LXI. PREPARATION OF COLLOIDAL GOLD FOR THE LANGE TEST.

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A PRELIMINARY communication of the writer's method was made to the *British Medical Journal* [1922], since when he has examined 250 cerebro-spinal fluids with entirely satisfactory results. It is now proposed to redescribe the method, in part because its utility would appear to be established and partly because he has slightly modified it. Although Faraday and many authors since have considered neutrality a desideratum, the question of reaction has not been worked out and elaborate directions as to the preparation of the distilled water etc. are still given to the obscuring of the real issue. For what is happening when the reaction is adjusted at the end is in effect a neutralisation of the acids in the medium, whether present from the outset (as in the gold chloride and distilled water) or formed in the reduction. The mistake is frequently made of speaking of gold chloride as though only one preparation were known, whereas of course several are known; and they differ in acidity. Anyone can satisfy himself how true this is by carrying out the method about to be described, first using the double chloride of gold and sodium (the ordinary Scales brand used in photography) AuCl_3 , NaCl , $2\text{H}_2\text{O}$; and then the hydrochloride (AuCl_3 , HCl , 3 vel $4\text{H}_2\text{O}$).

Solutions prepared by Lange's modification of Zsigmondy's method, although looking well, often lack sensitivity and are acid; these may be called red slow samples.

Eskuchen using Eicke's method frequently made beautiful solutions which, for no known reason, would not react. In the absence of protective substances in the glassware (an important subject which will be dealt with later), the reason would seem to be that in these acid samples the particles are so small that the pathological constituents of the C.S.F. (or their experimental electrolytic equivalent) are unable to supply the energy necessary to aggregate them.

On the other hand, samples containing a frank bluish tinge (too alkaline and too sensitive) are liable to be produced by adding too much alkali; and curiously enough with certain reducing agents, e.g. glucose.

Between the beetroot red slow samples and the red blue fast samples there is to the eye a comparatively wide range of rose-coloured solutions which give satisfactory results. The main thing is not to read against some ideal colour in the mind's eye but against the red of the actual sample. The colour contrasts show well by reflexion in a pane of glass under which a piece of black paper has been placed on the bench.

The keynote of the method is simplicity. Ordinary laboratory distilled water is used, stale or fresh; any form of gold chloride (but the amount of adjuster will vary with the preparation); ordinary commercial formalin freshly diluted. The only novelty is the alkali added last—which may be called the adjuster—containing both the carbonate and the bicarbonate of potassium.

The reasons which led me to adopt a mixture of carbonates are these. I noticed that samples prepared with freshly made up K_2CO_3 were liable to be bluish red (corresponding already therefore to partial aggregation on the scale) and that the best samples were prepared with K_2CO_3 solution two or three weeks old; but if the solution were allowed to become yet staler, the samples tended to become rather pale like samples adjusted with $KHCO_3$ alone. This appeared to mean that at a certain point in the conversion of K_2CO_3 to $KHCO_3$ the optimum adjuster was formed. It was then attempted to determine the best proportions of the two carbonates and it was found after many trials that 2 % of each made an admirable adjuster which kept well.

The Method. Into a 250 cc. flask place 100 cc. ordinary laboratory distilled water. (We use an old tin-lined copper still.) Add 1 cc. of a 1 % solution of any preparation of gold chloride, say the double salt of gold and sodium (Scales brand) used in photography ($AuCl_3$, $NaCl$, $2H_2O$). Heat, and as the contents of the flask begin to bump, add 0.45 to 0.5 cc. of a $2\frac{1}{2}$ % solution of formalin (freshly diluted). Remove flame to the edge of the wire gauze and add boldly, say from a Dreyer pipette, 18 drops (0.7 cc.) of the adjuster; then proceed cautiously drop by drop until faint red streaks appear. Take no notice of a *faint* blue tinge which sometimes appears before the red streaks. Add one more drop, when coarser streaks will come up, rapidly developing into a smart blush. Cease now.

The sample as it cools in the flask will assume a rich old rose colour to transmitted light, throwing on to white paper a red colour with a violet tinge. It will be dichroic and have a curious yellowishness to reflected light; 5 cc. of it will be completely precipitated by 1.5 cc. of 1 % saline in half-an-hour; it will give lilac luetic and paretic curves in appropriate cases and no greater reaction than 1 with known negatives; p_H 7.0–7.5.

The reagent should not be used quite fresh; we make our samples the evening before the test; on the other hand they may not keep, hence the advantage of preparing small quantities. Samples which keep well (no dichroism) are liable to be too stable for the test.

All apparatus used should be scrupulously clean to begin with and be used for nothing else but the test. Once, however, a set of apparatus has

been appropriated for the test, no more cleaning (of pipettes, for example) is desirable, except of the flask, which, if a film of metallic gold has deposited—as occasionally happens—may be cleaned out forthwith with a test-tube brush kept for the purpose, and distilled water. Curiously enough the best way to clean a new flask is to make a bad sample in it; this will get rid in a most efficient manner both of protective substances and electrolytes.

CONCLUSIONS.

(1) Colloidal gold possessing the required sensitivity for the Lange Test may be prepared in any laboratory in a few minutes with

(a) Ordinary laboratory distilled water.

(b) Commercial formalin.

(c) Any preparation of gold chloride; say the double chloride of gold and sodium used in photography (Scales brand). The fact is constantly overlooked that the various preparations of gold chloride differ in acidity, a consideration which renders an adjuster imperative.

(2) Neutrality is secured by adding an alkaline adjuster, consisting of potassium carbonate and bicarbonate, last, the reduction taking place at the same time.

(3) Some dichroism in the sample is not only unobjectionable but desirable.

(4) Care must be taken, as before, to see that the apparatus set aside for the test is free from protective substances and electrolytes.

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REFERENCE.

Grey (1922). *Brit. Med. J.* ii, 1120 (correction 1923, i, 88).