Middle Articles

CONTEMPORARY THEMES

Bristol Floods 1968. Controlled Survey of Effects on Health of Local Community Disaster

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Summary: An investigation into the health of people in Bristol flooded in July 1968 was made by means of a controlled survey and a study of mortality rates. There was a 50% increase in the number of deaths among those whose homes had been flooded, with a conspicuous rise in deaths from cancer.

Surgery attendances rose by 53%, referrals to hospital and hospital admissions more than doubled. In all respects the men appeared less well able to cope with the experience of disaster than the women.

Introduction

On 10-11 July 1968 5 in. (13 cm.) of rain fell in Bristol between 5 p.m. and 5 a.m. and about 3,000 houses, shops, and other properties were flooded. Many other urban and rural areas were inundated in the storms which swept that night across south-western England, but Bristol was especially badly hit, as the tidal river Avon runs through its centre. The peak of the rainfall happened to coincide with a high spring tide which blocked the outflow into the river, and so the water spread out over the extensive low-lying areas in the southern part of the city. It reached no higher than the ceilings of the ground floor, and after about 10 hours in most cases it subsided, leaving the streets, the buildings, and their contents covered with a fine layer of stinking mud. Luckily it was July; otherwise there would have been an appreciable morbidity and perhaps mortality from exposure, as many people were soaked through.

Compared with earthquakes, tornadoes, and other natural disasters of fiercer climates such flooding will seem trivial; the community services were not dislocated and there was no food shortage or any serious threat of disease. Nevertheless, having 6 ft. (1·8 m.) of what was in effect dilute sewage appearing suddenly and saturating the dwellings of people enjoying a relatively high standard of living can be regarded as an event of some significance, maybe with long-term consequences.

After a disaster the rescue services come into operation, friends and relatives gather round to give much-needed support, as they do when there is a death in the family. Later on the flooded family or individuals are left to manage as best they can, to live an austere life until the damage has been repaired, and to work through the distress of the experience of having been flooded.

What happens to these people after the excitement of the rescue period has passed? Are there any long-term effects, effects which perhaps could not have been predicted early on after the disaster? In particular, might they enjoy less good health than those who had not been flooded? These questions are suggested by the known association between disturbing events in a person's life and his ill health. Morris and Titmuss (1944) showed how the mortality from peptic ulcer rose in London at the time of the bombing; and Hinkle and Wolff (1958) found an association between events "perceived" by the individual as distressing and the onset or exacerbation of illness—all illness, that is, not merely the conventional "psychosomatic" ailments. The specificity of the association has been explored further by Rahe *et al.* (1967), Rahe and Arthur (1968), and Rahe (1969), and the whole question has been critically reviewed by Thurlow (1967).

One event stands out as having an especially close association with morbidity, and that is the loss by death of a close relative. Rees and Lutkins (1967), Maddison and Viola (1968), and Parkes *et al.* (1969), among others, have shown that the morbidity and mortality of the bereaved is significantly higher over the first 12 months than would be expected by chance alone, and that if the loss comes suddenly the effects on the bereaved will be even more striking. Disaster leaves its victims bereft, if not of family and friends, certainly of possessions and perhaps the home itself, and it strikes suddenly.

The similarity can be taken further. It has been observed in clinical practice how people are dazed and numb immediately after the death of a close relative, and later, after a few days, how this is replaced by intense grief, often with the need to talk and talk, and to find some explanation for what has happened. Blame may occasionally be fixed on a person or a hospital, or the fact of death may be denied altogether. Reports of disasters describe much the same processes: the stunned populace wandering aimlessly about, later talking repeatedly of their experiences to anyone who will listen, and later again finding scapegoats (Friedman and Linn, 1957; Baker and Chapman, 1962; Popović and Petrović, 1964; Beach, 1967).

Hypothesis

Accordingly, when the floods struck Bristol there seemed an unusual opportunity to investigate the effects on health of the experience of having been flooded, and to test the hypothesis that the general health of people who had been flooded will over the succeeding 12 months be less good than it had been over the 12 months before the flooding, and less good than that of people who had not been flooded.

Method

There are two parts to this inquiry—extending from 11 July 1967 to 10 July 1968 (the 12 months before the flooding), and then from 11 July 1968 to 10 July 1969 (the 12 months after).

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Controlled Survey

A comparison was made between people who had been flooded and people who had not with regard to surgery attendances, hospital referrals, and admissions. A road of council houses was selected in which 88 had been flooded and 88 had not, plus a block of 44 houses in a neighbouring road as additional controls. Information was obtained from all households in the designated area.

It was essential to start the survey quickly (the first interviews were made on 14 July), so there was little time for elaborate matching and selection of representative populations, but the groups were reasonably similar (Table I).

TABLE I.—*Percentage Composition of Subgroups**

Age Groups (Years)		Original Population		G.P. Records		Self-reporting	
		Flooded	Not Flooded	Flooded	Not Flooded	Flooded	Not Flooded
1–4	Male	9	7	9	10	15	16
	Female	3	7	3	6	5	10
5–14	Male	22	16	20	19	41	36
	Female	19	15	21	15	25	20
15–34	Male	29	25	36	26	6	3
	Female	26	24	26	25	16	11
35–54	Male	22	22	22	22	17	9
	Female	21	23	23	28	24	25
55–64	Male	10	14	8	13	9	10
	Female	11	13	10	12	15	13
≤ 65	Male	9	16	4	11	13	26
	Female	19	18	17	14	17	20
N	Male	167	227	113	121	88	89
	Female	149	227	96	117	109	142
Total		316†	454†	209	238	197	231
		770		447		428	

*To nearest whole number.
†Includes 9 children under 1 year on 10 July 1968 (2 flooded, 7 not flooded). They have been excluded from the percentage calculations.

Altogether 770 persons were involved: 316 flooded and 454 not flooded. All but four were in the Registrar General's social class III (202 flooded, 241 not flooded), social class IV (50 flooded, 102 not flooded), or social class V (64 flooded, 107 not flooded).

Each household was visited by me as soon as possible after the floods (77% of the flooded were seen within six days of the flooding, and 92% within two weeks) and again one year later. Where possible each member was interviewed personally (though not always in private), but failing that a parent, spouse, or other responsible family member gave the information. The reports of those actually interviewed in person, and in the case of children of 14 or under the report of one or other parent, on both visits were extracted for separate study; the results are given under the heading "Self-reporting."

It was possible to examine the general practitioners' records for 58% (66% flooded, 52% not flooded) of the population. Naturally there was considerable variation in habits of record keeping so only practices with fairly even proportions of flooded and non-flooded patients and which appeared to have complete records over the two-year period were included. This gave five practices with 209 flooded and 238 non-flooded persons, representative of the whole population for age, sex, and social class. Those who died (10) or were born (10) within the period were excluded. It was felt that only the simplest data could be extracted with any reliability, and so only the number of surgery attendances was recorded. Sometimes this figure included home visits, but evidently there were many home visits for the flooded and non-flooded which were not recorded on the cards, especially among the elderly.

Hospital referrals were estimated by counting the number of patients who had letters from hospital outpatient clinics (but not local authority or other clinics). Similarly, hospital admissions were estimated by the number of patients with discharge summaries in the envelope.

Mortality Rates

A register was drawn up of all the homes anywhere in the City and County of Bristol which had been flooded on 10-11 July 1968, and the number of deaths from these addresses in the 12 months before and the 12 months after the floods was compared with those from the rest (not flooded) of the city. Those rehoused after the floods were excluded, but others moving in after the houses had been restored could have been included in the second figure: the net result, however, is an underestimate.

Survey Results

(1) G.P. Records.

(a) Surgery Attendances

The attendances of the people flooded increased overall by 53% (males 81%, females 25%), though the total number of individuals attending did not change substantially. There were fewer not attending at all or attending only once or twice (21% fall: males 31%, females 7%); the increase was in those attending three or more times (42% rise: males 76%, females 11%) (Table II). The 1 to 4-year-olds and those aged 55 and

TABLE II.—*Surgery Attendances. Numbers Attending 0-2 or 3 or More Times over the Two 12-month periods*

	No. of Attendances	Numbers Attending. Percentages in Parentheses to nearest whole number				
		Flooded N = 209		Not flooded N = 238		Flooded and Not Flooded Compared
11 July 1967 to 10 July 1968	0–2 ≥3	140 (67) 69 (33)		142 (60) 96 (40)		N.S.
		Male N = 113	Female N = 96	Male N = 121	Female N = 117	
	0–2	80 (71)	60 (63)	73 (60)	69 (59)	Male N.S.
	≥3	33 (29)	36 (38)	48 (40)	48 (41)	Female N.S.
11 July 1968 to 10 July 1969	0–2 ≥3	111 (53) 98 (47)		158 (66) 80 (34)		$\chi^2 = 7{\cdot}64$ $P < 0{\cdot}01$
	0–2	55 (49)	56 (58)	86 (71)	72 (62)	Male $\chi^2 = 11{\cdot}33$ $P < 0{\cdot}001$
	≥3	58 (51)	40 (42)	35 (29)	45 (39)	Female N.S.
Before and after compared	0–2 ≥3	21% fall 42% rise $\chi^2 = 7{\cdot}82$, $P < 0{\cdot}01$		11% rise 17% fall N.S.		
	0–2	31% fall	7% fall	18% rise	4% rise	
	≥3	76% rise $\chi^2 = 10{\cdot}6$ $P < 0{\cdot}01$	11% rise N.S.	27% fall N.S.	6% fall N.S.	

over had attendance rates higher than average, but there were no differences associated with social class. The non-flooded showed no such rise in attendances; indeed they showed a slight fall, and the men's attendances fell more than the women's.

χ^2 tests on the attendance pattern showed a highly significant increase in the attendances of the flooded men as compared with men who had not been flooded ($P<0{\cdot}001$). Within the flooded group there was a significant rise in male attendances after as compared with before the floods ($P<0{\cdot}01$). In both instances the women's attendances increased, but not to a significant level. There was no significant shift in any of the non-flooded groups.

Depth of Flooding.—The deeper the water in the house the greater presumably the damage and personal distress, and with 4 ft. (122 cm.) or more virtually everything in a room would be saturated. There were 149 people who had floods of 4 ft. or more. Before the flooding there was no significant difference between them and those who subsequently had less than 4 ft. of flooding, but there was a significant shift in the attendance pattern—0-2 to 3 or more for men with 4 ft. or

over of floodwater in the year after ($\chi^2=9{\cdot}63$, $P<0{\cdot}01$. D.F.=1). Women in that subgroup and those with less than 4 ft. showed the same shift, but not to a significant extent.

Temporary Rehousing.—Of the 209 flooded, 138 did not move from their homes at any time after the flooding. There was no significant difference in attendance patterns for the preceding year between those who had temporarily to be evacuated from their homes and those who did not, but the men who were not rehoused showed a significant shift in their attendance pattern from 0-2 to 3 or more ($\chi^2=8{\cdot}47$, $P<0{\cdot}01$, D.F.=1). All the rehoused subgroup and the non-rehoused women showed the same shift in the year after, but none to a significant degree.

For comparison, attendances at the local authority William Budd Health Centre were unchanged over the same two-year period. The population attending there was similar; they lived adjacent to the flooded areas but had not been flooded. Also the National Health Insurance sickness returns for the whole of Bristol showed no change over the same period. In the four months after the flooding, however, there was a 15% rise for Bedminster (the district worst affected and including the survey area) as compared with the same period in the previous year, but for the rest of Bristol the rise was only 2·5%. There was scattered flooding elsewhere in the city.

(b) Hospital Referrals and Admissions

The hospital referrals from the flooded people more than doubled in the year after the floods ($P<0{\cdot}01$), and they were accounted for mostly by the men (Table III). Hospital admissions showed the same trend. The number of pre-flood admissions from the flooded group was applied to the flooded, giving a hypothetical value of 10, the rise was still significant at the 0·05 level. The actual rise was highly significant for both sexes (Table IV). The reasons for admission read almost as though they were a random selection: arterial insufficiency, maternity (three women), injury from an explosion, T's and A's, surgery for duodenal ulcer, deflected septum, nephritis and purpura, aural polyp, fractured neck of femur, gastric polyposis, reamputation of finger, and glandular fever; but nothing suggests any direct physical consequence of flooding.

TABLE III.—*Hospital Referrals*

	Numbers Referred to Hospital				Flooded and Not Flooded Campared
	Flooded N = 209		Not Flooded N = 238		
11 July 1967 to 10 July 1968	19		23		N.S.
	Male N = 113: 8	Female N = 96: 11	Male N = 121: 12	Female N = 117: 11	Male N.S. Female N.S.
11 July 1968 to 10 July 1969	40		28		$\chi^2=4{\cdot}14$ $P<0{\cdot}05$
	24	16	13	15	Male $\chi^2=4{\cdot}08$ $P<0{\cdot}05$ Female N.S.
Before and after compared	$\chi^2=7{\cdot}89$, $P<0{\cdot}01$		N.S.		
	$\chi^2=8{\cdot}19$ $P<0{\cdot}01$	N.S.	N.S.	N.S.	

TABLE IV.—*Hospital Admissions.*

	Numbers Admitted to Hospital				Flooded and Not Flooded Compared
	Flooded N = 209		Not Flooded N = 238		
11 July 1967 to 10 July 1968	3 (actual value)	10 (hypothetical value)	11		Using actual value, $P=0{\cdot}046$* Using hypothetical value, N.S.
	Males N = 113: 3	Females N = 96: 0	Males N = 121: 5	Females N = 117: 6	Male N.S. Female $P=0{\cdot}026$*
11 July 1968 to 10 July 1969	23		12		$\chi^2=4{\cdot}69$, $P<0{\cdot}05$
	13	10	2	10	Male $P=0{\cdot}002$* Female N.S.
Before and after compared	Using actual value: $\chi^2=14{\cdot}8$ $P<0{\cdot}001$		N.S.		
	Using hypothetical value: $\chi^2=4{\cdot}74$ $P<0{\cdot}05$				
	$P=0{\cdot}0085$*	$P=0{\cdot}0008$*	N.S.	N.S.	

*Fisher's exact probability.

(2) Self-reporting

The results are set out in detail in Table V, but the statistically significant changes concerned the advent of new symptoms. These were recorded as "psychiatric" for complaints such as anxiety, depression, irritability, sleeplessness, etc.; and "physical" for the rest, including such conditions as dyspepsia and migraine. Among the flooded men 33% reported new physical symptoms compared with 16% of non-flooded men. Among the flooded women 18% reported psychiatric symptoms (including psychiatric symptoms which might have been present before the floods), but only 6% of the non-flooded women did so.

TABLE V.—*Self-reporting of Health*

	Subject's Estimate		Flooded No.	Flooded %*	Not Flooded No.	Not Flooded %*	
General health over 12 months since flooding compared with health over the 12 months before	Better	M.	3	3	1	1	
		F.	2	2	2	1	
	Worse	M.	10	11	14	16	
		F.	18	17	13	9	
	Unchanged	M.	75	85	74	83	
		F.	89	82	127	89	
Attendances at G.P. surgery compared with attendances over the 12 months before	More	M.	7	8	4	5	
		F.	13	12	6	4	
	Fewer	M.	3	3	3	3	
		F.	2	2	0	0	
	Unchanged	M.	78	89	82	92	
		F.	94	86	136	96	
New symptoms since flooding†	Physical	M.	29	33	14	16	$\chi^2=6{\cdot}23$, $P<0{\cdot}05$
		F.	17	16	21	15	N.S.
	Psychiatric	M.	3	3	2	2	N.S.
		F.	20	18	9	6	$\chi^2=7{\cdot}57$, $P<0{\cdot}01$
	None	M.	56	64	74	83	
		F.	77	71	112	79	
Effect on health of flooding	Some bad effects	M.	23	26	—	—	
		F.	41	38	—	—	
	No bad effects	M.	65	74	—	—	
		F.	68	62	—	—	
	Total	M.	88		89		
		F.	109		142		
			197		231		

*To nearest whole number.
†Some in this group reported both physical and psychiatric symptoms.

Mortality Rates

There were 58 deaths during the 12 months before 10 July 1968 from the homes subsequently flooded on that date. Over the next 12 months the number of deaths from the same addresses was 87, a rise of 50%. There was no appreciable change in the deaths for the rest of Bristol (in fact, a fall of 1%), so the increase is significant at the 0·02 level ($\chi^2=5{\cdot}64$, D.F.=1). The most pronounced rise was in the age group 45 to 64, where male deaths rose from 7 to 20 and female deaths from 5 to 9, and these occurred mainly in the third three-month period (January to April) after the flooding. Otherwise the increases were predominantly among those over 65, especially women over 75 (a rise from 9 to 19). One man, aged 33, was drowned in the floods and has not been included here.

The causes of death were those entered on the death certificate, and it is not known which were confirmed at necropsy. Causes relating to heart diseases or cerebrovascular accidents may at times be unreliable, but when a specific malignant disease has been recorded it may be assumed to be reasonably accurate, though there will be several deaths from malignant disease the diagnosis of which is never discovered.

In the year before the flooding there were nine deaths from malignant disease (*International Classification of Disease* 140-209); in the year after the number rose to 21. For the rest of Bristol (not flooded) the deaths from malignant disease over the same periods were 1,010 and 1,068 respectively. With a χ^2 of 3·50, D.F.=1, this just fails to reach a level of significance.

Discussion

In all aspects studied the health of the flooded people was worse during the 12 months after the floods than the health of those not flooded; and for the older people there was an increased likelihood of dying within 12 months. For the men the change in health was statistically significant in all instances; for the women there was an increase of ill-health, but it did not reach a significant level.

Accepting that there was a significant change in the health of the flooded, can this change be ascribed to the flooding or may there be other influences affecting the health of the community?

The control group (the non-flooded) proved to be well matched, though perhaps less healthy on account of the over-represented younger and older age groups. They attended surgery less frequently after the floods; this fall matched the flooded attenders' rise as though the groups were somehow complementary. Possibly if one part of a practice is making great demands the rest of the practice inclines to stay away or is put off by queues or full appointment books. Only a fraction of the patients on any doctor's list, however, were flooded.

For the two-year period under study further measures of the health of the community were called for. The William Budd Health Centre attendance figures and the National Health Insurance sickness returns showed no significant change; so it is concluded that there were no other factors at work in the community, such as epidemics, which might have adversely affected the health of the flooded people. Further support for a causal connexion between the flooding and the ill-health comes from the internal comparisons—the effects of depths of flooding, and between those who were rehoused and those who were not.

Some men doubtless were "off sick" attending to their damaged homes. In sociological terms this absence is of significance, though doctors may argue about what constitutes being genuinely ill. Inevitably the knowledge that a man has had his home flooded was taken into account, but the patient did go to the surgery with a medical complaint, and in most cases he came away with some treatment. Social factors that might have been affecting the surgery attendance figures would be unlikely to have affected referrals to hospital outpatient departments and hospital admissions. And since the increased male ill-health runs right through at a significant level one is tempted to conclude that the surgery attendances are a fair measure of ill-health.

In the self-reporting section the men described more physical symptoms, but the women admitted to more psychiatric ones and more frequently to having had their health affected by the experience of having been flooded. Whether men tend to express their distress more in terms of bodily ailments and women express it directly in emotional symptoms is hard to say. Rees and Lutkins (1967) showed that the mortality from all causes (though causes were not stated) for widowed men is significantly greater in the first year of bereavement than it is for widowed women; and Parkes (1964), studying the incidence of mental illness of all kinds occurring in the first six months of bereavement, found that there was a significantly greater incidence among women, though here the women were a slightly older group than the men. The rise in deaths from the flooded homes over the succeeding 12 months is a logical extension of the increased morbidity, affecting particularly the old and the sick. The same kind of rise is observed after, say, an influenza epidemic, but in this case the causal connexion is more obvious.

Lorraine (1954) studied the Canvey Island floods of 31 January/1 February 1953. He found that there was a rise in the mortality rate, excluding the 58 who died as an immediate result of the flooding (mostly children and the elderly), and the depth of water did not exceed 8½ ft. (2·5 m.), though many of the homes were bungalows. The Registrar General's (1953-6) returns show that there were 183 deaths in Canvey Island (excluding the 58) in 1953, and in 1951 and 1952 there were 151 and 147 deaths respectively; and the population at risk in each of those years was, in order, 11,050, 11,640, and 11,692. Compared with the rest of England and Wales in 1953 the increased mortality was highly significant (χ^2=18·60, P<0·001, D.F.=1).

This increase in mortality probably means that death can be *hastened* by the experience of having been flooded rather than somehow being *caused* by it. If this is so then we might expect a lowering in the mortality rate during the second year after the floods, and this happened in Canvey Island, where 135 died in 1954 (out of 11,990).

A number of patients (not necessarily from the survey population) were referred for psychiatric care whose symptoms dated from the floods. Some ascribed their troubles to the flooding, others did not. All of them had been having difficulties in their lives before July 1968—some only just managing to keep going—and the floods came as the last straw. In the same way those who are referred to psychiatrists after a bereavement are often found to have had difficulties beforehand with interpersonal relationships or in their general ability to cope and to run their lives.

The physiological processes by which distressing events in a person's life may lead to illness are not at present understood. Certain responses, such as depression, may be adaptive, allowing the individual to withdraw from active life for a period. Others, such as dyspepsia, palpitations, headaches, may be recognized by patient and clinician alike as being associated with a stressful event; or else such symptoms can provide a ticket of entry to see the doctor, who may be perceived as the one who can help at this time. But this still leaves a larger group, particularly those with organic illness, where no physiological mechanisms can be proposed. Nor can we make any guesses in terms of simple cause and effect; the empirical evidence is there with regard to bereavement and disaster, but we cannot at present explain it.

Despite our ignorance in this area, it is probably worth trying to identify people who might reasonably be regarded as being at special risk and then taking steps to give them the extra support they need. Apart from the whole of the male sex no group appeared to be at particular risk except the aged. It could be useful to have on a street basis a register of the elderly and those requiring regular medical attention, since those in the greatest need might be the least in evidence at the time of disaster. In the well-integrated area studied here everyone knew their neighbours, and the doctors knew all their patients, and so there was no problem; there would have been a problem on a new housing estate in the middle of winter.

Conclusion

It is felt that a causal connexion has been shown between the experience of having been flooded and subsequent ill-

health and mortality. Flooding is one example of a distressing event in a person's life, bereavement is another, and both of these have proved amenable to study. But there are many others that are seen in the course of clinical practice. Knowledge of such factors can be of direct value to the clinician: it makes possible a fuller understanding of the patient and a more realistic planning of treatment and estimate of prognosis.

Many people contributed in the completion of this survey. In particular I should like to thank Mr. W. J. Hutchinson (Town Clerk), Professor R. C. Wofinden (Medical Officer of Health), Mr. John Fleming (Housing Manager), and the officers of the Bristol Corporation, for their assistance at all stages and for making available the detailed background data; the general practitioners with practices in the flooded areas for their ready co-operation on clinical matters, and Mr. C. M. Richards for his part in recording their data; Mr. G. A. Birch of the Public Health Department for the records of community health; Miss Ethel H. L. Duncan (senior lecturer in medical statistics) and Mrs. Audrey Morris for their help with the statistical handling, and Mrs. Hilary Steeds for processing the records; the Board of Governors of the United Bristol Hospitals for their financial backing; and Professsor D. Russell Davis for much valuable advice and for providing the facilities which made the survey possible.

An extended version of this survey with fuller details of method and results is available on request.

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NEW APPLIANCES

Improved Semilogarithmic Haematological Chart

Dr. A. S. D. SPIERS and Dr. D. A. G. GALTON, Medical Research Council Leukaemia Unit, Royal Postgraduate Medical School, London W.12, write: The management of patients with leukaemia is facilitated by serial recording of haematological values and therapeutic manoeuvres on special charts (Galton, 1962). The technique is also useful in therapy of malignant lymphomas, haemolytic anaemias, and other disorders where treatment with toxic drugs is monitored by haematological values. Apart from their usefulness in the control of therapy, the charts serve as a concise summary of the case history, a means of comparing patients with the same disorder, and a valuable aid to teaching. The usual form of chart has a linear horizontal timescale, with 10 days to 1 cm., and a logarithmic vertical axis for recording white cell and platelet counts. Haemoglobin values are recorded on a vertical linear scale in the upper part of the chart. Besides summarizing past treatment and progress, the chart allows some prediction of future events. For example, during busulphan therapy the trend of the white cell count can be extrapolated with some accuracy about 14 days ahead, and the safety of therapy is thereby increased, as necessary dosage modifications can be anticipated.

Haematological charts of this type have been in regular clinical use in many hospitals for a number of years, and their usefulness in the treatment of leukaemia is comparable to the value of the temperature chart in the management of infections. The space available on the earlier charts, however, is insufficient for recording the complex regimens of treatment now used for acute leukaemia, Hodgkin's disease, and other forms of malignant disease in which four or more drugs may be used simultaneously. Details of immunotherapy, platelet transfusion, intrathecal therapy, and other manœuvres cannot be clearly entered on these charts. Furthermore, the time scale is often too contracted to illustrate rapid alterations in the blood count. At the same time the advent of new rapidly acting and potent therapies has greatly increased the need for accurate monitoring of treatment. The present modified chart satisfies these new needs.

THE CHART

The chart is printed on white card measuring 35·5 by 24 cm. (see Fig.). Owing to its size, which is dictated by the requirements of illustration, the chart must be folded if it is to be filed in conventional hospital case notes. On the other hand, it fits easily into standard hanging files or foolscap-size box files. The scales and legends are printed in light orange. Details of the patient recorded at the top of the chart include the blood group and hospital case number, and space is provided for a special unit or laboratory number. The patient's age is recorded in relation to the year—for example, 32/70; this obviates the need for alteration with the passage of time.

The body of the chart is divided into three parts.

(1) An area 8 by 24 cm. for recording transfusions, drug therapy, and other important details, the nature of which will vary with the disease concerned. For example, the composition of bone-marrow aspirates or plasma proteins can be shown as histograms, and physical findings may be recorded at intervals by small sketches

(2) A haemoglobin scale, 0 to 16 g./100 ml., occupies a further 8 cm. Changes in haemoglobin concentration of 0·2 g./100 ml. are shown as a deviation of 1 mm. By choosing a suitable scales determination, such as reticulocyte count or erythrocyte sedimentation rate can also be entered in this part of the chart.

(3) The lower 16 cm. is occupied by four cycles of a logarithmic scale (1×10^2 to 1×10^6). This will accommodate almost all white blood cell and platelet counts likely to be met with. With suitable colour-coding and by using fine-line ballpoint pens the platelet count, total white cell count, neutrophil count, and blast cell count