

cians of the opportunities they will have to help solve the problems of ovarian function. The basic outline of the human cycle has been worked out, and it can be understood in relation to the general pattern of mammalian reproduction. Its time-schedule is fairly well known statistically. Much has been learned about the endocrine factors that control cyclic events. Because we have gone so far it is becoming possible to study some of the major variations and abnormalities of the cycle in individuals, with the hope of relieving the distress and suffering that so often attend them. More and more this investigation will have to be carried on in the consulting-room, the operating theatre, and the hospital laboratory, but it calls for workers who know the biology of the cycle.

This word to the clinicians is the first half of my peroration. Let me finish it in the spirit of Thomas Henry Huxley's broad curiosity about mankind's place in nature. Comparing the human cycle with that of other primates, we find that human ovarian functions operate through similar anatomical structures and follow the general primate pattern. In this respect our race is simply another simian species; and yet, passing upward through the primate line we find an increasing domination of nervous and mental processes in the control of reproductive behaviour. This trend reaches its height in mankind. Possessing a generalized animal body with a highly specialized brain, our species has grown into a realm beyond the merely animal in which we not only undergo the cycles and fluctuations of animal life but also seek to understand and to direct them; a realm where sex and reproduction are at their best bound up with reason, and a sense of beauty, and human affection.

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According to a report in the *New York Times* (August 14) all packages of chloramphenicol distributed in the United States must now bear a special warning label. The label will read: "Warning: blood dyscrasias may be associated with intermittent or prolonged use. It is essential that adequate blood studies be made." This ruling by the Food and Drug Administration, Washington, follows a nationwide survey of blood-disorder cases. Out of 410 cases reviewed by a committee of the National Research Council, 177 were found to have been associated with the use of chloramphenicol. About half of these cases were fatal. Death was attributed to failure of haemopoiesis in the bone marrow. The committee, headed by Dr. John Holmes Dingle, professor of preventive medicine at Western Reserve University, Cleveland, has recommended the Administration to promote further study of the toxic reactions to chloramphenicol.

THE END-RESULTS IN PRIMARY STERILITY

BY

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In the field of infertility so many diverse factors are involved that a sense of perspective is a prime necessity, for if one is particularly interested in any single factor it becomes easy to exaggerate its importance. From that the next step is to evaluate the result of correcting the particular factor, and indeed the literature contains many reports of excellent results obtained purely by tubal insufflation, or hysterosalpingography, or thyroid medication, or irradiation of the ovaries, or encouraging a clear cervical mucus, or even by having a long waiting-list. There are fewer reports of successful treatment of male infertility.

Consequently it is difficult on the basis of published reports to assess the value of any particular form of treatment, or even to be convinced that subsequent conceptions were in fact therapeutic successes and not due at least in part to the effects of chance and time.

The present investigation has aimed at a wide view of the problem. First, it was thought desirable to ascertain what percentage of all couples seen by the gynaecologist on account of primary sterility achieved a pregnancy; and, more particularly, in what proportion of these the medical treatment of either or both partners could reasonably be held to have effected the desired result. Further, the outcome of these pregnancies was inquired into to see whether it differed appreciably from that of the population in general, especially in regard to the abortion and foetal malformation rates.

Material

The material on which this investigation was based consisted of 700 consecutive traced cases seen by certain members of our departmental staff between 1934 and February, 1949. All the traced couples have been included, whether investigated and treated or not, and whatever the findings and treatment. The youngest woman in this series was 19 and the oldest 43. The longest any couple had been married before seeking specialist advice was 17 years. In this connexion it should be borne in mind that the fertility of the partners when first seen is no index to their fertility when first married. Sterility may be due to some factor or factors acquired after marriage. Because a man examined after 15 years of marriage has oligospermia, it does not follow that his fertility has always been below average.

Standard for Primary Sterility

The prerequisites for inclusion in the series were that the woman had never been pregnant prior to the first consultation, and that there had been the opportunity for normal married life for at least two years, during which time contraception had not been practised. Emphasis is laid on "opportunity," because infrequency of coitus, impotence, and failure of penetration are not unimportant causes of infertility.

The generally accepted standard of two years' married life before considering infertility a legitimate complaint probably errs on the cautious side. It may have originated with Matthews Duncan (1866), but in fact his figures showed the calculated percentage of women in various age groups delivered of their first living child within two years of marriage, the overall figure being 71.33%. Russell (1946)

found that 85% of married women became pregnant within a year of uncontracepted intercourse; while Diddle, Jack, and Pearce (1947) gave a figure of 86% within one year and 95.4% within two years, although admittedly from a selected sample of Service men and their wives. In France the figure of 90% within two years has been given by Palmer (1950). Teitze *et al.* (1950), reviewing the time required for conception in 1,727 planned pregnancies, found that more than 30% conceived within a month of discontinuing contraception, more than 60% within three months, and more than 90% within a year. Of 714 primigravidae seen in our obstetric units, 77.4% conceived within one year of first coitus or marriage (Table I) and 86.7% within two years.

TABLE I

Age at First Coitus or Marriage	No.	Became Pregnant Within			80% Became Pregnant Within
		3 Months	6 Months	12 Months	
Under 20..	156	99	123	134 (86%)	6 months
20-24 ..	345	174	227	280 (81%)	11 ..
25-29 ..	144	53	71	95 (66%)	21 ..
30-34 ..	48	14	21	29 (60%)	26 ..
35 and over	21	7	9	15 (71%)	23 ..
	714	347 (49.5%)	451 (64.4%)	553 (77.4%)	13 ..

Note.—The woman who marries after 35 and then becomes pregnant may take less time to conceive than a woman in her earlier thirties, because unless her fertility is high at that age she may not conceive at all.

The average time taken by a woman to conceive must, however, vary with her age. Therefore overall figures such as those given above are weighted by the relative numbers of women in successive age groups. As Table I indicates, the higher the proportion of women under 25 included, the higher will be the percentage becoming pregnant within a year. This Table represents the results of an inquiry recently made into the interval between first coitus and last menstrual period in primigravidae, according to age, and *excluding* those who practised contraception at any time. These figures are derived from women of proved fertility, but when considering after what interval infertility becomes a legitimate complaint the standard must be that not of all women, but only of those proved by pregnancy to be fertile.

It seems reasonable to allow, arbitrarily, a woman to complain of infertility when, by time, 80% of her chances of becoming pregnant, *if she is to become pregnant at all*, have passed. On the basis of the figures in Table I a woman of 20 might be regarded as subfertile if she does not conceive within 10 months, while by the same standard her sister of 33 requires a test of 24 months. But here a paradox arises, because the woman of 20 can probably better afford to wait 24 months than the woman of 33 can afford to wait 10. In practice, therefore, there are strong grounds for departing from the standard of two years demanded of the cases in this series, and for considering infertility a legitimate complaint warranting investigation if no pregnancy occurs within 12 months of uncontracepted married life.

Method of Investigation and Treatment

In this department the general approach to the problem of the infertile couple is essentially a simple one. After a carefully taken history of both parties and of their marital relationship, a general clinical examination is undertaken. Of the special tests for the male, repeated seminal analyses and, if indicated, testicular biopsy are carried out. In the female the usual practice is to rely basically on dilatation of the cervix, endometrial biopsy, tubal insufflation, and hysterosalpingography, together with, in recent years, the use of basal body temperature charts. The post-coital test is rarely employed and tests for cervical hostility are only exceptionally performed.

Similarly, treatment is on simple lines, with hormone therapy seldom employed and pre-coital douches only occasionally advised. Reconstructive operations on the

Fallopian tubes were carried out in 9 of the 700 women. No woman was treated by low-dosage irradiation of the ovaries.

Follow-up.—Each case was followed for at least three years and at the most 17 years. Table II shows the distribution of cases according to the length of follow-up, and

TABLE II.—Distribution of Cases According to Length of Follow-up

Period Followed	Total No.	No. Who Conceived
3-5 years	265	104 (39.2%)
6-10	363	180 (49.6%)
11-17	72	40 (55.5%)

indicates that the conception rate given below is almost certainly less than if all patients had been followed to the menopause.

The Conception Rate in Primary Sterility

Before considering the results given below, emphasis must be laid on the following points: (1) Cases in which investigation and treatment were refused by the patient are included. (2) Cases in which the indicated treatment rendered the sterility permanent—for example, hysterectomy for fibroids, radical operation for pelvic infection—are included. (3) Cases in which the patient was advised against pregnancy on account of constitutional disease—for example, chronic nephritis—are included. (4) Some patients may still become pregnant as all have not been followed to the menopause.

Overall Conception Rate.—Of the 700 women followed up 324 (46.3%) became pregnant. It is difficult to find in the literature a comparable figure, because other workers have combined their results for primary and secondary sterility, or excluded women with gross pelvic disease, or omitted couples not completely studied. But, even so, there are few reports of a conception rate of over 40%, and two of the most recent figures are 28% in 1,402 cases (Westman, 1950) and 36% in 2,359 women (Grant, 1951). Of the 324 women who conceived, 162 (50%) became pregnant within six months of their last consultation, investigation, or treatment. A further 47 conceived in between 6 and 12 months, so that almost two-thirds of the pregnancies began within a year of consultation, investigation, or treatment (see Table III).

TABLE III

Age at First Consultation	No. of Women	Pregnant When First Seen	Became Pregnant				Total Pregnant
			1-3 Months	4-6 Months	7-12 Months	Over 12 Months	
Below 30	312	9	56	22	23	53	163
30 and over	388	6	48	21	24	62	161
	700	15	104	43	47	115	324

Conception Rate According to Age.—Because fertility in the female is generally held to fall off naturally in the second half of the reproductive phase, and good results might therefore be due to a preponderance of younger patients, a separate analysis has been made of the figures for women below 30 and of those for older women, the latter group being the larger (Table III).

Women Under 30.—Of the 312 women in this group 149 (47.7%) remained sterile. However, in 22 of these an absolute barrier to conception was found, 5 having proved genital tuberculosis and a further 17 being married to husbands known to have azoospermia. The remaining 163 conceived, but nine of these were already pregnant at the time of first consultation. Of these 312 women, 53 (17%) conceived more than a year after the last consultation, investigation, or treatment.

Women of 30 and Over.—The conception rate in this larger group of 388 cases was lower than in the younger

women: 227 of them (58.5%) remained sterile, but 10 of these had proved genital tuberculosis and a further 22 were married to husbands known to have azoospermia. Of the 161 who conceived, 6 were pregnant at the time of first consultation, and 62 of the 388 (16.1%) became pregnant more than a year after investigation and treatment.

Thus in both groups of women there was a similar proportion (14-15%) of those remaining sterile in whom an absolute barrier to conception was known to exist.

From these figures it can be calculated that the higher conception rate in the younger women is accounted for almost entirely by the greater number of pregnancies occurring within the first year. After this first year the conception rates in the two groups are very similar (17% and 16.1%).

In summary, therefore, the conception rate in 700 women of all ages seen on account of primary sterility in a conservative clinic was 46.3%. Included in this figure are 2.1% who were already pregnant when first seen, although this was not always recognized at the time. In fact, tubal insufflations and hysterosalpingograms (with positive as well as negative results) and endometrial biopsies were occasionally performed on women presumably already pregnant, but the pregnancies continued undisturbed—experiences which have also been reported by Claye (1950). But how often such procedures did disturb an undiagnosed pregnancy is of course unknown.

The conception rate was 52.3% in 312 women under 30 and 41.5% in 388 women who were older. Half of all the conceptions occurred within six months of consultation or last investigation or treatment of the couple.

Proved genital tuberculosis occurred in 15 women, 4% of the 376 who remained sterile; the incidence in private patients was less than half of that in the hospital clinic cases.

Relationship of Seminal Analysis Results to Conception Rate

The results of seminal analysis were recorded for 533 out of the 700 husbands. Of the 376 women who remained sterile, 39 (10.3%) were married to men known to have azoospermia. Azoospermia on repeated analyses was found in 7.5% of all the men examined, a figure half-way between the 8.1% reported by Davidson (1949) and the 7.1% reported by Page and Houlding (1951). In addition another 1.5% (eight men) showed azoospermia in one or more but not all analyses.

Nevertheless, as Jeffcoate (1946) has pointed out, it is practically impossible to say that a man is sterile until he has died without issue. He described two cases in which the husband had impregnated his wife after two previous seminal analyses had shown azoospermia. In each case semen examined after the wife's conception contained spermatozoa. In the present series one husband had a count at the time of conception of 700,000 spermatozoa per ml., while in several cases of oligospermia the count showed no significant difference before and immediately after conception occurred. In addition, one man impregnated his wife after bilateral epididymovasostomy for obstructive azoospermia.

Table IV shows the conception rate in wives according to the sperm density of the husband's seminal specimen. In this department the sperm population is considered the

TABLE IV.—Conception Rate in Relation to Sperm Density

Sperm Count/ml.	Total No.	No. of Wives Who Conceived
100 millions and over	114	64 (56.1%)
60-99 millions	161	81 (50.3%)
40-59 "	55	29 (52.7%)
20-39 "	70	31 (44.3%)
10-19 "	36	13 (36.1%)
Below 10 "	57	19 (33.3%)
Azoospermia	40	1 (after epididymovasostomy)

most significant single feature of a seminal analysis, for there is a definite correlation between sperm density, motility, and morphology. Where more than one specimen from the same man was examined, only the highest count is included. No correction has been made for any adverse factors in the wives.

These figures suggest that there is little difference in the rates when the semen contains above 40 million spermatozoa per ml., a suggestion to which the findings of MacLeod and Gold (1951) offer considerable support. But what requires emphasis is that when the count is repeatedly extremely low, but not nil, the outlook is far from hopeless. Thus of 57 men with repeated counts of below 10 millions per ml., 19 were apparently successful in impregnating their wives, extramarital intercourse being excluded so far as was possible. These 57 cases are further analysed in Table V.

TABLE V.—Analysis of Cases of Oligospermia

Sperm Count/ml.	Total No.	No. of Wives Who Conceived
Less than 1 million	16	4
1-3 millions	13	5
4-6 "	13	5
7-9 "	15	5

Proportion of Success Attributable to Medical Treatment

The overall conception rate of 46.3% in the present series is a relatively high figure. But when an attempt is made to ascertain what proportion of success might reasonably be ascribed to treatment of one or both partners many difficulties present.

Obviously, pregnancies already present at the time of first consultation cannot be claimed as therapeutic successes, nor can pregnancies which occur subsequent to consultation in couples who have had no investigation or treatment, either because these were refused by the patients or because the waiting-list is long. But, once investigation and treatment have been instituted, it becomes necessary to lay down some arbitrary time limit beyond which any subsequent conception is not to be regarded as consequential. It seems reasonable to set an outside limit of 12 months after the completion of investigation and treatment, especially as of the 324 women who conceived one-half did so within six months. On the other hand, all conceptions occurring in treated cases within the 12 months have been accounted therapeutic successes, although, in fact, a proportion of them will not have been due to treatment.

On this basis it can be calculated that, of the 324 women who conceived, 15 were already pregnant when first seen; a further 24 who conceived within the prescribed 12 months had had no investigation or treatment other than a clinical examination; and 115 became pregnant more than a year after the last investigation or treatment of one or both partners. These three figures, totalling 154, represent 47.5% of the 324. If the 12-months limit is thought to be too generous and is reduced to six months the total is 200—that is, 61.7% which can be considered not directly due to treatment.

It would therefore seem that at least half, and probably more, of the conceptions were unrelated to medical treatment. This is a much higher proportion than generally conceded. The only relevant references found in the literature are the report by Mazer and Israel (1946) that 13.1% of their patients became pregnant during diagnostic study, and the unsubstantiated statement by Hanson and Rock (1950) that spontaneous cures of sterility are generally regarded as likely in 10% of cases.

In some couples, notably when the wife is already pregnant when first seen, some measure of success might be attributed to the psychological effect of transferring the burden of infertility from the couple to the medical attendant. In only two cases in this series was adoption followed by a first pregnancy, whereas in 14 it was not; but one woman, not in this series, who adopted a baby

after three consecutive abortions, had her first full-time pregnancy in the following year. These figures lend support to the contention of Hanson and Rock (1950) that "the therapeutic effect of adoption on infertility is speculative and without proof."

Outcome of Pregnancies in Women Previously Sterile

There is a general clinical impression that when a woman hitherto sterile becomes pregnant the pregnancy is relatively more often unsuccessful. Thus Kaplan (1950) writes: "It is probably true that a greater incidence of spontaneous abortion exists in sterile women who become pregnant, by whatever method employed, than in the normal group of pregnant women. Treatment of sterility by irradiation does not increase this incidence." This impression has never been confirmed or refuted. However, during the present investigation the details of 431 pregnancies occurring in 313 of the 700 women seen on account of primary sterility have been collected. The fate of these pregnancies is shown in Table VI.

TABLE VI.—*Outcome of Pregnancies*

	313 First Pregnancies	118 Subsequent Pregnancies	431 Total Pregnancies
Carried beyond 28 weeks..	247 (78.9%)	84 (71.2%)	331 (76.8%)
Abortions ..	*60 (19.2%)	33 (28.0%)	93 (21.8%)
Ectopic pregnancies ..	6 (1.9%)	1 (0.8%)	7 (1.7%)

* Including 1 hydatidiform mole.

Abortion Rate

The difference between the abortion rates for first and subsequent pregnancies is hardly significant ($\chi^2=3.41$, $P=8\%$). A higher abortion rate in pregnancies, excluding the first, might in part at least be due to the fact that once a couple had a living child further pregnancies were not welcome. There was no significant difference between the abortion rates in the older women and those in the women under 30.

At first sight the abortion rate may not seem excessive, but when it is remembered that by the very nature of these cases self-induced or criminal abortion can be ruled out, at least in first pregnancies, the incidence of miscarriage is high. It is in fact double that given for spontaneous abortion in Britain in the recent papers of the Royal Commission on Population (1950).

It is interesting to note that in this series, in which many therapeutic measures were employed but not irradiation, the abortion rate compares closely with those given by Kaplan (1947) of 18.4% in 130 pregnancies occurring after irradiation therapy for sterility, by Rubin (1947) of more than 15.5% in women who became pregnant after tubal insufflation, and by Westman (1950) of 15.5% in 389 women seen on account of infertility. On the other hand, Grant (1951) reports only 88 abortions in 851 pregnancies in women previously complaining of sterility (10.3%), but in 289 of these 851 the outcome was not known at the time of the report, and the abortion rate was therefore 15.6% in the 562 pregnancies followed to conclusion.

These figures therefore bear out the view that when a woman previously sterile becomes pregnant her chances of spontaneous abortion are considerably increased as compared with her sister of normal fertility. The reason for this increased risk is obscure. We have been unable to relate it to the quality of the husband's semen, but a paternal genetic factor cannot be excluded completely. What does seem reasonably well established is that the high abortion rate is related to the previous infertility rather than to the method of its treatment.

Ectopic Rate

The frequency of ectopic pregnancy in general is given as 0.3%, although the incidence varies in different localities. The incidence of 1.7% in this series shows a significant increase, for the probability of observing 7 or more

ectopics in 431 pregnancies when the standard rate is 0.3% is less than 1 in 500. Moreover, the figure of 1.7% compares with ectopic rates of at least 2% reported by Grant (1951), of 1.7% given by Mazer and Israel (1946), and of 1.3% in Kaplan's latest series (1950). These writers, however, included cases of secondary as well as primary sterility, which may have weighted their figures somewhat. Presumably tubal dysfunction is the chief factor in the increased ectopic rate, but the details of the six cases occurring in first pregnancies are of interest (Table VII). None of these six women has become pregnant again.

TABLE VII.—*Ectopic First Pregnancies*

- (1) Tubal: No previous treatment of wife. Hormonal treatment of husband for low sperm count.
- (2) Tubal: Was pregnant at time of first consultation.
- (3) Tubal: Conception within 1 month of positive tubal insufflation.
- (4) Tubal: Conception 26 months after positive hysterosalpingography.
- (5) Tubal: No treatment, but had at least one fibroid in uterus.
- (6) Ovarian: Conception 36 months after removal of opposite tube and ovary for chronic post-appendicitis pelvic infection.

None of the tubal pregnancies among our cases followed on operations for salpingostomy. Incidentally, in two cases routine section of the small pieces of tube removed at salpingostomy provided the first evidence that the underlying pathology was tuberculous. This accords with the view of Sharman (1944) that blocked Fallopian tubes in the apparently healthy woman may be due to subclinical tuberculous salpingitis.

Malformation Rate

This has been investigated from two points of view. The first is bound up with the general opposition in Britain to irradiation of the ovaries in sterility, partly on the ground that the malformation rate in children subsequently born, and in their descendants, would be not inconsiderable. Thus Crainz (1946) collected from the literature 1,305 cases of pregnancies in women previously irradiated. Of 881 full-time and premature babies born, 23 (2.6%) showed congenital malformations. But his series included women irradiated for causes other than sterility, such as fibroids and pelvic infection, which involved the employment of a relatively high dosage.

It must be stated, however, that Greenhill (1944), Kaplan (1947), Wolfe (1950), and others insist that the malformation rate following irradiation for sterility is not raised if proper precautions are taken; and Kaplan (1950) would claim this for the second generation also. Thus in 130 pregnancies in Kaplan's 1947 series only one foetus was malformed, and that was ascribed to the fact that the mother was already pregnant when treatment was begun. It is universally agreed that *post-conceptual* irradiation does involve a high risk of foetal abnormality.

However, even if the malformation rate following irradiation therapy for sterility is significantly raised, it might not be on account of the irradiation, but because the rate is increased in all women previously infertile who become pregnant, however treated. Therefore, to be logical, the malformation rate in babies conceived after irradiation should be compared with the rate, not in all babies, but in babies born of women treated for sterility by other means. The present investigation offers such a control figure because none of the patients were treated by irradiation. There were four abnormal babies among the 331 of more than 28 weeks' maturity (1.2%) (Table VIII).

TABLE VIII.—*Abnormal Babies*

Mother's Age at Delivery	Husband's Semen	Baby's Birth Order	Abnormality
33	Not tested	3rd	Mongol
38	110 million sperm/ml. 70% normal forms	1st	Absent ureters and kidneys
33	78 million sperm/ml. 95% normal forms	1st	Absent left hand
31	46 million sperm/ml. 45% normal forms	2nd	Hare-lip

A recent Ministry of Health Report (1949) gives a tentative figure for the general population in Britain of 0.5 to 1%, but this almost certainly understates the frequency, for Record and McKeown (1950) report an incidence of 0.59% for major malformations of the central nervous system alone.

It would therefore seem that the congenital malformation rate in viable babies of women previously sterile is similar to that of the population in general, and this probably irrespective of the method of treatment. This is supported by a recent paper by Grant (1951), who found six abnormal babies among 457 born to women previously sterile, a rate of 1.3% against the rate of 2% in his general obstetric service.

With regard to the second point of view, it was thought desirable to see whether any support could be offered by this investigation to a theory that there is a sterility-abortion-malformation sequence due presumably to "defective germ-plasm."

There is certainly an increased incidence of abortion in women previously sterile, but this investigation has shown no proportional increase in congenital abnormalities in foetuses of more than 28 weeks' maturity. However, Hertig and Livingstone (1944) have repeatedly demonstrated a high incidence of pathological ova and foetal anomalies in abortions. It may also be significant that Schultze (1949) has been quoted, although without specific reference, as having reported that previous sterility is a much more common finding in women aborting with abnormal than with normal ova (58% against 31.2%). There is therefore a possibility that there is an increased incidence of foetal abnormalities in women previously sterile, but it is not apparent; and in fact these abnormalities thereby account for the high abortion rate in these women.

The possibility of a sterility-abortion-malformation sequence thus remains to be refuted or confirmed.

Summary

Sterility should be regarded as a legitimate complaint when no pregnancy occurs within one year of unaccepted married life.

The overall conception rate in 700 couples seen on account of primary sterility was 46.3%, so far as could be ascertained by a limited follow-up. If all of the women had been followed to the menopause the actual rate would probably have exceeded 50%.

In only one-half of the successes at the very most does it seem reasonable to ascribe the conception to medical treatment, the remainder being due to time and chance. The high rate of spontaneous cure should be borne in mind when evaluating the results of any form of treatment.

Among the women previously sterile who became pregnant the abortion rate was double that given for spontaneous abortion; the ectopic rate was also significantly increased.

The incidence of congenital malformations in foetuses of more than 28 weeks' maturity was not increased, but the high abortion rate might be due to foetal anomalies.

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NOTES ON CUIRASS RESPIRATORS

BY

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The experience of recent years has made it apparent that considerable preparation must be made for dealing with outbreaks of poliomyelitis in this country if the victims are to benefit from advances in knowledge of the disease and its treatment. In this disease the correct use of mechanical aids to respiration is important as a means not only of saving life but also of resting a partially paralysed but very vital group of muscles. For this purpose there is nothing to compete with the cabinet respirator as regards efficiency, but for convalescent patients still requiring some respiratory assistance a type of respirator which makes nursing and physiotherapeutic care easier is very desirable; in this connexion the possibilities of cuirass-type respirators require investigation.

The early models of cuirass respirators were described in the M.R.C. Report, published in 1939, and were thought to be promising. Since that date respirator development in this country has been curtailed by the war, and is only now getting into its stride again. Work has, however, continued in America and Sweden, and we describe below two representative types—one American and one Swedish—which have been tested. These tests are a continuation of investigations previously reported (Bourdillon *et al.*, 1950).

Two Types in Use

Cuirass respirators are of two types: first, those which completely surround the trunk, and, secondly, those in which a light "shell" (or chest-piece) is applied to the front of the chest and abdomen. Both types of respirator have to be airtight on the body, and negative pressure is applied intermittently. The two respirators described below are of the second type, in which the upper edge of the shell rests on the upper ribs or clavicles; the respiratory movement produced is of the lower ribs and diaphragm, the latter being pulled down by the outward suction effect on the upper abdominal wall. Expiration depends on the recoil of the chest and abdomen after the suction phase.