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THE ROLE OF X-RAY THERAPY IN THE TREATMENT
OF FEMALE STERILITY

BY

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Being asked to contribute to the Indian Journal of Radiology Anniversary Number is an honour that I deeply appreciate. I have chosen this subject because it has occupied my close attention for thirty years, and because with this method I have achieved such universal success.

Through the ages the infertile wife has sought remedies of every sort, whether legitimate or not, and regardless of cost.

After Halberstadter¹ in 1905, reported that X-Ray had a specific affinity for human ovaries, many attempts were made to relieve sterility by stimulating the ovaries with measured doses of X-Ray. However, it was only in 1926, after Rubin² had reported that he believed X-Ray therapy to be valuable for treating female sterility associated with menstrual disorders, that this procedure was accepted for trial by gynecologists. Since the many reports of successful results from it have been published and it is now recognized as a legitimate procedure for the treatment of ovarian dysfunction and sterility, it has been employed by me, with little change in method, for the past thirty years. In the beginning I irradiated only the ovaries, but later I treated both the ovaries and the pituitary, and having achieved better results that way, I have consistently used that procedure for the last twenty-five years.

The irradiation method employed by me is as follows:

Three treatments are given at seven day intervals, with high voltage, low dosage X-Rays administered to the pituitary and ovaries. The factors are 180-200 kV., at 10 Ma, with 0.5 mm. Copper plus 1 mm. Aluminium filter, at 50 cm. distance, through pelvic fields of 8 x 10 or 10 x 15 cm. for the ovaries, and a 5 cm. round field on the forehead, for the pituitary.

At the first session, the X-Rays are directed through anterior right and left pelvic fields aimed at the ovaries. A dose of 50 'r', measured in air, is given to each field. Then a dose of 75 'r', measured in air is directed to the pituitary through a center forehead field.

The second treatment is 75 'r' to the posterior right and left pelvic areas, directed to the ovaries, and 75 'r' to the center forehead for the pituitary.

The third treatment is administered to the anterior pelvis and the forehead, as given in the first session.

Just how X-Rays to the pituitary and ovaries produce a favourable response is still a moot question. Kotz³ believes that, because the pituitary plays an important part in the functioning of the ovaries, dysfunction is not a primary fault of the ovaries, but a secondary one due to the failure of the pituitary, which may be corrected by the action of the X-Rays. Arnold⁴ states that the pituitary is rather radio-resistant and the favourable reaction to the X-Rays is probably due to the effect on the more sensitive adjacent hypothalamus. As some workers, notably Asherman⁵ have reported good results from irradiation of the pituitary alone, I have been successful in only a few cases treated in this manner.

As to the exact action of the X-Rays on the ovaries we can only conjecture. Often a response to treatment suggests the activation of the ovary towards extruding ova from previously unerupted Graafian follicles. The response in some cases suggests a resolution action on persistent corpus lutea. In some cases the action may be on some persistent ovarian cysts, which as Stein and Levinthal⁶ noted, are responsible for the dysfunction and sterility.

In many cases, however, the favourable response to X-Ray therapy is not readily explained, and one must agree with Israel that in many instances irradiation is used empirically. However, there is today no longer any doubt that regardless of the mode of action of the X-Rays, their use in the treatment of ovarian dysfunction and sterility is recognized as a useful, essential and effective therapeutic measure.

In all the cases treated by me, the diagnosis was made by the referring gynecologist, and my duty was solely that of administering the appropriate irradiation. In practically every case the patient has been referred only after all other methods of treatment had proved unsuccessful. In many instances, medical and surgical treatment had been given before and after marriage without improvement. Only then was irradiation advised.

The younger the patient the more probable the favourable response to X-Ray therapy. The most successful group were those 20 to 30 years old.

Five Negro women were treated in my series, and unfortunately none responded favourably to irradiation. However, they had not responded to other remedies either.

The following case histories illustrate the types of patients treated and the results achieved with irradiation.

The woman who has borne one child and then fails to normally menstruate, or to conceive again, and the woman who conceives and

miscarries and then fails to function normally, will often respond favourably to irradiation.

Mrs. B. B., aged 24, was referred for irradiation on May 10, 1927. The menarche had occurred at age 12½ and thereafter periods were regular. In 1924, at the age of 21, she married, readily conceived in December, 1925, but miscarried in February, 1926, and was curetted. Menstruation then occurred irregularly, stopping in October, 1926. Tests and treatments afforded no relief and she failed to conceive. X-Ray therapy was administered in May 1927 to the pituitary and ovaries. Menstruation was resumed and on November 18, 1928 she gave birth to a normal boy. She continued to function normally, conceived and gave birth to a second boy on May 15, 1934, and a baby girl on March 22, 1940. Fig. 1.

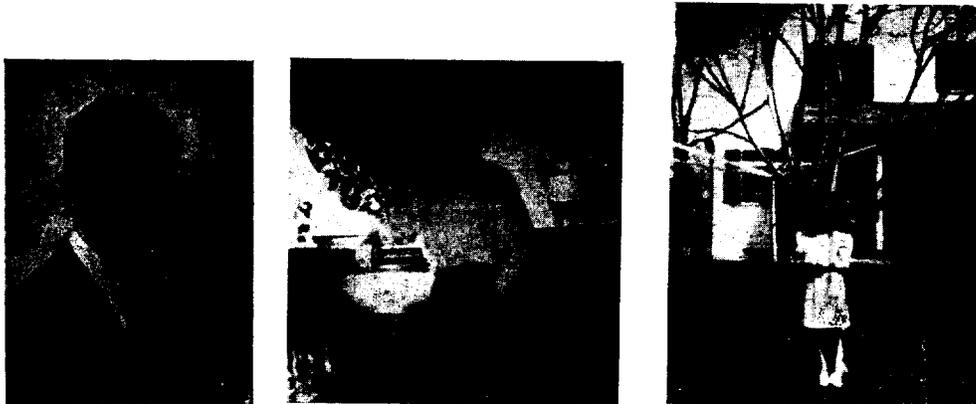


Fig. 1

Mrs. B.B. Age 24, referred May 10, 1927 for amenorrhea and sterility. Menstruated at 12½ — regular, until married at 21 then irreg — 2-3 intervals. Became pregnant Dec. 1925, then misc. Feb. 22, 1926 followed by curettage. Menstr. June 1926 and Oct. 5, 1926 — none since. Had patency test, pessary dilatation and endocrine therapy with growth of hair and increased weight. Gyn report, retroverted uterus and enlarged right ovary. X-Ray therapy given May 10, 18, 25, 1927. Responded well. Baby boy born Nov. 18, 1928, 2nd baby boy born May 15, 1934, 3rd baby girl born March 22, 1940.

Photos in 1948.

Mrs. E. L., aged 29, was referred for sterility on May 24, 1948. Her menstruation had begun at 13 and had been regular. She had married at 23 and avoided conception until 27, then readily conceived, but in May 1946, miscarried. Curettment was followed by menstruation in June 1946. On March 25, 1947, she gave birth to a normal girl. After the birth of this child, she again failed to menstruate or conceive, and medication did not improve the condition. X-Ray therapy was administered in May, 1948. She responded with regular menstruation, conceived

in December, 1950, and on September 20, 1951, gave birth to a normal girl. Fig. 2.



Fig. 2.
MISCARRIAGE, ONE CHILD STERILITY.

Mrs. E. L. Age 29. Referred May 24, 1948 for sterility. Menstr. 13 regular. Marr at 23. Conceived, miscarried May, 1946. D&C. No menstruation since June 1946. Conceived baby girl born March 25, 1947. Not nursed. No Menstr. no conception. Med. no avail. X-Ray therapy to pituitary and ovaries May 24, 31, June 7, 1948. Menstruation resumed regularly, conceived, baby girl born Sept. 20, 1951.

Mrs. F. P., aged 23, was referred for sterility on October 29, 1952. The menarche had appeared at 15, but periods occurred only 3 times a year. Medication failed to help. She married at 18, used contraceptives for 3 years, then conceived and bore a normal girl on May 2, 1951. She did not menstruate again until August 1952, only after hormone medication. Failing to conceive again, X-Ray therapy was advised and administered in October-November, 1952. She responded well, menstruated regularly, and on December 24, 1953, gave birth to a normal boy.

The following cases are examples of sterility caused by ovarian cysts, and relieved by irradiation:

Mrs. F. S., aged 28, was referred for sterility of 7 years duration, on July 26, 1948. The menarche had appeared at 15. Periods always had been irregular, occurring but 3 to 4 times a year. She did not improve despite medication before and after marriage at 21. Culdescopy revealed cystic ovaries and biopsy anovular endometrium. The last period occurred in July, 1948. Surgery was refused; then X-Ray was advised and admini-

stered in July-August 1948. She responded well, and on June 21, 1949 gave birth to a normal baby girl. Fig. 3.



Fig. 3.

CYSTIC OVARY

Mrs. F.S. age 28, referred July 26, 1948 for sterility. Menstr. 15. Irreg. 3-4 times per yr. Marr. at 21. Medication-culdescopy showed cystic ovaries. Endometrium biopsy anovular last period July 1, 1948. Treatment no avail. X-Ray therapy to pituitary & ovaries July 26, Aug. 2, 9, 1948. Responded well, conceived. Baby girl born June 21, 1949.

Photo at 4 weeks of age.

Mrs. A. W., aged 23, was referred on August 6, 1947, for sterility. Menstruation had not appeared until 15, and was always irregular with periods at intervals of 5 to 6 months; the last had occurred in April, 1947. In 1942 she was married at the age of 18, and menstruation continued to be irregular, and she did not conceive. In February 1944, she was operated upon and numerous ovarian cysts were excised, but the ovaries were not removed. Menstruation again occurred irregularly, and she failed to conceive. X-Ray therapy was then advised and administered in August, 1947. She menstruated regularly for two years and then decided to try for a child. She readily conceived and on February 24, 1950, bore a normal girl, and on January 26, 1952, a second daughter.

In the following cases, with sterility probably due to the non-eruption of the Graafian follicles, irradiation evidently corrected the situation and permitted normal ovarian function and subsequent pregnancy.

Mrs. B. S., aged 32, was referred for sterility on November 6, 1942. The menarche had appeared at age of 15, and periods were always regular. She married at 25, used no contraceptives, and though her husband was tested and proved potent, she did not conceive. Biopsies showed an anovular endometrium, of the hypoplastic type. Medication over a long period and curettage in 1942, failed to improve the condition. X-Ray therapy was administered in November 1942. She conceived and bore

a normal girl on November 27, 1943. She continued to menstruate regularly and conceived again, bore another girl on October 28, 1945, and on May 9, 1948, a normal boy. Fig. 4.



Fig. 4.

REGULAR MENSTR. 7 YEAR STERILITY.

Mrs. B.S. age 32, referred Nov. 6, 1942 for sterility. Menstr. at 15. Reg. Marr. at 25. No contraceptives. Husband tested—O.K. No conception. Medical care no avail. D&C 1942—Hypoplastic endometrium, anovulatory. X-Ray therapy to pituitary & ovaries Nov. 6, 12, 19, 1942. Responded well, conceived. Baby girl born Nov. 27, 1943. Girl born Oct. 28, 1945. Boy born May 9, 1948.

Photo April 1953.

Mrs. G. B., aged 32, was referred on October 6, 1949. The menarche appeared at 13 and periods were always irregular; the last had occurred in June, 1949, and the previous one in September, 1948. From age 16 on, she had hormone injections without relief. She was married at 25, but the condition was unchanged despite a curettage in 1945, and continuation of medication. Biopsy revealed anovular endometrium. X-Ray was administered in October, 1949, and she responded well, menstruated regularly, conceived and on September 18, 1950, gave birth to a son. She continued to function normally and on October 30, 1953, gave birth to a second son.

Mrs. C. S., aged 28, was referred on April 11, 1951. The menarche had appeared at 14, with periods occurring but once or twice a year. She had a hemorrhage at 16, was curetted, and menstruated only 3 to 4 times a year. She married at 23, and despite continued medication did not improve or conceive. X-Ray therapy was administered in April, 1951, she menstruated regularly for 3 months, conceived, and on March 9, 1952 gave birth to a normal girl. Fig. 5

As a rule but one course of X-Ray therapy is given and favourable results usually follow in four to eight weeks. Occasionally, if the patient fails to respond in eight weeks, a booster treatment is given. This consists of a single treatment, a repetition of that given at the first session to the anterior pelvis and forehead. The following case is an example:



Fig. 5.

Mrs. C.S. age 28. Referred April 11, 1951 for sterility. Menstr. at 14, irreg. once or twice per year. Hemorrhage at 16 followed by curettage. Then menstr. 3-4 times per year. Last Dec. 20, 1950. Married at 23. Treated before and after marriage with medication. No results. X-Ray therapy April 11, 18, 25, 1951. Result Menstr. April, May, June. Became pregnant. Baby girl born March 9, 1952.

Photo at 7 weeks.



Fig. 6.

BOOSTER TREATMENT

Mrs. S.G. age 19 was referred Sept. 24, 1952 for sterility. Menstr. at age 12, regular until marr. at 19. Then irregular every 3 mos. No conception. Med. aid no avail. X-Ray therapy to pituitary and ovaries Sept. 24, Oct. 1, 8, 1952. Menstr. monthly, no conception. Additional treatment to pituitary and ovaries Dec. 31, 1952. Responded, menstr. Conceived March 1953. Baby boy born Dec. 20, 1953.

Photo at age 1 year.

Mrs. S. G., aged 19, was referred on September 24, 1952 for sterility. The menarche had appeared at 12, and periods were regular until marriage at 19, and then occurred irregularly at 3 month intervals, and though she tried to conceive with the aid of hormone therapy, was unsuccessful. X-Ray therapy was administered to the pituitary and ovaries in September-October, 1952. Menstruation occurred at monthly intervals, but she did not conceive. A booster treatment was then administered to the ovaries and the pituitary on December 31, 1952. She then menstruated regularly, conceived and on December 20, 1953, bore a normal boy. Fig. 6.

Should the patient respond to the first course of treatment, and bear a normal child, and then again lapse into irregularity and fail to conceive a second time, a new course of X-Ray treatment may be administered one or two years after the first series. The following cases demonstrate this procedure:

Mrs. D. O., aged 23, was referred for irregularity and sterility on September 28, 1938. Menstruation began at 11, and occurred only once

or twice a year. Medication before and after marriage at 21, failed to improve the condition. X-Ray therapy was advised and administered in September-October, 1938. She menstruated, readily conceived and on August 7, 1939, gave birth to a normal girl. For one year following the birth of this child she menstruated regularly, then periods occurred irregularly at intervals of three to four months, the last in January 1944, and she failed to conceive. At the patient's earnest request, another X-Ray treatment was administered to the anterior pelvis and forehead, on January 9, 1945, but she failed to respond. The patient was very anxious to have another child and pleaded for further treatment. Not having previously treated a second time, I took this opportunity to try such a procedure. X-Ray therapy was administered in the customary three treatments to the pituitary and ovaries in April, 1945. She responded well, conceived immediately and on December 11, 1945, gave birth to a normal girl. Fig. 7.

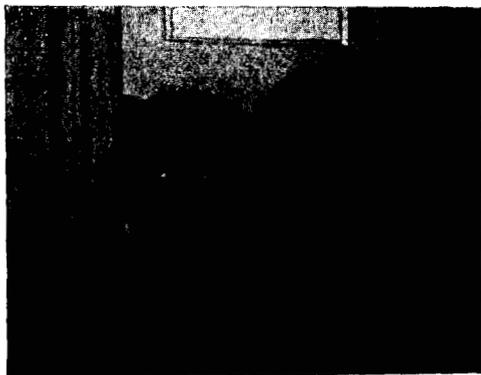


Fig. 7.

Mrs. D. O. 23. Sept. 28, 1938 Menstr. 11 but appeared once or twice a year. Medical care without result. Marr. at 21, no change. Further medical treat. given without result. Heavy build, much hair over limbs and pelvis. X-Ray treat. on Sept. 29, Oct. 6 & 13, 1938. Responded well, became pregnant, normal baby girl Aug. 7, 1939. Remained well, menstr. nor. for one year after birth, then became irreg. every 3-4 mos. last period in Nov. 1944. Jan. 9/45 she requested X-Ray treat. in order to have another child. Was loathe to give treat., but because patient anxious and Rubin test proved tubes patent, treat. was administered. One treat. given Jan. 9, 1945, no result. Treat. again given, in regular manner April 13, 20 & 27, 1945, responded and became pregnant. Normal baby girl on Dec. 11, 1945.

Photo 1952.

Treatment was repeated in another case as follows:

Mrs. J. S., aged 23, was referred for sterility on January 2, 1947. Menstruation had begun at 15, and then had not resumed for 6 months. Following medication, menstruation appeared but once a year. An appendectomy had been done in 1942, followed by menstruation for 3 months, then not again until 1944. She married in 1945 at age 21. She failed to menstruate and a curettage was done in April 1946. Only one period occurred in September 1946, and she failed to conceive. Biopsy showed anovular endometrium. Medication did not help and X-Ray therapy was advised and administered in January, 1947. Regular menstruation followed until she conceived in May 1947, and on February 14, 1948 gave birth to a normal girl. Menstruation occurred regularly for a time, then ceased in June 1949. A hemorrhoidectomy was done in October, 1949. The patient was anxious to have another child, but despite continued medication failed to conceive. X-Ray therapy was again requested and administered in December, 1950. She menstruated normally, and on January

11, 1952 gave birth to a normal girl. She continued to function normally and on May 13, 1954, gave birth to a third daughter. Fig. 8.



Fig. 8

Mrs. J.S. age 23 referred Jan. 2, 1947 for sterility. Menstr. at 13 then none for 6 mos. Had injections and thyroid—no menstr. for 1 year then 1 per year. July 1942 appendectomy. Menstr. 3 mos. then none till 1944. Married 1945 at age 21. Menstr. once 1946 had D&C April 1946—no menstruation, last period Sept. 1946 with injections. All other therapy no avail. X-Ray therapy Jan. 2, 9, 16, 1947. Feb. 1947 menstruated and regular until May 1947—pregnant and baby girl born Feb. 13, 1948. Menstruated regularly for 3 mos. none since June 1948. Hemorrhoidectomy Oct. 1949. Wished second child-med. no avail. X-Ray therapy again instituted Dec. 20, 27, 1950 and Jan. 3, 1951. Regular menstruation Feb., Mar. and April, pregnant. Baby girl born Jan. 11, 1952. Again functioned normally, conceived and third baby girl born May 13, 1954.

Photo: elder at age 7 years, 2 mos.
middle at age 3 years, 3 mos.
youngest at age 11½ mos.

The younger the patient the more readily the response to X-Ray therapy. Most of the successful results in my series were with patients under thirty. However, an older woman will often respond, and it is advisable to extend to her this opportunity. The following cases illustrate the successful treatment of women 35 and older:

Mrs. E. G., aged 37, was referred for sterility on March 30, 1951. The menarche had appeared at 13½ and periods were regular until she was 19. The last period had occurred in 1939, after a lapse of 12 years. She was married at 23 and had not conceived despite medication. Uterograms had been made and she was told she had an infantile uterus, and probably could not become pregnant. The biopsy showed an anovulat

endometrium. She then adopted a child in 1948 but still desired one of her own. As a last resort X-Ray therapy was suggested and administered in March, 1951. Regular menstruation followed, and she readily conceived and gave birth to a normal baby boy on March 2, 1953.

Mrs. E. G., aged 36, was referred for irregular menstruation and sterility on May 28, 1945. The menarche had appeared at 12, and periods had always been irregular. She married at 32, and was delivered of a male child by Caesarian section on May 25, 1944, and at the same time one tube and ovary was removed. The child died at the age of 11 weeks. The mother menstruated irregularly and failed to conceive. X-Ray therapy was administered to the left ovary, and the pituitary, in May-June 1945, and on March 26, 1947, she gave birth to a normal baby girl.

Mrs. B. P., aged 35, was referred for sterility on April 26, 1951. The menarche appeared at 14, and periods occurred at intervals of 9 to 12 months, the last in September, 1950. She had married at 31, had two periods, then none for one year. Treatments begun before marriage were continued without success. Endometrial biopsy showed anovular endometrium and X-Ray therapy was advised. This was administered in April-May, 1951, and on April 15, 1952 the patient gave birth to a normal boy, and on June 5, 1953, she bore a normal baby girl.

I have been requested a number of times to treat some single young women who hesitated to marry because of amenorrhoea, and had gotten no relief from other forms of therapy. Irradiation in such cases is quite proper and harmless, for if the amenorrhoea continues it does so despite the X-Ray treatment and not because of it. The following cases are illustrative:

Miss L. L., aged 21, was referred for amenorrhoea on May 13, 1929. The menarche appeared at 11, and periods were always irregular and painful, at about 3 month intervals, the last in June, 1928. Hormone therapy was ineffectual and X-Ray therapy was advised and administered to the pituitary and ovaries in May, 1929. This induced painless regular menstruation. The patient then married at 23 (Mrs. L. M.), continued to menstruate regularly, readily conceived, and on August 8, 1932, gave birth to a normal boy; on February 7, 1934 a second normal boy; and in September 1936 had an ectopic. Fig. 9.

Miss T. J., aged 22, was referred for amenorrhoea on August 4, 1942. Menstruation had started at 13, and was regular until age 19, when because of a nervous reaction at the death of her mother, menstruation ceased entirely. She slowly recovered and though she gained weight medication failed to relieve the amenorrhoea. X-Ray therapy was administered to the pituitary and ovaries in August, 1942. Regular normal menstruation followed, and on November 8, 1942 she was married (Mrs. S. G.)



Fig. 9.

SIMPLE AMENORRHEA. RESPONDED TO X-RAY THERAPY.

Married. Children. Miss L. L. Age 21. Single. Referred May 13, 1929, for irregular menstruation with dysmenorrhea. Menstr. at 11, always irregular, q. 3 mos., painful; endocrine therapy no avail. X-Ray therapy to ovaries and pituitary May 13, 20, 28, June 4, 1929. Responded, regular painless periods. Married 1931, Mrs. M. M. Continued regular. Conceived, baby boy born Aug. 4, 1932; baby boy born, Feb. 7, 1934 and ectopic Sept. 1936. Photo older, age 22; younger, age 20. Older son born 1932, now married, June 1954.

to a soldier, who was sent overseas and did not return until January 1945. During his absence she menstruated regularly, and after the husband's return readily conceived, and on November 2, 1945 gave birth to a normal girl. Fig. 10.

Although in most cases pregnancy followed irradiation, not all of these women carried successfully to term. In this series there were 67 women who miscarried after conceiving. Of these 40 again readily conceived and successfully bore one or more normal children. I have been unable to determine the cause of miscarriage following irradiation, except for those who had an accident. Kleegman suspects miscarriage may be related to conception too soon after irradiation. However, in this series, not a few women who conceived very soon after irradiation, successfully carried through their pregnancies. For example:

Mrs. S. W., aged 23, was referred for sterility on October 5, 1951. The menarche had appeared at 13, periods were irregular, at intervals of 2 to 12 months, the last in September, 1951, induced by medication. She had had medical treatment before and after marriage, at age 31½, without relief. Biopsy showed anovular endometrium. X-Ray therapy was administered in October, 1951. She evidently conceived rapidly, for on August 21, 1952 she gave birth to a normal boy. She continued to function normally and on July 15, 1954 bore a second normal boy.



Fig. 10

SINGLE THEN MARRIED

Miss T. J. aged 22, single, referred August 4, 1942 for amenorrhea. Menstr. at 13 reg. until 19. Nervous break-down got stouter, doctor gave injections, little relief. Last period February 1941. X-Ray therapy advised and administered to pituitary and ovaries. Aug. 4, 11, 18, 1942. Responded well. Periods regular. Married Nov. 8, 1942 (Mrs. S. G.) Husband in army, returned Jan. 1945, conceived. Baby girl born November 2, 1945.

Photo at age 5½ years.

Mrs. L. E. age 23 referred April 27, 1950 for sterility. Menstr. 12½ always irreg. Medication, injections, and pills, little benefit. Marr. at 21, no improvement. Medication continued. No menstr. since marriage. X-Ray therapy to pituitary and ovaries April 27, May 4, 11, 1950. Responded well. Menstr. Conceived. Baby girl born Mar. 9, 1951. Continued normal. Baby girl born Jan. 3, 1953.

Photo both at 4 mos.



Fig. 11

The following is the history of an infertile woman who failed to menstruate for 2 years after marriage and yet with X-Ray therapy readily conceived, and safely carried her pregnancy to term:

Mrs. L. E., aged 23, was referred for amenorrhoea and sterility on April 27, 1950. The menarche had appeared at 12½, and menstruation was irregular. Medication before and after marriage at age 21, was ineffectual. X-Ray therapy was administered in April-May 1950, regular menstruation followed, and on March 9, 1951, she gave birth to a normal girl, and on January 3, 1953, to another normal daughter. Fig. 11.

The following patient conceived right after irradiation, miscarried, later functioned normally again and bore a normal child.

Mrs. E. R., aged 27, was referred for amenorrhoea and sterility on September 18, 1946. The menarche had appeared at 13, menstruation was always irregular, the last on March 15, 1946. Medication not being effective, X-Ray therapy was administered in September-October, 1946. The patient immediately conceived but miscarried in February, 1947. She again became pregnant, and on September 10, 1948, gave birth to a normal girl.

The following cases are of interest because the patients repeatedly miscarried after irradiation:

Mrs. M. M., aged 27, was referred for sterility on May 21, 1951. The menarche had appeared at 15, but she menstruated but 4 times a year. Medical treatment gave no relief. She married at 21, and continued medication without improvement. Biopsy showed anovular endometrium. X-Ray therapy was administered in May-June, 1951. She conceived but miscarried at 2 months. She again conceived in August, 1951, but miscarried October 30, 1951. Normal menstruation was resumed, but the patient advisedly avoided conception until August, 1952. She carried through this pregnancy successfully to term and was delivered by Caesarian section of a normal baby girl on April 6, 1953.

Mrs. R. K., aged 32, was referred for sterility on June 11, 1953, after having repeatedly miscarried. The menarche had appeared at 11½, and periods were always irregular. Thyroid medication at age of 18-19 gave no relief. She was married at age 23 to a young soldier just before his departure for overseas service, and upon his return 2 years later she readily conceived, but spontaneously miscarried at 4 months, in January, 1950. In September, 1950, she again became pregnant and miscarried in January, 1951. She conceived again in November, 1951, but despite careful medical attention, miscarried in April, 1952. Psychiatric therapy was then given for the next year along with hormone and other medication. Periods were markedly irregular and she was not able to conceive. X-Ray therapy was then administered in June, 1953, normal menstruation followed, and she readily conceived and on October 17, 1954, gave birth to a normal boy.

I am unable to say what influence the length of the sterility period has on the response to irradiation. In my series quite a number of the women who sought treatment had been sterile for 5 or more years. The following are examples of successful treatment of sterility of long duration:

Mrs. L. M., aged 28, was referred for sterility of 5 years duration, on October 13, 1950. The menarche had appeared at 12, periods were always irregular, the last in March, 1950. She married at 23. She had had medical care for irregularity since youth without relief. Biopsy showed anovular endometrium. She failed to conceive and X-Ray therapy was administered in October, 1950. Menstruation became regular, and on

September 6, 1951, she gave birth to a normal boy, and on August 9, 1952, was delivered by Caesarian section, of a normal baby girl.

Mrs. L. S., aged 31, was referred for sterility of 9 years duration, on March 7, 1949. The menarche appeared at 14, menstruation was regular, and she married in 1940, at age 23. She failed to conceive despite medical care. Biopsy showed anovular endometrium. X-Ray therapy was administered in March, 1949. In January, 1951 she conceived but miscarried in April. She again conceived in December, 1951, and on September 19, 1952 gave birth to normal twin girls. Fig. 12.



Fig. 12

Mrs. L. S. aged 31 referred on March 7, 1949 for sterility. Menstr. at 14 R. Last Feb. 28, 1949. Marr. at 23. Husband in army 3 years. Did not conceive with med. treat. Biopsy anovulatory endometrium. X-Ray therapy to pituitary and ovaries March 7, 14, 21, 1949. Responded, preg., misc. April 1951, at 3 mos. Again normal, conceived Dec. 1951. Twin girls born Sept. 19, 1952.

Mrs. E. R., aged 33, was referred for sterility of 13 years duration, on January 24, 1951. The menarche had appeared at 13; periods were irregular. She had married at 20, and in spite of treatment had failed to conceive. X-Ray therapy was administered in January-February, 1951, and on April 3, 1945, she gave birth to a normal boy. She then purposely avoided conception with the use of contraceptives, because she and her husband were constantly travelling. In 1921 she settled down and readily conceived, and gave birth to a normal baby girl on November 13, 1952.

The following case is of unusual interest:

Mrs. I. K., aged 35, was referred for sterility on April 5, 1949. The menarche had occurred at 10¹/₂, with menstruation but once a year. Medication resulted in excessive hair growth on the face and body. She did not improve, and an adrenalectomy was performed in 1936. She failed to improve. She married at 32, and despite continued medication menstruated irregularly and failed to conceive. Her last period occurred on

March 13, 1949. X-Ray therapy was administered in April, 1949. She menstruated in May and June, 1949, conceived and on February 28, 1949, was delivered of a normal boy, and on August 31, 1953, of a normal girl. Fig. 13.



Fig. 13

1 PERIOD PER YR. ADRENAL SURGERY

Mrs. I. K. age 35 was referred on April 5, 1949 for sterility. Menstr. at 10½. Always irreg. One period per year. Medication in youth resulted in excessive hair growth on face and body. Adrenal surgery in 1936, no improvement. Marr. at 32, continued irregular and medication no relief. Last period Mar. 13, 1949. X-Ray therapy to pituitary and ovaries April 5, 12, 19, 1949. Responded, menstruated May, June 1949, then conceived and baby boy born Feb. 28, 1950. Continued normal and regular, conceived and baby girl born Aug. 31, 1953.

Photo boy at 19 mons. Girl at 10 weeks.

In a number of cases the patients were referred for irradiation following failure of fertilization by artificial insemination and continued medication. For example:

Mrs. P. G., aged 28, was referred for sterility on November 4, 1952. Menstruation had begun at 11, and was regular. She married at 21, and despite medication for 7 years, failed to conceive. Because the husband's sperm was found to be of poor quality, artificial insemination was tried. Both the husband's and a donor's sperm were used and after four attempts with this procedure had failed to bring on conception, X-Ray therapy was suggested. X-Ray therapy was administered in November, 1952. She menstruated and then readily conceived in the normal fashion with her husband. On October 13, 1953, she gave birth to a normal boy. Fig. 14.

Mrs. R. G., aged 29, was referred for sterility on April 23, 1951. Menstruation had begun at 13, and was irregular and painful, occurring at 2 to 3 month intervals. She married at 25, and for 3 months did not



INSEMINATION FAILURE

P. G. age 28 referred Nov. 4, 1952 for sterility. Menstr. at 11 regular. Marr. at 21, never conceived. Since 1948 persistent medical care. Husband sperm test poor. 4 times insemination also donor sperm-no result. X-Ray therapy Nov. 4, 11, 18, 1952. Responded well. Impregnated by husband. Baby boy born Oct. 13, 1953.

Photo at age 7 weeks.

Fig. 14

menstruate, then used contraceptives for 8 months. The last period occurred in December, 1950. Believing herself pregnant she had an A.Z. test which proved negative. She then wished to conceive and in spite of medication failed to become pregnant. Artificial insemination with the husband's sperm was tried several times, the last in January 1951, without success. X-Ray therapy was then advised and administered in April-May 1951. She conceived after normal relations with her husband, and on May 2, 1952, gave birth to a normal girl, conceived again and on August 13, 1954 bore a normal boy.

In the past thirty years, to July 1955, I have treated 750 married women for amenorrhoea and sterility. I have been able to trace only 575, of whom 322 have definitely become pregnant, some more than once, for a total of 519 pregnancies. These women have borne 407 children (200 boys and 207 girls). There were 6 ectopics, 69 miscarriages, 40 of whom later became pregnant and bore one or more normal children. There were 5 sets of twins. In this series there also were 2 stillbirths and three babies who died during delivery because their umbilical cords were knotted about their necks. Otherwise they were normal.

In my series only three of the progeny were abnormal, and of these only one could probably be attributed to the irradiation of the mother. That was a case reported by me⁸ in 1932, and in all probability this patient had inadvertently been irradiated while already pregnant. The Russels⁹ and Hicks¹⁰ noted that even if a small dose of X-Ray was administered to pregnant mice uteri, abnormalities in the offspring were likely to occur.

In another case, the woman bore an abnormal child two years after irradiation, and in another, the child had Hirschsprung's disease and died

after surgery. There have been no other abnormal children in my series of cases.

In 1954, Rustin McIntosh¹¹ and his co-workers reported that of 5,964 births observed by them at the Babies Hospital and the Sloane Hospital for Women, New York City, seven per cent of the babies were abnormal. This series, in which irradiation was not employed, compares very unfavourably with mine.

I am not in accord with Muller¹², who on the basis of his experiments with *Drosophila*, makes dire predictions of mutations in the progeny of irradiated human females. One cannot always deduce from animal experimentation the effects on human beings. No one as yet has exhibited an example of an abnormal child definitely proven to have resulted from the proper radiation treatment of an infertile female, in the human race. The type of damage that would be important to gene mutations, says Slatis¹³, "requires that two individuals descended from the same irradiated person shall marry and have children. Since our customs and laws forbid such incest, it will be at least another three generations before we have any families in this category". Evans¹⁴ states, "that from the experimental data now available, it seems safe enough to conclude that no detectable increase in hereditary abnormalities is likely to result, even after many generations, if a small fraction of the population receives radiation doses up to 0.1 roentgens per day". The dose used in my method of irradiation for the treatment of female sterility is never as large as that employed by Evans in his experimentation procedures.

Holmes¹⁵ studied the people of Hiroshima to determine the effects of the atom bomb explosion. In a recent public announcement, he said, "no genetic effects have been observed in the first generation of children born to persons exposed at Hiroshima and Nagasaki". This is in contradiction to Muller's many statements that it is in the first generation born of irradiated parents that the unfavourable mutations are most likely to appear.

Neel¹⁶ and his co-workers have also studied the effects of the atomic blast and have concluded that the mutation rate in man was probably the same as observed in the mouse. But they did not perceive any significant differences during the first year of life in children conceived following the bombing at Hiroshima, whether one or both parents were exposed to radiation, and children born subsequently to control parents. They further state that their investigation revealed no indication of any unusual sensitivity of human genes to irradiation. This was concluded, even though the exposure of these Japanese mothers was to a dose of irradiation tremendously higher than that used for the therapeutic alleviation of human female sterility.

Rubin¹⁷ says: "the long span of time between generations obviously makes it difficult to give an absolute answer to the theoretical question of the ultimate harmful genetic effect of irradiation on the human race, but the long interval between the births of a first and second generation would warrant the assumption that whatever the harmful effects may have been produced by the X-Ray irradiation to the ovaries of a grandmother, would have been dissipated over the years. No acquired lethal effects on the genes have been observed in hundreds of babies born following this treatment for the relief of infertility and menstruation".

I had to wait twenty years before I could report on a first grandchild of a woman treated for infertility by me. I am now fortunate in having traced 16 women of the first generation whose children married and have produced 24 grandchildren of their own, so far. In this group of grandchildren there are 14 boys and 10 girls, and of these there is one set of twins, boy and girl. The histories of these cases are as follows:

Mrs. C.A., aged 28, was referred for sterility on June 9, 1925. The menarche had appeared at 11, and periods were always irregular. She was married at 26, and did not improve or conceive. X-Ray therapy was suggested after other forms of treatment had proved unsuccessful. Irradiation was administered only to the ovaries in June 1925. On December 21, 1926, she gave birth to a girl, who matured normally, married in March, 1946, functioned normally, and on October 22, 1948, gave birth to a normal boy, and on October 13, 1950, bore a normal girl. The boy and girl are grandchildren of Mrs. C. A. Fig. 15.



Fig. 15

GRANDCHILDREN

Mrs. C. A. aged 28 referred June 9, 1925 for sterility. Menstr. at 11, irreg. Marr. at 26, continued irreg. with painful menstruation. Last period May 3, 1925. Medication not helpful. X-Ray therapy advised and administered June 9, 16, 30, 1925 to the ovaries. Regular menstr. without pain 9 months. conceived baby girl born Dec. 21, 1926. Girl developed normally, menstr. regularly since age 13. Marr. March 1946. Conceived baby boy (grandson of C.A.) born Oct. 22, 1948. Conceived again, baby girl (granddaughter of C.A.) born Oct. 13, 1950.

Photo boy age 7, girl age 5.

Mrs. H. B., aged 22, was referred for irregular and scanty menstruation and sterility on March 12, 1925. The menarche had appeared at 13-1/2, and periods were irregular and scanty. She was married at 21, and medication failed to improve her condition, and she did not conceive. X-Ray therapy was administered only to the ovaries in March, 1925. On January 16, 1926 she gave birth to a girl, and on October 25, 1928 to a



Fig. 16

Mrs. H. B. age 22, referred for irreg. menstr. and sterility, March 12, 1925. Menstr. at 13 1/2 irreg. marr. at 21. Conceived and misc. at 1 mo. Aug. 1924. Menstr. Oct. 1924 and Jan, 1925. None thereafter. Med. treat., no avail X-ray advised. Administered to ovaries alone. Mar. 12, 19, 1925, Menstr Apr. 1925, conceived baby girl born Jan. 16, 1926, baby boy born Oct. 25, 1928 Girl matured menstr. normally, marr. Mar. 1949 at 23, conceived baby boy (grandchild) born Aug. 30, 1950, second grandchild boy born Nov. 7, 1953.

Photo: Mother and child (grandchild at 11 mos.) Two grandchildren at 3 1/2 yrs. and 3 mos. Son born Oct. 25, 1928 married Mar. 4, 1954.

boy. These children matured normally. The girl was married in March, 1949, and on August 30, 1950, gave birth to a normal boy, and on November 7, 1953, another boy, and is again now (July 1955) pregnant. The two boys are grandchildren of Mrs. H. B. The son of Mrs. H. B. was married in March, 1954, and his wife gave birth to a normal girl on March 30, 1955, a granddaughter to Mrs. H. B. Figs. 16 & 17.

Mrs. B. C., aged 26, was referred on October 27, 1927 for sterility. The menarche had appeared at 12-1/2 and periods were always irregular. She married at 21, and, not functioning normally, was operated upon in 1925 without improvement, and she failed to conceive. X-Ray therapy was given to the ovaries alone in October-November, 1927. On November 28, 1928, she gave birth to a normal boy. This boy was married on May 28, 1953, and his wife gave birth to a baby girl, granddaughter of Mrs. B. C., on May 26, 1955.

Mrs. M. B., aged 24, was referred for irregular menstruation and sterility on October 10, 1927. The menarche had appeared at 16, and periods were always irregular. She married at 21, and failed to conceive despite medication. X-Ray therapy was administered only to the ovaries



Fig. 17

GRANDCHILD

Mrs. H. B. age 22, was referred for irreg. menstr. and sterility March 12, 1925. Menstr. at age 13½ always irreg. Marr. at age 21 Conceived and misc. at 1 mon. Aug. 1924. Menstr. Oct. 1924 Jan. 1925 and then not again in spite of med. treat. X-ray advised and administered to ovaries only March 12, 19, 1925. Menstr. April 1925 then conceived, baby girl born January 16, 1926. Again conceived baby boy born Oct. 25, 1928. Both children normal.

Boy matured married Mar. 4, 1954 and on March 30, 1955, wife bore baby girl granddaughter of Mrs. H.B.

Photo father, mother and daughter at age 2 months.

in October, 1927. On August 18, 1928, she gave birth to a normal girl. This girl married on November 22, 1950, functioned normally and on October 16, 1953 gave birth to a normal girl, granddaughter to Mrs. M. B. The daughter is again pregnant, July, 1955.

Mrs. F. C., aged 30, was referred for scanty menstruation and sterility, on October 14, 1927. She was the survivor of twin girls. The menarche had appeared at 14, and periods were regular but scanty. She married at 22, conceived, and in August, 1926, was delivered of a stillborn child. Despite medication she failed to conceive again, and X-Ray therapy was administered to the ovaries alone in October, 1927. She responded well, and on March 18, 1931, she was delivered by Caesarian section of a normal boy. This boy was married on January 6, 1951, and his wife gave birth to a normal boy on March 1, 1953, a grandson of Mrs. F. C. Fig. 18.

Mrs. G. G., aged 21, was referred for sterility on February 18, 1932. The menarche had appeared at 13, and periods were always irregular. Medication before and after marriage at 20 gave no improvement. X-Ray therapy was administered in February-March, 1932, to the pituitary and ovaries. On May 27, 1934 she gave birth to a normal girl; another girl



Fig. 18

Mrs. F. C. aged 30, stout, was referred for scanty menstruation and sterility on Oct. 14, 1927. She was the surviving one of twin girls. Menstr. at 14, regular. Marr. at 22 but did not conceive until late 1925. Aug. 1926 had instrumental delivery of a still born child. Irregular, scanty menstruation followed last Sept., 22 1927. Occasional flushes. Hormone and medical treatment no avail. X-ray therapy administered to ovaries only, Oct. 14, 21, 27, 1927, Responded well, conceived Baby boy (Caesarian) born March 18, 1931. Boy developed, married Jan. 6, 1951, wife conceived and on Mar. 1, 1953 bore a baby boy (grandchild of F.C.)

Photo Father 21, son (grandson) at 1 month.

on May 28, 1938; to a boy on June 3, 1947, who unfortunately was accidentally drowned at the age of 2. She gave birth to another boy on November 15, 1950. The oldest daughter matured normally and was married on October 25, 1953. She conceived in the Fall of 1954, and her child is expected in October, 1955.

Mrs. I. G., aged 30, was referred for sterility on September 19, 1926. The menarche had appeared at 12, and periods were regular until 1918, and then were very irregular, the last on May 16, 1926. She married at 23, and after 5 years of marriage conceived, but miscarried in September 1924. She failed to conceive again, despite medication, and X-Ray therapy was administered in September 1926, only to the ovaries. Normal menstruation followed and on November 10, 1927 she gave birth to twin girls. On September 14, 1930 she bore a normal boy. One of the twin girls married on October 27, 1951 and is now pregnant (August 1955). The son married in April, 1954, and the second daughter is engaged.

Mrs. S. E., aged 24; was referred for irregular menstruation and sterility on October 22, 1924. The menarche had appeared at 13, and periods were irregular. She was married at 21, and not conceiving, X-Ray therapy was administered in October-November, 1924. On October 15, 1925,

she gave birth to a normal boy, and on April 25, 1927, bore a second son. The oldest son was married at 27, on November 9, 1952, and on March 3, 1954, his wife gave birth to a normal boy, grandson of Mrs. S. E.

Mrs. L. K., aged 31, was referred for sterility on March 18, 1926. The menarche had appeared at 14, and periods were irregular. She married at 29, and failed to conceive despite many forms of treatment. X-Ray therapy was administered to the ovaries only, in March, 1926. On March 20, 1927, she gave birth to a normal boy, and another boy on June 28, 1929. She conceived again but miscarried in October, 1952. The oldest son was married on August 19, 1950, and his wife bore a son, on September 24, 1951, and another son on January 29, 1955, both grandsons of Mrs. L. K.

Mrs. J. L., aged 22, was referred for sterility on April 21, 1935. The menarche had appeared at 14, and periods were always irregular. She was married at 20, and despite medication did not conceive. X-Ray therapy was administered in April-May 1935. She bore four children, a girl on March 30, 1936; a girl on January 16, 1936; a girl on October 29, 1942; and a boy on July 31, 1947. The oldest girl was married on April 26, 1953, and on August 17, 1954 gave birth to a baby girl, granddaughter to Mrs. J. L.

Mrs. M. M., aged 24, was referred for sterility on February 22, 1927. The menarche had appeared at 12¹/₂, and periods were always irregular. She was married at age 21. A curettage and medication failed to improve her condition, and X-Ray therapy was administered to the pituitary and ovaries in February-March, 1927. On November 18, 1928, she gave birth to a normal boy; on August 28, 1930, to a girl; on August 8, 1934 to a girl; and on July 18, 1940 to a third daughter. The son was married in 1949, and his wife gave birth to a normal boy on May 10, 1950, and a girl on October 26, 1951, both grandchildren of Mrs. M. M. The oldest daughter was married on January 26, 1952, and on August 20, 1952, gave birth to twins, a boy and a girl, grandchildren of Mrs. M. M. The second daughter married in September 1952, but has so far avoided pregnancy. Figs. 19 & 20.

Mrs. M. Me., aged 25, was referred for irregularity and sterility on February 21, 1927. The menarche had appeared at 13, and periods were irregular. She was married at 21, and despite medication failed to conceive. X-Ray therapy was administered in February-March, 1927, and on January 31, 1931 gave birth to a baby girl. This daughter was married in November, 1951, and on September 8, 1952 gave birth to a normal boy, and on April 26, 1954, to a normal girl, both grandchildren of Mrs. M. Me.

Mrs. E. R., aged 22, was referred for sterility on October 10, 1928. The menarche had appeared at 12, and periods were irregular. She was married at 19, and despite medical care did not conceive. X-Ray therapy



Fig. 19

TWIN GRANDCHILDREN

Twin grandchildren of Mrs. M. M. treated in Feb. 1927 for sterility. Her daughter born Aug. 1930. Married Jan. 1952; gave birth to these twins Aug. 20, 1952 (premature delivery). Photo at 3 yrs. of age.



Fig. 20

Mrs. M. M. age 24, referred for sterility Feb. 22, 1927. Menstr. at 12½ never regular, 2-3 months. Marr. at 21. Courretage in 1925, medication, no relief. Last period March 1926. X-Ray therapy given. Feb. 22, 28, Mar. 7, 1927. Responded well. Baby boy born Nov. 18, 1928, baby girl born Aug. 28, 1930, baby girl born Aug. 8, 1934 and baby girl born July 18, 1940. Baby boy born Nov. 18, 1928, married in 1949, and wife gave birth to baby boy March 10, 1950, and second baby girl Oct. 26, 1951.

Photos of grandchildren (1) 21 months old (2) three months old.

was administered in October, 1928, and on August 30, 1929, she gave birth to a normal girl; on August 2, 1931, to a normal boy, and on February 4, 1936, to another girl. The first daughter married in September, 1951, conceived, and on September 23, 1952 gave birth to a normal boy, and on September 22, 1955, to a normal girl, both grandchildren of Mrs. E. R.

Mrs. M. R., aged 28, was referred for sterility on July 31, 1930. The menarche had appeared at 12, and periods were always irregular. She married at 22, and did not improve with medication or conceive. X-Ray therapy was administered in July-August 1930. On July 19, 1931, she gave birth to a baby boy, and on November 28, 1934 to a second boy. The older son was married on December 17, 1950, and on May 2, 1952 his wife bore a normal boy, grandson to Mrs. M. R. Fig. 21.

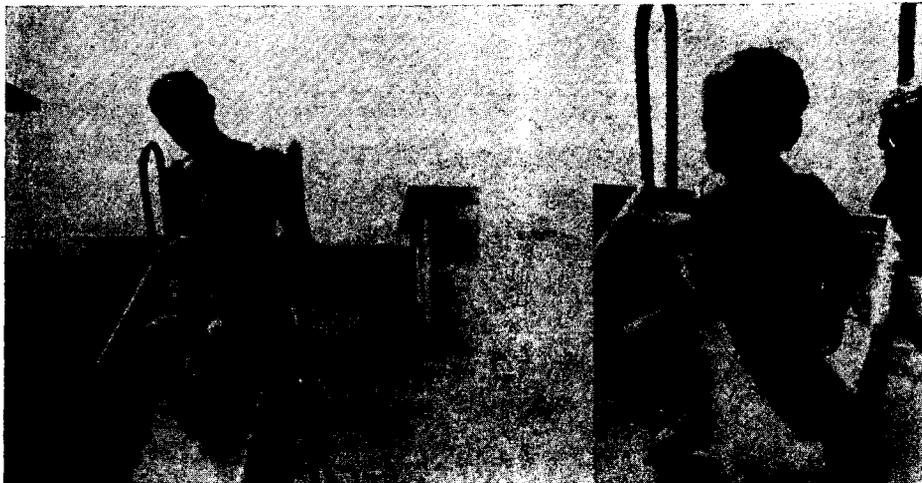


Fig. 21
GRANDCHILD

Mrs. M. R. aged 28, was referred July 31, 1930 for amenorrhea and sterility. Menstr. at 12, always irreg., q 3-4 mos. Marr. at 22. Last period few drops June 1930. Med. treat. cervix cauterized, no result. Short stout, no pregnancy. X-ray therapy advised, administered to pituitary and ovaries July 31, Aug. 7, 13, 1930. Responded well, periods regular last Oct. 10, 1930, conceived baby boy born July 17, 1931, and baby boy born Nov. 28, 1934. First baby boy served in army then married Dec. 17, 1950. Baby boy grandchild of M.R., born May 2, 1952.

Photo father age 24, child age 2 yrs.

Mrs. L. S., aged 33, was referred for sterility on January 13, 1925. The menarche had appeared at 18, one year after marriage. Periods were irregular and a curettage in 1925, and long periods of medication did not improve the condition and she had failed to conceive. X-Ray therapy was administered to the ovaries and the thyroid in January 1925. On March 19, 1926 she gave birth to a normal boy; on March 7, 1928, to a normal girl; and on April 13, 1930 to another boy. She again conceived but miscarried in February 1931. The oldest son was married in October,

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1951, but was divorced. He has married again. The daughter was married in November 1949, and on March 29, 1951, gave birth to a normal girl, and on October 29, 1952, to a normal boy, both grandchildren to Mrs. L. S. Fig. 22.



Fig. 22

Mrs. L. S. Age 33. Referred 1-13-25 for sterility. Menstr. 18, irregular. Married at 17 yrs. 11 mos. of age. No change. Curetted at 21. No menstruation occurred for one year. Last period Oct. 1924. Quite obese. Medication and thyroid no avail. X-ray therapy given to ovaries and thyroid Jan. 12, 21, 30, 1925. Menstruated regularly for 4 months. Became pregnant. Baby boy born Mar. 19, 1926. Baby girl born Mar. 7, 1928. Baby boy born April 13, 1930. Second child girl born Mar. 7, 1926. married Nov. 1949. Gave birth to baby girl (granddaughter) Mar. 29, 1951 and baby boy born Feb. 11, 1952. Photo bride at 21 and groom and baby girl at 31 months. Baby boy at 8 months of age.

Mrs. R. U., aged 28, was referred for irregularity and sterility on August 12, 1927. The menarche had appeared at 13, and periods were always irregular. She married at 20, and despite medication, and a curettage in 1925, failed to conceive. X-Ray therapy was administered in August, 1927, and on March 24, 1928 gave birth to a normal girl. This girl was married on November 22, 1952, and on June 5, 1954 gave birth to a normal boy, a grandson of Mrs. R. U.

I have records of several more children who have married, but who have as yet intentionally avoided pregnancy.

At the present time, September, 1955, I have recorded and have reported on 24 grandchildren born to children of irradiated mothers. In this group there are 14 boys and 10 girls, including twins, girl and boy. All of these third generation children are normal both physically and mentally.

As a result of more than thirty years' experience with the use of X-Ray therapy for the treatment of infertility and sterility in married women, I feel justified in stating that when X-Ray therapy is properly

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administered for amenorrhoea and sterility, it is harmless to the patient, her children, and her children's children. No one as yet has demonstrated genetic damage to progeny of women properly irradiated for sterility. Adverse pronouncements are based on animal, chiefly insect, experimentation, which cannot always be translated into human experiences.

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