mean of 4.48 and a standard deviation of 1.56 g. This series is too small to give more than a rough indication of the normal variation.

THROMBOTIC STATES Blood was obtained from 30 patients diagnosed as suffering from coronary, or deep vein thrombosis. Most were under treatment with dicoumarol drugs at the time of testing. The tensile strength determinations ranged from 2.9 to 13.0 g., with a mean of 7.24 and a standard deviation of 2.27 g.

There is thus a significant difference between the mean of this series and that of the normal range ($P = < 0.01$).

HAEMOPHILIA It was expected that haemophilic blood clots would be weaker than normal. Blood was obtained from six cases of severe haemophilia and though it was slow to coagulate, the clots once formed were, in four cases, abnormally strong, the figures obtained being as follows: 10.4, 22.0, 6.9, 3.5, 20.7, and 10.6 g., the mean for the group being 12.3 g.

DISCUSSION

The instrument described is simple to use and measures the tensile strength of blood clots with reasonable reproducibility. In its present form it is cumbersome, but, should further observations indicate the usefulness of the method, a smaller and more elegant version could be devised. Preliminary results suggest that wide differences in clot tensile strength exist in pathological states, though the significance of this cannot be judged until the factors responsible have been studied. It is possible, for example, that the increased tensile strength observed in cases of thrombosis and haemophilia is merely a reflection of an increased blood fibrinogen concentration. Many other factors, such as temperature during clotting, packed cell volume, number of platelets, age of clot, contact with glass and other surfaces, and the effect of therapeutic anticoagulants require investigation. As a further application the method might be used to measure the progress of fibrinolysis, and it could be adapted to measure the adhesion of clots to surfaces of different physical or chemical composition, giving information of possible relevance to the understanding of haemostasis, thrombosis, and embolism.

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An automatic staining machine for blood and marrow films on slides

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An automatic staining machine for blood films on cover-slips was designed by Davidson, Bareham, Kitchen, and Pegg (1958) and later developed commercially by Elliotts Liverpool Ltd. A modification of this machine was made by Elliotts Ltd. for this laboratory for the automatic staining of blood and marrow films on standard 3 in. $\times$ 1 in. slides, and it has been in routine use now for nine months with very satisfactory results. No mechanical or electrical faults have occurred.

GENERAL DESCRIPTION OF SLIDE STAINING MACHINE

Overall dimensions are approximately 20 in. $\times$ 20 in. $\times$ 13 in. high (Fig. 1). A maximum of seven different staining solutions can be used, each being contained in a standard glass trough (4 in. $\times$ 3½ in. $\times$ 2¼ in. high) and each of 200 ml. in volume. A maximum of 18 slides (3 in. $\times$ 1 in. $\times$ 1.0 to 1.2 mm. thick), in pairs back to back, can be stained in any one load. The slides are fitted into a simple stainless steel carrier which is hooked on to the undersurface of the plastic covering disc. The disc bears eight hooks so that the carrier can be hooked on to the disc in any of its eight positions.

FIG. 1. This photograph is of a machine with the aeration supplied to troughs 6 and 7 and not to troughs 5 and 6 as described in the text; also the safety device to prevent double staining as described in the text is not shown.

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The timing mechanism is similar to that used on the Elliott tissue processor, a slowly rotating metal disc with notches cut around the edge at the required intervals. As each notch comes into position, the slide carrier is transferred from one staining trough to the next. The minimum time interval is one minute on the standard machine (minimum time intervals of 30 seconds can be provided), with longer intervals in one-minute steps, and a maximum staining cycle of 60 minutes. After the slide carrier has been taken through the staining solutions, it is transferred from the last trough in the seventh position to a draining rack in the eighth position and a warning bell rings for about 30 seconds. Normally the machine is then switched off and the slide carrier removed by hand; if the machine should be left switched on, a safety device, operated by a projection on the edge of the timing disc, prevents the slide carrier from starting on a further staining cycle.

The plastic covering disc, when not in motion, rests on the tops of the staining troughs, so limiting evaporation and dust entry.

Davidson *et al.* (1958), using the coverslip staining machine, found that if the buffered washing solution was kept in motion by bubbling air through it, the scum formed in this solution did not adhere to the coverslips. The same beneficial effect of aeration was found on the slide staining machine. Accordingly an air-pump is fitted to deliver a stream of air to two adjacent staining troughs.

ROUTINE USE OF MACHINE FOR STAINING BLOOD AND MARROW FILMS

The staining cycles on the machine as used in this laboratory (Table) are almost exact copies of the previously employed hand procedures, in which smaller staining troughs (3½ in. × 2¼ in. × 1½ in. high) and 100 ml. volumes of solutions were used. The only difference is that the two one-minute washes with aeration in troughs 5 and 6 take the place of two quick rinses in buffered distilled water in the hand procedures.

The troughs are filled with fresh solutions (200 ml. volumes) at the beginning of each day, an average day's work involving about 80 to 100 blood films and a set of six marrow films. The effect of using the diluted May-Grünwald and Giemsa solutions for two days was tried, but the staining on the second day was rather pale. Normally the timing disc for blood films is kept fitted on the machine; when marrow films are to be stained, the marrow timing disc is easily substituted in a matter of seconds, and to ensure perfect fixation, fresh absolute methyl alcohol is put into trough 2 and also into trough 1. To start the machine, the carrier, loaded with slides bearing the air-dried films, is hooked on to the appropriate hook on the covering disc and lowered into trough 2 for blood films or trough 1 for marrow films, the machine switched on, and the timing disc set at 0

TABLE
MACHINE STAINING CYCLES FOR BLOOD
AND MARROW FILMS

Trough	Blood Films		Marrow Films	
	Solution	Time (min.)	Solution	Time (min.)
1	(Not used)	—	Absolute methyl alcohol	10
2	Absolute methyl alcohol	10	Absolute methyl alcohol	10
3	May-Grünwald diluted 1/2 ¹	5	May-Grünwald diluted 1/2 ¹	5
4	Giemsa diluted 1/10 ¹	15	Giemsa diluted 1/10 ¹	15
5 ²	Buffered distilled water ³	1	Buffered distilled water ³	1
6 ²	Buffered distilled water ³	1	Buffered distilled water ³	1
7	Buffered distilled water ³	10	Buffered distilled water ³	7

¹Stock solutions (prepared at the laboratory) diluted with buffered distilled water.

²Aeration of the solutions in these two troughs is carried out.

³Distilled water buffered to pH 6.8 with 150 ml. 0.2M KH₂PO₄ and 71 ml. 0.2N NaOH per 5 litres.

minutes, again in a matter of seconds. Events at the end of a staining cycle have been mentioned above.

ADVANTAGES OF THE MACHINE

The introduction of this machine has proved to be of great value. Consumption of methyl alcohol, staining solutions, and buffered distilled water has been exactly doubled, but consistent first-class staining of all films is now ensured, regardless of the experience of the person in charge of routine staining, both throughout the day and, if necessary, during the night, as the troughs are left filled overnight. Time and labour are also saved to a considerable extent, as, once the solutions have been renewed at the start of the day, each batch of films requires attention only twice (on to and off the machine) instead of five or six times.

SUMMARY

An automatic staining machine for blood and marrow films is described. It has been in routine use in a busy laboratory for nine months and has proved to be a great asset.

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