and phonation fairly good, though her voice was very uncertain in quality and pitch, and changed with disconcerting suddenness. It was observed that if annoyed she spoke with a strong gruff voice, but under examination began to whisper again. On this date the patient was given a general anaesthetic and Killian's laryngoscope was used. The direct view of the cord confirmed the above findings. An attempt was then made by means of a curved and insulated electrode, which was passed into the pharynx, to cause contraction of the crico-arytenoides posticus muscles, but no abduction of the cords occurred. The only movement observed was a very vigorous adduction of the cords. The adduction movement is the stronger movement, and may have overwhelmed the weaker contractions of the abductors if this occurred.

Under deep anaesthesia a paradoxical movement of the vocal cords (inspiration adduction) was observed. This also has been seen in monkeys after this anastomosis has been done. The abductor muscles are very sensitive to deep anaesthesia. A second attempt, a month later (April 9th), to cause contraction of the abductor muscles by direct faradic stimulation was made, but the result was as before. Strong adduction of the cords was alone seen.

On May 21st, 1927, the right cord was as before, with about one-third of the normal abduction, but the left cord was obviously retrogressing; adduction was still strong, but there was no evidence of abduction beyond the rebound.

On June 8th, 1927, the right cord was as before; the left cord was almost motionless in mid position; a slight adduction movement alone remained. For the first time since she was seen in May, 1926, the patient spoke continuously in a fairly strong voice, not in a whisper, while under examination. Her general condition is continuing to improve.

Remarks.

The presence of an extensive area of scar tissue on both sides of the neck not only made the operations of great difficulty, but made us doubtful of a satisfactory result.

The patient had definite improvement in the tone of the right cord seven weeks after the operation; the inner border of the cord was straight and tense. She had no further attacks of dyspnoea. Subsequently (four months after the first operation) she had definite laryngeal tone in the voice and definite movement of the right cord.

Nine months after operation she sometimes spoke in a strong voice (we are of the opinion that there is a functional element in her aphonia) and had abduction of both vocal cords giving rather less than one-third of a normal glottis opening. Adduction was strong. Her general health was definitely improved, though still far from good.

Nearly one year after the operation the left cord could no longer be seen to abduct. We are of opinion that the condition of the right cord is permanent. It has strong adduction and crosses the mid-line, and abduction to one-third of the normal.

It may be asked, what has the patient gained by these anastomoses? The answer is that she has been saved from imminent suffocation, and can now go about the world without fear of sudden death, and that though the result is far from perfect, owing to the peculiar circumstances of the case, we think it is better than if the woman had been permanently sentenced to the wearing of a tracheotomy tube. She has also gained a fairly good voice.

The period of time required for the recovery of tone in the cord and the commencement of movement in the cord in this patient coincides with what has been observed in corresponding experiments in the monkey. In man when an end-to-side recurrent laryngeal-phrenic anastomosis is done we recommend that the nerves should be passed behind and not in front of the carotid sheath.

It is to be noted that both halves of the diaphragm recovered their complete motility. The paralysis of the diaphragm did not appear to inconvenience the patient. Part of the right half of the diaphragm was probably recovering before the second operation was done.

The splitting of the phrenic nerve on the right side appeared to us an unsatisfactory method of anastomosis, and one likely to be specially sensitive to pressure by scar tissue, but it has given a better result than the end-to-side anastomosis on the left side. On the left side, however, tension at the anastomosis could not be avoided, and tension at the site of nerve anastomosis may spoil the result of any such operation.

THE EXPERIMENTAL PREVENTION OF STONE IN THE BLADDER IN RATS.*

BY

R. McCARRISON, C.I.E., M.D., D.Sc., F.R.C.P.,

LIEUTENANT-COLONEL I.M.S.,

DIRECTOR, DEFICIENCY DISEASES INQUIRY, PASTEUR INSTITUTE, COONOR, SOUTH INDIA.

In a paper in the JOURNAL of April 16th, 1927 (p. 717), the experimental production of stone in the bladder in rats was recorded. The composition of the calculus-producing diet was:

Tinned Scotch oatmeal or <i>atta</i> *	53 parts
Linseed meal	20 "
Tinned cornflour	25 "
Sodium chloride	1 "
Calcium phosphate	1 "
Distilled water	<i>ad libitum</i>

* *Atta* is whole-wheat flour.

The present report deals with the prevention of stone in the bladder in rats fed on an "oatmeal diet" of the above composition.

THE EXPERIMENT.

Two groups of young rats, 18 in each, were selected; their aggregate body weight was the same—910 grams. There were 9 males and 9 females in each group. The body weight of the males ranged from 50 to 58 grams, of the females from 46 to 52 grams; all were of approximately the same age. The 36 animals were confined in twelve precisely similar cages; 3 males or 3 females being placed in each. All were fed on the oatmeal diet and water, and were allowed to eat as much as they liked. One group received fresh whole milk in addition to the oatmeal diet; the other did not. A ration of 2 ounces of milk was provided for the three rats in each cage, but some secured more than their share.

The experiment was continued until the death of all animals receiving the oatmeal diet without milk; the last two animals died on the 150th day. The experiment was protracted for a further seventeen days in the case of the animals receiving milk in addition to the oatmeal diet; the survivors (15) on this regimen were killed by drowning on the 167th day. All animals were subjected to *post-mortem* examination.

RESULTS.

The results of the experiment may be summarized as follows:

The animals fed on the oatmeal diet without milk grew badly; all died within periods ranging from 66 to 150 days. Nine (50 per cent.) were found at *post-mortem* examination to have stones or gravel or both in the bladder, usually with, but in one case without, cystitis. Cystitis was present in one case without associated stone or gravel. The stones ranged in weight from 2.4 to 99 mg. The sequelae of calculus (dilated ureter, hydronephrosis, and pyonephrosis) were not present in any case in this series; nor was stone found in the ureter or kidney. In one animal a large grey-white, pear-shaped, fibrinous mass was present in the bladder, the thin end being drawn out into a fine thread which extended into the urethra; this condition was associated with haematuria. Bloody urine was passed by two other animals, in one of which cystitis was present in association with a number of minute stones (gravel). The three animals in which haematuria was observed prior to death were found at *post-mortem* examination to have suffered from severe anaemia, associated with a lemon-yellow tinting of the skin and subcutaneous tissues. Three of the 18 rats in this group died of pneumonia; in 3 others no cause of death could be found except asthenia.

The animals fed on the oatmeal diet with milk grew well as a rule, though some better than others; this was no doubt due to the fact that some of them secured more of the milk ration. Two died of pneumonia, and one of an unknown cause. The other 15 remained in good health.

* This abstract is published by permission of the Director-General, Indian Medical Service. The full paper will appear in the *Indian Journal of Medical Research*.

Neither stone in the bladder nor gravel, or cystitis, or any abnormality of the urinary tract was found at *post-mortem* examination in any of these 18 animals.

CONCLUSION.

The addition of whole milk, in the proportion of two-thirds of an ounce per rat daily, to a diet capable of causing urolithiasis in 50 per cent. of young rats, completely prevented the development of phosphatic calculi.

THE BACTERICIDAL ACTION OF LIGHT ON TUBERCLE BACILLI.

BY

ALBERT EIDINOW, M.B., B.S.LOND.

(From the National Institute for Medical Research, Mount Vernon, Hampstead.)

THE value of ultra-violet rays in the treatment of lupus vulgaris is well established, but the mechanism of their mode of action is still a matter of controversy. Some maintain that the local application of light produces direct bactericidal action in the depths of the lupus nodule. If there is no direct bactericidal action of these rays, some general effect on the whole body or the local effects of irradiation must be responsible for the results and cures which have been obtained.

While bacteria can be readily destroyed by exposure to light, the culture medium, the depth of layer of fluid, the age of the culture, the intensity of light, and temperature are all important factors. Coliform bacilli suspended in Ringer's solution are readily destroyed by long ultra-violet rays, staphylococci by short rays, while, according to Weisner,¹ the Friedländer pneumo-bacillus is resistant to light owing to the mucous envelope surrounding the organism. Robert Koch² found that cultures of tubercle bacilli were destroyed by prolonged exposure to sunlight which passed through the window glass of his laboratory. J. Bang showed the bactericidal action of the concentrated Finsen light on the tubercle bacillus, and the *Staphylococcus pyogenus aureus*. Mme V. Henri³ and Baroni investigated the effects of irradiation of tubercle bacilli with the mercury quartz arc, and found that the bacilli lost their acid-fast staining reaction after three to four minutes' exposure, and were destroyed after ten minutes. Kattenbracher found that tubercle bacilli were readily killed after five to sixty seconds' exposure to the iron arc. Such experiments have definitely proved the bactericidal action of ultra-violet rays on the tubercle bacillus, but in the case of sunlight the effect of ultra-violet rays has not been clearly separated from heat effects. Thus, results obtained from the experiments of Mitchell and Crough,⁴ von Bergen, Triskanokaja, and Fr. Krusius show variations in the lethal time from half an hour to six hours.

While concentrated solutions of tuberculin are resistant to light,⁵ solutions of 1 in 1,000 concentration can be weakened by exposure to rays shorter than 3,250 A.U. Recently W. Hausmann,⁶ W. Neumann, and K. Schubert have shown that inoculations of irradiated tuberculin do not give rise to any local reaction, but the usual general reaction is obtained.

As the review of the literature indicated that the tubercle bacillus can be destroyed by ultra-violet rays, but failed to demonstrate the selective region, further investigations were carried out. Surface scrapings of a fourteen-day culture of tubercle bacilli (a virulent bovine strain obtained from Captain S. R. Douglas) were placed in a sterile test tube; 250 mg. of this culture were mixed with 250 c.cm. of sterile saline, and quantities of 50 c.cm. of the mixture were placed into sterile vaccine bottles and sealed off.

EXPERIMENT 1.—Control.

Four guinea-pigs were inoculated subcutaneously into the right thigh with 1 c.cm. of the suspension of tubercle bacilli in saline (dose=1 mg. of tubercle bacilli). The animals were kept under observation, and the time of the appearance of a hard swollen inguinal gland was recorded. Forty-one days after inoculation all the animals were killed and *post-mortem* examinations were performed. All these animals had generalized tuberculosis.

EXPERIMENT 2.—Exposure of Tubercle Bacilli to Mercury Vapour Lamp (7,620-2,300 A.U.)

Of the emulsion of tubercle bacilli in saline 15 c.cm. were placed in a sterile quartz flask. The flask was attached to an electric motor and was exposed to two mercury vapour lamps (K.B.B. type, 2.5 amperes, 210 volts, D.C.) eight inches distant. The flask was slowly rotated during the exposure, so that a thin fresh film of fluid was constantly exposed to the lamp. The flask was kept cool during rotation by a trough filled with cold water. At intervals of 5, 10, 15, 30, and 60 minutes samples of the suspension of the irradiated bacilli were removed from the flask and 1 c.cm. of each specimen inoculated into a guinea-pig. The experiment began on December 20th, 1926, and ended on January 31st, 1927, when the animals were killed.

Time of Exposure to Lamps.	Weight.	Weight when Killed.	Result when Killed.
	Grams.	Grams.	
5 minutes	5.0	—	Died December 24th, 1926; ? cause pneumonia.
10 "	330	520	No evidence of tuberculosis.
10 "	330	600+	Small caseous gland 2 by 0.5 by 0.5 c.m.
15 "	370	590	Healthy when killed.
15 "	450	590	No histological evidence of tuberculosis.
30 "	310	420	
30 "	510	600+	
60 "	390	430	Healthy.
60 "	410	510	

Conclusion.—The tubercle bacilli suspended in saline are destroyed after 10 minutes' exposure to the radiations (7,620-2,300 A.U.) of the mercury vapour lamp.

EXPERIMENT 3.—Exposure of Bacilli to Mercury Vapour Lamp (Filtered).

Tubercle bacilli were exposed as in experiment No. 2 to radiations of a quartz mercury vapour lamp, but filtered through a screen of vitaglass (radiations=5,720-2,800 A.U.). The experiment began on December 12th, 1926, and ended on January 31st, 1927, when the animals were killed.

Time of Exposure to Rays.	Weight.	Weight when Killed.	Result when Killed.
	Grams.	Grams.	
5 minutes	350	450	Two small caseous glands 1 by 0.5 by 0.7 cm., and 1.5 by 0.5 by 0.7; otherwise nil.
5 "	300	360	Big caseous glands; nodule in spleen.
10 "	375	560	Small caseous inguinal gland.
10 "	330	540	Small caseous inguinal gland 1 by 0.5 by 0.5 c.m.
15 "	420	550	Nil.
15 "	390	390	Small caseous inguinal gland 1 by 0.75 by 0.5 cm.
30 "	350	600+ (pregnant)	Nil.
30 "	325	470	Nil.
60 "	380	510	Nil.
60 "	360	570	Nil.

Conclusions.—The tubercle bacilli in saline are destroyed or attenuated after 30 minutes' exposure to the rays (5,720-2,800 A.U.) of the mercury vapour lamp filtered through a sheet of vitaglass, which allows the passage of rays from 5,700 to 2,800 A.U. There was evidence of a local lesion at the site of inoculation in the right groin, in the animals injected with the tubercle bacilli exposed for 5, 10, and 15 minutes. When the animals were killed on January 31st, 1927, only one guinea-pig (No. 15) showed a macroscopic tuberculous nodule in the spleen. No macroscopic or microscopic evidence of the disease was found in the remaining animals, which were injected with suspension of bacilli exposed for 30 and 60 minutes.

EXPERIMENT 4.—Exposure of Bacilli to Mercury Vapour Lamp Through Window Glass.

The suspension of tubercle bacilli in saline was exposed to the rays of the mercury vapour lamp as in Experiment 2, but through a screen of window glass (radiations=5,720-3,300 A.U.). At intervals after 5, 10, 15, 30, and 60 minutes' exposure samples