that this rise is not an inevitable physiological phenomenon but depends more on environmental factors in the mode of life of European Jews in Israel, factors probably absent in the life of the Yemenites.

Young Ashkenazi Jews, who belong to the upper middle social classes, have higher total cholesterol levels than the Yemenites, but these levels are significantly lower than those in the middle-aged Ashkenazi group of mixed social classes. With regard to the low average values of β-cholesterol and the relatively high percentage of α-cholesterol the young Ashkenazis, unlike the middle-aged Ashkenazis, are identical with Yemenites of all ages.

We have previously suggested that the high absolute values of β-cholesterol and the small proportion of cholesterol connected with the α-lipoproteins (e.g., the percentage of α-cholesterol and not α-cholesterol in mg. per 100 ml.) are characteristic of "atherogenic activity" (Brunner and Loebl 1958a). The identity of this lipid fraction in the young Ashkenazis and all the Yemenites strengthens this view.

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REFERENCES

Adlersberg, D. (1957) *Amer. J. Med.* 23, 769.
— Schaefer, L. E., Steinberg, A. G., Chun-I-wang (1956) *J. Amer. med. Ass.* [illegible], 619.
Brunner, D., Loebl, K. (1957) *Lancet*, i, 1300.
— — (1958a) *Ann. intern. Med.* 48, 732.
— — (1958b) *Harefuah*, **54**, 87.
— — Fischer, M., Schick, G. (1955) *ibid.* 43, 1. See *J. Amer. med. Ass.* 1955, **158**, 1306.
Dreyfuss, F. (1953) *Amer. Heart J.* **45**, 749.
Epstein, F. M., Boas, E. P. (1955) *J. Gerontol.* **10**, 331.
Keys, A., Fidan, F., Scardi, V., Bugemi, G., Keys, M. H., Dilorenzo, F. (1954) *Arch. intern. Med.* **93**, 328.
— Michelson, O., Meller, E. V. O., Hages, E. R., Todd, R. L. (1950) *J. clin. Invest.* **29**, 1347.
Kornerup, V. (1950) *Arch. intern. Med.* **85**, 398.
Loebl, K., Brunner, D. (1958) *Harefuah*, **55**, 10.
Page, I. H., Kirk, E., Lewis, W. H. W., Thompson, W. R., Van Slyke, D.D. (1935) *J. biol. Chem.* **111**, 613.
Toor, M., Katchalsky, A., Agmon, J., Allalouf, D. (1957) *Lancet*, i, 1270.
Walber, A. R. R., Arvidsson, U. B. (1954) *J. clin. Invest.* **33**, 1358.

IRON CONTENT OF THERMAL SWEAT IN IRON-DEFICIENCY ANÆMIA

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Foy and Kondi (1956, 1957) and Foy et al. (1958) have suggested that excessive loss of iron through sweat in hot and humid climates is an important contributory cause of iron-deficiency anæmia. Having examined 4000 people between the ages of 15 and 40, they are also of the opinion that iron-deficiency anæmia is far more common than the megaloblastic anæmias, particularly in the hot, damp, low-lying plains of India. The amount of sweat secreted in tropical climates varies from two to eleven litres in twenty-four hours (Kuno 1934). This makes it necessary to ascertain the loss of iron through sweat.

Mitchell and Hamilton (1949) reported that as much as 6·5 mg. iron may be lost daily in cell-rich sweat even when sweating is slight and that this loss could increase tenfold with profuse sweating. Adams, Leslie, and Levin (1950) also thought that iron lost in cell-rich sweat could amount to 6–10 mg. in twenty-four hours; but they did not believe that cell-free sweat contained more than negligible amounts of iron. Foy and Kondi (1957) reported that the iron-content of cell-free sweat varied between 100 and 200 μg. and the iron content of cell-rich sweat between 0·3 and 6·0 mg. iron per litre. In 35 healthy adults observed by ourselves iron-loss was 0·63–1·90 mg. and 0·15–0·53 mg. per litre of cell-rich and cell-free sweat respectively.

Since active thermal sweating is always accompanied by cell desquamation, the loss of iron in sweat can be of far greater importance than is generally supposed. The present study was undertaken to estimate this loss in patients suffering from hypochromic anæmia. The work was done in the environs of Coonoor in the Nilgiri hills at an altitude of 5500–6000 feet above sea-level.

Material and Methods

Sweating was induced as described by Adams et al. (1950).

The subject sat with her feet and one arm in water kept at 42–43°C for one hour. Sweat was collected in polyethylene bags reaching up to the middle of the other arm. The sweat was drained in a graduated centrifuge tube and well mixed: aliquots were then taken for determination of iron in cell-rich sweat. The remainder was centrifuged for fifteen minutes at 3000 r.p.m. The supernatant was pipetted off and aliquots were taken for the determination of iron: this was done by the *o*-phenanthroline method adopted by Adams et al. The surface area of the sweating region was measured by pasting paper tape and by planimeter. On anæmic patients complete hæmatological investigations were performed on samples of venous blood; in healthy subjects the hæmoglobin and red-cell count were determined on capillary blood.

We examined 6 healthy women (22–32 years) and 17 anæmic women (20–42 years) none of whom were pregnant. As shown in the table, the anæmia in all cases was

AVERAGE HÆMATOLOGICAL VALUES AND IRON-CONTENT OF SWEAT IN HEALTHY AND ANÆMIC WOMEN BEFORE AND AFTER IRON THERAPY

Subjects		Numbers	Hæmoglobin (g. per 100 ml.)	Red-cell count (million per c.mm.)	Packed-cell volume (%)	Mean corpuscular volume (c.μ)	Mean corpuscular hæmoglobin (μμg.)	Mean corpuscular hæmoglobin concentration (%)	Surface area of sweating region (sq. cm.)	Quantity of sweat collected (ml. per hour)	Iron in cell-rich sweat (mg. per litre)	Iron in cell-free sweat (mg. per litre)
Healthy women		6	14·00 (*13·50–15·00*)	4·85 (*4·58–5·10*)	..	..	..	..	1025 (*916–1125*)	6·0 (*3·5–9·2*)	1·61 ± 0·165 (*1·21–2·30*)	0·44 ± 0·056 (*0·30–0·60*)
Anæmic women group I	Before treatment	12	7·90 (*5·10–10·50*)	3·53 (*3·17–4·08*)	28 (*24–34*)	79 (*76–83*)	22 (*15–26*)	28 (*20–31*)	957 (*894–1094*)	3·7 (*1·3–7·0*)	0·47 ± 0·073	0*
	After 42 days' treatment	12	13·10 (*11·70–14·20*)	4·54 (*4·13–5·10*)	42 (*38–46*)	92 (*86–96*)	29 (*28–31*)	32 (*30–32*)	954 (*898–1098*)	7·3 (*4·8–10·1*)	1·15 ± 0·073 (*0·70–1·66*)	0·41 ± 0·035 (*0·30–0·58*)
Anæmic women group II	Before treatment	5	6·78 (*5·00–8·10*)	3·37 (*2·89–3·61*)	27 (*20–32*)	77 (*69–83*)	20 (*17–22*)	26 (*24–28*)	951 (*842–997*)	4·1 (*2·5–4·8*)	0·36 ± 0·067	0
	After 28 days' treatment	5	11·60 (*10·80–12·60*)	4·31 (*4·03–4·51*)	41 (*38–44*)	94 (*90–98*)	27 (*26–29*)	29 (*27–30*)	951 (*860–996*)	5·2 (*4·3–6·2*)	0·93 ± 0·067 (*0·60–1·30*)	0·32 ± 0·064 (*0·20–0·56*)

Figures in parentheses give ranges of values. * Observations on 8 cases only.

microcytic hypochromic. The patients were treated with a daily oral dose of 600 mg. ferrous sulphate, equivalent to 178 mg. iron as determined on the sample of the drug used. The determinations of iron in sweat and the blood examination were repeated in 5 cases after twenty-eight days and in 12 cases after forty-two days' treatment.

Results

Our results are shown in the table. In normal women 17 the average volume of sweat collected in one hour was 6·0 ml. from a surface of 1025 sq. cm. The average iron content of cell-rich and cell-free sweat was 1·61 and 0·44 mg. per litre respectively. In anæmic women before treatment the average iron-content of cell-rich sweat was 0·44 mg. per litre, whereas cell-free sweat contained no detectable iron. After twenty-eight days' iron therapy the average iron content of cell-rich and cell-free sweat was 0·93 and 0·32 mg. per litre respectively; and after forty-two days' treatment 1·15 and 0·41 mg. This was almost within the normal range for healthy Indian women.

Conclusions and Summary

The cell-free sweat of 17 women suffering from microcytic hypochromic anæmia contained no iron; and the iron content of their cell-rich sweat was significantly lower than that of 6 healthy women.

After iron therapy, iron reappeared in the cell-free [illegible] and the iron content of cell-rich [illegible] significantly. Preliminary studies suggest that the increase of iron in cell-rich sweat was probably due to an increase in the iron content of the desquamated epithelial cells.

While full evaluation of our results must await the completion of further investigations, it seems legitimate to conclude that in iron-deficiency anæmia the body tends to conserve iron by reducing loss through sweat.

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REFERENCES

Adams, W. S., Leslie, A., Levin, M. H. (1950) *Proc. Soc. exp. Biol., N.Y.* 74, 46.
Foy, H., Kondi, A. (1956) *Lancet*, i, 423.
— — (1957) *J. trop. Med. Hyg.* 60, 105.
— — Sarma, B. (1958) *ibid.* 61, 27.
Kuno, Y. (1934) Cited by Foy and Kondi (1957).
Mitchell, H. H., Hamilton, T. S. (1949) *J. biol. Chem.* 178, 345.

A PUMP FOR USE IN OPEN HEART SURGERY

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A PUMP designed for the extracorporeal circulation of blood in open heart surgery should be simple in action and reliable in use. Maintenance, cleaning, and sterilisation should not be difficult. To avoid hæmolysis the pump should not subject the blood to excessive pressures. A wide range of flow should be possible. The output should be so predictable and constant in face of varying resistances and temperatures that an arterial flow-meter is unnecessary.

In this paper I describe a pump which, tested by routine clinical use, appears to meet these requirements. It was constructed from the Melrose-N.E.P. (New Electronic Products) machine (Cleland and Melrose 1955) after a prototype built for Dr. D. G. Melrose had been tested at the Postgraduate Medical School of London.

In the Melrose-N.E.P. machine, blood flows through a single 57 cm. length of plastic tubing which is compressed 72 times per min. against a rigid platform by the movement of a cam-driven horizontal steel bar. Changes in stroke-volume are obtained by altering the distance between bar and platform. Cam-driven occlusive valves permit flow in only one direction. The rate is not variable in operation.

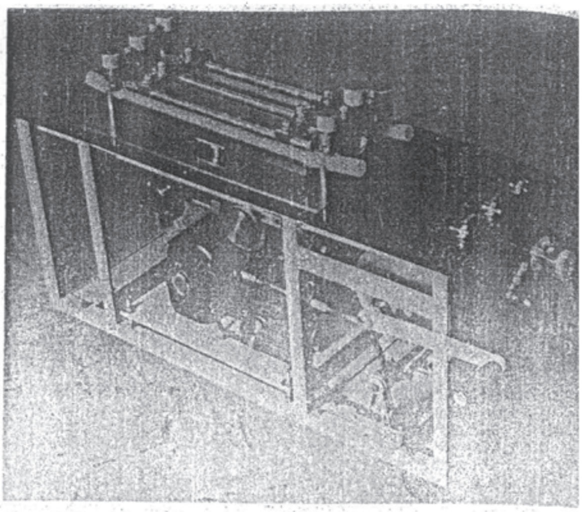

Fig. 1—The twin pump modification of the Melrose-N.E.P. machine.

The modified machine is a twin pump (fig. 1) in which two parallel lengths of plastic tubing lying on rigid platforms are alternately compressed by the movement of two steel bars. The distance between the bars and platforms is such that the bars never lose contact with the tubing in diastole, and never completely occlude the lumen in systole. Changes in output are obtained by altering the rate of action of the pump bars with a Kopp variator.*

The twin pump has a greater range of output than the Melrose-N.E.P. machine. The output alters remarkably little at different temperatures and against changing resistances. Wear and tear of the moving parts is reduced, and the life of the instrument is greatly prolonged. Similar flows are effected with fewer strokes in each minute; and, because the duration of systole is relatively increased, the systolic peak of pressure is reduced.

With $^3/_4$ in. 'Tygon' pump tubing in the machine the stroke-output is 95 ml. By a simple adjustment the pump is given a rate of action of 6–39 strokes per min., or of 18–35 strokes per min. In this way the output may be increased from 0·57 to 3·7 litres per min., or from 1·71 to 8 litres per min. The control knob of the Kopp variator is calibrated so that the rate of action of the pump, and thus its output, may be seen at a glance. A geared-down $^1/_2$ h.p. A.C. mains-operated motor drives

* Manufactured by Allspeeds Ltd., Accrington, Lancs.

PLASMA-HÆMOGLOBIN LEVELS DURING PERFUSION

[illegible]	Extracorporeal blood-flow (l. per min.)	Duration of perfusion (min.)	Plasma-hæmoglobin in pump-priming blood (mg. per 100 ml.)	Plasma-[illegible]
1	3·72	27	..	[illegible]
2	3·5	36	..	94
3	3·72	[illegible]	[illegible]	[illegible]
4	3·6	[illegible]	..	104
5	3·5	30	[illegible]	[illegible]
6	3·2	47	[illegible]	[illegible]
7	3·5	24	65	[illegible]
8	3·5	25	31	[illegible]
9	3·3	14	55	75
10	3·2	40	25	[illegible]