therefore completely immobilizes the colon bacillus without interfering in the least with the activity of the typhoid bacillus. The consequence is that the limb A is quite turbid, especially at its lower part, where masses of agglutinated coli bacilli are deposited. This turbidity decreases as we ascend the centre bend, and becomes faintly opalescent in the descending limb of this curve, whilst up to the twentieth hour of growth the limb B remains quite clear, and can be shown by subculture tests to be perfectly sterile. If now, after this period of growth, loopfuls of gelatine from the limb B are sown at hourly intervals into broth, it will be found almost invariably that the twenty-second hour test will produce a growth giving all the reactions of a pure typhoid culture; this result is very constantly obtained between the twentieth and twenty-fourth hours, but variations occur in accordance with the length of tube employed and the activity of the particular strain of typhoid bacillus used in any experiment. As will be seen from the following examples, the typhoid bacillus could always be separated with the greatest ease from mixtures with the colon bacillus, however such mixtures were prepared.

Examples.

1. Twenty-four hour broth cultures of colon and typhoid bacilli were mixed together, and one or two drops of the mixture sown in the W tube. Seventeenth hour test remained sterile; twenty-first hour test showed pure growth of typhoid in the opposite limb of the tube.

2. Scrapings from six-weeks old slope-agar cultures of colon and typhoid bacilli were sown in the W tube. The tube was kept at blood heat for twenty-four hours, and was then found to give a pure typhoid growth.

3. Various media, for example, agar, broth, neutral and acid peptone (Remy's formula), were sown simultaneously with loopfuls of typhoid and colon cultures and incubated; the resulting mixed growths were subsequently sown in W tubes at intervals varying from two or three days up to as many months, and in all cases pure growths of typhoid bacilli were recovered within twenty-four hours.

Moreover, on several occasions the typhoid bacillus was separated from artificially contaminated tap water, and in one case a defective filter was tested by passing through it 5 litres of tap water contaminated with three tubes of typhoid broth culture, with the result that three or four drops of the filtrate sown into a W tube gave a pure growth in the opposite limb twenty-two and a-half hours afterwards. It will be noted that the conditions of growth in these tubes at once separate off all non-motile organisms, whilst the presence of the Parietti fluid and the high incubation temperature are both inimical to the growth of most saprophytic water microbes.

Unfortunately, however, this method, which gives such excellent results in artificial mixtures with a given strain of colon bacilli, altogether fails when applied to mixtures containing different strains of colon bacilli for the simple reason that a colon serum prepared with a special culture of colon bacilli cannot be depended on to agglutinate any other variety of this organism. Thus, although the serum used in the above experiments agglutinated powerfully, the stock colon bacilli used in its preparation in a dilution of 1 in 1,000, it failed to produce any marked reaction with strains of colon bacilli isolated from the intestinal contents of dogs, rabbits, pigeons, and guinea-pigs, even when employed in dilutions of only 1 in 100. It is not surprising, therefore, that repeated attempts to isolate the bacillus typhosus from the discharge of typhoid patients by means of W tubes were completely unsuccessful, the colon bacilli in all cases coming over in a very active state before the typhoid bacillus. It hardly seemed feasible to attempt to produce a poly-agglutinating serum, considering the great variety of strains of colon bacilli to be met with in the digestive tract, not only of man but of animals.

For these reasons the above method, although possessing a certain value, was abandoned for practical purposes, and the following modification of an existing method was tried instead. The Elsner gelatine medium is undoubtedly the best process at our disposal for isolating the typhoid bacillus, but it is open to the objection that it is very slow, owing to the low incubation temperature, and consequently it allows time for the development of liquefying organisms, the growth of which frequently spoils the plates before the typhoid colonies have attained a size sufficient to enable them to be separated out. To obviate this, a medium was prepared as nearly as possible on the lines of the Elsner potato-iodide medium, but

substituting agar-agar for the gelatine. The exact mode of preparation is as follows:

Modified Elsner Agar Medium.—Take 500 grams of potato, peel them, and scrape them on a grater; the pulpy mass so obtained is then macerated in a litre of water for three or four hours, strained and allowed to stand overnight. Next morning the clear supernatant liquid is decanted off, and the volume made up to 1,000 c.cm. This liquid is then rendered distinctly alkaline and 20 grams of agar-agar added; the process is then continued as for ordinary agar. When sterile the medium is distributed into test tubes—10 c.cm. in each—and immediately before use 0.5 of the following solution is added to each tube: Potassium iodide, 10 grams; water to 50 c.cm. The agar tubes thus contain 1 per cent. of potassium iodide. It seems desirable to use this medium in as fresh a state as possible.

Plates prepared with this medium were sown with mixed cultures of the typhoid and coli bacilli, and incubated for twenty-four hours in the incubator at 37° C. At the end of this time, examination under the low power microscope showed very much the same difference between the two sets of surface colonies as is found in the Elsner gelatine after four or five days' growth; the typhoid colonies being very clear, transparent, and almost invisible when strongly illuminated, and with irregular clean cut margins, whilst the coli colonies were much larger, rounded, and opaque. By means of this method the typhoid bacilli were isolated in pure culture from numerous artificial mixtures, notably from 5 litres of very foul putrid Thames water, contaminated with 5 loopfuls of a typhoid broth culture, and from tubes of broth and sloped agar in which the typhoid and coli bacilli had been growing together for almost three months. It was also used successfully in the case of some old dejecta kept for five months in the cold storage room. Lastly, by its means bacilli, giving all the morphological and cultural characteristics of the typhoid bacillus (and which agglutinated well with several samples of positive typhoid blood at a dilution of 1-30, while they failed to react to a normal non-typhoid-blood) were isolated from the interior of some cockles suspected to have been the cause of an outbreak of typhoid fever. These results are very encouraging, even taken in conjunction with a certain number of failures, and it is hoped that more extended experience and further experiments along such lines as those indicated may result in an approach to the solution of that very difficult bacteriological problem—the isolation of the typhoid bacillus from contaminated material.

In conclusion, I should like to return my thanks to Dr. Macfadyen for his assistance and co-operation during the progress of the above work.

A NEW DIAGNOSTIC POINT IN TYPHOID FEVER

By HENEAGE GIBBES, M.D.,

Detroit Clinical Laboratory, Departments of Pathology and Photography, Detroit, Michigan.

SOME years ago I found that I could show the eruption in small-pox on a photographic plate before it was visible to the naked eye. I had shown long before this that structures which could not be made out with the microscope could be photographed, such as the unstained flagella in vibrio. I thought at first that this would be valuable in the diagnosis of small-pox, but on careful examination I found that the eruption could be felt at a stage when it could not be seen, and that it would not differentiate between small-pox and variella or some cases of measles. I think, however, that it will prove of value in typhoid fever where the eruption can be reproduced by photography before it can either be seen or felt. There have been many difficulties in the way of proving this; amongst these the foremost is the few cases in which it can be tried owing to the patient's objection to the process, and next, the necessity of having the exposure just right. The best plan is to use orthochromatic plates, and make a number of exposures as quickly as possible; a ray filter is required with some plates, but with Cadett's "spectrum" plates this would not matter on account of their great rapidity. The procedure is simple: Cover the head and face with a light shawl and remove the coverings from the abdominal region, moisten a small bit of printed matter, and stick it on the skin to get the focus. The operation is greatly facilitated by an assistant throwing all possible light on the part with a mirror.

No rule for exposure can be laid down, as the amount of

available light varies in every case, but out of six exposures of varying lengths, one or two should show the rash.

The greatest care is required in developing the plate, but anyone who has had experience in making cloud negatives can easily get a good result. Over-exposure must be avoided; slow development with a weak developer, and not carried too far, is the rule. Hydrokinon or paramol give good negatives.

Those cases where in making a Widal test a cessation of motility occurs, without clumping, will, I think, generally show the rash, and when they do a diagnosis may be assured.

I have been trying to use the telephoto appliances with a rapid anastigmat in these cases, so that the apparatus may be placed at a distance from the patient. I think this will eventually prove to be the best method when sufficient rigidity in the camera can be secured, as well as enough light.

I trust that the method will be tried by some having special hospital facilities, and that it will be found of value in those atypical cases now so common.

AN EXPERIMENT WITH ULTRA-VIOLET LIGHT.*

By DAWSON TURNER, M.D., M.R.C.P.LOND.,

Electrician to the Royal Infirmary, Edinburgh; Lecturer on Physics at Surgeons' Hall; Additional Examiner in Experiment Physics, Edinburgh University.

It has long been known that the oscillatory discharge of a condenser produced a very brilliant spark which was likely to have strong actinic qualities. It was recently suggested to me by Mr. Leslie Miller that such a spark might be of service in the production of the ultra-violet rays for the treatment of disease according to Professor Finsen's method. The lamp introduced by Goerl in Germany also appears to be of the same nature; Mr. Miller or Mr. Schall can supply such spark lamps. I accordingly commenced by performing a number of experiments to ascertain the physical nature of the radiation.

The ultra-violet rays may be recognized by the following properties:

- (a) They are powerfully actinic.
- (b) They can excite fluorescence.
- (c) They can discharge an electrified body (Hertz), provided the body is negatively electrified.
- (d) They have a special action on the skin of the higher animals and on the entire tissues of the lower animals and plants.
- (e) They can produce nuclei for cloud condensation in moist air (Wilson).

The chief difficulty that presents itself in dealing with these rays is due to the fact that glass is quite opaque to the extreme part of the ultra violet. Hence, glass lenses and prisms must be discarded, and to produce a spectrum by refraction some other substance must be made use of.

My experiments have consisted in comparing the ultra-violet radiation of an arc lamp with that of the spark.

A. The difficulty of comparing the photographic effects led me to discard such an attempt.

B. To compare the fluorescent effect I had some quartz lenses and prisms made, and projected by their means the spectra of the two sources of radiation. A screen of barium platinocyanide and one of potassium platinocyanide now by glowing with a pale-blue light in the ultra-violet region served to double the length of the visible spectrum as yielded by the arc light; in the case of the spark spectrum the barium salt did not fluoresce at all, but the potassium salt drew out the original spectrum to three or four times its original length; calcium tungstate produced the same extension, but with a dark band intervening. The calcium salt did not fluoresce at all in the arc spectrum. There are, therefore, some remarkable differences between the arc spectrum and that of the spark, chiefly in the direction of the latter's possessing a radiation of shorter wave length and greater frequency (more ultra violet).

C. The property of discharging an electrified body is the most easily tried. The radiation of an arc light will at ordinary atmospheric pressure only discharge a negatively electrified body, and the body must have a freshly-cleaned surface of zinc or other special material.

EXPERIMENT.

If + charged no effect will be produced. If we now attempt the same experiment with the spark gap radiation, the electroscope will be discharged whether + or - charged and whether provided with clean zinc or not. The discharging is, however, more rapidly produced if the electroscope be charged negatively, and also if a piece of zinc be put on to the electroscope, so the difference may be one mainly of degree. Judging also from the length of time required to produce the discharge, the spark-gap radiation is far more potent than the arc light. I next attempted some experiments on transparency and opacity, a short account of which I append, but I may summarize the results by stating that these experiments lead me to conclude that there are two degrees or qualities of ultra-violet radiation, the one yielded by the arc light, and the other by the spark discharge, and that the wave length yielded by the former is at its shortest considerably longer than the wave length of the latter at its shortest. The already noted and the appended experiments will serve to contrast the two. Thus the arc will discharge a - charged electroscope if it has a zinc cap and quartz and water are fairly transparent to its radiation and barium and potassium platinocyanide fluoresce (calcium tungstate does not).

The spark radiation will discharge a - charged or a + charged electroscope, whether fitted with zinc or not, but more rapidly if - charged, and if with zinc still more rapidly.

Quartz and water only allow the lower-frequency radiation—that of the arc—to pass through freely, and are somewhat opaque to the higher-frequency radiation which is yielded in abundance by the spark. Barium platinocyanide does not fluoresce in the spark spectrum, but the potassium salt and calcium tungstate do, and both draw out its spectrum to twice the length that the barium and potassium salts can draw out the arc spectrum.

A further advantage of the spark gap as a source of ultra-violet rays lies in the fact that its heat radiation is almost negligible, and, owing to this latter property, the light can be brought within an inch or less of the affected parts with very greatly increased effect.

With regard to the transparency of matter to the ultra-violet radiation of the spark discharge, clear dry, pure rock salt is the most transparent of the bodies I have tried. Ice, quartz, pure water, grape sugar, and gypsum are less transparent. A film of moisture on the rock salt, owing to the electrical conductivity of brine, makes it quite opaque; glass $\frac{1}{8}$ in. thick is quite opaque, so are mica and ebonite in sheets of $\frac{1}{8}$ in. in thickness.

Concluding from these experiments that the spark-gap radiation is more powerfully ultra violet than that from an arc light, and also that rock salt would form the best compressing medium, I put the apparatus into operation in the electrical department of the Edinburgh Royal Infirmary in the treatment of cases suitable for the Finsen rays, and so far with very successful results, an exposure of two and a-half to five minutes being sufficient to produce a marked effect.

The following case, which was exhibited to the Edinburgh Medico-Chirurgical Society on February 5th, will serve to illustrate these remarks:

CASE.

A man, aged 55, recommended by Professor Annandale, was admitted to the electrical department on December 4th, 1901. The patient had suffered for the last eight years from a rodent ulcer on the right side of the nose, which had been treated unsuccessfully in many different ways. The ulcer was bean-shaped and about the size of a small mussel shell, covered with brown crusts, which when removed left an irregular depression $\frac{1}{4}$ in. to $\frac{1}{2}$ in. in depth, with a raw greyish granular surface and shelving edges. Treatment by Roentgen rays was commenced on December 4th, 1901, with exposures of five minutes daily. Slow but steady improvement followed until January 10th, 1902, when the Roentgen-ray treatment was replaced by exposures of from two and a-half to five minutes to ultra-violet light three times a week. Three days after the first exposure marked improvement was observed, and after three exposures the ulcer had almost disappeared; after five exposures the patient returned home, the only trace of the disease that remained consisting of some slight scales towards the upper margin of what had been the ulcer.

I understand that Dr. Walsham, of St. Bartholomew's, has also been investigating the nature of these rays and treating patients by their means. This research has been an independent one.

FRANCISCAN HOSPITALS IN THE UNITED STATES.—According to the *American Practitioner*, the Franciscan Sisters of Lafayette, Indiana, are erecting a hospital in Louisville, which is to contain 200 beds. The Sisters have erected and are now conducting a number of magnificent hospitals all over the United States. The mother institution is at Lafayette, where they have a fine hospital. The arrangements in regard to heating, lighting, and baths are said to be of the most up-to-date character, and in particular the new hospital will have "one of the most elegant operating rooms in the South."

* Read before the Royal Scottish Society of Arts, January 27th, 1902.