RADIUM IN INTERNAL MEDICINE

ITS PHYSIOLOGIC AND PHARMACOLOGIC EFFECTS *

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Considerable has already been learned concerning the effects exerted by radium in its many forms on various physiologic and pathologic processes and conditions. Sufficient data, however, are not at hand to make this chapter in any way complete. Much more evidence is necessary before the findings of certain investigators can be considered properly established, while in other directions entire spheres of its influence are probably overlooked in our at present early acquaintance with radium and its activity. The briefest outline of the theories, facts and data as they appear in the literature relating to radium in internal medicine are here presented.

Uric Acid Metabolism.—Gudzent asserts that the lactim form of monosodium urate (the form present in gout) is converted *in vitro* by radium into the more soluble tautomeric or isomeric lactam form which in turn is broken up into ammonia and carbon dioxid. Neither Lazarus nor Wiechowski was able to substantiate this, Lazarus holding that Gudzent's results were dependent on infection of his solution with fungi (*Schimmel Pilze*).

The consensus of opinion is that the use of radium is attended with an increased urinary uric acid output and that disappearance of deposits (tophi or artificial deposits) is hastened. Uric acid disappears from the blood under radium treatment and appropriate diet, and its disappearance is frequently associated with subjective improvement. Grave doubt still exists, however, as to the mechanism whereby the undoubted therapeutic results in gout are accomplished.

Vasomotor Changes.—Loewy and Plesch have shown that the majority of patients treated in the emanatorium show a decrease in maximal blood-pressure which may be as great as from 20 to 25 mm. Hg. Decrease in minimal and mean pressures are usually associated, and the heart work is decreased. The decreased blood-pressure is ascribed, however, primarily to vascular changes. The sleep-inducing influence of emanatorium treatment first described by Furstenberg, is ascribed by Loewy to cerebral vasomotor changes.

Effect on Blood-Pictures.—A temporary fall in the number of red cells was encountered by Noorden and Falta, but an outspoken increase which may last over weeks is described by Zehner and Brill.

A temporary but considerable leukocytosis occurs after the first sitting in the emanatorium, the mononuclears being relatively increased, while long-continued treatment leads to leukopenia. In acute febrile diseases associated with leukocytosis, an increase in the white cells is sometimes encountered, but a decrease is more frequent. In leukemia long-continued use of radium has failed to decrease materially the number of white cells.

General Metabolism.—The work of Silbergleit and of Kikoji, using the Zuntz-Geppert apparatus, indicates that radium has a definite and outspoken effect in increasing the volume of air breathed, the oxygen consumed and carbon dioxid expired, and in raising the respiratory quotient, and hence that it increases total metabolism. Loewy and Plesch failed to find these results, but they worked on only one case.

Blood Coagulation.—Von de Veldon asserts that radium emanation administered in any way exerts a definite accelerating influence on the coagulation of blood. Hoffmann corroborates this.

Effect of Radium on Ferment Activity.—It is asserted that an activating influence is exerted on pepsin (Bergell and Beckel), on pancreatin (Braunstein and Bergell), on rennin (Richet), on autolytic ferments (Neuberg, Wohlgemuth, Lowenthal and Edelstein) and on tyrosinase (Wilcox). An almost constant accelerating influence on diastase was noted by Lowenthal and Wohlgemuth. Occasionally, however, a retarding influence was encountered at first.

The evidence of definite activation in all instances is not convincing, and an investigation of its influence on lipase, now being carried out by Marshall and Rowntree, shows no appreciable acceleration.

Other Influences of Minor Importance.—Sweating frequently occurs at the time of the emanatorium treatment and continues throughout the following night (Noorden and Falta). The agglutinins to *Bacillus typhosus* and *B. cholerae Asiaticae* were increased, according to Schutze, in animals injected with radium water, in from five to six hours after vaccination. No hemolyzing influence has been described.

Absorption and Excretion of Radium.—Radium emanation administered by inhalation is rapidly carried to all parts of the body and rapidly reaches the concentration in the blood that it has in the air of the emanatorium. It is rapidly excreted by way of the lungs, Kemen finding none in the blood fifteen minutes after the cessation of treatment. Given by mouth it is quickly absorbed by the mucous membrane of the gastro-intestinal tract, passed into the blood, distributed to all parts of the body and is excreted rapidly (in from two and one-half to three hours) by the lungs chiefly, only traces escaping in the urine.

The soluble salts of radium are rapidly excreted (four hours), no matter how administered. Injected subcutaneously, they escape (from 60 to 70 per cent.) through the intestines, smaller amounts (10 per cent.) appearing in the urine. The insoluble salts of radium pass through the intestinal canal, not being absorbed at all. Injected they remain at the seat of injection and give off small amounts of radio-activity constantly, the feces becoming radio-active.

METHODS OF ADMINISTRATION AND DOSAGE OF RADIUM EMANATION

As the Bath.—This is the original method since patients for centuries have been "taking the baths" at spas and watering-places. The degree of radio-activity varies in different spas, in the Joachim Valley 600 Mache units, at Carlsbad 90, and at Wiesbaden 10 Mache units per liter, and these all produce results. It is doubtful whether or not radium emanation can penetrate the skin—the good effects are usually considered to result from the inhalation of radium emanation as it constantly escapes from the surface of the water.

As Injection.—Emanation water containing from 500 to 1,000 Mache units to the cubic centimeter is utilized in Noorden's clinic, being injected subcutaneously or

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* A more detailed account of radium, its effects and its value, will be found in separate articles by the authors of this paper in an early number of the Johns Hopkins Hospital Bulletin.

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intramuscularly in the neighborhood of an involved joint once or twice a week for from ten to twelve injections. No injurious local effects result. This is usually used in conjunction with either the drink cure or emanatorium sittings, and is a valuable addition to treatment.

As Local Applications—Compresses, Fango Baths.—Lowenthal and Gudzent do not believe that radium emanation can pass through the skin, while Lazarus and Engelmann believe that it can. All admit that the beta and gamma rays of its decomposition products can penetrate the skin. Cotton compresses soaked in radioactive water (from 15,000 to 30,000 Mache units) are commonly used. The fango bath or *Umschlag* is an example of this form of treatment since fango is now known to be radio-active. Local applications should be used in conjunction with general treatment.

As a Drink Cure.—Radium emanation in solution is administered by mouth by varying and increasing doses (330, 1,000, 2,500, 5,000, 10,000 Mache units), repeated three times a day. Lazarus has introduced a sipping cure in which small amounts of radium emanation are drunk many times during the day, thus keeping a certain amount of the emanation constantly present in the body. This method is well adapted for general use.

As Inhalations.—This is the best but also the most expensive method of administration. An emanatorium is used—an air-tight room or cabinet in which the patients are confined and into which radium emanation is introduced, the size depending on the number of patients to be treated (six patients require from 25 to 30 cubic meters of air). The emanatorium is so equipped that the air is kept cool, and the excess of moisture and carbon dioxid removed. The desired number of patients are treated for two hours each day and the treatment repeated every day for weeks or months. The concentration of radium emanation in the contained air varies from 2 to 4 (His) to from 20 to 600 Mache units (average 22) per liter (Noorden). Masks have been introduced in an attempt to do away with the expensive emanatorium.

Reactions in the Course of Treatment.—Often during the first week or two of treatment, sometimes even after the first treatment, an outspoken increase in the subjective and objective manifestations of the disease occurs. This reaction lasts only from a day or two to a week and does not necessitate cessation of treatment. Reduction of dosage, however, may be advisable at times. Its occurrence early in the treatment of rheumatism is a good omen, since these cases usually do better than those not exhibiting the phenomenon. It is occasionally seen also in the treatment of gout but does not carry the same significance here.

Contra-Indications.—Certain authors have warned against the use of radium salts under certain conditions, hemorrhagic diathesis and purpura (Benczur), gastric ulcer (Eichholz), pregnancy (Eichholz), marked neuroses, especially when the vegetative system is involved Norden and Falta), advanced tuberculosis (?) and polycythemia (?). Nephritis was at first considered a contra-indication but cannot now be so considered (Gudzent, Furstenberg).

Indications.—The value of radium is unquestionably established in chronic and subacute arthritis of all kinds (luetic and tuberculous excepted), acute, subacute and chronic joint and muscular rheumatism (so-called), in gout, sciatica, neuralgia, polyneuritis, lumbago and the lancinating pain of tabes. In certain other conditions it is said to be of some value, although more data are necessary before this can be accepted—chronic bronchitis, chronic pharyngitis, pneumonia, myocarditis, arteriosclerosis, vasomotor disturbances, Raynaud's disease, scleroderma, idiopathic enlargement of the lymph-nodes and in chronic constipation.

CLINICAL RESULTS OBTAINED

An effort is here made to classify and bring together the results of all of the cases reported up to August, 1912. In many instances these figures are taken from tables submitted by individual authors, while in others the number of cases together with attempt to estimate the value of the treatment was made from case reports.

Chronic Arthritis and Chronic Rheumatism.—The methods of classifying these cases were so different with different authors that it was considered advisable not to attempt classification but to bring them together under this heading. All grades of severity are included. Great variation as to dosage and methods of administration and duration of treatment existed. No attempt to differentiate these cases is made but it may be stated that, as a rule, the earlier the treatment was begun and the less severe the anatomic changes, the more outspoken was the improvement.

The results in 471 cases as described by twenty-three authors are shown in Table 1. Some improvement was found in 371 cases (78.7 per cent.).

In certain instances arthritis deformans and muscular rheumatism were considered separately, and these are brought together in separate tables and are not considered in Table 1.

TABLE 1.—RESULTS OF RADIUM TREATMENT IN 471 CASES OF CHRONIC RHEUMATISM OR CHRONIC POLYARTHRITIS

Authors	Cases Treated	Improved	Markedly Improved	Practically Cured	No Change	Worse	Undetermined	Dosage
His	100	47	29	5	13	..	6	Small
Falta and Freund	46	8	21	2	15	2	..	Large
Hoffmann	12	..	8	..	..	..	..	.....
Furstenberg	26	6	..	9	11	..	..	.....
Mendel	3	..	..	3	..	..	..	.....
Benczur	18	11	..	5	..	..	..	.....
Laska	4	..	3	..	1	..	..	.....
Kemen	40	14	..	18	8	..	..	.....
Haupt	3	2	..	1	..	..	..	.....
Davidsohn	58	14	..	33	9	2	..	.....
Stern	19	..	16	..	3	..	..	.....
Nagelschmidt	7	..	7	..	..	..	..	.....
Strasser and Selka	8	2	1	4	1	..	..	.....
Frankel	1	..	..	1	..	..	..	.....
Lowenthal	4	1	..	..	..	..	..	.....
Sommer	16	9	..	5	2	..	..	.....
Warburg	6	..	6	..	..	..	..	.....
Strassburger	22	10	7	..	5	..	..	.....
Glaessgen	10	..	..	8	2	..	..	.....
Mayer	18	8	..	5	5	..	..	.....
Jansen	4	2	..	1	1	..	..	.....
Benedikt	44	..	37	..	..	..	..	.....
Kahle	2	..	..	2	..	..	..	.....

Arthritis Deformans.—The results in twenty-four cases (Table 2) reported by seven authors show improvement in sixteen. Objective as well as subjective betterment was noted at times.

Muscular Rheumatism.—Acute, subacute and chronic conditions are considered in Table 3. Twenty-seven of forty-nine cases treated by ten authors showed improvement. Many of these cases of chronic arthritis had failed to respond to previous treatment by other methods. The treatment was continuous in some instances over periods of months.

Gout.—According to Gudzent and Brugsch gout is not always easy of recognition. Clinically a study of the uric acid content of the blood should always be

made. In health, following five or six days of purin-free diet the blood no longer contains uric acid, whereas in gout the uric acid does not disappear as demonstrated by Gudzent and Apolant's test. Certain cases clinically called chronic arthritis show the same phenomenon, and according to Brugsch are gouty cases though not ordinarily diagnosed as such. Under radium treatment the blood of gouty patients on a purin-poor diet as a rule rapidly becomes free from uric acid. The symptomatic condition improves in association with decrease in blood uric acid according to Gudzent, but is independent of it according to Mendel.

TABLE 2.—RESULTS OF RADIUM TREATMENT IN 24 CASES OF ARTHRITIS DEFORMANS

Authors	Cases Treated	Improved	Practically Cured	No Better
Nagelschmidt	1	..	..	1
Strasser and Selka	3	3	..	..
Noorden and Falta	2	2	..	..
Mendel	1	1	..	..
Kemen	10	6	1	3
Sommer	5	3	..	2
Strassburger	2	..	..	2

TABLE 3.—RESULTS OF RADIUM TREATMENT OF CHRONIC MUSCULAR RHEUMATISM

Authors	Cases Treated	Improved	Markedly Improved	Practically Cured	No Better	Acute	
						Cases Treated	No Better
Sommer	8	5	..	2	1	2	2
Furstenberg	1	..	..	1	..	..	..
Hoffmann	1	..	..	1	..	..	..
Kemen	5	2	..	3	..	..	..
Frankel	1	..	..	1	..	..	..
Davidsohn	32	9	..	19	..	..	..
Strassburger	7	1	4	..	2	..	..
Kable	1	..	1	..	..	..	..
Warburg	..	..	..	..	..	1	1

TABLE 4.—RESULTS OF RADIUM TREATMENT OF GOUT

Authors	Cases Treated	Improved	Markedly Improved	Practically Cured	No Change	Worse
His	28	..	24	..	4	..
Gudzent	50*	..	..	..	..	..
Furstenberg	4	..	4	..	..	..
Kemen	25	11	..	7	7	..
Hoffmann	5	..	5	..	..	..
Mendel	3	..	3	..	..	..
Benczur	1	..	1	..	..	..
Sommer	1	1	..	..	..	..
Strasser and Selka	1	11	1	..	..	..
Warburg	22	..	17	..	5	..
Strassburger	12	11	1	..	..	..
Jansen	11	1	8	..	..	..
Kable	2	..	..	2	..	..

* In thirty-seven uric acid disappeared from blood.

In 106 cases by twelve authors eighty-six patients (81 per cent.) are reported as improved, markedly improved or cured. Some of His' patients have been free from symptoms for as long as one year following the last treatment. Joint uric acid deposits and tophi are said to disappear under treatment.

Neuralgia, Sciatica, Lumbago, Neuritis and Polyneuritis.—A large series of cases falling into this group are found in the literature, some clearly, others very poorly, defined. An effort has been made to group them.

Neuralgia, including tic douloureux (Table 5): Of fifty-nine cases treated by fourteen authors forty-seven were improved, and twenty-five practically cured. Tic douloureux usually resisted treatment.

TABLE 5.—RESULTS OF RADIUM TREATMENT IN NEURALGIA

Authors	Cases	Improved	Markedly Improved	Practically Cured	No Better
Furstenberg	2	..	..	2	..
Falta and Freund	4	3	..	1	..
Noorden and Falta	2	..	..	..	..
Mendel	1	..	..	..	1
Benczur	1	..	..	..	1
Sommer	6	3	..	2	1
Neumann	4	2	1	1	..
Stern	5	1	3	..	1
Nagelschmidt	1	..	..	1	..
Neusser	1	1	..	..	..
Glaessgen	5	..	..	5	..
Mayer	21	9	..	7	5
Jansen	2	..	..	..	2
Kable	4	..	..	4	..

Sciatica: The treatment of 115 cases (Table 6) by eighteen different workers resulted in benefit to ninety-one patients (79 per cent.). Some of the cases were of long standing.

TABLE 6.—RESULTS OF RADIUM TREATMENT IN SCIATICA

Authors	Cases Treated	Improved	Markedly Improved	Practically Cured	No Change	Worse	No Return
Falta and Freund	14	..	9	3	2	..	..
Furstenberg	9	1	..	2	6	..	..
Mendel	1	1	..	..	..	..	..
Benczur	6	..	2	..	..	..	..
Kemen	25	8	..	12	5	..	..
Haupt	1	..	..	1	..	..	..
Davidsohn	15	2	..	11	..	1	1
Sommer	2	1	..	1	..	..	..
Neumann	1	1	..	..	..	..	..
Stern	3	..	2	1	..	..	..
Strasser and Selka	8	2	..	5	1	..	..
Frankel	1	..	1	..	..	..	..
Lowenthal	1	..	..	1	..	..	..
Strassburger	8	3	1	..	4	..	..
Glaessgen	8	..	..	7	1	..	..
Jansen	7	1	4	..	..	..	..
Benedikt	9	..	7	..	..	..	..
Kable	1	..	1	..	..	..	..

Lumbago: Five cases are reported by as many authors, considerable benefit occurring in all but one instance.

Polyneuritis: Six cases were treated and benefited by Noorden and Falta and one each by Benczur and Kemen. Sommer and Nagelschmidt saw benefit, each in one case of neuritis, but Strassburger saw none in his three cases.

To recapitulate, 152 cases or 79 per cent. of the 192 cases coming under this heading were benefited by radium treatment.

Tabes Dorsalis.—The lancinating pains were relieved in a large proportion of cases, only temporarily (weeks) in most instances, but over longer periods in some cases. Table 7 shows forty-four cases from six sources in which the pain was alleviated in twenty-six.

TABLE 7.—RESULTS OF RADIUM TREATMENT IN TABES

Authors	Cases	Relief of Pain	No Change
Falta and Freund	16	5	10
Benczur	14	11	2
Kemen	5	3	2
Stern	3	1	..
Strasser and Selka	4	4	..
Warburg	2	2	..
	44	26	14

Miscellaneous Diseases in Which the Few Results Recorded Indicate Some Possible Value.—These cases are brought together in Table 8; 163 of the 186 cases treated exhibited some signs of improvement.

TABLE 8.—RESULTS OF RADIUM TREATMENT IN MISCELLANEOUS CASES

Disease	Observer	Number of Cases	Improved	Markedly Improved
Respiratory—				
Chronic bronchitis	Bulling	67	56	11
	Sommer	1	1	..
Asthma	Bulling	6	6?	..
	Falta and Freund	7	..	..
Pneumonia	Falta and Freund	3	3	..
Chronic rhinitis and pharyngitis	Bulling	27	..	19
Bronchiectasis	Strasser and Selka	1	1	..
Circulatory—				
Coronary sclerosis	Falta and Freund	3	2	..
Chronic myocarditis	Sommer	5	4	..
	Kemen	10	7	..
	Glaessgen	8	..	8
Raynaud's disease	Mendel	1	1	..
Cardiac neurosis	.....	5	5	..
Neurotic vasomotor disturbances	.....	3	3	..
Arteriosclerosis		10	10	..
Nervous System—				
Headache	Neumann	1	1	..
Migraine	Neumann	1	1	..
Apoplexy	Kemen	3	3	..
Miscellaneous—				
Acute rheumatism	Falta and Freund	10	..	8
	Benczur	4	4	..
	Haupt	1	..	1
Subacute rheumatism	Falta and Freund	3	2	..
Scleroderma	Benczur	3	1	2
	Kemen	1	1	..
Enlargement of lymph-nodes	Mendel	1	1	..
	Haupt	1	1	..

The collected results of treatment in these various groups of diseases are brought together in Table 9, from which it will be seen that in 837, or over 80 per cent. of the 1,038 cases, benefit was derived from radium treatment.

TABLE 9.—SUMMARY OF RESULTS OF RADIUM TREATMENT IN VARIOUS GROUPS STUDIED

	Diseases	No. of Cases	Improved
1.	Chronic arthritis	411	371
	Arthritis deformans	24	16
	Muscular rheumatism	59	49
2.	Gout	100	86
3.	Neuralgia	59	47
4.	Sciatica	115	91
	Lumbago	5	4
	Polyneuritis	8	8
	Neuritis	5	2
5.	Miscellaneous	186	163
		1,038	837

Gudzent, His, Furstenberg, Sommer and Klemperer speak in glowing terms of its value. The introduction of emanatoriums in a large number of the German spas as well as the establishment of a radium institute in Berlin for the treatment of medical cases express confidence in it on the part of the profession abroad.

It should be emphasized that the foregoing statements are based entirely on the results published by various foreign observers and not on the cases treated by us. Our experience has as yet been confined to too small a series of cases to permit of any special deductions. Furthermore, the cases treated have all been of a most unfavorable nature, since we have not felt that the results as published in the literature justified the exclusive use of radium therapy except in those cases which had been given the benefit of all other forms of treatment without improvement.

We must state frankly that the results in our small series of cases comprising only eighteen patients have not been gratifying. The brevity of this paper does not justify us in taking the space necessary for a detailed report of the individual cases; but briefly summarized, our results have been as follows: Our patients were treated entirely by the drinking method with water activated with radium emanation. They were under observation for periods varying from two weeks to three months and were given daily doses of from one-half to forty microcuries. Our series included the following diseases:

Five cases of arthritis deformans of the infectious type. (Of these three showed a diminution of pain and stiffness which for about one month was quite marked. Later the symptoms returned though not with the same severity as before.)

Five cases of muscular rheumatism and neuralgia, conforming somewhat to the group of polyneuralgias of von Noorden and Falta. (One of these patients was apparently cured; another was temporarily benefited, while the others were not affected.)

Three cases of tabes in which there was no recognizable change in the frequency or severity of the lightning pains. (It should be added that these patients were treated over a period of only two weeks and with doses which never exceeded two microcuries.)

One case of acute rheumatic fever (without benefit).

One case of sciatica (without benefit).

One case of Parkinson's disease (with temporary but definite lessening of the stiffness).

One case of chronic nephritis and high blood-pressure (with a lasting diminution of the pressure from over 200 mm. to about 180 mm., with marked improvement in the subjective symptoms).

One case of gout in which the treatment was followed by a severe exacerbation in all of the affected joints.

The most favorable results have been in the cases of arthritis deformans of the infectious type in which three out of the five patients showed some slight but definite improvement.

We make no attempt to draw any conclusions as to the efficacy of this form of therapy from our small number of cases, but feel that any form of medication which has yielded the results reported by the European writers should be the subject of a much more exhaustive test, until its real value can be definitely established and its limitations rationally outlined.

It is with great pleasure that we take this opportunity to thank Dr. Hugh H. Young for the radium used in this work, and also Drs. Howard A. Kelly and Curtis F. Burnam for their kindness in allowing us the use of apparatus which we have as yet been unable to procure.

ABSTRACT OF DISCUSSION

DR. R. ROBINSON, Danielson, Conn.: I have had but little experience in the use of radium, but a good deal of experience in its effect on my own wife. She was the subject of arthritis deformans and after being on crutches for nearly a year was practically cured by the use of radium and the hot electric-light bath, the electric-light bath being followed by the radium treatment. She drank the radium three times a day in solution and inhaled it once a day, combined with oxygen gas. The result was somewhat marvelous—one joint, which had been absolutely immovable for weeks, was easily movable as usual after the radium treatment. One knee which compelled her to be on crutches for six months and incapacitated for more than a year is practically so well cured that she is with me in the city and traveling anywhere from one to three miles with perfect ease.

DR. WILLIAM H. MERCUR, Pittsburgh: Those interested in radium therapy might possibly like to know something of the excellent clinical experimental work now being carried on in Pittsburgh by Dr. William H. Cameron. This work is being done under the auspices of a company whose business it is to extract radium on a very large scale. So far he has treated over one hundred and twenty-five cases. The cases treated are largely joint cases.

DR. CHARLES STEWART, Salt Lake City, Utah: For those whose pocketbooks do not allow them to buy radium I would call attention to pitchblende. An old mining man in the mountains of Colorado whom I know and who is very familiar with Denver told me that he picked up a nugget and put it in his pocket; he forgot it for a time and it burnt him. The nugget had radium in it and for a time the burn refused all the efforts of the local men to make it heal. That attracted my attention to the fact that pitchblende that does produce a burn might do some good. I have had cases which were benefited by the use of these pitchblendes.

DR. W. H. WITT, Nashville, Tenn.: The chief value of this paper is not that it encourages or discourages the use of radium in internal diseases, but that it represents an honest and painstaking effort at clinics in which they have all resources for working out the question as to whether or not it really does any good. I believe the main interest to us in this report is that the work has been done where we know good work is done and where we can be really guided by the results they get.

RUPTURE OF A MEDIASTINAL LYMPH-NODE INTO THE BRONCHUS *

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History.—G. S., aged 5, was admitted from the German Hospital Dispensary to the A. Jacobi Department for Children, Nov. 25, 1912, with a diagnosis of pus in the urine. The child had been in remarkably good health; the birth was normal; the baby was breast-fed for two years. Until the present illness life was uneventful; the child had no acute or chronic illness, no coughing or expectoration, and no gastro-intestinal complaint. No tuberculosis is present in the family of the father or mother. The mother had no miscarriages. The two living children are in perfect health. Four months before, the mother noticed mucus in the urine, and the child complained that urination was painful. He cried when urinating, but there was no increased pain at the end of urination; neither was there increased frequency. A few weeks before the mother noted a slight trace of blood in the urine.

Physical Examination.—The patient is a well-nourished little boy; pupils are equal and react to light; no swelling under the eyes. The cervical, axillary and inguinal lymph-nodes are normal. The tonsils are hypertrophied; the throat otherwise is negative. The heart percusses within normal limits; the sounds are clear; no murmurs are heard. Percussion and breathing-sounds show the lungs to be in normal condition. There is no tenderness over the suprapubic region, over the region of the kidneys or over other parts of the abdomen. Percussion of the liver shows that it extends nearly to the costal border; the edge is not felt. The percussion note over the spleen is normal. There is no tenderness of the region of the kidneys; neither kidney can be felt. Both testicles have descended and are normal. The extremities are in normal condition; knee-jerks are present; there is no edema.

Laboratory Reports.—The urinalysis showed a faint trace of albumin. The urine was yellow and turbid, with a white mucoid sediment. The centrifuge specimen showed few blood-cells, many leukocytes, and few triple phosphates; no tubercle bacilli were found, but the culture showed a growth of colon bacilli.

Examination of the blood showed conditions normal. Cystoscopy revealed ulceration on the right side, near the trigon. Trabeculae were seen in several places over the bladder wall; the meatus of the right ureter was enlarged and reddened; the urine from the ureter seemed to be clear. Dr. Rehling, who did the cystoscopy, thought that the ulcerations were not of a tuberculous nature, and no definite diagnosis was made. Roentgenoscopy of the genito-urinary tract on both sides did not reveal the presence of nephrolithiasis or other abnormality.

Treatment and Course.—Treatment consisted of regulating the diet and giving small doses of hexamethylenamin (urotropin) three times daily. With rest in bed, the urine became clearer from day to day and the boy was apparently doing well. On the night of December 5, eleven days after his admission to the hospital, he was put to sleep with the other children in the ward after having partaken of the usual evening meal, feeling perfectly well and in good spirits. About 11 o'clock at night the nurse, on going from bed to bed, noticed that the child was somewhat blue and was breathing heavily, and, on trying to arouse him, found that he was unconscious. She at once notified the house surgeon, who came to the bedside finding the child with flushed face, dilated pupils and rapid breathing. It was first thought that the child was suffering from some drug poison, possibly belladonna. I was summoned to the hospital and found the child cyanotic, pupils dilated, head thrown back, arms drawn up, legs spastic, big toes dorsally flexed, and knee-jerks exaggerated. Drug intoxication was excluded.

The stomach was lavaged; small flakes of food particles were returned, and lavage was continued until the water returned clear. The bowels were thoroughly irrigated; a lumbar puncture was made, and the fluid returned under slight pressure. A tentative diagnosis of tuberculous meningitis was made; the head was elevated, an ice-bag was applied, and the child was given 2½ grains of calomel. I returned home and the house staff went to bed. About three hours later the house surgeon was again summoned hurriedly to the bedside of the boy and found him apparently in collapse and lifeless. The face was almost black. Artificial respiration was resorted to but with no result. Intubation was then performed, which was also without result. Then a tracheotomy was done, but the child did not respond on the introduction of the tracheotomy tube. A catheter was introduced through the tracheotomy tube into the trachea, but without effect. Then the insufflation apparatus was connected with the end of the catheter and, when the catheter was moved back and forth, suddenly from half an ounce to an ounce of a thick cheesy mass exuded from the tracheotomy tube, between it and the catheter. On the expulsion of this thick mass the child began to breathe more freely, the lips reddened and the cyanosis disappeared. Although the general appearance of the child was greatly improved, he remained unconscious for four or five hours longer, when consciousness gradually returned.

During the next twenty-four hours his condition remained about the same, except that he occasionally dropped into a stupor-sleep. During the first day after the tracheotomy he vomited twice, the vomitus consisting of some undigested and

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