or if not so, with a very short and practically constant interval between them.

The discharge of the inner coatings of the jars by the timing sphere reaching the gap between them is accompanied by a simultaneous discharge of the outer coatings across the spark-gap in the dark room, and it is this that illuminates the splash, the stage of the splash that is illuminated depending on the height of fall of timing sphere, which can be adjusted at pleasure.

The duration of this discharge, if we may argue from Prof. Boys' experiments, probably did not exceed one-hundredth-thousandth of a second.

Great difficulty was at first experienced in getting enough illumination, and finally the spark-gap was placed in the focus

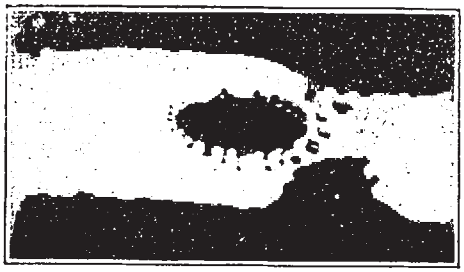

FIG. 2.—Splash of mercury on xylonite.

of a small silvered watch-glass, which enclosed an angle of nearly 180°, and this was placed to illuminate the splash from one side, at an inclination of about 30° to the horizontal at a distance of 6 or 7 cm.; it is to this that most of the detail obtained was due.

The camera was inclined at an angle of about 30° to the horizontal, looking downwards, and was fitted with a single pebble spectacle lens to avoid the loss of the ultra-violet rays which occurs with glass; as the lens was far from achromatic, the proper adjustment of the distances of object and plate had to be found by preliminary experiments. The most rapid plates obtainable (not isochromatic) were used, and were developed for thirty or

FIG. 3.—Splash of a drop of water into milk, early stage.

forty minutes with eikonogen, the developer being made as strong as possible in eikonogen. To avoid all chance of fogging, the operations were performed in the dark.

The mercury splashes with which we began turned out to be the most difficult to photograph, owing to the halation produced by the very bright reflection at some points, and the comparative darkness of the remainder (Fig. 2) We had to try various surfaces for the drop to fall on to find out how to obtain the best contrast; we finally adopted a piece of polished white xylonite.

Of many liquids tried, the easiest to photograph was milk, and with this there was plenty of detail (Fig. 3 and 4).

These photographs are, as far as we know, the first really detailed objective "views," as opposed to shadows, that have been taken with such a very short illumination.

Besides these we also took a number of shadow photographs, in much the same way as that in which Prof. Boys photographed a rifle bullet, by letting a drop of mercury fall on *the clean side* of the sensitive plate itself, and producing a spark between two

FIG. 4.—Splash of a drop of water into milk, late stage.

magnesium knobs vertically above the splash. No difficulty was found in this case in getting enough exposure.

It will be observed that the method requires that different stages should be photographed from different splashes. We hope, however, to succeed in the more difficult task of photographing many stages of the same individual splash.

R. S. COLE.

## On the Spreading of Oil upon Water.

IN a paper entitled "Die Lehre von der Wellenberuhigung," by M. M. Richter (see NATURE, vol. xlix. p. 488), the opinion is expressed that the tendency of oil to spread itself on water is only due to the free oleic acid contained in it, and that if it were possible to completely purify the oil from oleic acid, it would not spread at all.

This I found to be actually the case with olive oil, and though I agree by no means with the theoretical views of the author, I will mention the fact, for I may suppose it to be not yet generally known.

The Provence oil used in my experiment was shaken up twice with pure alcohol, and the rest of the latter being carefully removed, a drop of the oil was placed upon the freshly formed water-surface in a small dish by means of a brass wire previously cleaned by ignition. The oil did not really spread, but after a momentary centrifugal movement, during which several small drops were separated from it, it contracted itself in the middle of the surface, and a second drop deposited on the same vessel remained absolutely motionless.

Of course the surrounding water-surface proved to be in the anomalous state, the tension determined by the method of separating weights being =0·82 of the normal value. It has been diminished by the "solution-current" of the oil (as I have called the contaminating current, issuing from a body in contact with a clean water-surface), which may be observed if the surface be dusted over with sulphur or lycopodium before placing the oil upon it. The observation of the solution-current, preceding unpurified oil, is more difficult, because the oil itself covers rapidly the whole surface.

As soon as the relative tension 0·82 is attained, the slightest trace of a solution current ceases, whilst ordinary oil still shows solution-currents at much lower tensions. The surface-tension 0·82 is the lowest possible that can be produced on water by pure Provence oil; the surface then may be considered as saturated with oil.

This can be seen most clearly if the drop be deposited upon the adjustable trough filled with water, which was employed in my former experiments (NATURE, March 12, 1891, p. 437). The tension then remains constant on either expansion or contraction of the surface: on considerable contraction, however, one can perceive a slight precipitate of oil, which gives to the surface a turbid appearance.

Evidently the pure oil does not spread over a surface of the minimum tension attainable by its contact with water, because the sum of its surface-tension and the interfacial tension of oil and water, which we may call "tension of equilibrium," is greater than the minimum tension. Therefore upon a clean water surface the oil is repulsed by its own solution current.

On the other hand, a drop of common Provence oil placed upon the saturated surface spreads, while the surrounding surface diminishes its area and grows turbid. From this we see that the tension of equilibrium of the oil containing free sebacic acid is lower than its saturation tension, and this is also the reason why it is not prevented from spreading by its own solution-current.

I have repeated these experiments with various kinds of oil, and in each case found that by shaking up with alcohol the tension of equilibrium rose, and the tendency to spread was diminished.

In the case of ordinary olive oil there was but little difference between the purified and unpurified oil, although it was six times shaken up with fresh alcohol. With rape-seed oil and poppy oil I was more successful. Their tension of equilibrium was still somewhat inferior to the minimum tension, which was with rape-seed oil 0·85, and with poppy oil 0·82, but the spreading on a saturated surface was very slow, and upon a large clean surface the oils covered but a comparatively small area. The best success I had with almond oil, which behaved quite like Provence oil.

On the other hand, the tendency to spread, not only of pure oil, but also of benzol and petroleum, increased when oleic, palmitic, or stearic acid was dissolved in them.

Pure benzol can rest on water but in a rather thick layer. When the thickness is diminished to a certain degree, the layer breaks into drops, for which the following explanation seems to me most probable. The water-surface surrounding benzol, as in the case of oil, never is in the normal condition, the tension being diminished by the vapour streaming over the water. This vapour current ceases at the tension 0·88, which, as it appears, is somewhat lower than the equilibrium tension of benzol. Therefore a thin layer of benzol is broken by the vapour current.

When a floating fluid layer is not very thin, the tension of the surrounding anomalous water-surface, just balanced by it, is no longer equal to the sum of interfacial and surface tension. In the case of benzol it assumes a lower value than the minimum tension of the vapour-current, and therefore a sufficiently thick layer is allowed to spread coherently.

Benzol which is contaminated, for instance, by stearic acid or resin, behaves quite differently. The tension of equilibrium being lowered by those substances, it spreads so far as to show colours of thin plates.

Pure petroleum seems to be the only liquid which does not spread upon a normal surface. The vapour-current going out from petroleum ceases already at a relative contamination $< 1$, and therefore cannot produce a sensible decrease of tension. Nevertheless it may possibly prevent the floating drop from spreading. When sebacic acid is dissolved in petroleum, the latter shows a much greater tendency to spread.

In order to examine whether the effect of sebacic acids upon the tension of equilibrium be due to a decrease of the cohesion of the solvent, I have compared the surface-tensions of pure and contaminated benzol or petroleum, and those of the purified and unpurified oils. In no case have I found the surface-tension to be diminished by the sebacic acid, hence I came to the conclusion, that it is the interfacial tension which is altered.

Now let us consider the behaviour of common oil. It spreads in a coherent film to a certain thickness, which is different with various sorts of oil. Then small holes appear in the interior of the film, whilst the circumference of the latter is still increasing, and by the gradual increase in size of the holes the layer at last is broken and dissolved in small drops.

Why does the oil thus withdraw from the surface while its circumference is still increasing? The reason is, no doubt, that the oil spreads at the minimum tension of pure oil, but not at that of the free sebacic acid contained in it. The solution-current of the latter drives it back from the surface. Outside the oil-film spreading upon a large water-surface the tension of the latter does not sink below the minimum tension of the pure oil; in the interior of the holes, however, a newly-formed surface would be instantaneously saturated with oil, and here the tension, therefore, can be further diminished by the sebacic acid.

The minimum tension of oleic acid, at which the latter also does not spread, is in relative measure 0·52, and that of palmitic acid about 0·55.

The depression of surface-tension which can be attained by unpurified oil is not so great, but much greater than that produced by pure oil, and depends upon the quantity of oil applied.

If the quantity be such as to cover the whole surface before breaking, the surface afterwards is not contaminated with oil at all, but only with sebacic acid; and the tension is still sinking slowly by the effect of the continued solution-currents of the single drops.

When less oil is employed, the free sebacic acid contained in it is often not sufficient to produce the lowest possible tension. Then one may observe that freshly added drops of oil still give solution-currents, whilst those of the older drops have already ceased.

When a water-surface, on which minute drops of oil which have not yet dissolved are present, is expanded, the tension rises to the minimum value for pure oil, and then remains constant till the whole oil is dissolved, where it begins to rise again in the same manner as the curve given in NATURE, June 15, 1893, p. 152.

The value of surface-tension, at which the linear fall of the curve ceases, being identical with the minimum tension of pure oil, it is evident that the sudden change of direction at the relative contamination 1·3 means saturation of the water-surface with oil. AGNES POCKELS.

## Prof. Ostwald on English Chemists.

"To see ourselves as others see us" is so difficult of attainment, that no mirror, however imperfect, should be passed by without a glance bestowed upon it. The image of us which Prof. Ostwald displayed to the electricians assembled in conclave at the second anniversary meeting of the German electricians on June 7, is the less pleasant by reason of the consciousness that the reflector is a good one. The opening words of the Professor's address were virtually as follows:—

"It is a positive fact that every year there are imported into Germany from England so many thousand centners of benzene, amounting to nearly the whole of the production of this material in the latter country. Now benzene is an intermediate product, destined to be converted into dye-stuffs, medicaments, and other commodities, so that we have the remarkable situation that the country of all the world, in which industry has flourished longest, relegates the most important and profitable part of one of her manufactures to a foreign country. The reason is of the plainest: England *cannot* undertake the conversion of its raw material into the finished product, and why? Because of the insufficient training of the English chemist. The would-be practical Englishman with the intention of entering a dye-factory, studies, not general chemistry, but the chemistry of dye-stuffs. The German studies chemistry, lock, stock and barrel, never wrecking what his calling is to be. Only when he has a really scientific foundation will he begin to build up his special knowledge. By and by there comes a change over the face of the industry in which these competing chemists are employed. The German—he is ready; without difficulty he adapts himself, and follows up the novel course. But the Englishman—he cannot imagine at what position he has arrived; he must begin, so to say, over again."

Thus spoke one of Germany's—nay, the world's—greatest thinkers. Let our manufacturers, who despise the college-bred youth, meditate thereupon. A. G. BLOXAM.

Goldsmiths' Institute.

## "Testacella Haliotidea."

TATE, in his "Molluscs of Great Britain," gives a list of counties in which this mollusc may be found. In this list Worcester is not included. Hence it may be of interest to note that specimens are not infrequently collected in asparagus-beds here, as also are those of the much rarer *T. scutulum*. A good specimen of the latter was recently given by me to Mason College, Birmingham.

*Nematus grossularia.*—Here the gooseberry plantations are often devastated by the larvæ of this saw-fly, in the extirpation of which pest the insectivorous value of the cuckoo to planters may be appreciated through the following incident. Recently the attention of a resident of Crowle, a village near Worcester, was directed to his gooseberry plantation, close by a window of his house. A cuckoo was in one of the grub-infested bushes, fluttering its wings, and so causing numbers of the pests to fall on the ground, whence they were quickly gathered by the bird.