the elimination of these and other possible interfering substances is complete, and it is suggested that inconsistent and variable results obtained in determining the sugar present in blood filtrates are due to such phenomena as those recorded by Stasiak. In confirmation of these observations we have found (unpublished research) that the copper reducing value of the polarimetric solution obtained from dog's blood by the method of Winter and Smith exhibits *irregular variations* from day to day.

We have pleasure in expressing our thanks to Dr. Edwin Goodall for his kindness in allowing us access to clinical material at the Cardiff City Mental Hospital. One of us (J. P.) is indebted to the Medical Research Council for a grant.

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A COMPARISON OF VARIOUS FORMS OF COLLOIDAL FERRIC HYDROXIDE.

BY

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FERRIC hydroxide, $\text{Fe}(\text{HO})_3$, is readily obtained in colloidal solution by a variety of methods, the products of which differ in a number of important respects. It has long been recognized that several distinct modifications of colloidal ferric hydroxide exist and it may be of interest to record a number of points in connexion with their physical and chemical behaviour and their reactions towards physiological fluids.

The several so-called soluble forms of ferric hydroxide contain the latter substance as a suspensoid colloid—namely, in the form of submicroscopic particles suspended in a liquid medium. For purposes of convenience the colloidal ferric hydroxides may be ranged in two categories according as the suspensoid particles carry a positive or a negative electric charge; this classification is useful because many of the properties of colloidal solutions are determined by the sign of the electric charge of the suspensoid particles. The present note deals with the comparison of the four typical colloidal ferric hydroxide solutions next described.

A. The best known of the positively charged ferric hydroxide suspensoids was prepared by Graham in 1861 by dissolving ferric hydroxide in aqueous ferric chloride solution and subjecting the resulting solution to dialysis, ordinary parchment paper being used as the diaphragm; the solution thus prepared constitutes the liquor ferri dialysati of the old *Pharmacopoeia*. Under these conditions hydrochloric acid passes through the membrane into the surrounding water and the dialyser retains a deep brown-coloured colloidal solution of ferric hydroxide; the colloid always contains a small proportion of the acid radicle originally present in the ferric salt, but this, by prolonged dialysis, can be reduced to a minimum. In this way Duclaux reduced the percentage of chlorine until it corresponded with the presence in the colloidal solution of aggregates of the composition $450\text{Fe}(\text{OH})_3 \cdot \text{FeCl}_3$. The preparation used in the present investigation was the ordinary pharmaceutical material of commerce.

B. Another, and quite distinct, colloidal ferric hydroxide solution is prepared by blowing steam through a boiling aqueous solution of ferric formate until the escaping vapour gives no acid reaction. This solution is much deeper in colour than one of the same iron content of the dialysed

iron A, and is notably less stable towards the action of precipitating agents.

C. If a solution of ferric formate is heated to 100° for some hours and then submitted to prolonged dialysis a very pale-coloured colloidal ferric hydroxide solution is obtained which is still more readily coagulated. This colloid is remarkable in that the ferric hydroxide precipitated from it is of a light yellow colour and is apparently in a higher state of hydration than the red-coloured ferric hydroxide which separates from solutions A and B.

In the three above preparations the suspended particles of ferric hydroxide carry a positive electric charge, as may be shown by passing an electric current through the solution, when the ferric hydroxide particles travel towards the negative electrode or cathode.

D. Colloidal ferric hydroxide solutions in which the particles carry a negative electric charge were also prepared by Graham in 1861 by the dialysis of ferric chloride solutions containing sugar; such solutions have been since found to be more conveniently prepared by the dialysis of solutions of ferric chloride with glycerol or sugars, to which caustic soda has been added. In these negatively charged forms of colloidal ferric hydroxide solution the sugar or glycerol acts as a protective and prevents the immediate coagulation of the ferric hydroxide; the protectives named do not, however, render the colloidal solutions permanently stable, and other protectives such as gelatin must be added to ensure stability. The preparation now issued as collosol ferrum is a colloidal ferric hydroxide solution protected in the manner just indicated and is used in the comparative experiments described below.

The four solutions used throughout the experiments now described were of the same concentration in iron, containing 0.5 gram of iron per litre; the concentration in iron may thus be stated as 0.05 per cent.

The results recorded in Table I show that the three forms of positive colloidal ferric hydroxide differ considerably in stability towards electrolytes and ordinary reagents; it is evident that the liquor

ferri dialysati is more stable than the other two, and is, in fact, the only one of the three which is not coagulated by freezing at -40°C . and subsequent thawing. The collosol ferrum is, however, considerably more stable than the liquor ferri dialysati and gives no indication of the presence of a soluble ferric salt by such delicate tests as those with ferrocyanide, thiocyanate, resorcinol, or

salicylic acid; it is the only one which is not coagulated by addition of colloidal arsenic sulphide.

The ultramicroscopic examination of these colloidal solutions at various degrees of dilution shows them to be very different in colloidal character. The steamed ferric formate solution, B, and the collosol ferrum, D, show numerous particles (submicrons) upon a dark background; many more submicrons are present in solution D than in B and the background is slightly the lighter in the case of D, indicating the presence of a higher concentration of amicroscopic particles. The liquor ferri dialysati, A, shows but few submicrons upon a light background, this latter indicating the presence of numerous amicros. The dialysed ferric formate solution, C, contains very few particles or submicrons, but shows intense general illumination of the background, due to the presence of large numbers of amicros.

A rough count shows that the collosol ferrum solution contains about 2×10^{10} submicrons per cubic centimetre. The relative numbers of particles or submicrons, the indicated relative concentrations of the amicros, and the depth of colour of the four solutions are also given in Table I. A comparison of these particulars shows that these colloidal ferric hydroxide solutions follow Ostwald's rule that the colour deepens as the size of the particles increases.

TABLE I.

Test:	L. Ferri Dialysati. (A.)	Steamed Ferric Formate. (B.)	Dialysed Ferric Formate. (C.)	Colloidal Ferrum. (D.)
Reaction	Faintly acid; 0.0028 normal	Faintly acid; 0.0225 normal	Faintly acid; 0.018 normal	Very faintly alkaline to litmus, neutral to phenolphthalein.
Colloidal As ₂ S ₃ solution added	Immediate opalescence; complete flocculation in 1 minute	Immediate coagulation	Immediate gelatinization	No change.
Added 40 per cent. by volume of saturated K ₄ FeCys solution	Immediate development of dirty green colour, solution remaining clear	Immediate coagulation; no blue colour	Immediate gelatinization followed quickly by coagulation; no blue colour	No change.
Dilute 7 c.cm. of the last mixture to twice the volume and added 2 c.cm. N/10 HCl	Immediate change through blue-green to Prussian blue; complete in 12 minutes	No immediate change; precipitate still brown after 48 hours	No immediate change; precipitate green after 18 hours	Immediate opalescence; colour became greenish-yellow in 5 minutes, and flocculation occurred in 2 hours, leaving pale green solution.
Added 0.2 gram KONS in 10 c.cm. water to 5 c.cm.	No change; no further colour developed	Coagulation slow, but nearly complete in 90 minutes	Slight opalescence; coagulation followed in 3 minutes, giving very gelatinous precipitate	Immediate opalescence; no change in colour.
Added 2 c.cm. N/10 HCl to last mixture	Orange tint developed in 1 minute; solution deep red in 20 hours, remaining clear	No apparent change in half an hour; after 17 hours, a precipitate in clear red solution	Coagulate distinctly red after half an hour, becoming deep red in a clear solution after 17 hours	Orange tint developed in 5 minutes and partial flocculation in 1 hour; solution very deep red in 20 hours, remaining clear.
Added 40 per cent. by volume of saturated NaCl	Immediate opalescence; flocculation complete in 1 minute	Immediate opalescence and coagulation within half an hour; precipitate red-brown	Immediate gelatinization followed by coagulation within 1 minute; precipitate light yellow	No change after 1 week.
Added 40 per cent. by volume of saturated Na ₂ CO ₃	Immediate flocculation; complete in 30 seconds	As above, but coagulation slightly less rapid	As above, but coagulation perhaps rather more rapid	No change after 1 week.
Added 40 per cent. by volume of N/10 NaOH solution	Flocculation complete in 15 seconds	Coagulation instantaneous and complete; red-brown precipitate	Coagulation instantaneous and complete; precipitate light yellow and very gelatinous	No change after 1 week.
Added 40 per cent. by volume of N/10 HCl solution	Distinct lightening of tint in 1 hour	No immediate change, but colour lighter after 17 hours; no coagulation	No immediate change, but colour lighter after 17 hours; no coagulation	No change in tint observed in 1 hour.
Added equal volume of absolute alcohol	No change	Slow coagulation, complete in 2 hours	No immediate change, but partial coagulation after 2 hours	Immediate opalescence; flocculation complete in 15 seconds.
Added 40 per cent. by volume of saturated salicylic acid solution	Immediate development of a brown colour, opalescence in 10 minutes, and complete flocculation in 20, leaving violet solution	Coagulation complete in 5 minutes; no colour developed	Coagulation complete in 5 minutes; no colour developed	Light brown colour developed in 10 minutes, then no further change.
Added 20 per cent. strong resorcinol solution	Slow development of greenish tint	No change	No change	No change.
Frozen solid and then thawed	No coagulation	Completely coagulated	Completely coagulated	No coagulation.
Relative numbers of particles, submicrons	40	100	4	1,000
Amicrons	++	None	+++++	+
Intensity of colour by tintometer	5.4	11	3.3	10

The therapeutic disadvantages of liquor ferri dialysati and ferric salts—causation of indigestion, constipation, etc.—are attributed by Bechhold¹ to the deposition of the ferric hydroxide gel in the smaller intestine by reaction with the alkali present. The production of an embolism on intravenous injection of liquor ferri dialysati has been traced

TABLE II.

Reagent Used.		10 Minutes.	Action in 2 Hours.	20 Hours.
Various concentrations of egg albumen filtered till practically clear. To 10 c.cm. was added 1 c.cm. colloidal iron solution	A	Thick precipitate	No further change	No further change.
	B	Thick red precipitate	Ditto	Ditto
	C	Thick yellow precipitate	Ditto	Ditto
	D	Very slight precipitate	Ditto	Ditto
Casein in 2 per cent. solution dissolved with trace of alk. li. 10 c.cm. was added to 1 c.cm. of colloidal iron	A	Precipitate	Precipitate	Precipitate.
	B	Brick-red precipitate	No apparent change	Precipitate thicker.
	C	Yellow precipitate	Ditto	Ditto
	D	No precipitate	No precipitate	Slight precipitate.
Gastric digestive mixture (persin + HCl) was incubated with egg albumen for 2 hours and filtered. 10 c.cm. of the filtrate was added to 1 c.cm. of colloidal iron	A	Brown precipitate	Heavy brown precipitate	No further change.
	B	Heavy red precipitate	No further change	Ditto
	C	Slight yellow precipitate	Heavy yellow precipitate	Ditto
	D	No precipitate	No precipitate	Pronounced precipitate.
Pancreatic digestive mixture with sodium bicarbonate and egg albumen incubated for 2 hours and filtered. 10 c.cm. of the filtrate was added to 1 c.cm. of colloidal iron and solution kept in incubator at 37°	A	Heavy red precipitate	No apparent change	Degree of precipitation ++
	B	Slight yellow precipitate	Ditto	Ditto +
	C	Heavy yellow precipitate	Ditto	Ditto ++++
	D	Slight yellow precipitate	Ditto	Ditto +

by W. H. Fischer² to mutual flocculation of the positive ferric hydroxide colloid and the negative colloids of the blood. It therefore became of interest to ascertain the reactions of the four colloidal iron preparations used in the foregoing experiments with various body fluids and solutions of physiological importance. Dr. W. E. Dixon, F.R.S., Reader in Pharmacology at Cambridge, has made a number of observations with the preparations in question, sent him under distinguishing letters, and has kindly furnished the results recorded in Table II.

Dr. Dixon adds:

"None of the colloidal iron solutions caused precipitation when added to filtered horse serum and incubated for four hours. The solutions A, B, and C produced an immediate precipitate when added to sheep's defibrinated blood, but the solution D produced no effect up to two hours. The solutions A, B, and C produce haemolysis of rabbits' hirudinized blood and sheep's defibrinated blood, but D gives no such effect, the haemoglobin apparently remaining intact in the corpuscles. Intravenous injection of solutions A and D into rabbits and dogs in 2 c.cm. doses was without toxic action.

"The effect of a direct constant electric current in carrying iron from solutions A and D into the substance of freshly cut portions of potato was also determined, the experiments being arranged as shown diagrammatically at page 233, and the slice of potato being separated from the carbon poles by lint soaked in the colloidal iron solution. After passing a current of 10 milliamperes for two hours sections of the potato slices were made parallel with the direction of the current; the sections were then treated with aqua regia followed by potassium ferrocyanide. It will be noted that the iron passes into the section of potato only on the positive side from the colloidal iron solution A and into both positive and negative sides from solution D, as shown in the figure."

These results show that the colloidal ferrum solution is not only more stable than the liquor ferri dialysati towards

inorganic reagents, but that it also yields a coagulate much less readily when mixed with a number of physiological liquids. The investigation of this subject and its consequences is being continued.

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MEMORY SIGHT.

BY

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THERE is a widespread impression, not only amongst the laity but also in the ranks of the medical profession, that the blind—by which I mean the totally blind—live in perpetual, black darkness. This I believe to be an error in observation, for inquiries have elicited from my blind patients the information that, on the contrary, they habitually see “a bright background.” They describe this variously, but the terms “like a bright cloud,” or “like a luminous haze,” seem to convey the prevailing impression, whilst remarks as to “a play of colours” before the eyes are also met with from intelligent people. A patient of Dr. de Schweinitz, though totally blind, declared that “all things seemed to be a sea of red fire.” I cannot but think that this “outlook” powerfully modifies the mental qualities of the blind, and helps materially to give them that cheerfulness which is so strikingly their class characteristic. It would be difficult to believe that anyone who was surrounded by thick darkness could by any possibility be mentally cheerful.

There is another feature of “the sight of the blind” which is little known, and of which they seldom care to speak unless directly questioned, probably owing to the fear that it may excite scepticism or ridicule. On this point I venture to quote from my book on glaucoma (*A Treatise on Glaucoma*, second edition, p. 105):

“Even more striking is the fact that patients are to be found who will protest that there are occasions on which they can sit by a window, look out, and see all the features of a scene with which they were familiar in days gone by; and yet on examination the eyes are absolutely blind. To this condition the term ‘memory sight’ may be applied, for the pictures are but the aftermath of visual impressions stored in the cerebral cortex in a happier past. Such is the power of reflection and of recollection that the patient’s mind is enabled to summon these shadows of earlier impressions and to invest them with all the semblance of a reality. It is indeed a pitiable delusion, born of memory and imagination, of hope and despair.”

I have quite recently seen an elderly patient, long blind in one eye from glaucoma, who had lost all vision in the second eye from the same disease, and who had to have this eye removed on account of constant pain; her one great fear was lest the removal of the eye might rob her of the subjective sensations of light, from which she derived so much comfort. The enucleation of the eye made no difference whatever to these. She could still see the bright field of light, just as before, and she described in glowing terms how she could summon up to her consolation the “actual vision” of many objects around her. Her own words are of interest: “I can make myself see the things and people around me; I can even see every stitch of the knitting which I hold in my hand, just as I did in the days when I had my sight.” More recently I have seen a man over 70 years of age who had lost one eye as the result of an accident in his youth; he developed a malignant growth of the second eye, and this too was removed after a consultation in which all concerned were unanimous as to the right course to pursue. He describes his visual sensations thus: “I see a sort of white mist tinged by light from above; this appears to come from behind me.” He also sees pieces of furniture—such as a grand piano of dark wood, or a writing-table, or other articles of furniture—which are apparently so real and vivid that he tries to avoid walking against them. Be it remembered that he has no eyes whatever.

We are all of us aware that, with our eyes closed, in the dark, during sleep, we can see people and things most vividly in our dreams; but it might be argued that this is not very strange, since we still possess actively sentient ocular globes. It is of interest to learn from these cases,

not only that blind eyes may see during waking hours the images of objects perceived in bygone days, but that the complete removal of the globes is no bar to the memory sight, which brings so much comfort to the blind. Clearly we have here to do with memories stored in the brain, presumably in its cortex, as the result of earlier experience. In this connexion it is interesting to remember that a man does not see with his eyes, but with his brain; the eyes are but a complex mechanism, optical and neuro-electric, whereby external stimuli are conveyed to the cerebral cortex, there to give rise to visual sensations. This explains many things which are otherwise difficult to understand—as, for instance, the way in which a trained observer, with relatively less visual acuity, as tested by types, etc., will pick up and recognize distant objects with an accuracy and a speed which the ordinary man, untrained in the same direction, cannot emulate.

BUTYN AS A LOCAL ANAESTHETIC:

A WARNING.

BY

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THERE have been several communications in the *JOURNAL* recently on this subject, and the question of cocaine substitutes has been well summarized in the article by E. Watson-Williams, in the issue of December 1st, 1923. Having special opportunities for testing any cocaine substitute in intralaryngeal surgery, I accepted the invitation of the Ministry of Health to give butyn a trial. The following were the results in four cases:

CASE I.—A man, aged 34, with tubercle of lungs and larynx, was sprayed and painted with a 5 per cent. solution of butyn. The patient was only able to tolerate touching the epiglottis. Repeated swabbing of the interarytenoid region failed to benumb this important area even at the end of twenty minutes; yet it was quickly anaesthetized with a 10 per cent. solution of cocaine, and the galvano-cautery was easily used on the vocal cords. There was profuse secretion of mucus.

CASE II.—A woman, aged 38, with tubercle of lungs and larynx. Half an hour was spent attempting to anaesthetize the larynx with a 5 per cent. solution of butyn; in this object it entirely failed, but it produced much secretion of mucus. I was therefore obliged to have recourse to cocaine in a 10 per cent. solution, which had been used on the patient on several previous occasions, and quite successfully.

CASE III.—A man, aged 36, with tubercle of lungs and larynx, was a very tolerant patient who had had many cautery treatments to the larynx under cocaine. The butyn was effective as an anaesthetic, but it took longer to act and was less complete than cocaine. The patient remarked that his throat was less “numb” than usual. The profuse secretion of mucus was very inconvenient.

CASE IV.—A man, aged 31, with tubercle of lungs and larynx, was extremely tolerant. Complete anaesthesia was obtained, although the free secretion of mucus was troublesome. All pharyngeal and laryngeal reflexes were abolished and it was easy to make a satisfactory application of the galvano-cautery to each vocal cord. This application had just been completed and I was congratulating the patient on his behaviour, when, without any warning, he half rose from his chair in a condition of tonic convulsion and would then have fallen forward on the top of me if I had not seized his body and laid him flat on the floor. Here he passed through the typical phases of an epileptic convulsion—unconsciousness, congested face, foaming at the mouth, clonic spasms, dilated pupils, and large bounding pulse. At the end of two to four minutes he gradually recovered consciousness, but remained in a dazed condition for some time. He had no recollection of what had happened. Inquiry showed that he had never been subject to fainting or fits, and there was no history of epilepsy in his family. A month later his larynx was anaesthetized with a 10 per cent. solution of cocaine and then treated with the galvano-cautery, without any suspicion of faintness, convulsion, or other untoward incident.

During the last twenty years, though making free local use of cocaine, I have had no anxiety in a single case.

This alarming incident with butyn will certainly prevent me from employing it again. Compared with cocaine in laryngeal work it is slower in action, very much less effective, produces an irritating amount of secretion, and can evidently be extremely toxic.

Whatever its use may be in the eye, ear, nose, or pharynx, I can see nothing but disadvantages and dangers in using it in laryngeal work.

I should add that a few drops of adrenaline were employed with the solution of butyn and that a sterile solution was freshly prepared, according to directions.