110° Fahr., and then gave very markedly the murexide test in a single evaporated drop. It was left twelve hours more at 100° Fahr., and again tested, no change being apparent. It was then rendered more alkaline with a mixture of potassic and sodic carbonate, and left twelve hours at 100°, at the end of which time, one drop, evaporated as before, gave faint evidence of uric acid by the murexide test.

Again, a weighed quantity of 1 grain of uric acid and 60 grains of benzoic acid were dissolved in 6 ounces of water with soda to a clear solution, and left 12 hours at a temperature of 100°. One drop gave clearly the murexide test. A little mixed sodic and potassic carbonates were added, and the mixture again left 12 hours at 100°. There was now no evidence of uric acid, by the murexide test; but on precipitation with zinc sulphate solution, and solution of the precipitate in dilute sulphuric acid, abundant crystals deposited, of which a minute quantity gave very markedly the murexide test.

Again, a weighed quantity of one grain of uric acid was dissolved in 6 ounces of water by means of sodic and potassic carbonates in slight excess; and one drop of the solution evaporated rapidly (as in the other testings), gave a far fainter test spot of murexide than the drop from the same strength solution of the preceding experiment prior to digestion. This solution was then set aside, at 100° Fahr., for ten hours. One drop then evaporated gave very slight evidence of uric acid by murexide test. After twelve hours, no evidence of uric acid could be obtained by this test.

The results of the above experiments seem to point to the fact that the uric acid is not destroyed by benzoic acid, but exists in a state of combination (it may be as a compound acid), and when this combination is evaporated with nitric acid it gives no murexide with alkalis, and when it is precipitated by zinc sulphate solution, the uric acid combines with the zinc oxide. And the last experiment seems to demonstrate that an alkaline solution containing soda and potassa is capable of really destroying uric acid if kept at a temperature 98° Fahr., even without the presence of benzoic or hippuric acids, probably by oxydation. This was a discovery of Schunk, who found the products of decomposition to be oxaluric acid, and finally urea and oxalic acid; and Dr. Basham has noticed that this takes place in the animal economy when potash salts are administered, coincidentally with the diminution of uric acid (*Practitioner*, vol. v, 1870).

It is well known that there are many substances which, when present in a solution of uric acid, are capable of increasing its power of remaining dissolved, and benzoic acid certainly appears to be one of these.

I have not tried the effect of the administration of hippuric acid by mouth, because it is well known that if benzoic acid be administered, hippuric acid appears in the urine; and if this hippuric acid, formed in the animal, did not diminish the uric acid (though it did prevent its precipitation by acid), neither would hippuric acid administered by the mouth be likely to do so. Moreover, we have no guarantee whatever that hippuric acid, administered by the mouth, will appear unchanged by the urine; and, reasoning from the behaviour of uric acid when so administered or injected, it would certainly not do so.

It is tolerably certain that variations in diet will cause variations in the excretion of uric acid; and, if a strong vegetable variation in the diet of mixed feeders will cause it to be replaced by hippuric acid, it is reasonable to suppose that the same cause, acting in a less degree, will produce the same effect in a less degree; therefore, we may conclude that, in the urine of mixed feeders, we have more or less of a substance which will prevent the precipitation of free uric acid; that the quantity, and therefore the effect, varies with the diet. It must be evident, therefore, that a process of estimation, capable of being affected in this manner, cannot be reliable.

SANITARY INSTITUTE OF GREAT BRITAIN.—At an examination of local surveyors and inspectors of nuisances, held June 7th and 8th, the Institute's certificate of competency to discharge the duties of local surveyors was awarded to P. F. Comber and E. G. Mawbey; and the certificate of competency to discharge the duties of inspectors of nuisances was awarded to W. Dent, S. Edmondson, W. Hearne, G. Johnson, A. W. Merrie, and G. F. Wells.

LUMINOUS PAINT.—An ingenious use of luminous paint now provides, at the Lyceum, a reassuring safeguard against panic. The directions in the corridors and passages as to the "way out" are now as legible in darkness as in light, and thus if from fire or another accident the gas were suddenly cut off, the audience need experience no difficulty in finding their way to the several exits.

ON THE PATHOGENESIS OF PNEUMONIA.

By GEORGE M. GILES, M.B., F.R.C.S.,
Surgeon to the Indian Medical Department, 2nd Punjab Cavalry.

THE publication of a leading article on the above subject in the *JOURNAL* of March 3rd, 1883, leads me to now make this communication, which I have been delaying until I should have cleared up in my mind certain points in connection with an organism I have been observing in the blood and tissues of cases of pneumonia.

In February 1882, I was sent to do duty with the 4th Punjab Infantry at Dera Ismail Khan, on the Punjab frontier, and found that there was then so great an amount of pneumonia among the troops, that it might be well called epidemic. Outbursts of pneumonia of epidemic characteristics are not uncommon among native troops in this part of India, during the cold season, and there is a very generally diffused opinion among the medical officers of the Punjab frontier force, that the disease is, at any rate occasionally, communicated by contagion.

At that time, I had not seen any notice of the observations alluded to in the *JOURNAL*, but so many diseases had been recently demonstrated to be characterised by the presence of micro-organisms in the blood, that I was led to carefully examine the blood of my patients.

On submitting the blood of a case to a power of about 800 diameters (Ross, $\frac{1}{2}$ immersion objective), I was surprised to find that it contained immense numbers of minute more or less spherical foreign particles; and further careful observation of cases brought out the following facts. These particles are present from the very commencement to the end of the attack, and often persist in scanty numbers, far into convalescence.

If the blood be examined in a case of pneumonia as soon as the earliest symptoms declare themselves, there will be observed a number of micrococcus-like bodies about one-eighth to one-tenth of the diameter of a blood-corpuscle, i.e., about one micromillimetre. They appear spherical or nearly so, unless great care be taken in the adjustment of the lens. If examined in a warm, moist chamber, they will be found to possess two motions; first, the ordinary Brunonian vibration, and secondly, an independent locomotion of their own. On occasions when the adjustment of the screw-collar of the objective and the light have been favourable, I have made out, as they twist about, a pyriform outline, and have once or twice had a glimpse of an extremely fine lash springing from the smaller end. After two or three days, a second form appears, in the shape of a nucleated cell from two to three micromillimetres in diameter, the nucleus of which, in size and appearance, is much like one of the first described form. In these, no signs of locomotive power have as yet been observed. The smaller kind are still found in great numbers, and by this time will be often found joined into chains of from two to ten or more individuals. When this is the case, they too appear to have lost the power of locomotion.

Coincidentally with the appearance of this nucleated form (or stage, as I take it, of the micrococcus), a third appearance manifests itself, in the shape of large colonies of the smaller sort, united together by a hyaline structureless material, forming masses as large as fifteen to twenty micromillimetres. These collections are probably zoogloea, and are of a consistence of some firmness; for, in specimens examined warm, I have not unfrequently observed the red corpuscles to run against them, the corpuscle becoming altered in form, while the zoogloea-mass yielded scarcely at all. If the blood be dried on a cover and stained by "Koch's method," these micrococci will be found to stain well with most anilin dyes. That best suited is one I obtained some years ago under the name of "anilin blue." I am unacquainted with its exact name, but it is a different article from methyl blue.

During the progress of the case, these zoogloea-masses commonly disappear, and a more or less distinct repetition of the same cycle may often be observed; but as a general rule the process appears to become confused.

The sputa, too, may, by Koch's method, be demonstrated to absolutely swarm with micrococci, and often, in fact, to be largely made up of them.

After death, both in man and, as will be described below, in rabbits, I have made out their presence in the tissues of all parts of the body, but especially in the capillaries of the lung, which are often found blocked with clot containing immense numbers.

In severe and fatal cases, I have frequently observed a curious circumstance. When the patient is at his worst, the drop of blood

for examination can only be made to flow with great difficulty; and when it is examined, few or no micrococci will be found free in the blood, all present being either in the zoogloea-stage, or, if single, firmly adherent to the red corpuscles, so as to make them, even in freshly drawn specimens, look like mulberries.

If currents be produced under the cover by pressing on it with a needle, some of these may occasionally be seen to become detached, and to float about free; but the moment they happen to come into contact with some corpuscle, they adhere to and are carried about by it.

Now, the pneumonia seen here often runs an extremely rapid course, death sometimes taking place in as little as twelve hours, with signs of pulmonary engorgement; but with no pronounced dullness on percussion, and, *post mortem*, with only deep congestion of the lungs, and often extensive pulmonary apoplexy. It is in such, especially, that I have observed the appearance of blocking of the capillaries.

Is it carrying too far "the scientific use of the imagination" to surmise, that this blocking may be caused by the corpuscles becoming matted together by the adherent micrococci, and by the infarction of zoogloea-masses, many of which reach dimensions too great to allow their passing through the finer capillaries?

The presence of these microphytes in the blood and sputa appeared to me to lend considerable probability to the theory of communication by contagion; and, with a view to test this, I performed the experiments described below.

Experiment 1.—I injected into the pleural cavity of a rabbit a small quantity of the freshly ejected sputa of a pneumonic patient. Twenty-four hours later, immense numbers of the smaller or non-nucleated form of the micrococcus were present in the blood. In thirty-six hours after the injection, the animal died. *Post mortem*, there were present effusions into the pericardium of clear fluid, and of a turbid fluid into both pleurae. The lung on the side of the injection was covered with lymph, and partly adherent. Both lungs were intensely congested; the other organs were healthy. The blood and pleuritic fluid swarmed with the smaller form of micrococci. The next day, on examining some of the pleuritic fluid that had been put aside in a covered vessel, it was found to contain the nucleated form in addition.

Experiment 2.—I injected some pneumonic sputa into the subcutaneous cellular tissue of the back of a rabbit. As in the first experiment, the animal became ill. Micrococci, first of the smaller, and then of the nucleated form, appeared in the blood, and the animal died, but not until four days after the injection. *Post mortem*, the pericardium and pleurae were filled with a turbid fluid, and the lungs showed signs of pneumonia more advanced than in the first case. The other organs were healthy, and no sign of the point of injection could be made out.

Dogs and rats proved incapable of being infected, either with the fluids of the dead rabbits, or with human pneumonic sputa.

During the past cold season, Experiment 2 has been repeated, and the fluids from this animal proved infective to another rabbit.

Potato-Cultivations.—A minute quantity of sputum was placed on a slice of boiled potato, after the method recommended by Koch for cultivating the anthrax and other germs. In a few days, a greyish-white scum was seen spreading out over the surface, from round the point of sputum. This scum, on microscopic examination, proved to consist of a micrococcus, of exactly similar size and appearance to those already described in the blood. The cultivation of this micrococcus was carried on a potato to the seventh generation; and the experiment was several times repeated, and carried on through several generations, there being apparently no limit to the number. A minute speck of blood was placed on a slice of potato in the same way, and round it grew a scum of exactly similar appearances, consisting of micrococci exactly like those in the blood, or grown from sputum.

A little of the third generation of one of the potato-cultivations from sputum was mixed with distilled water, and injected into the cellular tissue of a rabbit's back. The animal became obviously ill, and the blood for many days swarmed with micrococci—all three stages, nucleated, nonnucleated, and zoogloea, being detected. It, however, recovered, and about three weeks after was used in an experiment with the injection of sputa. The poison in this case must have been very virulent (the patient from whom it was taken died a few hours after it was collected), for this animal died within a few hours. *Post mortem*, the lung was found to be in a state of recovery after pneumonia.

Afterwards, some of a sixth generation sputa-cultivation was injected. In this case, again, the animal became very ill—so obviously

so, that I was much surprised at its recovery. Three weeks after, it was killed, and the last traces of an attack of pneumonia were still apparent in the lungs.

Since I first noticed these bodies in the blood, in February 1882, I must have seen them in about fifty or sixty cases. They appear to be constant, for I have found them in every case that I have examined.

Under these circumstances, the possibility of communication of pneumonia by contagion can scarcely be doubted. Whether such an occurrence be at all common, or usual, is a matter by no means so easy to decide. At least, it appears that it is advisable to carefully disinfect sputa in this disease, before disposing of them where they will probably become constituents of the dust which fills the air in dry climates such as this.

Before concluding, I should add that, in the pneumonia we meet with in this part of India, a large number of cases, while running the same course, as to pyrexia and general symptoms, as seen in the typical acute pneumonia of Europe, are yet, as to physical signs, instances rather of lobular than of acute croupous pneumonia.

RE-FRACTURE OF THE PATELLA.

By HENRY PARSON, M.R.C.S.Eng.,

Assistant Medical Officer to the Surrey County Hospital, Guildford.

PERHAPS the following particulars of a case of re-fracture of the patella, together with a description of the appliances used during the treatment, may be of interest.

In December 1874, Mr. — fractured his left patella at the junction of the upper and middle thirds. In October 1880, he fractured the same bone at the junction of the middle and lower thirds; and, in August 1882, he re-fractured the left patella at the seat of the last injury—viz., at the junction of the middle and lower thirds.

This last accident occurred on August 6th, whilst staying at Amsterdam. He was seen by a local surgeon, who applied suitable splints; and the patient started for England on August 8th, reaching his home on the 9th. I was called in on the 11th, and found considerable swelling over the joint, with about three-fourths of an inch of separation between the fragments. The amount of separation which existed directly after the accident, I could not ascertain. The lower fragment was small, and very movable. He was wearing a leather splint, with side supports, to which were strapped two semilunar soft leather pads. By drawing the pads together, and fastening them, I got the fragments into close apposition; and the patient continued to wear this contrivance until the primary inflammation had subsided.

I then devised the appliance, of which an illustration is here given

It consists of two semilunar pieces, made of some sound, narrow, unyielding material, shaped to fit the edges of the lower and upper fragments. One piece slides on the other, and admits of closing and separating them by means of screws, and without any other movement: so that, when adjusted and firmly strapped to the side supports of a suitable splint prepared for it, the upper and lower pieces are perfectly rigid, one with the other; it is then almost impossible for the patella to slip out of position. The semilunar pieces being narrow, they form grooves for themselves behind the fragments, and have a tendency to run under the bone, instead of over-riding, as most other appliances do; so that the pieces are kept firmly in good position, in their proper place, and have no tendency to tilting. This apparatus was applied about the end of the third week from the date of the accident, and the patient was removed to the couch.

At the end of the fourth week, he came down stairs with assistance, and went out in a Bath chair. At the fifth week, he walked round the garden with the aid of sticks. At the seventh week, he walked a mile with one stick. At the end of the eighth week, he returned to business, walking to and fro—that is, two miles daily. He could walk well wearing the appliance, and experienced very little inconvenience; and, to the best of my knowledge, the fragments never slipped once during the twenty weeks that he wore the