followed by a most profuse haemorrhage after the third stage was complete. I made a point of personally attending her in the maternity ward. After the labour and the third stage, which were perfectly normal, she suddenly started to bleed profusely from the placental site, which was checked only by prolonged bimanual compression and the injection of pituitary extract.

The explanation of such a case is extremely difficult, as the course of labour, and also the third stage, on each occasion appeared normal. This in my opinion would rule out disease and also deficient retraction. There was no suggestion of placenta praevia. I think it may be explained by an experience I had when curetting a patient who had been bleeding for many weeks following a miscarriage at the fourth month. The curetting was done with a sharp curette as there were no retained fragments. Following the curetting she bled so profusely and so persistently in spite of treatment that a vaginal hysterectomy was performed. Section of the uterus showed a large vessel the size of the normal uterine artery passing through the musculature to the placental site.

I suggest that some of those rare and unaccountable haemorrhages from an apparently normal and empty uterus may be due to the presence of some unusually large arterial trunks in close proximity to the placental site. Occasionally cases which have been treated for ante-partum haemorrhage of the accidental type have a serious post-partum haemorrhage. Fortunately, the more serious cases of this condition, especially where the bleeding is concealed, are operated on, and this enables the operator to estimate the extent of the damage to the musculature, and whether or not it is safe to conserve the uterus without risking a severe and fatal post-partum haemorrhage. Many of these cases, however, are dealt with by domestic measures and have a spontaneous delivery or one aided by forceps, and there is no way of assessing the condition of the uterus. In one such case where there had been some concealed haemorrhage the third stage concluded with a most profuse and continuous haemorrhage. It was quite impossible to perform bimanual compression, as the empty uterus lay relaxed and flaccid in the abdomen and no mass of muscle substance could be squeezed. She died before a laparotomy could be performed. All cases of accidental haemorrhage, especially of the concealed type, should, if possible, be dealt with in a nursing home or hospital.

In cases of placenta praevia there is always the risk of a severe post-partum haemorrhage, but fortunately it is a rarity. I have met only one such case which failed to respond to any of the usual routine procedures, including bimanual compression. In this connexion it must be borne in mind that the rapid extraction of a breech baby in such a case may very readily cause a tear of the cervix and lower uterine segment and result in profound and even fatal haemorrhage.

Conclusion

As regards the problem of post-partum haemorrhage in general, with the exception of the rarer conditions, if the uterus is handled properly it will very rarely give rise to anxiety on account of bleeding, and with the rarest possible exceptions an empty uterus will not bleed except from a cervical laceration. I am against packing a uterus. The rule is to empty the uterus if the bleeding is to be stopped. The pathological uterus which is deficient in contractile and retractile power is less likely to respond if it is distended. I never repair cervical lacerations, and would perform bimanual compression

followed by a hot douche in preference to packing if faced with serious bleeding from such a lesion. My experience of cases sent into hospital with the vagina reported to have been packed before admission would in itself make me opposed to advocating deeper tamponage.

I consider that many of the cases at present treated by blood transfusions would do equally well if they were given gum- or glucose-saline.

OPHTHALMIC INJURIES FROM MUSTARD GAS (D.E.S.)

BY

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Recent letters in the *Journal* are evidence of the interest taken in ophthalmic lesions due to mustard gas. I felt, in the circumstances, that certain information on this subject collected by me in the last few years might be acceptable to others. The table below is compiled mainly from figures in the *Medical History of the Great War*, already quoted in part by Sorsby. Thuillier (1939), while giving the total number of British mustard gas casualties as not fewer than 150,000, states that the total number of eye casualties is unknown. In the *Official History of the War:—Medical Services* (1923), however, it is stated that "the great majority of D.E.S. casualties had eye burns." Yet out of this large number only ten had persistent impairment of vision after the war—this number rising from recurrent corneal trouble to thirty-four in 1937.

Reagent Mustard	Grading	%	Onset	Physical Signs	Symptoms	Treatment	Incapacity
Vapour <1/10,000,000	Mild	75	2-48 hrs.	Conjunctival congestion	Irritation and photophobia	2% NaHCO ₃ solution; paroline; paper shade	1-4 weeks
Stronger vapour 1/20,000	Intermediate	15	2-48 hrs.	Ditto + chemosis	Ditto more severe	Ditto + 1% ung. atrop.	4-6 weeks
Concentrated vapour and liquid	Severe	10	Maybe almost immediate	Ditto + blistered lids and white band across cornea	Ditto	Ditto + treatment for infected ulcers and symblepharon	8-16 weeks

The burn is divided into three stages by Bonnefon (1939): the period of impregnation, the established burn, and the period of decrescence. It is the period of impregnation which is most interesting therapeutically, as once the burn is established there appear to be very few curative possibilities other than the treatment tabulated above. The difficulties in countering D.E.S. in the period of impregnation are as follows:

1. *Liposolubility*.—The gas is even more readily absorbed by the cornea than by the skin, and Sorsby (1939) has stated that if "drops" of liquid D.E.S. are placed experimentally on both corneae of a rabbit, and one eye is irrigated, the lesions are identical in both next day.

2. D.E.S. is relatively insoluble in water.

3. Except for its peculiar and specific intracellular reaction it is not an active substance chemically. Dichlormethyl sulphide and $\alpha\alpha$ -dichlorethyl sulphide are equally liposoluble,

very similar in constitution, and just as easily broken up into hydrochloric acid under conditions resembling the intracellular, but are non-vesicant.

4. The eye will only tolerate in low concentrations reagents active enough to attack D.E.S.

As we may have an opportunity in the near future to try the effect of different remedies on the human subject, for those who may become dissatisfied with the accepted treatment I have included in the second half of this paper some notes on the chemical possibilities.

For the Established Burn

I find that Hederer and Istin (1935) have suggested the following applications, which I have not seen quoted elsewhere. These may be helpful in unsatisfactory cases which have not responded to the regular treatment. I have no other evidence as to their efficacy, however, than their quotation in the volume mentioned, and their recommendation by René Onfray in a personal communication in 1936. (1) For photophobia: 2 per cent. pilocarpine drops. (2) For pain and chemosis, ophthalmic ointment Z-1:

	Grammes
Orthoforme (benzocain)	5
Ichthosulphol	2
Sodium ichthosulphol	1
Thigenol	1
Sodium bicarbonate	1.5
Borax	1
Sodium sulphate	0.25
Magnesium sulphate	0.25
Excipient	ad 100

The benzocain does not produce corneal desquamation.

For the period of decrescence after the main infection has subsided they have suggested the use of ophthalmic ointment Z-2:

	Grammes
Medicinal scarlet red, insoluble	2
Methylene-blue, purified	0.5
Bismuth subgallate	1.5
Liquid paraffin, neutral	20
White vaselin, neutral	20
Anhydrous lanolin	60
	q.s., ad 100 gm.

Period of Impregnation: Antidotes

MECHANICAL REMOVAL

Oil, grease, and soapy solutions which remove the liquid from the skin have been shown to reduce the effects up to ten minutes after exposure, while, again, oily substances on the skin have a definite temporary prophylactic effect, clearly demonstrated experimentally (Sollman, 1919). I know of no experiments in which oily substances are used as a prophylactic in the eyes, and the skin experiments are not directly applicable, as the grease was removed after a time. The prophylactic effect may merely represent the partition coefficient of mustard gas between grease and human skin. While the vesicant effect of the tears in the earliest stages, custom, and the incidence of secondary infection suggest that ocular irrigation reduces the severity of the burn, the efficacy initially, owing to the rapidity of absorption of D.E.S., is open to doubt.

ADDITION COMPOUNDS OF D.E.S.

These are formed by *p*-toluene-sodium-sulphochloramide and toluene-sulphodichloramide (monochloramine-T and dichloramine-T). The end-product isolated by Mann and Pope (1922), $\beta\beta$ -dichlorodiethyl-sulphide-para-toluene-sulphonylimine, is in spite of its imposing name relatively inert. Dichloramine-T also breaks up lewisite into harmless oxidation products. Monochloramine-T has a solubility of 1 in 7 in water, and has been used as an antiseptic on mucous membranes in a 0.25 to 2 per cent. solution. It has also been employed as a 1.5 per cent. ointment and as a 1 in 500 aqueous solution for bi-daily irrigation in cases of trachoma.

Dichloramine-T.—A 0.5 per cent. solution in chlorosane (chlorinated medicinal paraffin) has been used in trachoma. This solution is stable for three days only and should not be employed if there is a precipitate. Warthin *et al.* (1918) claim that it has a definite prophylactic and therapeutic effect on rabbits' eyes when exposed to D.E.S. and that its effect on human eyes burnt by D.E.S. is beneficial. I can, however, find very little information elsewhere about its use.

OXIDATION OF D.E.S.

Oxidation of D.E.S. produces the less irritant tetrachlorodiethyl sulphoxide and the non-irritant sulphone. The eye, however, will not tolerate concentrations of reagents which leave the skin unaffected. Among possible applications are:

(a) 1 in 10,000 potassium permanganate.

(b) Diluted eusol solution as used by St. Margaret's on cases of ophthalmia neonatorum, and which I have employed on hypopyon ulcers for some time: it is equivalent to a 1 in 10 strength ordinary eusol solution. The prescription of ophthalmic eusol (J. D. M. Cardell, personal communication, 1936) is as follows. Two ounces of boric crystals and 2 oz. of chlorinated lime are dissolved in half a gallon of water. The solution is allowed to stand for twenty-four hours. It is then filtered and diluted with an equal quantity of water. This is kept as a stock solution. For use in the eyes nine parts of water are added to one part of stock solution, a further filtration being sometimes necessary. Unfortunately, I found only recently, the composition of the final aqueous solution is: hypochlorous acid, 0.027 per cent.; calcium borate, 0.128 per cent.; calcium chloride, 0.017 per cent. Some might object to the application of a solution containing calcium to a lesion in which punctate keratitis develops and extends after the first ten minutes.

(c) *Milton*.—This is a proprietary preparation of sodium hypochlorite, 1.01 per cent.; sodium chloride, 16.8 per cent.; with traces of sodium sulphate, sodium chlorate, sodium carbonate, and calcium chloride. It also is open to the objection that it contains calcium. According to the directions supplied with the bottle ten drops are to be placed in half a glass of cold water, as stronger solutions irritate the eye. If an eight-ounce tumbler is assumed, then this is a dilution of 1 in 152.

The free chlorine available in the latter two solutions and in Daufresne's solution is: eusol, 0.4 per cent.; Milton, 0.47 per cent.; Daufresne's solution, 0.45 per cent. This would suggest that it would be possible to utilize a much stronger solution of Milton than advised on the bottle if one were anxious to introduce more free chlorine, and that Daufresne's solution (liq. sod. chlorinat. & sod. bicarb.) can be used in a slightly greater dilution than eusol, and with the advantage that it would be less likely

to contain calcium. All these solutions contain hypochlorites and are unstable to a varying extent.

HYDROLYSIS OF D.E.S.

Although sodium bicarbonate solution was probably suggested originally as an eye-wash in the hope of producing hydrolysis, and irrigation by saturated boric acid followed by sodium bicarbonate ointment (Kinttoff, 1939) is still the German first-aid treatment, it is doubtful if hydrolysis of mustard gas in the conjunctival sac plays much part in reducing the severity of the lesion, for the following reasons:

(a) At 10° C. mustard gas has a solubility of only 0.07 per cent. in water. At body temperature 25 per cent. of the mustard gas in such a solution is hydrolysed in three minutes, but this reaction is not accelerated by alkalis (Peters and Walker, 1923).

(b) The tears, except in the earliest stages of the burn, have no vesicant effect on the conjunctiva of rabbits (Warthin). (Bonnefon dissents from this, stating that tears are vesicant for two to five days.)

(c) If mustard gas is applied to skin covered by a paste of sodium bicarbonate and water the resultant burn is worse than if it is applied directly to the skin (Warthin).

Consideration of these facts suggests that if sodium bicarbonate solution has any effect on eye burns it is simply by virtue of the irrigant effect of the aqueous vehicle. Saturated boric acid acts in the same way, but has the disadvantage that it dissolves slowly and that solutions must be prepared in quantity in advance.

Hypertonic Withdrawal

Bonnefon has advocated the use of hypertonic solutions on the grounds that a freer flow of lymph is produced in the already oedematous conjunctiva, and that D.E.S. is withdrawn through the conjunctiva by the osmotic effect of the solution—as shown by the fact that the fluid in the eye-bath used for application becomes caustic after a few minutes. The solution suggested is 800 grammes of saturated sodium sulphate + 200 grammes of saturated sugar syrup. It is extremely difficult to accept this scientifically, as he quotes no statistics of clinical results and the scientific basis for his claims is incorrect. He states that a porcelain-like burn of the cornea occurs only in the horse and the rabbit because they have no lacrimal glands. This porcelain-like burn is recorded in the *Medical History of the Great War* in the 10 per cent. of severe cases in human beings, and the horse and the rabbit have lacrimal glands—the lacrimal bones are notched for the duct (E. A. Spaul, personal communication).

Bonnefon also suggests earlier in his paper that the tears remain caustic for a few days in any case. A hypertonic solution in the ordinary way would withdraw water only through the living semi-permeable membrane. It is possible, therefore, that his hypertonic solutions merely act in the same way as sodium bicarbonate—that is, as a mechanical irrigant. Nevertheless as he makes strong claims for the clinical results it would be interesting to analyse the washings of eyes burnt by D.E.S.—one group being irrigated with sodium bicarbonate and the other treated by hypertonic solutions. This might give us a clue as to the relative value of the two methods, since it is doubtful if the mere production of further oedema will do very much good. The induction of conjunctival oedema is, I think, disappearing as a treatment from the armoury of most ophthalmic surgeons these days.

Summary

The tolerance of the eye to certain reagents capable of neutralizing mustard gas under various conditions is discussed.

Animal research on the following lines is suggested: (1) The effect of the application of the reagents discussed above to eyes exposed to low concentrations of mustard gas. (2) The comparison of the washings of such eyes of the first few days for total chlorides, after treatment by (a) alkaline lavage; (b) hypertonic solutions, as suggested by Bonnefon.

The results thus obtained might indicate further clinical trial of some of these reagents in the event of gas warfare.

I am obliged for information from Professors Spaul and Challenger of Leeds University and Mr. B. Wood, senior dispenser of the General Infirmary at Leeds.

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A RAPID PRESUMPTIVE SEROLOGICAL TEST FOR WEIL'S DISEASE

BY

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The macroscopic agglutination of bacterial suspensions in the presence of homologous sera on a slide, which is gently rocked to and fro about a longitudinal axis, has been known for more than thirty years as a rough-and-ready method for the determination of the nature of a bacterium. Garrow (1917) elaborated the procedure in the form of his clockwork agglutinator. It is claimed that the readings are on the average within one dilution of that found by the full macroscopic method, but, as the Medical Research Council's Report No. 51 points out, this represents a possible 100 per cent. error, and concludes that the field of usefulness of this apparatus lies where rapid work is required under stress of circumstances. It is exactly under such stress that the test described below is intended for use.

In the first place brief reference must be made to the standard agglutination technique devised by Professor Schüffner. This consists in making varying dilutions of the patient's serum, to which are added equal volumes of a formalized suspension of leptospira: after incubation, droplets are examined microscopically by dark-field illumination with a 2/3-inch objective and a high eyepiece; no coverslip is used. I have personally for several years been in the habit of examining for agglutination after the mixture of leptospira and diluted serum has been allowed to interact overnight at room temperature; other observers incubate for varying periods at different temperatures.

From time to time a macroscopic technique has been advocated similar to that used when studying bacterial agglutination, the results being read either by the naked eye or with a hand lens. Pot (1936), in describing a macroscopic test for Weil's disease, advocated the use of an antigen grown in Korthof's medium and incubated at 52° C. for two hours, the results being read with a hand