have come under my observation some months after treatment. As far as I could gather from the history of these patients, they were regarded as ordinary examples of Pott's fracture, and were all subjected to the process of so-called "setting" which entailed the administration of an anæsthetic. The limb was

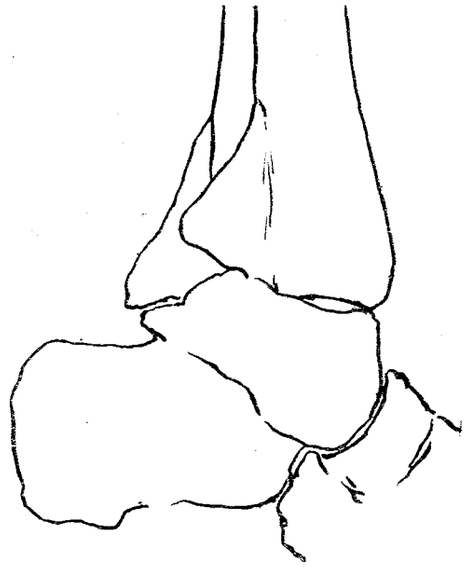

FIG. 4 shows the relationship of the bones to the foot after several months have elapsed since the receipt of the injury. The front of the tibia has formed a new joint with the upper aspect of the head of the astragalus, while the fragments of the tibia and fibula have blended together to form an irregular mass which no longer permits of free flexion and extension of the ankle-joint. The articular surface of the astragalus has also undergone extensive changes in form.

then put up in a splint and a perfect result was promised. Some were radiographed subsequently, but no mention was made to the patient of any residual displacement, if it was observed, and certainly no effort was made to rectify it.

It is unfortunate that once the fragments of the tibia and fibula have united in their displaced position the possibility of separating the tibial fragment and of restoring it to its normal position is very small. This is due to the fact that the end of the tibia has formed for itself a new joint with the upper surface of the neck of the astragalus and the adjacent portion of the tibial facet on the astragalus, while the fibular and tibial fragments, having united with the shafts, articulate with the rest of the facet on the astragalus—which has become much altered in form—with the process of bone behind it. (See Fig. 4.)

In the other varieties of adduction and abduction fractures it is usually possible by operation to replace the inner malleolar and fibular fragments in their normal position and to restore the function of the joint. In this particular fracture the presence of the displaced tibial fragment forms what is practically an insuperable obstacle.

Surgeons have no valid excuse for the very disastrous results that follow these methods of treatment, since it is possible to obtain excellent radiograms in most places in the country. What has puzzled me is that none of these unfortunate patients had resorted to the law courts, although the failure of the surgeon to perform his duty is only too obvious to the meanest intelligence, in view of the facility with which radiograms can be obtained by patients in the present day.

Treatment.

Apart from cases in which the bones are fragile and comminuted from advanced age or prolonged alcoholic excess, this fracture can be dealt with successfully by operation. A vertical incision exposing the fibular fracture enables the surgeon by suitable manipulation to restore the fragments of the fibula to their normal relationship. The accurate adaptation of the fibular fragments entails that of the tibial fragment, since the fibular fragments cannot be approximated unless the tibial section fits into the gap in the tibia. The fragment of the internal malleolus also falls automatically in position and remains so. The fibular fragments can then be secured accurately in position by means of a plate and four screws, supplemented in a few instances by the use of an encircling loop of steel wire.

Much of the difficulty and failure which the surgeon experiences in the treatment of fractures is due to the fact that while in his preliminary studies he is called upon to acquire a transitory knowledge of much that is relatively useless to him in the efficient performance of his profession, the fundamental principles of mechanics upon which a knowledge of the function of the skeleton and soft parts and of the treatment of the variations they undergo from injury or disease is absolutely essential, are excluded from his education. The fault lies not with the surgeon but with the teacher.

NUTRITION AND GROWTH ON DIETS DEVOID OF TRUE FATS.

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THE question as to whether fats are or are not necessary components of the diet of higher animals has always presented great interest to physiologists, but in spite of much research work and many theories no definite answer has as yet been given. As was pointed out by Drummond (1919) no solution of this problem was possible until it had been found practicable to separate the so-called fat-soluble vitamin from the true fats, because experiments of long duration—and experiments only extending over a period of a few days are useless in this study—in which diets nearly or wholly devoid of fats have been given, have of necessity entailed the absence of adequate amounts

of the associated vitamin, and therefore the results obtained are not free from complications which arise from this cause.

The absence of the vitamin A from the diet of animals induces an abnormal condition which may be recognised by certain symptoms, and in the paper referred to above it was shown that there was no appreciable difference in the type of symptoms, or in the time which elapsed before they appeared, in groups of animals fed on diets deficient in this vitamin with or without true fats. This was taken as indicating that true fats may be dispensable components of the mammalian diet provided that a sufficient supply of calories is given in other forms. The next step was obviously to attempt to feed animals on diets which would supply the requisite amount of the accessory vitamin, but which were devoid of free fats. Experiments on these lines, however, demanded that a natural source of the vitamin A containing no fat should be discovered, or that a method of separating the growth-promoting substance from the fats in which it naturally occurs should be found.

Conclusions Drawn from Preliminary Work.

During the last two years attempts have been made by us to accomplish both these tasks. In a former preliminary communication before the Physiological Society (1920) it was shown that by employing an extract prepared from carrots it was possible to supply the vitamin in a palatable form without, at the same time, giving more than minute traces of glycerides. Experiments were made with this preparation, and it was found that young rats will live and show growth for several months on diets freed from all but very small traces of fat. Allowing for the small amount of fat in the extract from carrots it was estimated that the animals received about 14 mg. of true fats per day in an average ration of 15–20 g.

The results were, however, regarded as preliminary, partly because normal growth was not obtained, and also because a certain amount of true fat was being given. The conclusions drawn from the results were summed up in the following statement :—

> "Unless this minute amount of fat plays as important a rôle in the metabolism of the organism as do the minute quantities of such substances as the accessory factors, it is reasonable to suggest that pure fats are dispensable constituents of the mammalian diet."

Since this work was carried out we have devoted further attention to this question, and as we have now succeeded in separating the vitamin from every trace of true fats we have at last been able to study the problem adequately. It is interesting to note that very shortly after the preliminary results were published by Drummond some very similar experiments were described by Osborne and Mendel (1920), who obtained good growth on diets containing mere traces of true fats and whose conclusions were almost identical with our own ; "if true fats are essential for nutrition during growth the minimum necessary must be exceedingly small."

The Separation of Vitamin A from Fat.

McCollum and Davis (1914) first stated that the vitamin found in butter fat would resist saponification processes applied to the fat, but this observation was not confirmed by Drummond. More recently, however, it has again been asserted by Steenbock and Boutwell (1920) that a fraction from the unsaponifiable matter of certain oils contains the vitamin. When this latter paper appeared we had ourselves just completed another study of the question, and had found that the negative result previously reported by Drummond was probably due to destruction of the active substance by contact with air, and that if such contact is prevented the activity passes into the unsaponifiable fraction of the fat. We have found it possible to prepare extracts of extraordinary potency from fish liver oils and from green plant tissues by this means, of which a fuller account will be given later.

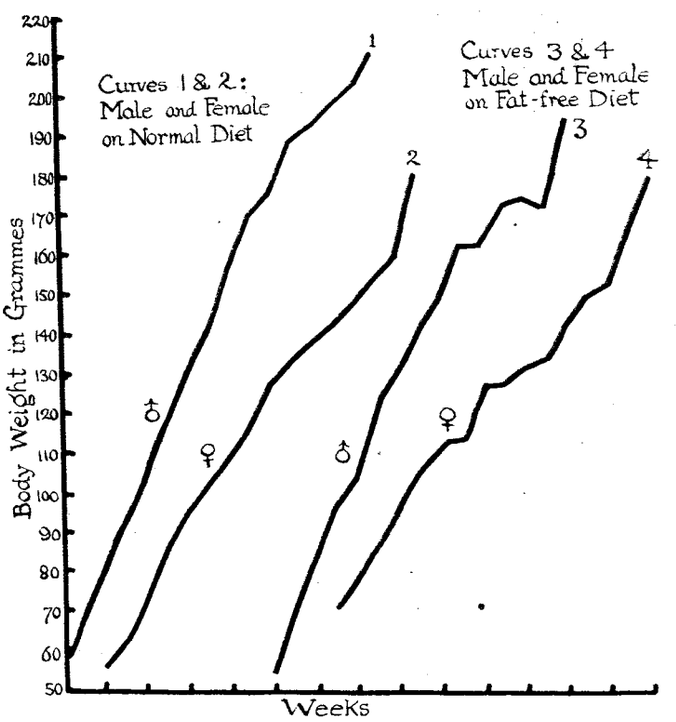
The possession of such material made it possible at last to test satisfactorily the problem of the dispensability of fat, since it was practicable to compound an artificial diet supplying all the known dietary essentials but devoid of neutral fats. The preparation of the constituents of the diet was the subject of great care. The protein (caseinogen) and the starch were rendered as free from fat as is possible by repeated and prolonged extraction with hot alcohol and ether, and so far as we are aware the only chance of the diets containing any trace of fat was from the inclusion of yeast extract as a source of the vitamin B. The ether extract of this product was, however, found to be almost negligible—0·08 per cent.—of which less than half was true fat.

Feeding Experiments.

The composition of the two dietaries used by us was as follows :—

	Normal diet.	Fat-free diet.
Caseinogen	20	20
Starch	50	65
Purified fat (tristearin)	15	0
Yeast extract	5	5
Lemon juice	5	5
Unsaponifiable matter from fish liver oil	0·02–0·04 g.	0·02–0·04 g. per day
Mixture of salts	5	5

The two dietaries were given daily in the form of food pastes made up with water, except for the unsaponifiable matter, which was given as a daily supplement, as is our custom. Young rats as soon as weaned were placed in groups on these two rations and have been under close observation ever since. The experiments have now been running for several months and the progress of the two groups has been parallel, apart from the fact that the few deaths which have occurred were of animals on the fat-free



Growth curves of young rats fed on a normal diet (1 and 2) and a fat-free diet (3 and 4).

diet. The food consumption of both groups has throughout been good, and no abnormality has as yet arisen which could be attributed to the absence of fats. Naturally the group on the fat-free diet consumes a larger amount of food daily, since this is necessary to ensure the requisite calorific intake.

Animals from each group have from time to time been killed and submitted to post-mortem examination, but without any abnormality being detected. The amount of body fat in those on the fat-free rations was normal. Several animals in both groups have

now reached maturity and it is hoped to continue the experiment further to ascertain whether any remote effects of the deficiency of true fats may be observed by changes in the capacity to breed and rear the young. The fact that we have obtained normal growth in rats from weaning to maturity on diets deprived as far as possible of all traces of neutral fats indicates that this class of foodstuff is not essential to the nutrition of these animals. (Growth curves in Figure.)

It is not intended to review the whole subject here, since the results will be published in a more complete form later. We may emphasise the truth of the remarks made by Osborne and Mendel in the paper to which we have referred, on the confusion which has arisen in the literature on this question through failure to recognise the disturbing factor introduced by the association of the vitamin with some fats and not with others. Our results support one opinion held by Hindhede (1920) who claims that fats are dispensable provided that a sufficient supply of vitamins is ensured.

Summary.

Young rats have been grown from weaning to maturity on diets, deprived as far as possible of neutral fats, and have shown normal development and behaviour. It is intended to ascertain whether the capacity for breeding and rearing the young is in any way inhibited by such diets.* More deaths were encountered amongst the animals on the fat-free diets than amongst those receiving fats. It would appear that neutral fats are, from a purely physiological standpoint, dispensable constituents of a diet, provided the other foodstuffs supply a sufficiency of the vitamin frequently found in association with natural fats. The real value of fats as convenient sources of energy is obvious.

References.—Drummond, J. C.: Biochemical Jour., 1919, xiii., 81, 95; Proc. Physiol. Soc., Jour. Physiol., July, 1920, p. 54. McCollum, E. V., and Davis, M.: Jour. Biol. Chem., 1914, xix., 245. Steenbock, H., and Boutwell, I. P. W.: Jour. Biol. Chem., 1920, xlii., 131. Hindhede, M.: Skand. Arch. Physiol., 1920, xxxix., 78.

A NOTE ON THE USE OF SULFARSENOL IN THE TREATMENT OF CONGENITAL SYPHILIS.

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MOST workers will admit that salvarsan or one of its allies along with mercury is the treatment par excellence for all manifestations of syphilis, especially of congenital type. Statistics have been published of cases treated at the Royal Hospital for Sick Children, Glasgow, which show a fall in the death-rate since the advent of salvarsan.[1] In pre-salvarsan days the mortality among children under 3 months old was 71 per cent., and after the introduction of salvarsan and kharsivan it was reduced to 26 per cent. Unfortunately, in order to avoid pain or sloughing of the tissues, it has been necessary to give these preparations of arsenic intravenously, and the difficulty of such a procedure has considerably limited its use.

Recently, however, sulfarsenol—a drug which can be given intramuscularly without causing either pain or sloughing—has been put on the market, and at first it seemed to give equally good results. Attention was drawn to this fact by Dr. Leonard Findlay[2] in the discussion on congenital syphilis at the Royal Society of Medicine in February, 1921, but more extensive experience has unfortunately considerably modified this opinion. In children treated with sulfarsenol the manifestations of the disease quickly disappear if doses equal to those employed with kharsivan (0·12 to 0·2 g.) are given, and the general condition of the children improves remarkably; but if the crucial test, the Wassermann reaction (W.R.) is employed, then the results do not compare at all favourably with those obtained earlier with kharsivan and neokharsivan.

For example, 35 children have now been treated with intramuscular injections of sulfarsenol and mercurial inunction. In order to compare the results with those published for kharsivan the children have been divided into two groups: (1) children under 1 year of age; and (2) children over 1 year of age.

As is shown in the table (Group I.), 19 children received from 7 to 9 injections and a negative Wassermann reaction was obtained in 8, or 42 per cent. Four children received from 10 to 18 injections and in one a negative W.R. was obtained. Thus in 9 of the 23 children under 1 year of age—i.e., in 39 per cent., a negative W.R. was obtained, but in 14, or 60 per cent., it remained positive after from 7 to 18 injections had been given. The figures given by Dr. Findlay for kharsivan indicate much better results. A negative W.R. was obtained in 64 per cent. of his cases after a course of 9 or fewer injections.

GROUP I.—*Children Under 1 Year of Age (23).*

No. of cases.	No. of injections.	Average No. of grammes of drug given in each case.	W.R. +	W.R. −
13	7	1·06	8	5
4	8	1·05	2	2
2	9	1·41	1	1
1	10	1·42	1	—
1	12	2·04	—	1
1	15	2·76	1	—
1	18	1·95	1	—
Total 23	—	—	14	9

GROUP II.—*Children Over 1 Year of Age (12).*

1	3	0·72	1	—
1	4	1·92	1	—
1	5	2·40	1	—
1	6	1·44	1	—
5	7	1·48	5	—
1	12	3·12	1	—
2	15	5·92	2	—
Total 12	—	—	12	—

In Group II., of 12 children over 1 year old (five of whom had previously been treated with neokharsivan) none gave a negative W.R. after from 3 to 15 injections of sulfarsenol, whereas among Dr. Findlay's cases over 1 year old treated with intravenous neokharsivan a negative W.R. was obtained in 50 per cent. Among the 35 children treated with sulfarsenol and mercury only one death occurred, and it was due to bronchopneumonia.

These results suggest that the intramuscular injection of sulfarsenol is not as efficacious in producing a cure of congenital syphilis, as evidenced by the W.R., as intravenous injection of kharsivan. Whether the virtue in the latter method lies in the drug per se or in the method of administration (intravenous as against intramuscular) we are at present unable to say. On the other hand, the work of Harrison, White, and Mills[3] seems to show that intramuscular injection of neosalvarsan or its substitutes is more efficacious in producing a negative W.R. than intravenous injection of these drugs. In these cases, however, a very much larger dose was given intramuscularly than intravenously, and they did not attempt to determine the relative efficacy of the various arsenical preparations they used.

* Since this was written the animals in both groups have reproduced, and several healthy normal litters of young have been reared by the females on the fat-free diet, as well as by those on the more normally-balanced ration.

[1] Findlay, L.: Syphilis in Childhood, Oxford Univ. Press, 1919, p. 143.

[2] Findlay, L.: Proc. Roy. Soc. Med., xiv., No. 8.

[3] Harrison, L. W., White, C. F., and Mills, C. H.: Brit. Med. Jour., 1917, i., 569.