necessary details for such correlation were not available in our cases, the provision of the necessary minutiae in the usual treatment notes being impracticable as a routine.)

The relative rarity of zoster in patients treated with *x* rays, even when the region of the spine is directly treated, suggests that patients vary in their sensitivity either according to the degree of fibrous reaction or according to the presence of the dormant virus. Even in a large group of cases of carcinoma of the breast treated by a similar post-operative technique the percentage developing zoster is small. A factor that may be important is that of immunity conferred by a previous attack of zoster or varicella. On the other hand, zoster developing after a prolonged period after irradiation—e.g., more than 24 months later—is likely to be purely coincidental.

Previous attempts to correlate zoster with cancer or reticulosis have been based on the hypothesis that the zoster was due to infiltration by the underlying disease of the spinal ganglia or other parts of the afferent nervous reflex arc. No other authors seem to have correlated the incidence of zoster with the administration of *x*-ray treatment in a large series where such infiltration was absent.

Summary

A series of 45 cases of zoster developing after irradiation is described.

The literature concerning the connexion between zoster on the one hand and malignant disease and reticulosis on the other is reviewed. Evidence is adduced to suggest that irradiation is implicated in the development of zoster in the majority of the cases described.

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According to the specification for stretchers recently published by the British Standards Institution the overall length of stretchers should be 7 ft. 9 in., though these requirements need not interfere with the use of 6-ft. stretchers to meet special needs, since the shorter stretchers can still be carried in ambulances designed to take those of full length. The institution recommends that stretchers should be held in position in ambulances by straps provided with buckles instead of by special locking devices, which are not universally applicable. Stretcher carriers and trolleys have also been specified. The British Standards Institution is a non-profit-making organization which was founded in 1901 and incorporated by Royal Charter in 1929. Its principal objects are to improve and simplify production and distribution. Organizations that co-operate with it include the Medical Research Council, various trade associations, and some of the Ministries. The B.M.A. is represented on the committee which prepared the standard for stretchers.

MALE SUBFERTILITY

INTERIM REPORT OF 3,182 CASES

BY

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This report contains a survey of the findings of an investigation into male subfertility carried out at the laboratories of the Family Planning Association over a period of four years. Nothing essentially new is presented, but the general information provided by a comparatively large amount of material may be of interest.

Material

Altogether 3,182 men were examined, with a total of 5,400 semen analyses. The patients were referred by hospitals, subfertility clinics, private consultants, and general practitioners. Most of them are the husbands of wives who had failed to conceive over an average period of about two years. In many cases the wives had been examined first and no gross subfertility factor had been found. In over 800 of these the initial post-coital examination was made in this laboratory and an unsatisfactory result was found. In over 180 cases conception had occurred in the past but had terminated in early spontaneous abortion. Thus it is obvious that the material is selected. The findings in a separate group of 15 normally fertile men are included in this report.

Methods

The technique of semen examination corresponds in almost every detail to that described by Harvey and Jackson (1945). A brief recapitulation of these methods may be helpful.

Collection of Seminal Specimens.—After a minimum period of abstinence of three to four days the specimen is produced direct into a clean thin-walled glass container previously warmed to body temperature by the hand or axilla. The specimen tube is closed with a paraffin-impregnated cork, wrapped in cellulose wadding, and brought to the laboratory as soon as possible. The maximum delay allowed is two hours, and the age of most specimens in this series was well below this. About one-third of the patients produce their specimens at the laboratory. Condom specimens are not accepted except for confirmatory tests in cases of total azoospermia or extreme oligozoospermia. Fresh specimens are allowed 20 to 30 minutes for liquefaction.

Semen Analysis

On receipt of the specimen the volume is measured and a note made of its consistence.

Density, Basic Motility, Viability.—A " bulk " dilution is prepared by adding 0.5 ml. of semen to the required amount of a buffered glucose solution at 37° C. The dilution and all pipettes and slides are kept in the incubator at body temperature. After one hour's incubation a drop of diluted semen is placed on a Thoma–Zeiss haemocytometer slide and allowed to sediment for five minutes. The count is done in two stages: (1) immotile and sluggish spermatozoa are counted, active ones are disregarded; and (2) all spermatozoa are immobilized by brief application of heat to the cover-slip and counted after further sedimentation. (This is a modification of Harvey and Jackson's technique, in which the two stages of counting are done on separate haemocytometer slides: on one of them the spermatozoa are immobilized immediately by exposure to osmic acid vapour. Repeated cross-checking has shown that these

methods give similar results.) From count 2 the sperm density is calculated, and by subtracting count 1 from count 2 the number of fully active spermatozoa is obtained. The motility found after one hour's incubation is called the basic motility of the specimen. Viability figures and a check on the density are provided by repeating the process after three and five hours' incubation.

No reliance is placed upon the observer's capacity to estimate the number of motile or immotile spermatozoa in a given field, but accurate counts of stationary spermatozoa are taken throughout.

Morphology.—A smear of semen is exposed to osmic acid vapour, fixed in Schaudinn's fluid, and stained with Weigert's haematoxylin and Rose Bengal. The smear is not allowed to dry at any stage of the process. It is finally embedded in Canada balsam and kept for reference. For routine purposes a differential count is taken of two groups of 100 spermatozoa each on opposite parts of the slide. Leucocytes and other cells are also counted. A report is sent to the patient's doctor recording the age of the specimen, period of abstinence preceding the test, the volume in millilitres, density in millions of spermatozoa per ml., motility in percentages of "active" and "sluggish" after one, three, and five hours' incubation, morphology in percentages of (*a*) head and (*b*) middle-piece and tail abnormalities, and, finally, a verdict classifying the specimen as "normally fertile," "borderline," or "subfertile." All features of the semen analysis are taken together in assessing the quality.

Repeat Tests.—A second specimen is invariably asked for in the following cases. (*a*) Total azoospermia. The need for this precaution became apparent when one of our patients produced 3.5 ml. of semen containing no spermatozoa or testicular elements, and three weeks later his specimen contained 30 million spermatozoa per ml. He had had no treatment in the interval, and both specimens had been produced at the laboratory. I have since heard of another similar case. (*b*) Poor motility, or absence of motility, in a specimen showing any but the grossest abnormalities in other respects. The motility of spermatozoa is the feature most easily influenced by extraneous factors (excessive age of specimen, faulty collection or transport, contamination), and so-called asthenozoospermia in a specimen of otherwise reasonable quality is very much rarer than its diagnosis. (*c*) A volume so small as to suggest an incomplete ejaculate. Whenever possible a second specimen is also examined before returning a verdict of subfertility, as it has been found that for no apparent reason normally fertile men occasionally produce unsatisfactory specimens.

Interpretation of Semen Findings

It is necessary to discuss in some detail the criteria we have used in assessing the quality of seminal specimens, for it must be admitted that no reliable figures exist which define the limits of normal fertility. Figures used by different workers vary a good deal, and apart from discrepancies attributable to different seminological techniques it is not usually stated by what criteria a man is classified as normally fertile.

Unfortunately the task of establishing the limits of normal semen findings is complicated by the fact that a couple's fertility depends upon both partners; certain types of semen defect can be compensated for by particularly favourable conditions of coital technique, of "timing" in relation to ovulation, and by a high degree of fertility in the wife. This means that a man whose semen has to be labelled "subfertile" may produce pregnancies under exceptionally favourable circumstances, whereas under average conditions the marriage might remain sterile.

It would seem futile to attempt research into male subfertility without the background of a normal range of values. It was decided, therefore, to collect semen analyses of men who might be considered to be above suspicion. The following conditions were postulated for inclusion in this group: (1) their wives should have had at least two full-term pregnancies, each resulting in the birth of a normal live child; (2) pregnancy should not have been delayed for more than one year from the time when it was first attempted; (3) the youngest child should not be more than 1 year old; and (4) there should be no history of miscarriage.

Unfortunately the various sources approached have provided only 15 such cases in three years. It is hoped that increasing interest in the subject may produce adequate co-operation in the future and enable us to complete the group of 200 originally envisaged. There should be no dearth of material in the post-natal clinics and centres advising on birth control.

Meanwhile it was decided to include this small series in the interim report, and to add to it the information obtained from 125 men whose wives conceived soon after the routine semen tests. I do not claim, however, that the criteria for the interpretation of semen findings are based upon statistically adequate material, and these figures are used only as a temporary expedient subject to confirmation.

The minimum "normal" figures used by this laboratory in assessing the quality of seminal specimens are as follows:

Volume	1.5 ml.
Density	40 millions per ml.
Basic motility	40–50%.
Morphology	Total abnormalities not to exceed 40%, head abnormalities not to exceed 25%.
Viability	The motility of the five-hour count should not be less than half the basic motility.
Leucocytes and other cells	Not more than 2 millions per ml.

Findings on which Minimum Normal Values are Based

Group A.—This consisted of 15 normally fertile men. The details collected are shown in Table I.

TABLE I

	Range	Average
Volume	1–11·2 ml.	3·8 ml.
Density	52–670 millions/ml.	143 millions/ml.
Total ejaculate	68–804 millions	395 millions
Basic motility	17–62%	39%
Morphological abnormalities:		
Total	16–35%	25%
Abnormal heads only	6–15%	10%

Group B.—This comprised 125 men who were sent for routine investigation and who are known to have produced pregnancies subsequently. In 104 cases the date of the wife's last menstrual period was obtained and the interval between the last test and conception was found to be 1–3 months in 75 cases, 3–6 months in 25, and 6–12 months in eight. No information is available whether the husbands were treated in this interval. However, it is doubtful whether this would have made much difference, because in more than half the cases the time would have been too short even for effective treatment to influence the semen picture materially, and because most of the methods of treatment in common use are ineffective. The figures collected are given in Table II.

Discussion of Groups A and B.—No marked discrepancy was found in the range of volume, density, total ejaculate, and motility of the specimens in these two groups. However, it will be noted that whereas in Group A the average incidence of morphological abnormalities was 25% and did not exceed 35%, in 21 cases of Group B the figure exceeded 40%, and in 22 even 50%. This may be partly explained

TABLE II

Volume in ml.

Range	Under 1·5	1·5–3	3–5	5–8	Over 8
No. of cases	4 (3·2%)	48 (38·4%)	48 (38·4%)	22 (17·6%)	3 (2·4%)

Density in millions per ml.

Range	Under 5	5–20	20–50	50–100	100–200	Over 200
No. of cases	3 (2·4%)	11 (8·8%)	21 (16·8%)	46 (36·8%)	33 (26·4%)	11 (8·8%)

Total Ejaculate in millions of Spermatozoa

Range	Under 15	15–60	60–150	150–300	300–600	Over 600
No. of cases	4 (3·2%)	10 (8%)	21 (16·8%)	39 (31·2%)	38 (30·4%)	13 (10·4%)

Basic Motility %

Range	Under 20	20–40	40–60	60–70	Over 70
No. of cases	15 (12%)	57 (45·6%)	45 (36%)	7 (5·6%)	1 (0·8%)

Morphology: Total Abnormalities %

Range	Under 10	10–20	20–30	30–40	40–50	Over 50
No. of cases	1 (0·8%)	6 (4·8%)	36 (28·8%)	39 (31·2%)	21 (16·8%)	22 (17·6%)

by the fact that the 125 pregnancies include a number which ended in early abortion. From evidence so far acquired I believe that pregnancy produced by morphologically unsatisfactory semen carries a distinctly increased risk of ending in early abortion. For the time being this can be put forward only as an opinion awaiting confirmation. A series of such cases is being collected and the findings will be published as soon as an adequate group of "normals" has been examined.

Findings in Routine Semen Tests

In 5,400 semen analyses of 3,182 men we found that 791 (24.8%) were normally fertile; 423 (13.3%) borderline; 1,711 (53.8%) distinctly subfertile; and 257 (8.1%) had total azoospermia. Although, as pointed out above, these figures do not represent an average sample of the population, they demonstrate the very substantial part played by male subfertility in the barren marriage.

The wives of many men in the "distinctly subfertile" and even "total azoospermia" groups had previously been subjected to prolonged investigations, and frequently attempts had been made to help matters by dilatation and curettage, ventrosuspension of the uterus, and a variety of hormone administrations. One childless woman had had two "D. and C." operations, a tubal insufflation, a salpingogram, an endometrial biopsy, and a host of injections, tablets, and douches, extending over a period of two years and costing a considérable sum, before someone thought of examining her husband. His semen contained no spermatozoa on repeated examination.

Some Common Fallacies

A considerable number of patients referred to this laboratory reported that previous attempts to investigate and treat their condition had been made and that often these had failed to clarify the situation or to improve matters. Certain types of mistakes were encountered so constantly that their discussion would seem desirable. As a rule the failure is accounted for by inadequate seminological technique.

Condom Specimens

For several years seminologists have been unanimous in condemning the examination of condom specimens for routine fertility assays. The rubber of condoms is known to contain substances injurious to spermatozoa, which may immobilize them quite rapidly. Nevertheless, even at the present time several laboratories accept such specimens and give reports on them. In some cases condoms are sent by post overnight.

It cannot be too emphatically stated that a specimen collected under such conditions cannot possibly show normal features, and that any verdict on the quality of such a specimen—except that of total azoospermia—is bound to be mere guesswork. The motility of spermatozoa is one of the most important indices of their quality, and distinctly poor motility on repeated examinations would brand a specimen as subfertile no matter how good the other features might be.

Two patients whose semen showed normal volume, density, and morphology but persistently low motility figures (1–4%) had previously been pronounced highly fertile on the evidence of condom specimens. No impairment had been found in their wives, and their marriages remained barren after four and seven years' trial.

Direct Microscopical Examination of Semen

Sometimes a patient will answer the request for a seminal specimen by saying that his doctor had looked at his semen under the microscope and found him "perfectly all right." Sometimes the semen was taken from a condom. This method is approximately as accurate as a blood picture obtained by direct microscopical examination of a more or less fresh drop of blood. In my opinion any attempt to short cut a complete semen analysis is bound to delay the discovery of the cause of a couple's failure.

Minimum Normal Findings

Density.—It is often argued that, theoretically at least, the presence of only one spermatozoon in a man's ejaculate makes him a potential father. On the other hand, a patient recently brought a report from his local hospital stating that he was sterile, as his semen contained only 8 million spermatozoa—a quite unjustifiable prognosis. It is alarming to speculate on the possible consequences of such a statement. In my series of 125 pregnancies the minimum densities are: 1½ millions before and after conception in one case, and three-quarters of a million before and 1½ millions after conception in another. In 11 other men of this group the densities ranged from 5 to 16 millions before conception, but subsequent specimens were not obtainable. Harvey and Jackson (1948) report pregnancies with repeated counts as low as 1 million. Whereas such semen findings obviously cannot be taken to indicate normal fertility—i.e., an average expectation of pregnancy—it would seem equally unwise to tell a man suffering from oligozoospermia either that he is sterile or that he needs no help.

Motility.—It is not uncommon to find that a patient has been subjected to prolonged treatment because "his spermatozoa are weak" whilst in other respects the semen is said to be normal. Usually this verdict is based on findings in a condom specimen or on one several hours old. In my experience true asthenozoospermia—i.e., poor motility without gross impairment of other features, especially morphology—is uncommon. I have records of only four men whose semen showed normal volume, density, and morphology but whose sperm motility remained persistently between 1 and 8%. Between five and eight semen tests were done in each case over a period of one to three years, and most specimens were produced at the laboratory. Two of these cases were quoted above as having been classified "highly fertile" on condom specimens.

At the other extreme, I have seen many semen analyses reporting 90% or even 100% motility. Several laboratories dealing with routine semen examinations put 80% motility as the lowest figure compatible with normal fertility. So far as I am aware, the technique of the motility count in these instances consists in counting both motile and immotile spermatozoa in a number of restricted microscopical fields.

"Pregnancy" groups A and B (see above) show a maximum motility figure of 62% in the former, and only one of the 125 cases in the latter exceeded the 70% limit. Among the remainder of the material I have occasionally found motility figures approaching the 80% mark, and in one case even exceeding it. However, these are exceptional cases, and I feel that 50% can be regarded as fully adequate.

It might be argued that the discrepancy between our findings and those of other workers is simply due to a difference in technique, and that, provided each keeps to his standards, results can still be reliable. However, I suggest that it is undesirable to rely upon a method which can produce variable results even with the same observer, and which in the past has produced most unlikely findings.

The ultimate purpose of semen examinations is not only to diagnose possible defects, but also to provide reliable indications of the patient's progress under treatment. This requires strictly comparable results from one test to the next.

Morphology

Comparable to the motility figures quoted above, the same reports are often found to record findings of 90 or 100% normal spermatozoa, and the minimum figure indicating normal fertility is stated to be 80% of normal forms. The 15 normally fertile men (group A) show a range of 16–35% of morphological abnormalities, and 60% of group B have 20–40% of abnormal spermatozoa.

Many excellent descriptions and illustrations of the various types of abnormal spermatozoa have been published. It is difficult to understand how different observers can disagree in deciding whether, say, a sperm head has a normal oval outline or is deformed; whether there is a well-marked division between the clear anterior and the darkly staining nuclear half of the head or whether it is just a pyknotic mass; whether a "collar" of cytoplasmic material surrounds the middle piece; or whether this is straight or bent—to mention only a few common and obvious features.

The following case will illustrate the practical importance of what might be regarded as an academic point.

A patient presented himself with an unusual semen condition encountered by me in only two other cases. In a specimen of normal volume and good density 98% of the sperm heads were small, spherical, and pyknotic, and more than half of them were surrounded by cytoplasm—i.e., they presented the appearance of degenerate spermatids—and the motility was poor. Yet the same patient brought two previous semen reports from a hospital running a large subfertility clinic pronouncing him normally fertile. A slide of one of his previous specimens generously loaned to us showed the same grossly abnormal features.

Furthermore, I believe that pregnancy produced by a specimen showing impaired morphology carries an increased risk of early abortion; and, whether to prove or disprove this contention, it is obviously desirable to pay the utmost attention to accurate differential counts.

The above descriptions refer only to the commonest sources of error encountered. But over and above these there are many more disagreements amongst laboratory workers and clinicians. They all tend to vitiate the attempts to provide an accurate diagnosis on which rational prognosis and treatment could be based. It is necessary to emphasize the fact that the examination of semen requires adequate time and a highly specialized technique, and that there is an urgent need for standardization of methods if our past neglect of the subfertile male is to be remedied.

Treatment

I shall discuss in some detail only two substances in common use on which the material examined has enabled me to form an opinion—namely, vitamin E and testosterone. Research is still in progress upon other methods of treatment, and it is intended to publish the results in a future report.

Vitamin E.—Forty-two unselected subfertile men, excluding only cases of azoospermia, were treated with "ephynal," a synthetic analogue of vitamin E. The doses given were from 10 to 40 mg. daily over a period of from 6 to 24 weeks. Six cases showed some improvement, seven showed some deterioration, and 29 were unchanged. Five cases in this group received additional doses of 5 mg. of methyl testosterone on alternate days at one time during the above treatment, and they were all in the "unchanged" group at the end. Subsequently, 34 cases treated with corresponding doses of natural vitamin E ("fertilol") for periods of six to ten weeks showed similar inconclusive results; the series was abandoned at this stage. Although I am not in a position to deny that more prolonged treatment—one to two years has been suggested—might not prove of some value, I do not feel justified in advocating vitamin-E therapy on the evidence available. The above figures, in my opinion, could be found in a similar untreated group. Detailed figures of the "ephynal" group are published in the *Proceedings* of the Family Planning Association Conference on Infertility held at Exeter in 1948.

Testosterone.—Fifty-three unselected subfertile men, again excluding cases of total azoospermia, were given methyl testosterone in doses ranging from 5 mg. on alternate days (21 cases) to 10 mg. a day over periods of from four to eight weeks. Two cases improved, 18 (mostly reduced density) deteriorated, and 33 were unchanged. In addition to this group many cases sent to me for examination have been treated with testosterone elsewhere and sent back for re-examination. They received doses similar to the above, or injections of testosterone propionate in doses of 10–25 mg. once or twice a week, for periods up to 12 weeks, or testosterone implants. The only fairly constant effect of the larger doses, and occasionally of the lower ones, on the semen picture is a reduction of sperm density. As a rule this effect is only temporary, and, even if it is alarming to see a case of oligozoospermia reduced to azoospermia, the semen picture can usually be expected to resume its original level a few weeks after the cessation of treatment. I consider that testosterone has no place in the treatment of semen deficiencies. However, provided the dose is not excessive, some cases might benefit from the temporary increase of libido it often produces.

Treatment with the gonadotrophins would still seem to hold out some hope, but reliable figures are not yet available.

Selection of Cases for Treatment

If it is difficult to assure the patient that any form of treatment will benefit him eventually, present-day methods of investigation can produce at least two definite and useful results: first, from the beginning to exclude from treatment those men whose fertility is damaged beyond repair; and, secondly, to eliminate those forms of treatment which are certain to prove useless in a given case.

The above refers mainly to cases of total azoospermia and oligozoospermia, and I consider it unwise to attempt treatment in such cases without first performing a testicular biopsy. A biopsy is a minor operation which can be performed in a few minutes at the consulting-room, clinic, or out-patient department, and leaves the patient fit to return to work next day. It is an essential step in deciding whether a case of azoospermia is due to blockage of the epididymides or vasa, or to failure of spermatogenesis. In the former case only surgical treatment is likely to help; in the latter, either absence of spermatogenic cells will prove the patient hopeless or the finding of incomplete maturation may hold out some hope of stimulating the process. Again,

in a case of oligozoospermia the presence of a few fully active seminiferous tubules with complete inactivity in the remainder indicates little prospect of improvement, whereas if most tubules are found to be active, but at a reduced rate, treatment is well worth trying.

Only 128 biopsies have been performed at this laboratory to date, and if nothing has been achieved beyond the fact that 27 patients could confidently be advised to abandon treatment, I feel amply repaid by the considerable time and expense thus saved.

The subject of testicular histology and its correlation with semen findings and with the effects of treatment is likely to prove of the greatest importance. It is mentioned here only briefly, as material is being collected for a more detailed report.

Summary

A survey is made of the semen findings in 3,182 male partners of subfertile marriages, 125 of whom produced pregnancies subsequently. A separate group of 15 selected normally fertile men is described. Cases are quoted illustrating the need for adequate investigation of the male and for standardization of seminological technique.

I am indebted to Roche Products Ltd., Vitamins Ltd., Ciba Laboratories Ltd., and Organon Laboratories Ltd. for the generous free supply of their products for our experimental series.

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THUMB RECONSTRUCTION BY TRANSFER OF BIG TOE

BY

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This is an interim report on the treatment of a patient whose lost thumb we have restored by a method seldom used, and one not everywhere held in good repute. Nevertheless we believe the method has advantages which should be seriously considered in cases in which restoration of a missing thumb or finger is thought to be desirable.

Nicoladoni (1900) introduced the method in 1898, and he reported an instance of successful tendon function when a toe had been used to replace an injured thumb. Gueullette (1930) reported from the literature 12 instances of the transfer of the big toe and five of the use of the second toe: there were only three good results. Five of the toes necrosed and the remainder were stiff and useless (quoted by Bunnell, 1949). We can find no record of the use of the method in this country until 1947, when J. B. Cuthbert demonstrated a successful result in a man at the Plastic Centre at Rooksdown House, Basingstoke. Cuthbert stressed the fact that selection of this method depends on the size of the big toe. A massive bulky toe is of little use because of its unpleasant appearance. Bunnell, in condemning the method, writes: "The second toe is too narrow and weak and the great toe is too gross." He draws attention to the disappointing results up to 1930, but states that he has seen one case successfully operated on by H. Hoyle Campbell, in which suture of the digital nerves had been followed by some return of sensation but without stereognosis.

The possibilities of a successful nerve suture, restoring cutaneous sensibility, and the maintenance of motion in the transferred interphalangeal joint make the method attractive. A point of great importance with many of the younger patients, particularly girls, is the appearance of the new thumb. To look well, a repaired digit must have a nail of appropriate length and skin of colour and texture approaching the normal. Other methods of reconstruction will cater for length and, to some extent, skin texture, but only by digital transfer can a nail be restored.

Unless the new thumb is elegant and functional the patient will develop "cover-up" mechanisms and will avoid use of the laboriously produced digit, which is often of more satisfaction to the surgeon than either function or appearance can justify.

Case Report

The patient was a girl aged 9. When 2 years old she fell on to an electric fire and burnt both her hands. The burning was so severe that all the digits of the left hand were destroyed. The burns of the right hand were less severe, but there was sufficient scarring and ankylosis to impair function.

Fig. 1 shows the condition of her left hand at the age of 3, in 1942. The maximum loss is in the index finger and thumb, only the epiphyses of the proximal phalanges remaining. The middle finger is represented by most of the shaft of the proximal phalanx, and the fourth and fifth fingers have been similarly destroyed.

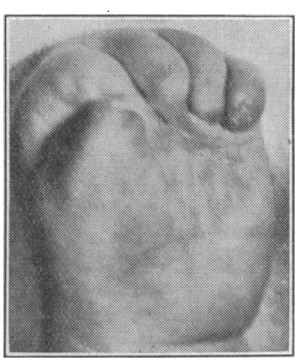

FIG. 1.—The hand at 3 years of age. Only the stump of the proximal phalanx of the thumb remains. The stumps of the medial four digits are bound to the palm. At this stage the complete palm was replaced by a dermatome graft and the digital stumps mobilized by Sir Harold Gillies.

When the child was 3 Sir Harold Gillies replaced the palmar scar by a dermatome graft. Later he deepened the first cleft by a large dorsal rotation flap with a free skin graft to the secondary defect. These operations were completely successful.

Six years later it was clear that the child could not develop a proper pick-up mechanism between the thumb stump and any digit, as the thumb stump was too short to be opposed even to the longest finger stump. Choice of this method of repair was suggested by Sir Harold Gillies, in the light of Cuthbert's case, because of the age and sex of the patient, and was influenced by the fact that her big toes were neat and not bulky. The tactics of the surgical campaign were explained to the parents so far as was possible, also the discomfort to be borne and the fact that the method was one that had seldom been used. The foot on the same side was chosen, as the hand can comfortably lie on the foot on the proper axis with less strain. The digits of both hand and foot lie parallel, and zinc oxide strapping ensures adequate fixation. The technique of the operation is described below.

Subsequently the transposed toe was shortened, with obliteration of the volar groove. The cleft between the middle and index fingers was deepened to increase their active length and aid the development of a pick-up mechanism. The extensor tendons of the thumb and transposed hallux were joined. Figs. 2, 3, 4, 5, and 6 show the appearance and condition of the hand.