the drug was given for 7 days; then a 5-day interval was allowed to elapse before restarting it. It was only on the second occasion that the supposed intolerance became apparent. The only other instances of spaced dosage associated with purpura are recorded by Russell and Page (1940), Harries (1942), Werner (1942), Gorham *et al.* (1943), and Hurd and Jacox (1943). In 8 cases the administration was uninterrupted. Drug hypersensitivity may remain after recovery. Hurd and Jacox found that giving a small dose of sulphathiazole or sulphadiazine to their patient caused a marked fall in the platelet count with an increased bleeding time and a positive tourniquet test. Rosenfeld and Feldman (1942), however, were able to give a later course to their patient with no further purpura.

In the reported cases no member of the sulphonamide group of drugs seems exempt as a causative agent, and sulphanilamide, sulphapyridine, sulphathiazole, and sulphadiazine have all been held responsible.

The high mortality of this condition—8 out of 9 cases proved fatal—makes early recognition essential. The first clinical sign is nearly always epistaxis. If this or other spontaneous bleeding is discovered in a patient receiving sulphonamide drugs the administration should be stopped immediately and a bleeding time and capillary resistance test done. Adequate transfusion of fresh blood is probably the best line of treatment.

Summary

A fatal case of acute purpura occurring in the course of sulphapyridine therapy in pneumonia is recorded.

The pathogenesis of this condition is discussed. Vascular lesions as a basis for its causation are emphasized.

In view of its high mortality a watch for extraneous bleeding should be made in all cases receiving sulphonamide drugs.

We wish to express our thanks to Prof. J. H. Dible and Dr. J. McMichael for much helpful criticism. The necropsy findings are reported by kind permission of Dr. C. Keith Simpson.

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determined on a sample of blood from the ear, using the technique suggested by the Committee and a standardized Haldane haemoglobinometer.

Results

Most of the W.A.A.F. were between 18 and 25 years of age and all between 18 and 35. The distribution of the haemoglobin levels in the groups of W.A.A.F. examined is given in the accompanying Table according to length of service. Separate analysis of the results for the N.C.O.s and the W.A.A.F. personnel from the bomber station and training wing shows no significant difference, so these groups have been combined.

It is seen that all the groups who had been in the Service for more than six months had significantly higher haemoglobin levels than the group of W.A.A.F. just entering the Service, but that after six months to a year there is no further improvement. The coefficient of variation, however, becomes steadily smaller with longer service. The mean value for all those who had been in the Service for more than six months is 103.05, with standard deviation 9.12. The results have also been analysed according to trade. Some of the trades are represented by very few W.A.A.F., so that comparison has been possible only for a few. There is no significant difference between the results for cooks and butchers, motor transport drivers, clerks, aircraft hands (general duty), and telephone operators.* Analysis of the results according to age shows no significant differences in the age groups represented (18–35 years).

Table showing Distribution of Haemoglobin Levels of W.A.A.F. according to Length of Service

Hb %	On Entry	Length of Service				
		½–1 Yr.	1–2 Yrs.	2–3 Yrs.	More than 3 Yrs.	Total More than 6 Mths.
126–	..	1	2	—	—	3
121–	..	2	2	6	—	4
116–	..	6	9	6	1	18
111–	..	6	9	16	2	32
106–	..	41	18	22	5	53
101–	..	80	26	25	5	66
96–	..	118	25	32	5	64
91–	..	143	12	15	7	48
86–	..	87	3	7	0	12
81–	..	52	1	2	1	4
76–	..	10	0	1	—	2
71–	..	3	0	—	—	0
66–	..	8	0	—	—	0
61–	..	2	1	—	—	1
56–	..	0	—	—	—	—
51–	..	2	—	—	—	—
46–	..	0	—	—	—	—
41–	..	1	—	—	—	—
Total	..	559	48	108	24	307
Mean value %	94.84	102.46	104.10	102.71	101.62	103.05
Standard deviation	9.22	9.90	9.51	8.47	8.26	9.12
Coeff. of variation	9.72	9.66	9.14	8.25	8.13	8.85

Forty of the W.A.A.F. from Group 1 were retested after ten months' service. The mean value of the haemoglobin levels of these girls on entry was 98.8 (standard deviation 8.32); after ten months the mean improvement was 4.25. This improvement is statistically significant (4.25 ± 1.70). The level reached is similar to that in the other groups with more than six months' service.

Discussion

Choice of Groups.—Almost all the girls in each group volunteered, so that there was practically no selection within the groups. The group of N.C.O.s were drawn from many stations to attend the course, and so constituted a fairly random sample of W.A.A.F. population so far as location is concerned. On the other hand, they were all training as N.C.O.s and were to that extent selected. They were presumably of more than average intelligence and their period of service was comparatively long; there was probably also some slight selection by trade. The group of W.A.A.F. from the bomber station and training wing, however, although selected as to location, were not selected by rank or trade. As the results for this group are not significantly different from those for the N.C.O.s,

* A smaller survey carried out on 82 W.A.A.F. aircraft fitters and 59 W.A.A.F. electricians showed the mean Hb of these to be 106.92 (standard deviation 10.2) and 106.87 (standard deviation 9.1) respectively. These figures are significantly higher than the mean for the general W.A.A.F. population after more than six months' service (difference 3.82 ± 0.91).

HAEMOGLOBIN LEVELS IN THE WOMEN'S AUXILIARY AIR FORCE

BY

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Between May, 1943, and April, 1944, a survey of haemoglobin levels among various groups of W.A.A.F. personnel was carried out. The main purpose of the survey was to determine whether the average haemoglobin levels showed any significant change during service in the W.A.A.F. In addition some of the results have been incorporated into the report of the nation-wide survey of haemoglobin levels initiated by the Haemoglobin Survey Committee of the Medical Research Council, whose report will shortly be published.

Plan of Experiment

The following groups were chosen: (1) W.A.A.F. personnel arriving to join the Service in May and June, 1943. (2) W.A.A.F. personnel attending an N.C.O.s' course in June, 1943. (3) W.A.A.F. personnel at a bomber station and a training wing in Sept., 1943. At each station all the personnel were asked to volunteer for the test, and, except at the training wing, almost all volunteered.

The girls completed a card giving information required by the Haemoglobin Survey Committee of the Medical Research Council (see Appendix). The haemoglobin level was then

it appears that the selection in the two groups did not affect the accuracy of the estimate of mean haemoglobin levels. It is possible that the group of W.A.A.F. which entered the Service some time ago might be differently constituted as regards social status, etc., from those which were entering later. The results for the new entrants are, however, similar to those of other groups of the population (M.R.C. report, 1944), and it seems very unlikely that earlier entrants could have had haemoglobin levels so much higher. Furthermore, the haemoglobin levels of the 40 girls of this group retested after ten months were by that time similar to those of other groups of more than six months' service.

Accuracy of Results.—Errors in the estimation of haemoglobin by the method used in this survey arise from three sources: inaccuracies in the apparatus, errors in collecting the sample of blood, and the error in matching. The apparatus was standardized and the appropriate correction applied to all readings. These corrected values are those given in the Table. The error in collection has been estimated by collecting samples from the ear and vein of 25 subjects and measuring the haemoglobin level in the usual way. This test showed that the samples from the ear were approximately 4.2% higher than those from the vein. It is probable that the levels as estimated from venous blood are more accurate. The error in matching was assessed by a test instituted by the Haemoglobin Survey Committee. The full results of this test are published in the report of the Committee; it may be stated, however, that I tended to read too low, as did most of the others taking part. The average correction to be applied in the ten samples estimated was approximately +4.4%. It is probable that a similar correction may be applied to all the results given in this report. The errors in collection and matching are similar in size but tend to alter the true values in opposite directions, so that the results given in the Table may be taken as being about the true values. The retesting of the 40 girls in Group 1 was carried out after the results of the matching test had been made known, and it was possible, therefore, that this error was being unconsciously corrected at the second test. A further 194 girls who had just come into the Service were therefore tested. The mean haemoglobin value of this group was 96.15 (standard deviation 10.0), which is not significantly different from that of the girls in Group 1 (difference 1.31 ± 0.817). It appears likely, then, that the error in matching was not being corrected and that the improvement in the 40 girls was real.

Normal Haemoglobin Values.—The mean haemoglobin level reached after six months' service is higher than any of the levels usually regarded as normal. The figure given by Price-Jones (1931) is 98.3%, and this has usually been accepted as the best estimate of normal averages. On the other hand, the value reached by the W.A.A.F. after six months' service (103% approximately) is well maintained without further improvement. This would suggest that the normal value is at least as high as this. It is possible that some of the W.A.A.F. with low values might not be consuming much of the Service diet and might be capable of showing further improvement; this would tend to make the mean value even higher.

Cause of Improvement.—The improvement is probably largely due to the high iron intake of women in the Service. The average intake per person per day is about 35 mg. (see Macrae, 1944); much of this iron comes from iron cooking vessels, which are rarely used in domestic cookery. What part is played by the intake of much protein of high biological value is not known, but there is little evidence of deficient intake of protein in the general population (H.M.S.O., 1944). It is doubtful if vitamin C intake plays any part in the improvement. The average ascorbic acid intake of W.A.A.F. personnel is about 25 mg. a day in the autumn and about 18 mg. a day in the spring (Macrae, 1944). It is probably at least as high among civilians, because domestic cooking methods are on the whole less destructive of this vitamin. Some slight improvement in average values may be due to the medical treatment of a few W.A.A.F. with low haemoglobin who develop symptoms during Service life.

Summary

The haemoglobin levels of W.A.A.F. personnel entering the service is about 95% (standard deviation 9.22) on the standard

Haldane scale. The haemoglobin level after six months' service is about 103% (standard deviation 9.12). This level is reached in six months to a year and is maintained thereafter. The error in collection results in readings which average approximately 4.2% too high, and errors in matching in readings which average approximately 4.4% too low. Correction for both these errors thus leaves the readings as given in the Table. It is probable that the "normal" mean value of women of this age group is at least 103%.

The improvement is probably due mainly to the high iron intake of W.A.A.F. personnel.

I am indebted to the commanding officers and W.A.A.F. administrative officers of the stations concerned and the W.A.A.F. personnel who took part in the test for their co-operation; to Dr. Bradford Hill for advice concerning the plan of the experiment and in the analyses of the results; and to Dr. Davies, pathologist to the Royal Gloucester Infirmary, for granting me laboratory facilities during May and June, 1943.

APPENDIX

Copy of Proforma Used in R.A.F. Haemoglobin Survey

Name	No.	Serial No.
Date of joining W.A.A.F.	Age last birthday	
Home address	Married, Single, Widow	
Previous occupation and town of work		
Occupation of husband		
Mark with a cross the circumstances applicable before joining the W.A.A.F.		
a. Lived with family on civilian rations usually supplemented by regular meals (5 or more a week) at canteen or restaurant		
b. Lived with family on civilian rations usually supplemented by some meals (less than 5 a week) at canteen or restaurant		
c. Lived with family on civilian rations without supplementary meals as described or with some meals as follows (Give short description)		
d. Lived in hostel, institution, or other communal life as follows (Give short description)		
e. Other circumstances as follows (Give short description)		
Serious illnesses during past six months ("Serious illness" if confined to bed for a week or more)		
Were you a blood donor?		
No. of donations in past 2 years		
Date of last donation		
No. of previous pregnancies		
Date of end of last		

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Medical Memoranda

A Note on Red Hair, Rheumatism, Tuberculosis, and Bleeding

The question of rheumatism, red hair, and bleeding has been raised again in the *Journal* (July 1, 1944, p. 33), and the stimulating reply there given suggests that the following data are worth stating.

RED HAIR

Of late all patients with red hair who consulted me have been noted, and this report concerns 100 consecutive red-haired patients. The accompanying Table shows the conditions in which the red-haired were seen with any frequency. It is clear that only a small minority (6%) of patients with rheumatic fever had red hair. The 3% of pneumonia patients with red hair probably coincides with the incidence of red hair in the population dealt with. Hill and Allan (1929) found an incidence of 3.1% in London children. A larger series will be necessary before it can be affirmed that the incidence of red hair in rheumatic patients is substantially greater than that in pneumonia or in the general population.

Hill and Allan (1929) found that 6.4% of 562 rheumatic cases had red hair, but only 3.1% of 536 controls (percentages which I confirm). According to the contributor in the *Journal*, this difference in 500 patients is probably significant. Yet Hill and Allan concluded that there were no physical characteristics peculiar to rheumatic children, no doubt because they considered other colours of hair and also eye colour, and did not concentrate on red hair alone. Shrubbsall (1903) found that blond traits were associated with acute rheumatism and tonsillitis, and brunette traits with pulmonary tuberculosis and malignant disease. Yet pulmonary tuberculosis was the chief disease with red-haired sufferers among these 100 red-haired.