disturbance in the pyramidal and spino-thalamic tracts was found." It is necessary, however, to point out that later in the paper it is stated that the tumour in one of these cases, a small pointed chondroma, was placed in such a position that it could compress a small circumscribed area of cord in the region of the left spino-thalamic tract, and that in this case the sensory disturbances were confined to the right side.

From personal observation it appears that uncomplicated compression of the spinal cord is commonly manifested by the following symptoms and signs, which as a rule present themselves in the order given:

1. Pain of a severe character, commonly described as of a "burning" or "tearing" nature, in the lower limbs and trunk below the level of the lesion. This may or may not be accompanied by pain in the distribution of the spinal nerves arising at the site of compression and produced by pressure on, or irritation of, nerve roots. In a few cases pain is absent, and the initial symptom is weakness of the legs.

2. Weakness and stiffness of the lower limbs and alteration of reflexes.

3. Objective sensory disturbances below the point of compression, at first affecting conduction in the spino-thalamic tract, but later affecting elements of sensation dependent upon other sensory tracts.

4. Bladder symptoms, accompanied in the limbs by more profound loss of voluntary power and movement and more profound and complete sensory loss.

It is not easy to offer any explanation for the occurrence of this dissociation of sensation, found often in compression of a peripheral nerve or of the spinal cord, as it is difficult to perceive any reason why the fibres conducting impulses concerned with pain and temperature should be more vulnerable than the others. In the case of compression of a peripheral nerve the effect must be upon the peripheral sensory neurones which have their cell station in the posterior root ganglion, whilst in compression of the spinal cord the mechanical effect of the lesion must be exerted upon the secondary sensory neurones, which for the pain and thermal paths have their cell station in the grey matter of the cord. It has been possible to follow the results of release from compression in a large proportion of the examples seen in the peripheral nervous system, and from the rapidity with which recovery of sensation appears in the earlier cases it seems improbable that actual degeneration had occurred during the early stages of the manifestation of the dissociated sensory loss. If the compression persists for some time before it is relieved it seems likely that degeneration subsequently occurs, but from the extremely rapid recovery in the earlier cases (within twenty-four hours of release in a few instances) it does not seem possible to conclude that degeneration of the fibres concerned with pain and thermal sensations is a necessity for the production of the characteristic sensory dissociation. It has not been possible to keep under observation a sufficient number of spinal cases after relief of the compression to express a definite opinion about the possibility of recovery from the objective sensory loss. In early cases where there has been only hypalgesia and thermal hypaesthesia, recovery, as far as one can determine by the customary clinical tests, has occurred. Nevertheless, it is very doubtful if recovery of sensation ever succeeds the establishment of complete analgesia and thermal anaesthesia, and this suggests the early development of degeneration, since there is no possibility of the fibres in the spinal cord undergoing regeneration.

When the analgesia was first observed in compression of peripheral nerves I was attracted for an explanation to the work of Ranson,⁴ which suggested that the afferent fibres concerned with protopathic sensibility are non-medullated, but subsequent researches have failed to support Ranson's view, and there appears to be no reason for believing that the protopathic fibres differ in structure from other sensory fibres.

SUMMARY.

Attention is directed to the frequent occurrence in spinal compression of a dissociated sensory loss, similar to that previously described as a result of compression of peripheral nerves.

Since the first indications of this characteristic sensory disturbance may be discovered at a fairly early stage in

the development of the compression and before the onset of profound paralytic symptoms, they may be regarded as a valuable aid to diagnosis. This often renders it possible to undertake the relief of compression before it has caused irreparable damage to the spinal cord.

In the present state of knowledge it is not possible to advance any explanation of the occurrence of this dissociation, but there is evidence which suggests that hypalgesia and thermo-hypaesthesia may appear before actual degeneration of fibres has occurred in either the peripheral nervous system or the spinal cord.

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THE EFFICACY AND STANDARDIZATION OF HAEMOSTATICS.

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DURING the last two decades the use of organic extracts and of haemostatic serums in the arrest of obstinate haemorrhage has gained some prominence in medical practice, but no unanimity exists as to the value of the preparations in use. On the one hand, the claims of the makers of haemostatics are supported by a considerable amount of clinical evidence; on the other hand, the results of laboratory experiments by different observers are contradictory, the same preparations being described by some as active and by others as inactive (cf. ¹⁻⁴); whilst one well known haemostatic has been included amongst the nostrums described in *The Propaganda for Reform in Pharmacy* (1922).

The work here summarized was undertaken to ascertain the causes of these discrepancies and to devise, if possible, simple and reliable methods of standardization of those haemostatics which decrease haemorrhage by increasing the coagulability of blood.

Previous Experiments.

An examination of the experimental methods used in testing the efficacy of haemostatics reveals the causes of the varying results obtained by different observers, and shows that the conditions imposed differ radically from those existing in blood escaping from wounds. This is apparent from the following summaries of the methods employed.

1. The blood is kept fluid by the addition of either soluble oxalates or citrates which remove or immobilize the calcium ions of the plasma. The haemostatic is then added and coagulant action is noted when present. Blood under these conditions only clots on the addition of thrombin, and this technique merely indicates either the presence or absence of that coagulant. As calcium ions are essential for spontaneous clotting conditions are introduced which are never present either in normal or pathological bloods.

2. A variant of this technique is commonly used by the manufacturers of haemostatics in the standardization of their products. The speed of the clotting of blood after oxalation and recalcification at room temperatures is compared with that of blood similarly treated to which the haemostatic to be tested has been added. The efficacy of the haemostatic is estimated by any increase in the speed of clotting following its addition. Several errors are inherent in this procedure. The acts of oxalation and recalcification modify the stability of the plasma, so that its coagulability differs markedly from that of normal

blood,⁵ whilst the texture of the clots formed depends both on the speed of recalcification and on the temperature of the reaction.⁶ The consistency of blood clots is as important a factor in the arrest of haemorrhage as is the speed of clotting, since loose clots provide but slight resistance to the escape of blood and are readily broken up when bleeding is rapid. The value of this method is also strictly limited. Solutions of both oxalates and citrates partially inhibit the coagulant action of free cephalin,⁷ which is the active constituent of the large group of haemostatics known as "thromboplastins."

3. Blood kept fluid by the action of "peptone" has been used as a test fluid for appraising the activity of coagulants containing cephalin,⁸ but this method is not generally applicable, as some substances which provoke clotting in "peptonized" blood have little or no action on pure blood.

4. Three other methods of standardization were introduced by Hanzlik.^{2,3} In his earlier work the preparations to be tested were dissolved in sodium citrate and were allowed to flow rapidly over the denervated pad of a dog's foot which had been cut down to below the papillary layer. The amount of blood escaping in a given time was gauged colorimetrically, and coagulant action was thus appraised. Tested by this method most of the newer haemostatics gave negative results, and were accordingly condemned as worthless. The favourable clinical reports were dismissed as examples of the inexplicable cessation of haemorrhage which sometimes occurs spontaneously. Later Hanzlik³ recognized that the use of citrates was a source of error, and he substituted normal saline as a diluent, again applying continuous irrigation. The efficacy of various haemostatics in the treatment of inaccessible haemorrhage was estimated by observing variations in the amount of blood issuing from a wound after their intravenous injection. In these experiments the wound was continuously irrigated with normal saline. In both groups of experiments either cessation or reduction of haemorrhage was frequently followed by a recurrence of bleeding. It was therefore concluded that the coagulant action of haemostatics is both variable and incomplete. Several circumstances contributed to these results. Continuous irrigation disturbs and dislodges clots, and thus favours a recurrence of bleeding. Although local vaso-constriction of the arterioles was prevented, alterations in the general blood pressure and changes in the tone of the capillaries of the wounded area were not estimated; consequently there were variations in the amount of escaping blood. The amount of tissue coagulant exuding from the cut tissue was not controlled, and in those experiments in which a haemostatic was injected intravenously and the wound continuously irrigated with normal saline uniformity of the dilution of the escaping blood was not assured. Nevertheless, experiments open to these objections have been used as the basis of statements intended to be authoritative.

Essentials in the Standardization of Coagulant Haemostatics.

The essential conditions for the accurate standardization of haemostatics may be summarized as follows: (1) No substance which acts either chemically or physically on blood, other than the haemostatic, should be present. (2) No substance should be removed from the blood. (3) The blood should be uncontaminated by tissue juices. (4) The blood should remain fluid sufficiently long to observe the effect of the haemostatic. In addition, the action of the haemostatic should be studied in different concentrations and at different temperatures, as these conditions modify its efficacy.

The Methods Employed.

Advantage was taken of the fact that blood shed through a paraffined cannula into a vessel completely coated with paraffin wax remains fluid at room temperature (17° C.) for at least an hour, provided the animal has not suffered severe haemorrhage. Blood under similar conditions remains fluid for thirteen to fifteen minutes at 37.5° C. Fluidity is thus preserved sufficiently to test the coagulant action of any haemostatic under the conditions previously named. Cat's blood was used, as it reacts more constantly to coagulants than that of the dog or rabbit. The animals were anaesthetized with a mixture of chloroform and ether.

In the standardization of the local action of haemostatics 10 to 12 c.cm. of blood was shed from an artery into a paraffined vessel through a paraffined cannula. By means of paraffined pipettes 1 c.cm. of blood was immediately transferred to each of a series of paraffined vessels containing 0.25 c.cm. of the haemostatic to be tested in the dilutions recorded in Table I, isotonic sodium chloride being used as a diluent. The speeds of clotting were then observed at 17° C. and at 37.5° C.

The efficacy of haemostatics when administered internally was tested as follows: 1 c.cm. of blood was shed through a paraffined cannula into a paraffined vessel, and was used as control blood. The haemostatic was then administered, and after an appropriate interval 1 c.cm. of blood was shed through another paraffined cannula inserted into another artery. The time of completion of clotting of this blood was observed at 17° C. and at 37.5° C. By "time of completion of clotting" is understood the time occupied in the conversion of the whole of the blood into a gel. The results given in Tables I and II are representative of 400 experiments. Fresh preparations of the haemostatics were used.

Results.

The haemostatics which precipitate blood plasma, such as ferric chloride and alum, have a low efficacy, as the coagula are loose in texture and permit the escape of blood from damaged vessels. The clots produced by the haemostatics named in Tables I and II are firm in texture and contract normally. They are thus efficient in the arrest of bleeding.

TABLE I.—Time of Completion of Clotting after the Addition of 0.25 c.cm. of various Haemostatics to 1 c.cm. of Pure Blood at 17° C. and 37.5° C.

Name of Haemostatic.	Source of Haemostatic.	Temperature.	Time for Completion of Clotting at Dilutions Stated.				
			Full Strength.	Half Strength.	Quarter Strength.	Eighth Strength.	Sixteenth Strength.
			min. sec.	min. sec.	min. sec.	min. sec.	min. sec.
Coagulen (Ciba)	Blood platelets	17° C. 37.5° C.	14 12 3 40	14 55 3 20	12 50 3 40	12 10 4 10	12 0 3 20
Thromboplastin (Armour)	Brain tissue	17° C. 37.5° C.	4 0 2 0	4 0 2 15	4 45 1 35	5 35 1 40	6 45 1 35
Thromboplastin (Ledele)	Brain tissue	17° C. 37.5° C.	2 5 1 0	2 15 1 5	2 20 1 0	2 50 1 0	2 40 1 35
Thromboplastin (Squibb)	Brain tissue	17° C. 37.5° C.	3 0 2 10	3 15 2 0	3 40 2 0	3 30 1 55	3 45 1 53
Cephalin (Armour), 3% solution	Crude cephalin	17° C. 37.5° C.	47 0 4 50	41 48 5 45	26 50 5 45	23 0 6 25	23 50 5 10
Protogulin	Thrombin	17° C. 37.5° C.	1 20 0 15	1 40 0 45	1 10 0 50	1 45 1 40	2 10 1 10
Hemoplastin (Parke, Davis)	Serum of ox and horse	17° C. 37.5° C.	19 30 8 10	19 30 8 25	16 10 4 57	15 0 4 48	15 0 3 25
Fibrogen (Merrell)	Lung extract	17° C. 37.5° C.	8 5 2 35	8 30 3 0	9 17 3 30	10 33 4 0	13 50 4 55

TABLE II.—Times of Completion of Clotting of Pure Blood shed into Paraffined Vessels after the Internal Administration of the Haemostatics Named.

Name of Haemostatic.	Amount Administered.	Mode of Administration.	Dose in Man Recommended by Makers.	Time of Completion of Clotting at 17° C.	Time of Completion of Clotting at 37.5° C.
Coagulen (Ciba)	1.25 c.cm. of a 3% solution	Intravenous	10 to 20 c.cm. of a 3% solution	min. sec. 24 0	min. sec. 10 55
Fibrogen (Merrell)	0.5 c.cm.	Intramuscular	3 c.cm. orally followed by 1 c.cm. subcutaneously for each 75 lb. of body weight	9 20	5 20
Thromboplastin hypodermic (Squibb)...	2.5 c.cm.	Intravenous	10 to 20 c.cm. every 24 to 48 hours	20 10	8 5
Thromboplastin hypodermic (Squibb)...	7.5 c.cm.	Intravenous		19 0	7 20
Hemoplastin (Parke, Davis)	0.25 c.cm.	Intravenous	2 c.cm. either intravenously or subcutaneously; in severe cases 5 c.cm.	11 0	8 0
Sodium citrate... ..	5 c.cm. of a 10% solution	Intramuscular	30 c.cm. of 10% solution intramuscularly	17 30	5 40

Note.—Hypercoagulability is evident in a few minutes after injection the results are naturally slower. In the experiment after injection, in that with sodium citrate one hour after

intravenous injection (two to three minutes). In intramuscular recorded with fibrogen (Merrell) the blood was shed three hours injection.

Conclusions.

Each of the newer haemostatics accelerated the clotting of pure blood *in vitro*. Table I shows that preparations which appear inefficient at room temperature (17° C.) are active coagulants at body temperature. The standardization of haemostatics by reactions at room temperature is therefore undesirable. It also follows that coagulant haemostatics should be applied locally at body temperature and the wound should not be allowed to cool.

The application of a haemostatic by continuous irrigation is inadvisable, as the clots formed are disturbed by the moving liquid and complete clotting of the escaping blood is thus hindered. The use of a hot bandage (37° to 40° C.) soaked in the haemostatic avoids disturbance of the clots whilst providing a temperature at or near the optimum for haemostatic action. This practice is also useful when the haemostatic is administered internally when haemorrhage continues from an accessible wound.

Of the preparations investigated only those mentioned in Table II are used internally. They do not produce either a severe fall in blood pressure or intravascular clotting in the cat when administered by the routes and in the concentrations named. The experimental results thus agree with the clinical observations. Periodicity is evident in the coagulant action of some of the preparations, the lower dilutions being more active than the higher. These results correspond with those shown in the experiments of Waksman⁷ on the coagulant action of cephalin. The greater activity at lower dilutions may account for the sudden cessation of bleeding which sometimes occurs when initial haemostatic action is small.

The increased coagulability of the blood after the intra-

venous injection of small amounts of sodium citrate is not described, as it is established both experimentally^{8, 9} and by numerous clinical observations.^{10, 11, 12}

Summary.

1. A method of standardizing the coagulant action of haemostatics is described.

2. Those haemostatics which precipitate blood plasmas are ineffective.

3. All the haemostatics named in Tables I and II are effective coagulants when the temperature of the blood is maintained at 37.5° C. Some are also effective at room temperature.

4. Stress is laid on the maintenance of the temperature of the wound at 37.5° C. in the use of haemostatics.

5. The experimental results recorded in this paper agree with the clinical observations on the efficacy of the haemostatics investigated, but are at variance with the findings of those investigators who have employed blood kept fluid by either oxalates or citrates.

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ACUTE DUODENAL OBSTRUCTION DUE TO NEO-NATAL VOLVULUS.

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We think this case may be of interest as illustrating one of the congenital causes of vomiting in infants dealt with by Dr. H. C. Cameron in his Lumleian Lectures, which were published in the *BRITISH MEDICAL JOURNAL*.

J. W. B., a male infant, born in the obstetrical unit of the Royal Free Hospital on July 23rd, 1925, after a normal pregnancy and delivery, was healthy, weighing 8 lb. 1 oz., at birth. Breast-fed, his progress was in every way normal for the first six days of life, and on the seventh day his weight was 8 lb. 6½ oz. On this day he began to vomit at irregular intervals after feeds, sometimes immediately, sometimes after a lapse of ten to thirty minutes. For three days he was given mercury and chalk 1/8 grain twice daily, and his food was changed successively to diluted breast milk, to Nestlé's milk (one part in twelve), to albumin water and brandy, and, finally, to normal saline.

On the second day of illness the vomit contained much bile, and on the third day vomiting became projectile. On the fifth day visible peristalsis of the stomach was observed. The abdomen was scaphoid, and at no time could any tumour be felt.

At first the stools were normal milk stools, but on the twelfth day of life (fifth day of illness) two stools were passed consisting apparently of pure meconium. All later stools consisted of mucus only, tinged green. On two occasions the stomach was washed out with sodium bicarbonate; the fluid returned contained large quantities of bile.

The diagnosis of low duodenal obstruction was made and the question of operation considered. The general condition of the infant, however, contraindicated operative measures. The child gradually grew weaker, and on the evening of the eighth day the temperature rose suddenly to 104° F., death occurring on the tenth day of illness.

Throughout the illness the baby at no time showed any sign of pain or shock suggestive of acute abdominal lesion. From the seventh day of life, when his weight was 5½ oz. above birth weight, he lost weight progressively, until at death, on the eighteenth day, he was 2 lb. 9 oz. below birth weight.

Post-mortem Examination.

On opening the abdomen the much dilated stomach and first and second parts of the duodenum presented; they formed one continuous distended cavity, the stomach passing from the pylorus to the left and upwards, to press on the left lobe of the liver. The coils of small intestine were collapsed and purplish-black. Gangrene of the small intestine had begun, and there was a very