A STUDY OF PSORIASIS,

with special reference to

METABOLISM AND FAMILIAL INCIDENCE,

by

WILLIAM STEELE WATSON GUTHRIE,

M.B., Ch.B. (Glasgow),
F.R.F.P.S. (Glasgow),

Captain, Royal Army Medical Corps.

ProQuest LLC.
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106 – 1346

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* Not incorporated in text. See pocket in binder.

I. INTRODUCTION.

In dermatology, as in all other branches of medicine, there are many mysteries. In the realm of skin diseases, however, there is no greater enigma than that common dermatosis, psoriasis. "Of making of many books there is no end" might well apply to the voluminous literature on the subject. For more than a century many theories have been put forward to explain the etiology of psoriasis. The great majority of these theories lack adequate scientific basis and only serve to show that the various authors have allowed faith in one or other of these hypotheses to obscure the path of logical reasoning.

In the following pages the writer intends to comment on the work of other investigators only if their researches have some bearing on his own observations. He has no intention of reviewing the whole literature on the etiology of psoriasis which has been attempted on several previous occasions, most notably by Nobl (1928) in Jadassohn's Handbuch.

The following investigations were conducted in Stobhill Hospital, Glasgow, during 1931 and 1932 and in the Skin Department, Metabolic Wards and Biochemical Laboratory of the Royal Infirmary, Glasgow, between 1932 and 1934. The statistical survey of out-patients attending the Skin Dispensary at the Royal Infirmary has been continued up to September 1939, and further investigation of sweating in psoriasis in a Military Hospital.

II. A COMPARATIVE STUDY OF THE SWEAT IN NORMAL PERSONS AND IN PSORIASIS.

(From the Skin Department and Biochemical Laboratory, Royal Infirmary and University, Glasgow).

A. THE COMPOSITION OF HUMAN SWEAT.

Various workers have estimated the concentration of chlorides, non-protein nitrogen, urea nitrogen and ammonia nitrogen in samples of sweat obtained by subjecting normal persons to high air temperatures. These findings are summarised in Table I. In addition the following constituents have been found in sweat:

Lactic acid (Schenk, 1926: Mosher, 1933)

Glucose (Usher and Rabinovitch, 1927)

do. (Silvers, Forster and Talbert, 1928)

Amino-acid nitrogen (Talbert and Haugen, 1928)

Uric acid (Saiki, Olmanson and Talbert, 1932)

Creatinine, sulphur (Mosher, 1933)

Potassium, calcium, magnesium (Talbert, Haugen, Carpenter and Bryant, 1933).

Of these latter constituents lactic acid is the only one of physiological importance. Koriakina and Krestownikoff (1930) showed that large amounts of lactic acid might be eliminated in sweat during a long distance race. There is no doubt that excretion of lactic acid by

TABLE I.

	AUTHORS	RANGE mgm. per 100 c.c.	AVERAGE mgm. per 100 c.c.	REMARKS.
Chloride (as NaCl)	Hunt (1912)	under 200	-	Higher concentrations due to evaporation.
	Moss (1923)	118-325	224	
	Barney (1926)	188-469	310	Pilocarpine gr. 1/5. Average fluid 300 c.c.
	Talbert & Haugen (1927)	430-830	550-650	
	Vass & McSwiney (1930)	(i) 265-501	370	14 males
		(ii) 223-387	300	10 females
Non-Protein N (i.e.Total N)	Barney (1925)	32-67	50	No pilocarpine
	Barney (1926)	27-63	42	Pilocarpine gr. 1/5. Fluid = 300 c.c.
	Talbert, Silvers & Johnson (1927)	47-130	-	
	Mosher (1933)	66-108	82	
Urea N	Riggs (1911)	35-69	45	
	Barney (1925)	20-41	26	
	Barney (1926)	16-38	26	Pilocarpine gr. 1/5. Fluid = 300 c.c.
	Talbert, Finkle & Katsuki, S. (1927)	24-112	-	
	Vass & McSwiney (1930)	(i) 11-33	21	14 males
		(ii) 14-28	19	10 females
	Mosher (1933)	40-81	57	
Ammonia N	Talbert, Finkle & Katsuki, D. (1927)	5-35	-	Latter figure unusually high
	Vass & McSwiney (1930)	(i) 2.55-7.0	6.0	14 males
		(ii) 2.60-11.1	4.7	10 females
	Mosher (1933)	8-15	11.0	

sweating would facilitate the performance of muscular work by avoiding an increase in the H-ion concentration of the blood and consequent respiratory distress. Apart from this the excretory function of the sweat glands is very much less important than their rôle in regulating body temperature. Mosher (1933) found that the urine was a much more concentrated solution than sweat as the former contained three to five times the amount of total solids and from five to nine times the amount of organic matter.

Chlorides. Hunt (1912) held that, as it leaves the orifices of the glands, sweat never has a higher concentration than 200 mg. per 100 c.c. Higher concentrations were brought about by evaporation of water. Kittsteiner (1913) as a result of experiments on himself and three students concluded that the concentration of chloride increased with increased sweat secretion and vice versa. Adolph (1923) found that the chloride content increased to a maximum and then remained stationary. Barney (1926) found that chloride formed approximately half of the total solids. This finding of course applies to persons at rest where the excretion of lactic acid is minimal.

B. THE SWEAT IN PSORIASIS.

Garbi (1924) investigated the secretion by the skin of sweat and fat in twelve cases of psoriasis. In the lesions and in a zone up to 0.5 cm. round them, the secretion of fat

and sweat was wanting. When the eruption cleared up, both secretions returned. Biopsy showed histologically well developed sweat glands. He therefore supposed that there was a functional disturbance of the secretory nerves.

Barney (1925, 1926) investigated the content of non-protein nitrogen and chlorides (as sodium chloride) of blood and sweat of normal persons and sufferers from psoriasis. He also calculated the elimination per hour in the sweat of non-protein N, urea N and Cl (as NaCl). In all cases the values for psoriasis were well within the normal limits.

C. PERSONAL INVESTIGATION.

As Barney's findings have not been verified, it was decided to compare the composition of the sweat and blood plasma of normal persons and psoriatics.

Freshly voided sweat was obtained by exposing the subjects to temperatures of 47-59°C. (117-138°F.) for half an hour. The substances investigated were chloride (as NaCl), non-protein nitrogen and urea nitrogen in sweat and plasma and ammonia nitrogen in sweat only. Twelve estimations were made on six normal healthy males and ten estimations on seven male cases of psoriasis. The normal subjects were students of the Royal Infirmary School of Massage and assistants in the Biochemical Laboratory along with Dr. S. L. Tompsett, Assistant Biochemist and the author. The cases of psoriasis

were attending the Out-patient Department.

A few preliminary experiments were conducted in which the subjects were given pilocarpine gr.$^{1}/_{6}$ hypodermically before sweating. They drank 500 c.c. water whilst exposed to temperatures of approximately 50°C. It was found in most cases that sweat was freely secreted but several of the patients felt sick or faint so that the experiment had to be discontinued. In these cases it was found that there was a drop in the plasma NaCl after sweating as compared with the value before entering the sweat bath.

Moss (1923) has pointed out that with continued sweating a great loss of chlorides occurred and, if the subjects were working in hot places and drinking water freely, symptoms of water poisoning were brought on. Priestley (1921) had previously shown that, if excess water volume was drunk, the excretion of chlorides by the kidneys fell very markedly. Miners and stokers working in hot atmospheres are apt to suffer from severe muscle cramp. In these cases the plasma NaCl is lowered due to a combination of loss of chloride by sweating and excessive drinking of water. The writer's cases did not complain of cramp (perhaps because they were doing no muscular work during the experiment), but in view of the unpleasant symptoms, nausea and faintness, it was decided not to use pilocarpine nor to give water to drink.

Method of Collection of Sweat.

The subject had a warm bath the previous evening.

Before the experiment he was washed down in a spray bath about blood heat using a soft brush but no soap. He was then carefully dried and afterwards enveloped in an oiled cambric bag 6 feet 6 inches long by 2 feet 6 inches broad. It was closed by a zipp fastener over each shoulder so that the bag could be made to fit comfortably round the base of the neck. To make this bag watertight, it had a double row of stitching along one side - on the other side the cambric was merely folded. It was also provided with a double bottom pierced in its centre by a glass tube. The inner end of the latter had a flange held by stitching between two layers of oiled cambric. To the outer end of the glass tube was attached a short length of rubber tubing closed by a spring clip and ending in tapered glass tubing for running off the sweat.

Sweating was produced in a radiant heat cabinet which was brought to a fairly constant temperature by heating for half an hour before the experiment. The subject sat on a stool in the centre of this cabinet, the head and neck alone protruding from it. On the floor was a pan of water designed to prevent evaporation of the sweat by keeping the relative humidity of the bath at a high level. A thermometer was suspended inside the cabinet and readings of the air temperature were taken every five minutes. The body temperature was taken in the mouth at the start and every ten minutes thereafter. It was found to rise usually to about 100°F. and in two cases to above 101°F. These subjects, who did not receive

injections of pilocarpine or have water to drink, did not suffer from sickness or faintness. The duration of sweating was thirty minutes in every case.

ANALYTICAL METHODS.

Plasma. Blood was obtained by venipuncture immediately before the experiment, centrifuged at once and the plasma was pipetted off.

Non-protein N, Urea N } Folin and Wu's colorimetric methods

Chlorides (as $NaCl$) Van Slyke and Sendroy (1923)

Sweat was filtered and kept in the ice box.

In the preparation of a protein free filtrate, the following were pipetted into a flask:

2 c.c. filtered sweat

16 c.c. distilled water

1 c.c. 10% sodium tungstate

1 c.c. $^2/_3$ N sulphuric acid - drop by drop with gentle agitation of the flask.

After the usual shaking of the flask no red or chocolate brown colour appeared in any of the specimens of sweat analysed. It seems therefore that there is no protein in sweat.

Methods of analysis.

Total N - as for non-protein N of plasma

(Urea + ammonia) N - as for urea N of plasma

Ammonia N - absorption with permutit and nesslerisation (Folin and Bell, 1917).

All estimations were done in duplicate and the results found to agree within 3 per cent. The average value is given in each case.

The results obtained both for the normal subjects and for the cases of psoriasis are shown in Table II. Tables III and IV give a summarised comparison of the findings for chloride and nitrogenous constituents respectively.

DISCUSSION.

(1) SWEAT.

(a) Chloride (Tables I, II and III).

The results in normal subjects are considerably lower than those given (Table I) by Talbert and Haugen (1927) and somewhat higher than those of Moss (1923). They are however comparable with the findings of Barney (1926), i.e. 188 to 469 mgm. per 100 c.c. as against the writer's figures of 211 to 445 mgm. per 100 c.c. The values given by Vass and McSwiney (1930) for their male subjects (265 to 501 mgm. per 100 c.c.) correspond fairly well with my findings.

As regards psoriasis, Barney (1926) found sweat chlorides in seven cases to vary between 215 and 515 mgm. per 100 c.c. with an average of 341 mgm. per 100 c.c. This result is comparable with the figures obtained in this investigation - 154 to 494 mgm. per 100 c.c. with an average of 329 mgm. per 100 c.c. (Table III). From his personal observations, the

TABLE III.

Chloride (as Sodium Chloride). Percentage Content in Sweat and Plasma.

	No. of analyses	Bath Temp. (°C.)		Sweat (mgm. per 100 c.c.)		Plasma (mgm. per 100 c.c.)	
		Range	Average	Range	Average	Range	Average
NORMAL	12	47-58	52	211-445	346	550-620	582
PSORIASIS	10	49-59	53	154-494	329	562-661	603

author agrees with Barney (1926) that there is no change from normal in the concentration of chlorides in the sweat of persons suffering from psoriasis.

(b) Total Nitrogen (Tables I, II and IV).

As already stated (page 7) no protein appeared to be present in any of the samples of sweat collected either from normal persons or psoriatics.

In comparing the sweat and plasma as regards their nitrogen content, the total nitrogen of the former corresponds to the non-protein nitrogen of the plasma.

When pilocarpine was not used, Barney (1925) found values from 32 to 67 mgm. per 100 c.c., with an average of 50 mgm. per c.c. in normal subjects. These results correspond closely with the author's figures (Table IV), i.e. range 38.3 to 64.7 mgm. per 100 c.c., average 48.0 mgm. per 100 c.c. Talbert, Silvers and Johnson (1927) and Mosher (1933) both found higher values (Table I).

In cases of psoriasis Barney (1925) gave the range as 30.0 to 51.7, the average being 42.5 mgm. per 100 c.c. His later results (1926) were 27 to 58 with an average of 42.2 mgm. per cent. Table IV shows values from 34.7 to 76.8 mgm. per 100 c.c. but, though two findings are above his upper limit, the average is only 49.2 mgm. per 100 c.c.

TABLE IV.

Nitrogenous Constituents. Percentage Content in Sweat and Plasma.

	No. of Analyses	Bath Temp. °C.	SWEAT (mgm. per 100 c.c.)				PLASMA (mgm. per 100 c.c.)	
			Total N	(Urea + NH_3) N	Ammonia N	Urea N	Non-protein N	(Urea + NH_3) N
NORMAL:								
(a) Range	10	47-56	38.3-64.7	15.8-37.5	1.9-6.8	8.8-33.7	23.5-33.2	12.5-18.6
(b) Average	10	51	48.0	23.1	4.1	18.8	27.8	16.2
PSORIASIS:								
(a) Range	10	49-59	34.7-76.8	16.4-30.2	2.9-8.8	13.4-25.0	21.5-31.8	14.3-21.4
(b) Average	10	53	49.2	23.8	4.3	18.3	26.2	17.3

(c) Ammonia Nitrogen (Tables I, II and IV).

The results personally obtained (1.9 to 6.8 mgm. per 100 c.c.) correspond roughly with those of Vass and McSwiney (1930) for their male subjects but are considerably lower than the findings of Talbert, Finkle and Katsuki, D. (1927) and Mosher (1933). In the author's opinion it is very important that estimations of ammonia N in sweat should either be made immediately after collection or that the sweat should be kept in an ice box to prevent decomposition of urea to ammonia by skin bacteria.

Barney (1925, 1926) did not estimate ammonia N in the sweat of psoriatics and no reference can be found that this has been done by other investigators. In the estimations made personally by the author the content of ammonia N in the sweat of normal persons and patients afflicted with psoriasis did not vary materially (Table IV).

(d) Urea Nitrogen (Tables I, II and IV).

Comparing the author's results for normal subjects with those of other investigators, it is found that they are much lower than the values given by Talbert, Finkle and Katsuki, S. (1927) and Mosher (1933), but are comparable with the figures given by Barney (1925, 1926) and Vass and McSwiney (1930). As Barney made no estimation of ammonia N, it is presumed that his values are for urea + ammonia. His range is from 16 to 41 mgm. per 100 c.c. which corresponds closely to the author's figures for (urea + ammonia) N.

The author's results for (urea + ammonia) N in his cases of psoriasis have a range of 16.4 to 30.2, with an average of 23.8 mgm. per 100 c.c., very similar to those of Barney (1925, 1926). In the controls these constituents form on an average 47 per cent. of the total sweat-N as against 50 per cent. in the cases of psoriasis.

(2) BLOOD PLASMA.

(a) Chloride (Tables II and III).

The upper limit for plasma chloride is somewhat higher in psoriasis than in the normal controls. This higher figure is due to two estimations on one case of psoriasis which gave values of 661 and 647 mgm. per 100 c.c. The usually accepted upper limit for plasma chloride is 620 mgm. per 100 c.c. If this exceptional case is excluded the range of values was from 562 to 608 with an average of 590 mgm. per c.c. - figures close to those obtained for the normal controls.

This case of psoriasis with high plasma chloride had very low values for sweat chloride (154 and 180 mgm. per 100 c.c.). He was a case of widespread psoriasis affecting both surfaces of all four limbs. The buttocks were particularly involved. The dorsum and palms of both hands showed a thickly scaling condition with pitting and fissuring of the nails. The author, however, does not think that these unusual values in sweat and plasma chloride have any connection with the extent or severity of his dermatosis as in two cases of

psoriasis universalis the values for sweat chloride were 349 and 494 mgm. per 100 c.c. with normal figures for plasma chloride in each case.

The average value for sweat chloride in the normal controls was 61 per cent. of the average for plasma chloride and in the cases of psoriasis 55 per cent. From the results of these experiments, it may be stated that both in normal persons and in psoriasis, the figure for sweat chloride is from half to two-thirds of that for plasma chloride.

(b) Non-protein nitrogen (Tables II and IV).

The values found in cases of psoriasis corresponded closely to those obtained from the plasma of the controls.

(c) (Urea + Ammonia) Nitrogen (Tables II and IV).

By the method used the nitrogen present as urea and ammonia is estimated. The amount of ammonia present in plasma is however so small as to be negligible (Harrison, 1937) and the result of the estimation is usually taken as the urea nitrogen of the plasma. The ammonia nitrogen of sweat however may amount to 15 mgm. per 100 c.c. (Mosher, 1933). In comparing plasma and sweat it is more accurate to consider the figures for sweat as those given for (urea + ammonia) N rather than those for urea N.

In this investigation the values for plasma are slightly higher in psoriasis than in the controls. This may be explained by the greater age of the former. The highest

value however (in a man of 48 years) is 21.4 mgm.per 100 c.c. - equivalent to a figure for blood urea of 46 mgm. per 100 c.c. The fraction of the non-protein N of the plasma present in the form of urea is higher in psoriasis (59-76 per cent.) than in the controls (46 to 67 per cent.). The average age of the psoriatics was 34 years while that of the normal subjects was 25 years.

SUMMARY.

(1) The concentration of chloride and nitrogenous substances in sweat and plasma was investigated in normal subjects and in sufferers from psoriasis.

(2) The values for normal sweat were found to agree fairly closely with those obtained by Barney (1925, 1926) and Vass and McSwiney (1930) and for the cases of psoriasis with those of Barney (1925, 1926).

(3) The concentration of chloride in the sweat both in normal controls and in psoriatics was from one half to two thirds of that found in the plasma.

(4) In the normal controls and in psoriasis the concentration in the sweat of nitrogen present in the form of urea and ammonia was approximately half of the total nitrogen.

(5) The values for plasma non-protein nitrogen corresponded closely in both types of subjects, but the proportion

present in the form of urea was greater in psoriasis than in the controls. This may be due to the higher average age in the cases of psoriasis.

(6) The results of this investigation show that there is no significant difference in the sweat of normal persons and in patients with psoriasis as regards the concentration of chloride, total nitrogen, urea nitrogen and ammonia nitrogen.

III. THE DAILY OUTPUT OF TOTAL NITROGEN AND CHLORIDE IN THE SWEAT OF NORMAL PERSONS AND OF PSORIATICS.

(From the Skin Department, Metabolic Wards and Biochemical Laboratory, Royal Infirmary and University, Glasgow).

A. PREVIOUS OBSERVATIONS.

The author has already considered the quality and quantity of the various solutes secreted during periods of profuse sweating. In Table I are summarised the values found by other workers in similar investigations on normal subjects only. Less numerous experiments have been made to determine the daily output of the sweat constituents in normal subjects at ordinary air temperatures.

Most observers have determined the daily output of nitrogen and chloride by analysing extracts of the underclothing worn by their experimental subjects. With subjects at rest the average daily values for nitrogen were 0.071 gm. (Benedict, 1905), 0.128 gm. (Cramer, 1890), 0.286 gm. (Graham and Poulton, 1912) and 0.33 gm. (Schwenkenbecher and Spitta, 1907). In tropical climates the nitrogen excretion is considerably increased (Eijkman, 1893). When work is done the output of nitrogen may be as much as 0.22 gm. per hour (Benedict, 1905).

Schwenkenbecher and Spitta (1907) recovered on an average 0.33 gm. NaCl per day from the clothing of subjects at rest in bed. Cramer (1890) found a maximum of 2.27 gm.

per day secreted in sweat of subjects actively employed.

Bost and Borgstrom (1926) found that in two subjects doing office work and walking in the morning and evening, the average air temperature being 29.4°C. (85°F.) and the relative humidity 67 per cent., the excretions of nitrogen in sweat during 24 hours were 0.900 gm. and 0.613 gm. The outputs per sq. m. body surface were respectively 0.522 gm. and 0.353 gm. per day. The nitrogen intakes were respectively 9.8 gm. and 16.1 gm. (61 and 101 gm. protein). These writers concluded from other experiments lasting 2.5 to 3.75 hours that the protein content of the food eaten in the twelve hours previous to the experiment did not seem to alter to any appreciable extent the amount of nitrogen excreted per sq. m. body surface per hour.

Cuthbertson and Guthrie (1934) studied the excretion of nitrogen in the sweat of four normal subjects at rest in bed. They discovered that, when the room temperature was constant, high protein intake (175-187 gm. daily) was accompanied by an increased daily output in the sweat as compared with the output when on low protein diet (67-77 gm. daily). With the same protein intake, increase of air temperature within the limits 15.0-17.8°C. (59-64°F.) apparently led to a higher daily excretion of nitrogen in the sweat. The effect of alterations in protein intake was in all cases in excess of that due to air temperature. The variations in protein intake were however of a much greater order than the changes

in air temperature.

Kittsteiner (1911) asserted that systematic addition of salt to the diet increased the NaCl content of the sweat and vice versa, but that changes of diet of short duration had no effect. Cuthbertson and Guthrie (1934) found that, at the same room temperatures, increase of salt intake from 5-6 gm. daily to 11-12 gm. daily had no constant effect on the output of chloride in the sweat, at least when the subjects had the same daily intake of chloride for 6 to 13 days prior to the collection of sweat. They also established that the output of chloride in the sweat rose with increase of air temperature, if the intake of chloride was constant.

B. PERSONAL INVESTIGATION.

The following investigation was conducted with the object of comparing the output of sweat nitrogen and chloride in normal persons and in patients affected with psoriasis. The normal subjects were admitted to the Metabolic Ward of the Royal Infirmary, Glasgow. The cases of psoriasis had been attending the Skin Department and were also admitted to the Metabolic Ward by kind permission of Dr. J. Ferguson Smith and Dr. D. P. Cuthbertson. The subjects remained in bed during the experiments, in order to avoid as far as possible variations in the amount of sweat secretion due to differing degrees of physical exercise.

EXPERIMENTAL METHODS.

The duration of each periods of sweat collection was 48 hours, both in the normal subjects and in the cases of psoriasis.

(i) Normal group. Subjects I-IV.

These were four healthy young males aged from 17 to 26 years. Though they had been unemployed for several months before the experiments, they were in good condition due to participation in some form of sport.

Subjects I and II were placed first on a moderately low protein + normal salt diet (A) and then on a moderately low protein + low salt diet (B). Subjects III and IV were placed on the same types of diet but the order was reversed. Diet A. Protein content 71-77 gm. per day. Salt content 11-12 gm. per day.

The diet consisted of non-meat soup, potatoes, carrots, "Creamola" pudding,* tinned pears, milk, saltless bread, butter, eggs, jam, bran, tea, cocoa and sugar. No meat was given. Salt was dispensed with in cooking and 5-6.5 gm. added each day. Diet B. Protein content 71-77 gm. per day. Salt content 5-6 gm. per day. This diet was identical with A except that the extra salt was omitted.

Subjects II and III had exactly similar diets through-

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* Daily ration - 4 gm. "Creamola" powder + 200 c.c. milk was boiled down to 100 c.c.

out the experiments. Slight modifications were made in those of Subjects I and IV, according to appetite. Throughout each period the same diet was adhered to from day to day. A constant intake of 200 c.c. water per day was allowed.

(ii) Psoriasis. Subjects V-VIII.

The ages of these cases were higher than in the normal controls, being from 31 to 48 years. One was a case of psoriasis universalis, in another the scalp, lumbo-sacral region and limbs were chiefly affected, and in the remaining two there were mummular lesions on the arms and legs only.

Diet A. Protein content 71 gm. per day. Salt content about 8 gm. per day.

The diet consisted of the same foodstuffs given to the normal cases. As before no salt was used in cooking and 5 gm. added daily.

Diet B was similar to A except that the added salt was omitted.

In both diets A and B the ration of water was 200 c.c. daily.

The object of varying the salt content of the diet was to obtain data for a study of chloride metabolism which is described later in this thesis.

Daily estimations of the urinary output of total N and NaCl were made. When there was less than 1 gm. of difference between the urinary N outputs on two successive days. and the urinary excretion of NaCl was at a relatively constant level, the collection of sweat was commenced.

Method of Collection of Sweat.

A roomy one-piece suit of calico was obtained with gloves and socks attached. All openings were fastened by tapes so arranged that the two sides overlapped. A loosely fitting jaconet suit, constructed on somewhat similar lines, was worn over the calico garment. While it is natural to suppose that such an arrangement must tend to prevent normal evaporation to a certain extent, yet some waterproof material was necessary to prevent loss of sweat on the bed linen.

A blank estimation was performed on control pieces of calico and jaconet of the same weight and quality as the suits. Each garment was boiled along with the control material in ordinary tap water, to remove any loose matter and to distribute evenly between the suit and the control any traces of soluble substances still present. Both were washed out several times in the same changes of water and dried.

Approximately at 10 a.m. on the day the collection of sweat commenced the subject had a bath, was sprayed down with distilled water and carefully dried. He donned the calico garment over which was worn the jaconet suit. The hands and feet were enclosed in both garments but the head and neck were left exposed. For two days the subject remained in bed, being covered only by a cotton sheet, one blanket and a counterpane.

During this time the urine was collected in 24-hourly lots. The greatest possible care was taken to avoid contamin-

ation of the garments with urine, the parts being washed after micturition. It was realised that a few c.c. of urine voided on the clothing would lead to false results.

After 48 hours the clothing was removed. In most cases it seemed quite dry except for the gloves and socks. When the air temperature was high, the calico garment was damp throughout and moisture was present on the inner surface of the jaconet suit.

The subject was washed down with 4,000 c.c. tap water and dried with gauze towels which had been well boiled and rinsed. The clothing was placed in an enamelled bath containing the washings from the body and a further 8,000 c.c. tap water added.

Control pieces of calico, jaconet and gauze towelling of the same weight and quality as those used for the experimental subject were placed in a similar bath containing 12,000 c.c. tap water. The contents of both baths were acidified with 5 c.c. concentrated sulphuric acid.

As a control for evaporation 12,000 c.c. water were run into a third similar bath.

After 24 hours' steeping, during which period the contents of the first two baths were stirred round from time to time, the clothing and control pieces of calico, jaconet and gauze were removed. Half the original volume, corrected for evaporation, was filtered in each case and concentrated to 1,000 c.c.

Analyses were then made on the extracts of (1) sweat and clothing, (2) clothing only, and by subtraction values for the sweat alone were obtained.

ANALYTICAL METHODS.

Urine. Total N : Kjeldahl.

Chloride (as NaCl): Volhard-Arnold method.

Sweat. The same methods were employed as for urine, 100 c.c. of concentrated sweat washings being used in each case.

Diet. The values for the protein content of the diet were calculated from the tables of Sherman (1924).

The chloride content was determined on 3 gm. of dried diet by the method of Sunderman and Williams (1933).

The Reaction of Sweat.

Using a colorimetric method Talbert (1922) showed that sweat produced by work or heat is invariably acid. Sweat collected under rubber jackets is more acid, probably because there is not quite the same freedom for the escape of volatile organic acids. Mosher (1933) obtained pH values of 5.02 to 5.71.

Vass and McSwiney (1930) in a study of 14 normal males found the sweat to be acid except in two specimens which gave pH values of 7.2 and 7.35. In a sample of freshly voided sweat kept in a sterile bottle at 37°C., the ammonia N increased

gradually from 3.8 mgm. to 37.58 mgm. per 100 c.c. at 66 hours. They proved that this decomposition was mainly accomplished by the bacteria normally present on the skin. These organisms attack the urea and then the epithelial débris.

Although estimations of urea and ammonia nitrogen were made by the author of this thesis in the present investigation, he does not believe that such results are reliable where sweat is collected over a period of 48 hours. They are thus not reported. In every case the sweat washings when tested with B.D.H. universal indicator showed a pH of less than 7 and escape of nitrogen in the form of ammonia while the clothing was steeping for 24 hours was prevented by acidification of the washings.

Freshly voided sweat, the analysis of which has been reported in Table II, was also tested by B.D.H. universal indicator. In one normal subject (Case 3) the pH was 8 on two occasions. In the other normal subjects and all the cases of psoriasis the values were never above 7. As this method is much less accurate than the quinhydrone electrode used by Vass and McSwiney (1930), the writer does not feel justified in detailing the values obtained.

DISCUSSION.

It will be seen from Tables V and VI that irrespective of the diet the N and NaCl content of the sweat per square metre body surface of Subjects I-IV (normal) was 0.118-0.226

gm. N and 0.083-0.318 gm. NaCl per day at 15.0-17.8°C. In subjects V-VIII (psoriasis) the range was from 0.073 to 0.213 gm. N and from 0.056 to 0.246 gm. NaCl per sq. m. per day at 16.5-21.9°C.

TABLE VI.

Sweat-N and Sweat-NaCl - Range of values (gm. per day).

Condition	No. and Sex	NITROGEN		CHLORIDE (as NaCl)	
		Total	Per sq.m.*	Total	Per sq.m.*
Normal	4 M	0.215-0.465	0.118-0.301	0.151-0.483	0.083-0.318
Psoriasis	4 M	0.126-0.369	0.073-0.213	0.097-0.426	0.056-0.246

* The surface areas of the subjects were calculated from their heights and weights by the formula of Du Bois and Du Bois (1916). The values given for the output per sq. m. per day are lower than the actual values as the sweat from head and neck is not included.

Increase in the weight of the clothing under the conditions of these experiments cannot be an accurate guide to the total weight of the sweat secreted. The greater part of the water of the sweat was found to evaporate and, in order to keep the experimental conditions as normal as possible, this evaporation was desirable.

The relative humidity existing in the Ward during the experiments can be but a rough guide to the relative humidity of the air within the clothing, especially if sweating

is profuse owing to increased air temperature. No figures are therefore included for the relative humidity.

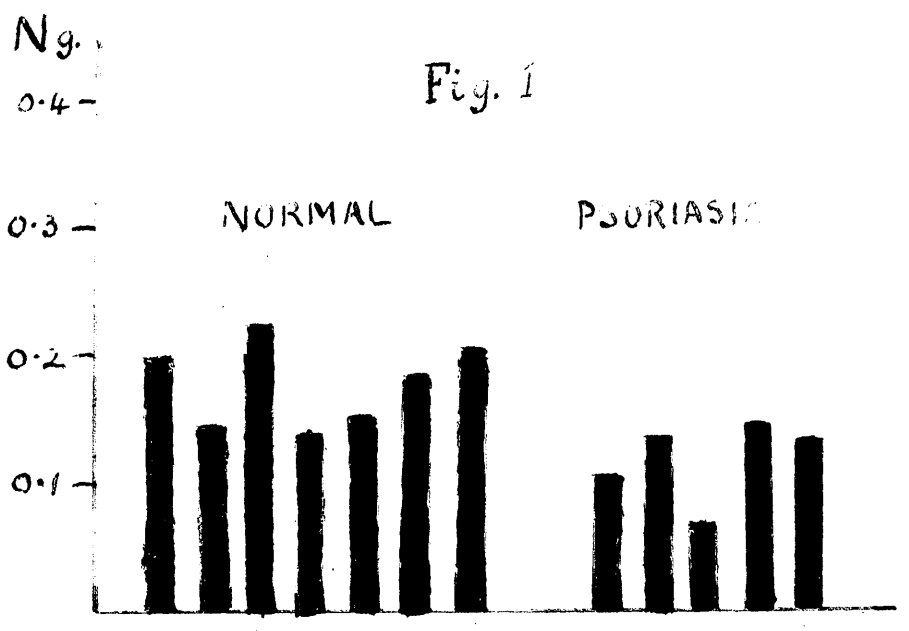
Table V shows that both in normal cases and in psoriasis an increase in ward temperature was accompanied by an increase in the excretion both of nitrogen and chloride in the sweat in every case.

The question of any effect that alterations in diet may have had does not arise. All cases had protein intake approximately the same (71-77 gm. per day). As regards chloride, Cuthbertson and Guthrie (1934) have shown that at the same air temperature increase of salt intake had no constant effect on the excretion of chloride in the sweat. The four normal cases used in this investigation are the same persons as were reported on in 1934.

The experiments on the four cases of psoriasis were carried out in much warmer weather (16.5-21.9°C.) than in the case of the normal controls (15.0-17.8°C.). This rise in air temperature caused the results for the psoriatics to approximate more closely to the values obtained in the normal subjects than would have been likely to occur if the temperature had been the same in the two groups.

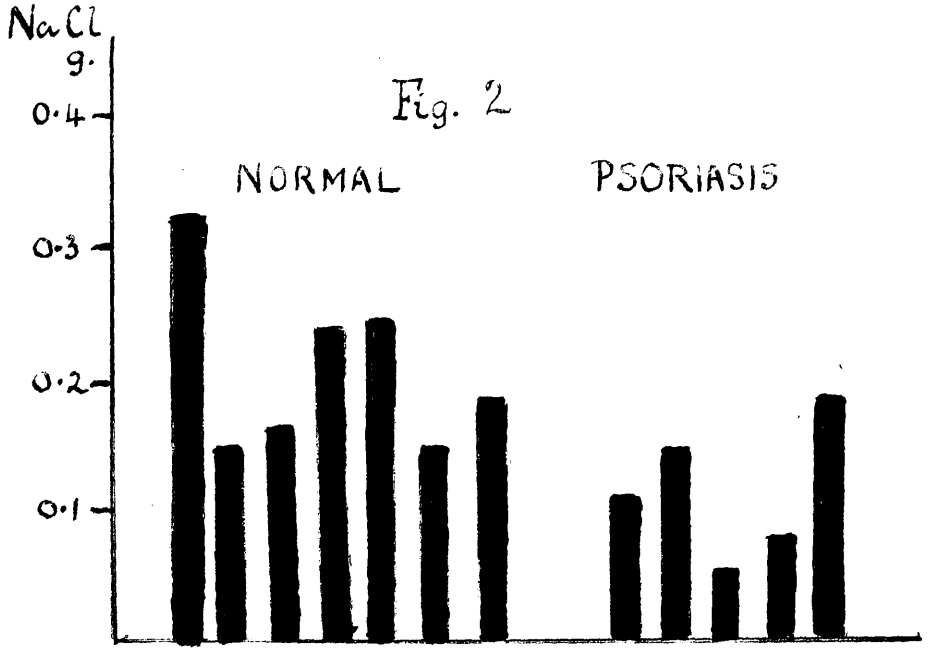
In Table VIA are compared the results for those experiments in which the average ward temperature lay between 16°C. and 18°C.

Fig. 1



Total sweat-N per sq. m. per day
(Average room temperature - 16 to 18°C.)

Fig. 2



Sweat-chloride (NaCl) per sq. m. per day
(Average room temperature - 16 to 18°C.)

TABLE VIA.

Sweat-N and Sweat-NaCl (gm. per sq. m. per day) at 16-18°C.

Condition	No. of estimations.	NITROGEN		CHLORIDE (as NaCl)	
		Range	Average	Range	Average.
Normal	7	0.140-0.226	0.181	0.144-0.318	0.192
Psoriasis	5	0.073-0.162	0.107	0.056-0.187	0.166

Although the writer is unwilling to draw definite conclusions from such meagre evidence, the results shown in Table VIA and Figs. 1 and 2 suggest that at approximately the same room temperature, there may be a diminution in the amount of nitrogen and chloride excreted daily in the sweat of patients with psoriasis as compared with normal subjects.

Another factor which may have some bearing on this question is the age of the subjects, the average for the patients with psoriasis being 40 years as against 23 years in the controls. It might be postulated that in these younger persons, who were all in the habit of taking active exercise, the sweat glands would secrete more plentifully. There is however no evidence either to support or refute this suggestion. It was extremely difficult to obtain the consent of the subjects to undergo these experiments and quite impracticable to make a selection according to age.

A study of the clinical condition of the patients at the time of sweat collection did not reveal any correlation

between the severity of the dermatosis and the daily excretion by the sweat glands of nitrogen and chloride. If the contention of Garbi (1924) that the lesions of psoriasis do not sweat be accepted as true, the resulting diminution in the volume of sweat secreted per unit area would explain the lower values for nitrogen and chloride in psoriasis. It is, in the writer's opinion, irrational to argue that this diminution in the volume of sweat and consequently of nitrogen and chloride should be proportional to that portion of the total skin surface showing lesions of psoriasis. Though psoriasis has certain areas of predilection such as scalp, buttocks and extensor surfaces of the limbs, the distribution of the dermatosis varies considerably from the generalised acute guttate type to the chronic plaques affecting the extensor surfaces of the elbows and knees only.

In normal adult subjects the sweat glands are present most densely on the palms and soles, next on the head and neck, and much less on the trunk and extremities (Kuno, 1930, 1934). This Japanese author from measurements made in his laboratory found that individual variations are so great that no standard figures referring to unit area of skin in different regions can be given. There is no evidence that persons suffering from psoriasis are exceptional in this respect.

Garbi's claim, that in lesions of psoriasis the sweat glands cease to function, may thus be quite consistent with the finding in this investigation of diminished secretion

per unit area of sweat nitrogen and chloride unrelated to the extent of the dermatosis.

The relative amounts of nitrogen excreted in the urine and sweat is of interest. In the normal subjects, on diets of 71-77 gm. protein (11.36-12.32 gm. N) per day, the daily excretion of nitrogen in the urine was from 9.80 to 11.48 gm. The cases of psoriasis, all on a daily intake of 71 gm. protein (11.36 gm. N), excreted in the urine only 7.08 to 8.92 gm. nitrogen.

Cuthbertson and Guthrie (1934) showed that within the limits 15.0 to 17.8°C. increase of air temperature led to an increase of nitrogen excreted in the sweat where the protein intake remained the same, and to increased output of sweat chloride if the chloride intake was constant. They also found that variations in salt intake had no constant effect on the excretion of chloride in the sweat. These conclusions were based on the findings for normal subjects shown in Table V. Dietary changes can thus be ignored as protein intake in all cases was approximately the same and changes in salt intake have been found to have no influence on sweat-chloride. In Table VIB the percentage of the nitrogen intake excreted in urine and sweat is compared in those experiments where the ward temperature was approximately the same (16-18°C.).

TABLE VIB.

Percentage of nitrogen intake excreted in urine and sweat (at 16-18°C.)

Condition	No. of estimations	URINE		SWEAT		URINE N:SWEAT N	
		Range	Average	Range	Average	Range	Average
Normal	7	81-101	90	1.8-3.4	2.5	27:1-51:1	36:1
Psoriasis	5	62-79	71	1.1-2.6	2.0	27:1-71:1	35:1

The ratio 71:1 is exceptional as four results for psoriasis ranged between 27:1 and 36:1. It may therefore be said that at this temperature range the urine excretes 25 to 50 times as much nitrogen as does the sweat in normal persons. The author is not prepared to state a range for psoriasis.

The low urinary output of nitrogen in psoriasis will be discussed further when considering nitrogen metabolism (p. 32).

The variations in the percentage of the chloride intake excreted in the urine were very considerable - 69-129 per cent. in the controls and 66-116 per cent. in psoriasis at average room temperatures of 16-18°C. It seems to be much more difficult to attain a state of chloride equilibrium than it is in the case of nitrogen. The question of the daily values for urinary chloride will be considered over much longer periods of time in the investigation of chloride metabolism to be reported later in this thesis (p. 70). The values for sweat-NaCl as a percentage of the chloride intake are summarised in Table VIC.

TABLE VIC.

Percentage of chloride intake excreted in the sweat (at 16-18°C.)

Condition	No. of estimations	Range	Average
Normal	7	2.9-6.8	4.7
Psoriasis	5	2.4-8.4	4.7

At the average room temperatures obtaining in these experiments the output of chloride in the sweat both in normal persons and in psoriasis was on an average 5 per cent. of the dietary chloride.

SUMMARY.

(1) The daily excretion of nitrogen and chloride in the sweat was investigated in four normal persons and four cases of psoriasis at rest in bed.

(2) A comparison is made of the values obtained in seven estimations on normal subjects and five estimations on cases of psoriasis, where the air temperatures were approximately the same.

(3) The suggestion is put forward tentatively that there may be a diminution in the daily excretion per unit area by the sweat of nitrogen and chloride in psoriasis as compared with the normal.

(4) At air temperatures of 16-18°C. twenty five to fifty times

as much nitrogen was excreted in the urine as in the sweat in normal subjects. Corresponding figures cannot be given for psoriasis.

(5) At the above temperature range in both groups the chloride excreted in the sweat was on an average 5 per cent. of the chloride intake.

IV. METABOLISM IN PSORIASIS.

Nobl (1928) discussed very fully the rôle of metabolism in the etiology of psoriasis and concluded that there was no foundation for the theory that psoriasis was due to an anomaly of metabolism. If such were present, it must be regarded along with many other external and internal influences in the sense of a changeable exciting factor acting on a constitution prone to develop the characteristic reaction in the skin.

A. NITROGEN METABOLISM.

Schamberg et alii (1913) from a most thorough study of nitrogen metabolism concluded there was a retention of nitrogen in psoriasis and advocated as a therapeutic measure a diet low in protein. Schamberg (1932) still believed in this alleged nitrogen retention and claimed good results from low protein diet. He insisted latterly that avoidance of meat and fish might not be enough as there might still be an excess of vegetable protein in the diet.

PERSONAL INVESTIGATION.

In considering the relationship of nitrogen in the urine and in sweat secreted at air temperatures of 16-18°C., the author found (Table VIB) that the urinary nitrogen in the normal controls was on an average 90 per cent. and in psoriasis only 71

per cent. of the nitrogen intake. Corresponding figures for sweat were 2.5 and 2.0. The average ratios Urine N : Sweat N were however almost identical.

The balances between nitrogen intake and excretion in urine and sweat of normal subjects and cases of psoriasis in nitrogen equilibrium was studied over a period of 48 hours. The figures given in Table V are average values for 24 hours and are the basis of the analysis in Table VII. All values are in gm. per day.

TABLE VII.

No.	Condition	OUTPUT			Intake	Balance + or -
		Urine	Sweat	Total		
IA	Normal	10.92	0.31	11.23	11.36	+0.13
IB	do.	11.48	0.23	11.69	11.36	-0.36
IIA	do.	9.80	0.22	10.02	12.00	+1.92
IIB	do.	10.78	0.41	11.19	12.00	+0.81
IIIB	do.	10.78	0.23	11.01	12.00	+0.99
IIIA	do.	10.22	0.25	10.45	12.00	+1.55
IVB	do.	10.36	0.34	10.70	12.32	+1.62
IVA	do.	9.94	0.37	10.21	12.32	+2.11
VA	Psoriasis	7.84	0.20	8.04	11.36	+3.32
VB	do.	8.02	0.29	8.31	11.36	+3.05
VIA	do.	7.87	0.25	8.12	11.36	+3.24
VIB	do.	8.92	0.13	9.05	11.36	+2.31
VIIA	do.	8.89	0.37	9.26	11.36	+2.10
VIIB	do.	7.08	0.26	7.34	11.36	+4.02
VIIIA	do.	7.98	0.24	8.22	11.36	+3.14

Intake minus Output:- (Normal subjects) Range: -0.36 to +2.11 gm. per day. Average: +1.10 gm. per day.

Intake minus Output:- (Psoriasis) Range: +2.10 to +4.02 gm. per day. Average: +3.02 gm. per day.

No account was made of the nitrogen excreted in the faeces. Schamberg et alii (1913) compared for a period of one week (Period 13) the nitrogen balance in their Patient No. 3 and a normal control. On a nitrogen intake of 7.60 gm. per day the case of psoriasis lost on an average 1.51 gm. per day in the faeces. The control on a diet of 7.52 gm. nitrogen per day averaged 1.78 gm. per day for the loss in the faeces.

On the higher intakes (11.36 to 12.32 gm. N) shown in Table VII the positive balances in the controls, which might amount to 2.11 gm. per day, can therefore be explained by the failure to include faecal nitrogen on the debit side.

In the cases of psoriasis (Table VB) the lowest positive balance is equal to the highest found in the normal subjects (2.1 gm. per day). The average positive balance in psoriasis is higher than that in the controls by approximately 2 gm. per day. This can be explained by loss of nitrogen in the scales. Quinquaud (1890) found that in a case of psoriasis the scales collected over a period of one month contained an average of 4.24 gm. nitrogen per day. Schamberg and his co-workers found in their Patient No. 4 that the total loss of nitrogen in the scales in 42 days was only 2.21 gm., though they state that scaling was comparatively slight.

The patients reported in Table VB when not in sweat-collecting garments were kept in bed and were bathed and had a daily inunction of soft paraffin. These measures in every case led to a diminution of scaling. Table VB shows that in all four

patients the apparent nitrogen retention was less in the second than in the first experiment, presumably due to reduction in nitrogen loss via the scales.

The author therefore agrees with Tidy (1914) that the explanation of nitrogen retention claimed by Schamberg is to be found in an incomplete collection of the scales.

This loss in the scales may be at the expense both of the urinary and sweat nitrogen. The average ratio Urine N : Sweat N in the controls was 36 : 1 and in psoriasis 35 : 1, a finding which fits this supposition. Such a contention would explain the lower values for sweat nitrogen found in psoriasis as effectively as the claim of Garbi (1924) that the sweat glands in lesions of psoriasis cease to function.

It was intended to test the secretory powers of the sweat glands in psoriasis by a colorimetric method. The method of Rieder and Neumann (1932) was chosen. This is a simple procedure which had previously been found satisfactory in studying the return of sweat secretion in a case of myxoedema under treatment with thyroid. A powder composed of exsiccated ferrous sulphate 5 parts, tannic acid 5 parts and talc 20 parts is thoroughly ground together. This greyish white powder is then suspended as follows:

Iron-tannic acid-talc powder	20 gm.
Arachis oil	10 c.c.
Sulphuric ether Alcohol 96 per cent.	equal parts to 100 c.c.

The patient is placed in bed under a radiant heat cage, given a cup of hot tea and 1.0 gm. (15 gr.) aspirin. After half an hour the suspension described above is painted on one of the psoriasis lesions and on a corresponding area of unaffected skin on the other side of the body. The suspending solution dries in a few seconds leaving a white powder. In the absence of sweat secretion, this powder remains white, but if there is the slightest secretion of sweat a blue-black colour quickly appears from the formation of iron tannate (ink).

This method is sufficiently sensitive for all practical purposes. If the back of the dry hand is painted with the suspension, which is then allowed to dry, breathing on the hand will cause a bluish discoloration almost immediately.

By the courtesy of Lieutenant-Colonel Clive J. Sharp, M.C., Officer Commanding a Military Hospital, and Major A. Girdwood Fergusson, R.A.M.C., Specialist in Dermatology, it was arranged to test all cases of psoriasis admitted to the Skin Division of the Hospital. Exigencies of the service however determined that the author was posted away temporarily from this Military Hospital. Only two cases were investigated and those very chronic eruptions of the extensor aspects of the limbs. In both of them there seemed little difference in the blue-black reaction obtained from the lesions and from the unaffected skin of the patients.

It is intended at a later date to carry out a thorough investigation of this question. At present it seems probable

that the lesions of psoriasis do sweat, but no final deduction can yet be drawn in view of the paucity of the evidence.

Non-Protein Nitrogen and Urea Nitrogen of Plasma.

Hammett (1920), in an investigation of the blood withdrawn 3½ hours after food in 60 normal persons, found that the non-protein N of the plasma varied between 27.3 and 45.5 mgm. per 100 c.c. The average value was 35.6 mgm. per 100 c.c. These results are higher than those obtained by the author where the average value in 10 normal persons was 27.8 mgm. per 100 c.c. (Table IV). The urea N of the plasma formed from 33.0 to 65.7 per cent. of the non-protein N, the average being 47.8 per cent. (Hammett, 1920).

Harrison (1937) gives the following range for the urea N of the whole blood and plasma - 7 to 20 mgm. per 100 c.c., corresponding to 15 to 40 mgm. per 100 c.c. for blood urea. The author's values for ten healthy persons (12.5 to 18.6 mgm. per 100 c.c.) reported in Tables II and IV fall within the limits for urea N given by Harrison.

Schamberg and Brown (1930) took 40 mgm. per 100 c.c. as the upper normal limit for non-protein N and 20 mgm. per 100 c.c. for urea N. They found that 6 out of 50 cases of psoriasis had a raised value for non-protein N and 8 out of 52 cases for urea N. In the author's opinion the fact that 12 to 15 per cent. of their cases of psoriasis have abnormally high values does not necessarily mean that there is an upset of nitrogen metabolism

in a similar proportion of psoriatics. Unless the age is taken into consideration and an investigation made of the renal efficiency, it is not possible to say that this azotaemia is of significance in psoriasis. It may well be a sign of some co-existing disease such as chronic interstitial nephritis or back pressure on the kidneys in prostatic hypertrophy.

On the other hand Jamieson (1921) and Levin and Kahn (1921) stated that the non-protein N and urea N of the blood were normal in psoriasis.

PERSONAL INVESTIGATION (see also p. 12).

The few estimations of these substances in the plasma made by the author and reported in Tables II and IV suggest that the plasma non-protein N and urea N are within normal limits. In no case was the non-protein N over 40 mgm. per 100 c.c. and only one had a value for urea N over 20 mgm. per 100 c.c. This finding was in a man of 48 years - the oldest case in the series.

The urea N in 10 normal controls formed 46-67 per cent. of the non protein N. The lower limit is much higher than that found by Hammett (1920). He however investigated 60 cases with a correspondingly greater probability of variations. The author therefore does not wish to stress the values obtained by him in ten estimations, which is too small a number on which to form final conclusions if unsupported by the more extensive investigations of other workers.

As already stated (p. 13) the fraction of the non

protein N present as urea N was somewhat higher in psoriasis than in the normal persons in the author's series. The difference however was not so marked as to justify any drastic conclusion and might easily be due to the minor variations to be expected in such a small series or to the higher average age of the cases of psoriasis (34 years as against 24 years in the controls).

SUMMARY.

(1) There is no valid evidence that nitrogen metabolism is abnormal in psoriasis.

(2) From a study of the nitrogen intake and excretion in psoriasis, it appears that the apparent nitrogen retention in psoriasis (Schamberg et alii, 1913) can be explained by loss of nitrogen in the scales and their incomplete collection. This finding is in agreement with that of Tidy (1914).

(3) In ten cases of psoriasis, the values found for plasma non-protein nitrogen were all within the limits obtained in similar estimations on the plasma of ten normal persons.

B. FAT METABOLISM.

Grütz and Bürger (1933) claimed that there was an upset of lipoid metabolism in psoriasis. They found the average fasting value for total fat, cholesterol and phosphatide to be higher in the serum of 19 cases of psoriasis than in 32 healthy controls. Previous work on the cholesterol and lecithin content of whole blood in psoriasis had been reported by several investigators but their results are not comparable with those for blood serum.

Grütz's series of 19 cases of psoriasis was investigated by means of Bürger's test, i.e. cholesterol 5 gm. in olive oil 100 gm. was given orally to the fasting patient and 50 c.c. blood were withdrawn after 4, 8 and 24 hours. It was found that, starting from a lower level, healthy people showed a relatively higher climb in the curve of alimentary hyperlipaemia and hypercholesteraemia. In both normal subjects and in psoriasis the final values were near the original fasting levels.

These investigations were suggested to Grütz by the observation of Unna and Linser that psoriasis scales had a high cholesterol content. In a patient suffering from psoriasis and xanthoma diabeticorum Grütz found on histological examination that the enlarged papillae of the psoriasis lesions were packed with granules of lipoid. These granules were conveyed from the capillaries into the inter-cellular spaces of the epidermis and

finally accumulated in the scales.

In a later paper by Grütz (1934) an illustration was given of a section from a psoriasis lesion in the above mentioned patient. Stained by Sudan III and haematoxylin, it showed a stream of fatty granules spreading outwards from the papillae through the epidermis to the parakeratotic stratum corneum. Sections stained by Sudan III from cases of uncomplicated psoriasis failed however to show this fatty infiltration. Grütz concluded, in rather surprising fashion, that in these typical cases of psoriasis, fatty substances did escape in excess from the capillaries but the amount was not sufficient to be shown by the usual staining methods.

Such is the basis for Grütz's claim that low fat diet will cure psoriasis. This remarkable example of a faith which might be expected to remove volcanoes has so far failed in the author's experience to banish permanently one single eruption of psoriasis.

Grütz (1934) claimed that good results were obtained in the treatment of psoriasis by low fat diet alone. In severe cases the cure might not be complete for six to eight months. He considered that low fat diet should only be used for the most severe cases in which the patient would be glad to put up with an unpleasant diet even for several months. Localised or moderate cases should be treated by ointment.

The author of this thesis can see no valid reason why an allegedly effective treatment should not be used on moderate

cases which greatly outnumber the severe types for which this diet was devised.

Semon (1934) reported promising results in this country from treatment with low fat diet. Guthrie (1934) pointed out the fallacy on which this régime was founded, and Goldsmith (1936) thought that the benefits claimed by Schamberg (1913, 1934) for low protein intake and Grütz (1933, 1934) for low fat diet might be due to a reduction of total calories. This contention may be true in the congestive type of psoriasis, especially in plethoric overfed individuals. In the author's opinion this only holds when the patient is treated in the wards of a hospital where a low calorie diet can be rigidly enforced.

The researches of other workers on the lipoid fractions in the serum are very conflicting. It should be borne in mind that the technique required in investigations of fat chemistry is complicated. No credence should be given to the claims of amateur biochemists unless they can produce evidence that the analytical methods used are satisfactory and that their results for normal controls correspond within reasonable limits to the values obtained by competent workers in this field.

Krasnow in collaboration with Isadore Rosen and other workers for several years conducted investigations on analytical methods as applied to lipoid fractions in the serum, and applied these methods in a study of various dermatoses (Krasnow et alii, 1929, 1935: Rosen, I., et alii, 1931, 1932, 1934). These papers are perhaps overburdened with detail but their arguments are very

convincing.

Rosen, I., Rosenfeld and Krasnow (1937) produced a very comprehensive study of lipoid partition in psoriasis and the effect on the lipoid components of the serum of the oral administration of cholesterol. Their results were completely at variance with those of Grütz and Bürger (1933). In a series of 130 psoriatic patients male and female aged from 6 to 69 years and 33 normal persons, the values for total serum cholesterol were compared. They found that in psoriasis 42 per cent. fell below the average normal range, 59 per cent. within it, and 9 per cent. above the average normal values. Their results are in agreement with those of Bernhardt and Zalewski (1925) who stated that hypocholesteraemia was typical of the psoriatic process. Rosen, I. et alii (1937) found in contrast to Grütz and Bürger (1933) that there were no significant variations in the other lipoid constituents of the serum.

In comparing the effect of ingestion of cholesterol by Grütz and Bürger's method in 10 psoriatics and 10 normal controls, Rosen et alii (1937) found this to be very slight. There was no regularity in the type of curves obtained. On the basis of this test, they could not agree that there was a disturbance of lipoid metabolism in psoriasis.

Rosen et alii (1937) gave a résumé of the literature on the subject. The results obtained by different investigators are so much at variance that it seems unnecessary to consider them seriously.

Madden (1939) also used the Cholesterol Tolerance Test of Grütz and Bürger (1933) in psoriasis. His estimations were made on plasma which however does not differ from serum in its cholesterol content. He had no normal subjects but used patients with other diseases (unspecified) as controls. The normal range of plasma cholesterol was taken as 150 to 200 mgm. per 100 c.c.

The curves obtained showed wide variations but the effect of the intake of cholesterol on specimens taken during the test was comparatively slight. He considered the Cholesterol Tolerance Test of no value as a check on progress or in prognosis.

The average plasma cholesterol in 35 patients with psoriasis was 213 mgm. per 100 c.c. and in 29 patients with other diseases 183 mgm. per 100 c.c. The cholesterol level in psoriasis was usually slightly higher, but hypercholesteraemia was generally not present.

Madden (1939) studied also the effect of low fat diet (20 gm. daily). He treated 22 cases of psoriasis for periods varying between 6 and 30 weeks. Sixteen patients of this total improved or cleared up completely. Hospitalisation or positive control of the patient seemed to be the most important factor in obtaining improvement. Better results were obtained with in-patients than with out-patients. The effect of the low fat diet was not influenced by the age of the patient, the duration of the psoriasis or the relative obesity or thinness of the patient. Cases where the body weight did not increase seemed to react more favourably.

Madden concluded that the favourable effect of the diet might be explained on the basis of a general re-alignment of metabolism and tissue function rather than on the basis of disturbed fat metabolism. The author of this thesis cannot understand this nebulous statement but agrees that hospital treatment is more effective than treatment in the out-patient department or patient's own home.

SUMMARY.

(1) The claim of Grütz and Bürger (1933) that there is an increase in the level of serum cholesterol in psoriasis has not been substantiated by later and more accurate investigators.

(2) There is no significant alteration from the normal in the lipoid partition in the serum as claimed by Grütz and Bürger.

(3) The Cholesterol Tolerance Test devised by them is of no value as a check on treatment or in prognosis.

(4) There is no valid evidence that disturbed fat metabolism is a factor in the etiology of psoriasis.

(5) Improvement occurring in cases of psoriasis while on low fat diet is more probably connected with other factors inherent in a hospital régime.

C. CARBOHYDRATE METABOLISM.

Pulay (1929) asserted that there was hyperglycaemia in 50 per cent. of a series of patients with psoriasis. Glucose tolerance tests showed impaired function of the pancreas.

Rost (1932) used the micro-chemical method of Hagedorn-Jensen for blood sugar estimations. Instead of administering glucose by mouth he injected intravenously 20 c.c. of a 40 per cent. solution after the patient had fasted for twelve hours. Blood sugar estimations were made of the fasting level and on ten specimens withdrawn at intervals up to two hours. He found that, though there might be no glycosuria or increase in fasting blood sugar, the curve often showed a delayed drop. Only 49 of 84 cases of psoriasis had a completely normal curve.

Fisher (1932) reviewed the findings of other workers on the blood sugar level in psoriasis. He found in 34 out of 35 cases that the fasting blood sugar was below 120 mgm. per 100 c.c. The higher values obtained by other workers he considered due to their using less accurate micro-methods.

After a careful perusal of the articles reviewed by Fisher, the author of this thesis agrees with him that there is no convincing evidence of deranged carbohydrate metabolism in psoriasis.

D. CALCIUM METABOLISM.

It was fashionable about ten years ago to postulate an upset of calcium metabolism in various dermatoses and to advise the administration of preparations of calcium in the hope that some beneficial result might be obtained. Percival and Stewart (1927) found that the serum calcium was normal in psoriasis and that variations in the diffusible fraction lay within normal limits. After administration of parathyroid extract, there was a definite rise in total serum calcium as there was in healthy persons. Vitamin D plays an important part in the absorption of calcium from the gut and its utilisation by the tissues. The latest dietary component to be incriminated for the production of psoriasis is Vitamin D (Bailey, 1938), but on this occasion it is a lack of the vitamin that is suspected as the etiological factor. The pendulum has swung in the opposite direction. Instead of treating psoriasis by low fat diet which is also deficient in Vitamin D, large doses of this vitamin are now recommended as a therapeutic measure.

If a deficiency of Vitamin D is a factor in producing this dermatosis, why is psoriasis in childhood not more often associated with rickets and why is there no alteration in the serum calcium in psoriasis? The paper already quoted by a dermatologist and an expert biochemist (Percival and Stewart, 1927) gives no support to the theory that Vitamin D deficiency is an etiological factor in psoriasis.

The author regrets that difficulty in gaining access to the most recent literature on the subject has made it impossible to consider this question of vitamin deficiency more thoroughly.

E. CHLORIDE METABOLISM.

It has long been known that the skin is a depôt for the storage of salt. Wahlgren (1909) found in normal dogs that the percentage of chloride in the skin was higher than in any other organ. On an average 35 per cent. of the total chloride of the body was located in the skin. Padtberg (1910) confirmed this finding and showed that in the dog the skin had the power of storing chloride if there was excess and of paying it out in case of need.

As regards human skin Goldsmith (1936) stated "In all circumstances it is the tissue richest in chlorine. When chlorine is lost (from sweating, etc.) as much as 60-90 per cent. may be at the expense of the skin, although the weight of the skin is only 16 per cent. of the total weight of the body. In pemphigus and dermatitis herpetiformis there is an abnormal retention of chlorides in the skin." It is possible, therefore, that in another chronic dermatosis, psoriasis, there might be some upset in this power of the skin to store chloride and give it up as required.

Various claims have been made as to the efficacy of diets low in salt in the treatment of psoriasis. Gerson (1930) claimed to have obtained marked improvement and even cure with his low chloride diet. Dörffel (1931) reported favourable results from low salt diet in exudative forms of psoriasis. Levin and Silvers (1931) used low salt diet combined with sweat

baths. Only cold cream or boric acid ointment was used externally. They claimed that such a régime was of therapeutic value.

On the other hand, using Gerson's diet, Sellei (1930) noticed marked improvement in only three cases out of twenty-five. Similarly Urbach (1932) was of the opinion that low salt diet had no influence on psoriasis.

The tendency to spontaneous improvement in some cases of psoriasis makes it exceedingly difficult to come to a just conclusion on the worth of any therapeutic measure. Those who claim clinical improvement due to low salt diet must admit it is obtained empirically for they have provided no valid evidence that there is an upset of chloride metabolism in psoriasis. The author therefore has conducted a thorough investigation of chloride metabolism in psoriasis, using normal persons as controls whenever possible.

The author has already confirmed the finding of Barney (1926) that the chloride content of the sweat of sufferers from psoriasis corresponded with the values found in normal persons (p. 8 and Table III).

There appeared however to be a diminution in the daily excretion of chloride per unit surface area in psoriasis as compared with normal controls, when the ward temperature was approximately the same in both groups (p. 26 and Table VIA).

In this part of the thesis the following aspects of chloride metabolism will be discussed:-

(i) The gastric secretion of free HCl in psoriasis.

(ii) The concentration of chloride in the blood plasma in normal persons and in psoriasis.

(iii) The concentration of chloride in the skin in normal controls and in psoriasis.

(iv) The effect of reducing the daily intake of salt on the excretion of chloride by the urine, faeces and sweat in cases of psoriasis, healthy young males being used as controls.

(v) The clinical effect of low salt diet.

(i) GASTRIC SECRETION OF FREE HCl in PSORIASIS

(From the Skin Department,
Stobhill Hospital, Glasgow).

(a) PREVIOUS OBSERVATIONS.

If disordered metabolism does play a part in the production of an outbreak of psoriasis, it seems reasonable to start an investigation by inquiring into the function of the stomach. Here, for all practical purposes, the chemical reactions necessary for the assimilation of our food first come into play. In the fractional test meal we have a useful means of investigation not only in diseases limited to the stomach and juxta-pyloric region but in at least one dermatosis, rosacea.

Ryle and Barber (1920), Brown (1925) and Eastwood (1928) have in turn shown the presence of subacidity in rosacea. Brown, Smith and McLachlan (1935), from a study of 200 cases of rosacea and of 216 cases of dermatosis other than rosacea, concluded that marked subacidity was not a feature peculiar to rosacea. A degree of hypochlorhydria seemed to be a feature of chronic dermatosis in general. They considered however that the number of cases investigated in each particular disease was not sufficient to allow them to be dogmatic on this point.

Ayres (1929) found that in 19 cases of psoriasis 52 per cent. had a low output of free HCl, 26 per cent. were

normal and 21 per cent. showed high acidity of the gastric juice. In correlating the presence of gastro-intestinal symptoms, severity of the eruption and abnormality of gastric secretion, he discovered that all three agreed in 5 cases, the history of gastric symptoms and test meal curve in 3 cases and the severity of the eruption and abnormality of the gastric juice on 3 occasions. Though the results show that more than half of his cases had a deficient secretion of free HCl and total acid, the figures for correlation do not indicate that gastro-intestinal disorders are of much importance in psoriasis, at least as far as was shown by his small series of cases.

Dyson (1932) reported the following results in gastric analyses on 100 cases of psoriasis, 31 being males and 69 females.

	Both Sexes:	Males:	Females:
Achlorhydria	18%	16.1%	18.6%
Hypochlorhydria	32	22.8	36.2
Normal*	43	41.9	43.4
Hyperchlorhydria	7	19.3	1.4

* Between 10 and 60 units $^{N}/_{10}$ NaOH.

The greater tendency to achlorhydria in the women agreed with the finding of Vanzant et alii (1932) that in normal persons between the ages of 20 and 80 years, the incidence of achlorhydria was higher by about 3 per cent. in females than in males.

Vanzant and his colleagues (1932) in a series of over three thousand normal persons of both sexes showed that from youth to about 65 years of age there was a straight line correlation between the incidence of achlorhydria and the age. After 65 there was a definite falling off in the proportion of achlorhydric subjects, possibly because persons with achlorhydria were not so long lived. Davies and James (1930) had already found that in 100 normal persons over 60 years of age, 32 had achlorhydria.

(b) PERSONAL INVESTIGATION.

The investigation now reported was conducted in patients of both sexes and of all ages from 9 to 74 years with the eruption in various stages of development. 23 of these cases were patients in Dr. A. D. McLachlan's Wards. They were quite unselected and represent the total number of cases of psoriasis admitted to Stobhill Hospital, Glasgow, from 1st May 1931 to 30th April 1932, except for two who refused to undergo the test. The remaining 7 were patients of Dr. W. Herbert Brown at the Victoria Infirmary, Glasgow. The analyses were made within a few days of admission.

In the cases personally investigated at Stobhill Hospital, the fasting juice was withdrawn at 10 a.m. after a fast of 14 hours. The test meal was of oatmeal gruel made according to the recipe used by Bennett and Ryle (1921).

Specimens were withdrawn every half hour for two hours. The titration was done in the usual manner on 5 c.c. of unfiltered gastric contents using dimethyl-amido-azo-benzol as an indicator for free HCl. The estimations were done in duplicate if the amount of gastric juice obtained made this possible; otherwise one estimation had to suffice. The average results are given in Table IX.

Classification.

It was felt that in the method of classification used by Ayres (1929) the groups were not well enough defined to simplify the allocation of borderline cases. The method of Bell (1922) was employed with the amendments adopted by Eastwood (1928). It was founded on a comparison of the free HCl curves with the area shown by Bennett and Ryle (1921) to contain the curves of 80 per cent. of normal persons - the standard generally accepted in Great Britain.

Eastwood's groups are as follows:-

I. Achlorhydria in which no free HCl was found during the test.

II. Hypochlorhydria in which the free HCl never reached 10 units $^{N}/_{10}$ NaOH.

III. Low Normal in which it never passed 18 units, i.e. never rose to the lower level of what Bennett and Ryle (1921) found to be the average secretory curve of 50 per cent. of normal people.

IV. Normal corresponding to their 50 per cent. zone.

V. High Normal corresponding to the upper limit of the last.

VI. Hyperchlorhydria in which free HCl reached 60 units or more.

Dyson (1932) considered as normal all results between 10 and 60 units. Brown (1925) fixed a higher upper level for hypochlorhydria and the low normal division. His method therefore does not lend itself so readily to a comparison with the results obtained by Bennett and Ryle (1921).

DISCUSSION.

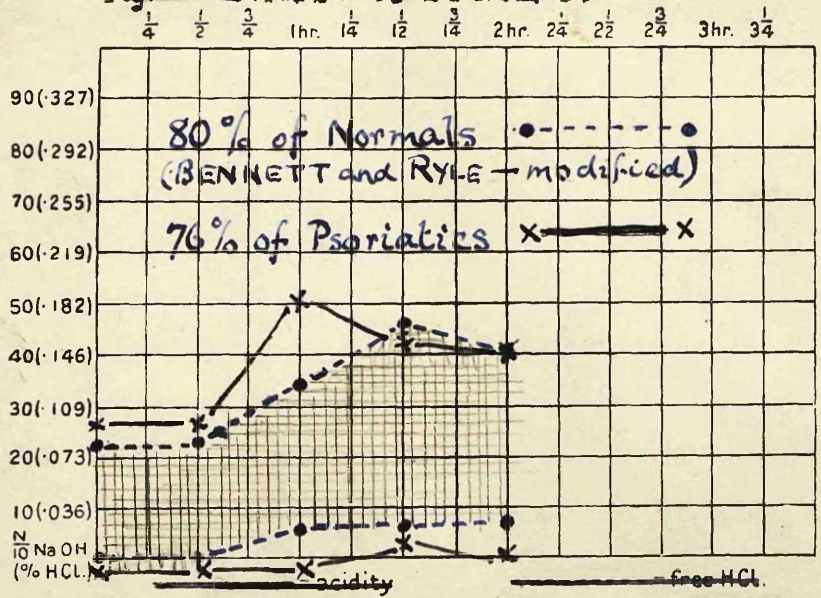
It will be seen from a study of Table IX that in all but two cases the values for free HCl fall without any dubiety into one or other of the groups. Cases No. 5 and 24 are difficult to classify. In both the values from ½ hour to 2 hours are typical of Low Normal curves but the higher fasting levels of 25 and 20 units $^{N}/_{10}$ NaOH determined that they should be included in Eastwood's Normal group.

Table X gives a comparison of Bennett and Ryle's curves from 100 normal male medical students classified by Bell (1922) with the present series of psoriatics grouped in the same manner.

TABLE X.

	Achlor-hydria	Hypo-chlor-hydria	Low Normal	Normal	High Normal	Hyper-chlor-hydria
"Normals" (Bennett & Ryle)	4%	1%	10%	59%	18%	8%
				87%		
Psoriasis (Present Series)	6.7%	6.7%	13.3%	50.0%	13.3%	10.0%
				76.6%		

Fig. 3 LIMITS OF FREE HCl



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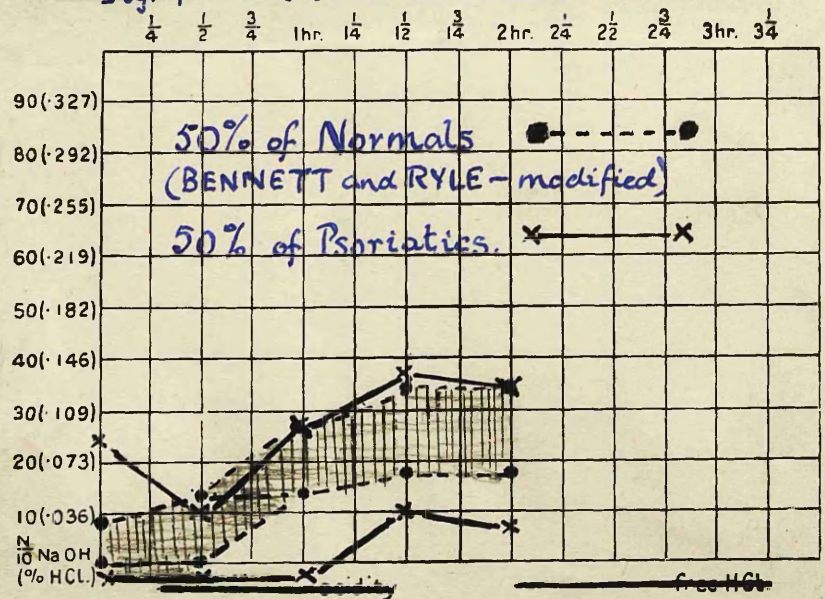
Gastric Analysis.

Fig. 4 LIMITS OF FREE HCl



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Gastric Analysis.

In Bennett and Ryle's series 87 per cent. are included in the Low Normal, Normal and High Normal groups as classified by Bell (1922). In these cases of psoriasis 76.6 per cent. fall into these three groups. In Figs. 3 and 4 the 80 per cent. zones and 50 per cent. zones of Bennett and Ryle (1921) have been modified, by kind permission of Dr. T. Izod Bennett, to suit an analysis limited to specimens withdrawn at half-hourly intervals for a period of two hours. The points plotted in Chart VIII in their paper as the limits fasting and at 30 minutes, 1 hour, 1 hour 30 minutes and 2 hours have been joined and similar charts superimposed for the psoriasis cases.

Fig. 3 shows that except at 1 hour, the upper limit of the 80 per cent. zone for normal persons corresponds closely to the upper limit for 76.6 per cent. of the author's series of psoriatics. This peak at 1 hour is due to one case (No. 17) who had a High Normal curve of the "Quick" variety. With this exception the highest value at 1 hour is 33 units $^{N}/_{10}$ NaOH, a figure which corresponds with the upper limit of the 80 per cent. zone in normal subjects.

As regards the 50 per cent. zone (Fig. 4), the upper limit for psoriasis closely follows that for normal persons except for a higher fasting value. This is due to the two cases already mentioned on p. (Nos. 5 and 24), which caused difficulty in classification. The lower limit is distinctly below that for the normal subjects.

In the author's opinion the lower level of gastric

acidity in his series of psoriatics is explained by their age being higher than in the case of Bennett and Ryle's normal subjects who were medical students. A comparison is given in Table XI below of the numbers in the different groups in all the cases of psoriasis according to age.

TABLE XI.

Degree of gastric acidity in different age groups.

	A G E (years)				
	Under 30	30-39	40-49	50-59	60+
Achlorhydria	0	0	0	0	2
Hypochlorhydria	1	0	0	0	1
Low Normal	0	1	0	3	0
Normal	8	2	1	3	1
High Normal	3	0	0	1	0
Hyperchlorhydria	1	2	0	0	0
TOTAL = 30	13	5	1	7	4

In 11 out of 13 cases of psoriasis (85 per cent.) under 30 years of age, the curves for free HCl were normal or at the upper limit of normal. This percentage agrees closely with 87 per cent. of normal subjects shown in Table X as belonging to the Low Normal, Normal and High Normal groups. That two out of four cases over 60 years of age should have achlorhydria is in accordance with the high incidence of achlorhydria found by Davies and James (1930) in normal persons at this time of life.

There seemed to be no connection between the level of free HCl and the severity of the eruption. Case No. 27, an acute generalised psoriasis, had hyperchlorhydria. On the other hand, Case No. 13, with a severe widespread dermatosis, showed quite a normal curve, and Case No. 16, who had a generalised psoriasis, had complete achlorhydria, though his advanced age of 74 years was probably a factor in this connection. In five very chronic inveterate cases two were classed as High Normal, two as Normal, and one as Low Normal.

SUMMARY.

(1) A study of fractional gastric analyses in thirty cases of psoriasis aged from nine to seventy-four years shows that the results for free HCl were slightly lower than those found by Bennett and Ryle (1921) in normal medical students.

(2) A comparison of thirteen cases of psoriasis under thirty years of age with the above mentioned normal students suggests that at the same age there is no significant difference in the levels of free HCl. The small number of cases of psoriasis as compared with the normal series makes a dogmatic statement on this point inadvisable.

(3) There appears to be no connection between the severity of the dermatosis, as regards either extent or chronicity, and the level of gastric acidity.

(ii) CHLORIDE CONCENTRATION IN BLOOD PLASMA.

(From the Skin Department and Biochemical Laboratory,
Royal Infirmary and University, Glasgow).

Peters and van Slyke (1931) held that, in studying abnormalities of blood electrolyte concentrations in disease, determinations of whole blood chloride content are seldom of value. "The chloride content of whole blood does not indicate accurately the concentration in either cells or plasma. The concentration in the cells is only half as great as that in the plasma. Consequently the chloride concentration in whole blood depends chiefly on the proportion of cells to plasma. It will prove high in anaemia because of the small proportion of cells and low in polycythaemia for the reverse reason."

In this study therefore the author has confined himself to estimations of plasma chloride.

All the results for psoriasis in this and in subsequent parts of the investigation were from patients of both sexes under the care of Dr. J. Ferguson Smith. Normal values were obtained in a few cases from volunteers (male laboratory workers and massage students), but generally from patients of both sexes who had been attending the Out-patient Department and were now cured of scabies, impetigo contagiosa or folliculitis.

All estimations were done in duplicate, the average value being taken as correct. The duplicate results were found to agree within 2 per cent.

Those cases of psoriasis who were in-patients were having the ordinary ward diet with no restrictions as to the amount of salt they consumed. The out-patients had their usual type of food.

Blood was withdrawn from the median basilic vein as nearly as possible at 11.30 a.m. on each occasion, i.e. 3 to 4½ hours after breakfast. The normal subjects followed their usual routine but were requested to have breakfast not later than 8.30 a.m. Immediately following venipuncture the blood was centrifuged and the plasma pipetted off.

For the estimation of plasma chloride, the method of van Slyke and Sendroy (1923) was employed. All results are expressed as sodium chloride.

Thirty estimations were made on plasma from twenty-four normal adults and twenty-four estimations on twenty-one cases of psoriasis as shown below.

TABLE XII.

Chloride Concentration in Plasma (mgm. per 100 c.c.)

Normal Controls	Psoriasis
1. (585 (610	1. (562 (597
2. (558 (580	2. 589
3. (550 (562	3. 586
4. (603 (620	4. 589
5. (585 (562	5. (608 (603
6. (597 (576	6. (661 (647
7. 585	7. 589
8. 625	8. 626
9. 558	9. 591
10. 575	10. 602
11. 564	11. 603
12. 602	12. 597
13. 615	13. 604
14. 571	14. 591
15. 611	15. 565
16. 564	16. 608
17. 593	17. 589
18. 575	18. 585
19. 567	19. 596
20. 575	20. 625
21. 578	21. 601
22. 575	
23. 576	
24. 561	

In Table XIIA the author's results are compared with the accepted normal range of 560 to 620 mg. per 100 c.c. (Harrison, 1937).

TABLE XIIA.

	No.of cases	No.of esti-mations	Below 560 mgm.%	560 to 620 mgm.%	Above 620 mgm.%
Normal controls	24	30	3	26	1
Psoriasis	21	24	0	20	4

As regards the controls the values correspond closely with the accepted standard. Three estimations were just below the lower limit and one slightly above the upper limit. All the results fell between 550 and 630 mgm. per 100 c.c.

Of the four high results obtained in the cases of psoriasis two were under 630 mgm.per 100 c.c., the upper limit found in the control estimations. The other two were from the same patient. This man who was aged 48 years had a chronic mummular and gyrate psoriasis of the scalp, lumbar region and all four limbs which had been present with intermissions from 1920 to 1934. The values (660 and 647 mgm.per 100 c.c.) were very high. He had also the highest figures for urea-N both in plasma and sweat and the lowest for sweat-NaCl of any patient in the author's investigation of the concentration of chloride and nitrogenous substances in sweat and plasma (Table II - Psoriasis Case No. 6). The writer suspects that there may have been renal

inefficiency in this case as the figures for blood urea were 46 and 40 mgm. per 100 c.c. (Urea = 21.4 and 18.7 mgm. per 100 c.c.). He had no albuminuria. Unfortunately his blood pressure was not determined.

SUMMARY.

(1) Thirty estimations of plasma chloride are reported from twenty-four normal subjects of both sexes. The results are compared with twenty-four similar estimations from twenty-one cases of psoriasis of both sexes.

(2) There is no indication that the chloride content of the plasma in psoriasis shows any marked change from normal.

(iii) CHLORIDE CONCENTRATION IN THE SKIN

(From the Skin Department and Biochemical Laboratory, Royal Infirmary and University, Glasgow).

The concentration of chloride in pieces of skin removed by biopsy was estimated by the method of Sunderman and Williams (1933).

In five cases of psoriasis a whole lesion of psoriasis was removed if possible from the extensor surface of the forearm just below the elbow. In five normal controls (all healthy laboratory workers) the skin was taken in every case from this part.

0.5 per cent. cocaine nitrate in sterile distilled water was used for infiltration anaesthesia. Of this solution 1 c.c. gave an anaesthesia sufficient for excision of a portion of skin weighing from 0.1 to 0.3 gm. Adrenalin hydrochloride obviously could not be used to check bleeding. The sections therefore contained some blood. Most of this however had drained away before the skin was weighed.

In Case 1 only, 1 in 1,000 solution of cocaine nitrate was used for anaesthesia. As several c.c. were required, this led to a dilution of the skin chloride. This solution was therefore discontinued. In Subject No. 1 the salt content of the skin per 100 gm. wet weight was accordingly lower than in the other cases. On making allowance for the water content,

the sodium chloride expressed as a percentage of the dry weight corresponded fairly well with the other results.

The skin after removal was divided into two approximately equal parts. The chloride content of one portion was estimated and the second part was dried to constant weight in an electric oven for a period of forty-eight to seventy-two hours.

DISCUSSION.

In a newly amputated limb Close (1933) found that the chloride content of the skin (expressed as Cl) was 0.21 per cent. of the wet weight. This corresponds to a value of 0.395 per cent. of chloride expressed as NaCl.

The author of this thesis estimated the content of NaCl in two specimens of skin obtained at autopsy. The first patient had died of cirrhosis of the liver and the other from carcinoma of the oesophagus. The results, 0.383 per cent. and 0.387 per cent. (wet weight) correspond fairly well with the figure given by Close.

The results however from skin obtained by biopsy in all the controls except Case 1 and in all the cases of psoriasis are higher than the values given above (Table XIII). This is probably due to the inclusion of some blood, the NaCl content of which varies between 0.45 and 0.50 per cent. As this slight inclusion was present both in the normal skin and in the psoriasis lesions, it would not invalidate a comparison between them, unless

TABLE XIII.

The Chloride Content of the Skin in Terms of Sodium Chloride.

No. of Case	Condition	NaCl per 100 gm. Wet Skin (gm.)	% Dry Weight	NaCl per 100 gm. Dry Skin (gm.)	Diet
1.	NORMAL	0.315*	21.6*	1.46	Normal Salt
2.	do.	0.445	26.3	1.69	do.
3.	do.	0.439	29.8	1.47	do.
4.	do.	0.419	30.1	1.39	do.
5.	do.	0.497	31.6	1.57	do.
6.	PSORIASIS	0.452	28.8	1.57	do.
7.	do.	0.453	28.2	1.61	do.
8.	do.	0.487	31.0	1.57	do.
9.	do.	0.445 0.464	26.3 29.4	1.69 1.58	do. Low Salt
10.	do.	0.433 0.484	25.6 32.0	1.69 1.51	Normal Salt Low Salt

* Low values due to large volume of local anaesthetic used.

the blood NaCl in the two groups was at a different level.

The whole blood chloride (as NaCl) was estimated in 15 controls and in 15 cases of psoriasis. Taking 450-500 mgm. per 100 c.c. as the normal range (Harrison, 1937), it was found that thirteen of the normal controls and twelve cases of psoriasis fell within these limits. In the remaining subjects variations from the standard laid down were of a minor degree (less than 10 mgm. per 100 c.c.). For reasons stated when studying plasma chloride concentrations (p. 60), the values for whole blood chloride are of much less significance than the plasma chloride content. They are therefore not given in detail, but are only used as evidence that a comparison between the chloride content of sections of skin in the normal controls and in the cases of psoriasis was in no appreciable degree affected by the small unavoidable inclusion of whole blood in these sections.

Table XIII shows that in the normal controls the range of chloride was from 1.39 to 1.69 per cent. of the dry weight of the skin. In five cases of psoriasis on a diet of normal salt content the limits were 1.57 and 1.69 per cent. of the dry weight. It is therefore permissible to assert that the salt content of the lesions in psoriasis (at least in these cases) does not differ materially from that of normal skin.

In two cases of psoriasis (9 and 10) a reduction in the daily chloride intake from 7.58 gm. to 2.58 gm. was accompanied by a slight fall in the chloride content of the lesions

but the values were still within normal limits.

Case 9 was on low salt diet (2.58 gm. per day) for 18 days before the second biopsy was done. During this period the body weight fell from 67.0 Kgm. to 64.72 Kgm. The daily intake of water throughout this period was 200 c.c. and there was no variation in the diet from day to day. In this case it was found that the level of chloride per 100 gm. wet skin varied inversely with the body weight.

$$\frac{\text{NaCl per 100 gm. Wet Skin on Normal Salt Diet (mgm.)}}{\text{Body Weight on Low Salt Diet (Kgm.)}}$$

$$= \frac{\text{NaCl per 100 gm. Wet Skin on Low Salt Diet (mgm.)}}{\text{Body Weight on Normal Salt Diet (Kgm.)}}$$

$$\text{i.e.} \quad \frac{445}{64.72} = \frac{464}{67.0} = 6.8 \text{ (approximately).}$$

In Case 10, after low salt diet (2.58 gm. per day) for 21 days, the loss in weight was only 0.06 Kgm. Thus the water content of the skin fell from 74.4 to 68.0 per cent. in Case 10 where the body weight was almost stationary. In Case 9 who was losing weight on low salt diet, the decrease in the water content of the skin was about half as much (from 73.7 to 70.6 per cent.).

The lower decrease in water content of the skin (3.1 per cent.) in Case 9 was accompanied by a fall in the percentage of NaCl in the dry skin from 1.69 to 1.58. In Case 10 the water content of skin fell 6.4 per cent. while the chloride content of the dry skin also was reduced to a much greater degree (1.69

to 1.51 gm. NaCl per 100 gm.).

In both cases the decrease in the water content of the skin was roughly proportional to the decrease in the chloride concentration in the skin (dry weight). These subjects illustrate the principle that if the organism is depleted of salt it will not retain water without salt (Daniel and Högler, 1927).

The close agreement of the results of the five estimations in psoriasis when on a normal salt diet was probably due to the fact that all five subjects were in-patients receiving practically the same amount of salt in their diet and a standard fluid intake. The controls on the other hand were having an ordinary mixed diet, salted according to their own personal taste and a varying amount of fluid.

Where the conditions of local anaesthesia were standardised, in four controls (2, 3, 4, 5) and five cases of psoriasis on diets of normal salt content the water content of the skin was respectively 68.4 to 73.7 per cent. and 69.0 to 74.4 per cent.

SUMMARY.

(1) In subjects receiving diets of normal salt content, the chloride content of lesions taken from five cases of psoriasis corresponded with the values obtained from the skin of five normal controls.

(2) Both in normal skin and in lesions of psoriasis the water content was approximately seventy per cent.

(3) On low salt diet, two cases of psoriasis showed a slight fall in the chloride concentration in the lesions. This fall was accompanied by a decrease in the water content of the psoriatic skin.

(4) The skin in psoriasis appears to act as regards chloride storage in the same manner as does the skin of normal individuals.

(iv) THE EFFECT OF DECREASING THE DAILY INTAKE OF SALT ON THE EXCRETION OF CHLORIDE.

It was decided to make an investigation with the purpose of discovering if there was any retention of salt in psoriasis.

Three normal healthy males and four male patients with psoriasis were put on diets of (1) normal salt and (2) low salt content for varying periods. During the greater part of the time on each diet the urine was collected in 24-hourly lots and the daily output of chloride determined. The periods on diet and during which the urine was collected are shown in Table XIV.

The patients and normal controls were admitted to the Male Metabolic Ward, Royal Infirmary, Glasgow, in which the sister and nursing staff are specially trained for such investigations.

Diet A. Normal Salt Content.

The diet consisted of saltless bread, fresh butter, milk, eggs, "Creamola" pudding, one orange, bran, potatoes, carrots, tinned pears, tea, cocoa and sugar. No salt was used in cooking. 5-6 gm. pure sodium chloride (sodii chloridum B. P.) were added to bring the salt intake to a normal level.

Diet B. Low Salt Content.

This diet was identical with A except that the extra

salt was omitted.

In neither diet was meat given as it was felt that the meat without salt would be most unpalatable if included in Diet B and it was advisable to keep Diets A and B for each patient similar except for their salt content. The protein intake however varied between 71 and 77 gm. per day, a quite sufficient allowance for a patient confined to bed.

The amounts of the various dietary constituents were fixed according to the patient's appetite. After one or two days' trial to decide how much food was required, the same diet was adhered to from day to day. A constant allowance of 200 c.c. of water per day was given.

TABLE XIV.

Periods on normal and low salt diet and duration of collection of urine in days.

Subjects	NORMAL SALT DIET		LOW SALT DIET	
	Diet	Urine Collection	Diet	Urine Collection
CONTROLS:				
I	11	11	8	8
II	-	-	12	12
III	23	15	10	10
PSORIASIS:				
IV	18	17	17	17
V	15	12	-	-
VI	17	12	18	12
VII	16	12	19	12

METHODS OF ANALYSIS.

Urine. The urines were collected in 24 hourly lots and the daily output of chloride determined by the Volhard-Arnold method.

Diet. A half-day sample of diet was dried on a steam bath, ground up into a fine powder and thoroughly mixed. The chloride content was determined by the method of Sunderman and Williams (1933).

DISCUSSION.

The results of the investigation are contained in Tables XV-XXI. It was hoped that chloride balance experiments might be carried out, but it was impossible to arrive at a state of chloride equilibrium in periods of time varying up to twenty-three days.

The output of urine per day in the normal controls varied very considerably both on normal and low salt diet. The same finding was obtained in the cases of psoriasis. This variation in the volume of the urine excreted in twenty-four hours did not seem to have any regular relationship with the amount of chloride excreted in the urine.

TABLE XV.

Case I - Control.

Day No.	Date 1933	DIET NaCl gm.	URINE Volume c.c.	URINE NaCl gm.
1	Sept. 25-26	11.42	1480	8.42
2	" 26-27	"	1760	7.96
3	" 27-28	"	1015	5.85
4	" 28-29	"	2540	13.69
5	" 29-30	"	2240	11.58
6	" 30-Oct.1	11.21	1080	9.41
7	Oct. 1-2	"	1400	11.44
8	" 2-3	"	1080	19.32
9	" 3-4	"	1500	15.25
10	" 4-5	"	1480	11.40
11	" 5-6	"	1740	19.12
1	Oct. 6-7	5.21	2240	6.32
2	" 7-8	"	1520	5.15
3	" 8-9	"	1560	7.02
4	" 9-10	"	880	3.39
5	" 10-11	"	1760	5.15
6	" 11-12	"	1500	4.91
7	" 12-13	"	1770	1.99
8	" 13-14	"	1840	7.31

TABLE XVI.

Case II - Control.

Day No.	Date 1933	DIET NaCl gm.	URINE Volume c.c.	URINE NaCl gm.
1	Nov. 21-22	5.77	1120	6.20
2	" 22-23	"	1640	7.16
3	" 23-24	"	1290	5.50
4	" 24-25	"	1440	4.05
5	" 25-26	"	1320	3.58
6	" 26-27	"	1740	6.20
7	" 27-28	"	940	3.58
8	" 28-29	"	1000	3.58
9	" 29-30	"	780	4.09
10	Nov.30-Dec.1	"	1240	4.54
11	Dec. 1-2	"	1630	5.24
12	" 2-3	"	1610	6.20

TABLE XVII.

Case III - Control.

Day No.	Date	DIET NaCl gm.	URINE Volume c.c.	URINE NaCl gm.
	1933			
1	December 19-20	5.63	1500	6.73
2	"	"	1090	3.42
3	" 21-22	"	1180	2.95
4	" 22-23	"	1120	2.25
5	" 23-24	"	1300	2.48
6	" 24-25	"	870	2.25
7	" 25-26	"	910	2.25
8	" 26-27	"	920	2.71
9	" 27-28	"	900	2.27
10	" 28-29	"	1600	5.31
	1934			
1	January 2-3	11.29	-	-
2	" 3-4	"	-	-
3	" 4-5	"	1400	9.03
4	" 5-6	"	840	5.96
5	" 6-7	"	1400	7.39
6	" 7-8	"	1060	6.79
7	" 8-9	"	900	6.32
8	" 9-10	"	1020	6.55
9	" 10-11	"	1360	11.82
10	" 11-12	"	890	8.50
11	" 12-13	"	1110	7.44
12	" 13-14	11.19	-	-
13	" 14-15	"	-	-
14	" 15-16	"	-	-
15	" 16-17	"	-	-
16	" 17-18	"	-	-
17	" 18-19	"	-	-
18	" 19-20	"	1380	11.70
19	" 20-21	"	1120	8.19
20	" 21-22	"	1340	9.36
21	" 22-23	"	1380	9.36
22	" 23-24	"	1420	10.06
23	" 24-25	"	1840	11.47

TABLE XVIII.

Case IV - Psoriasis.

Day No.	Date 1934	DIET NaCl gm.	URINE Volume c.c.	URINE NaCl gm.
1	March 20-21	9.07	-	-
2	" 21-22	"	1340	11.35
3	" 22-23	"	1400	11.23
4	" 23-24	"	1240	7.63
5	" 24-25	"	1170	7.16
6	" 25-26	"	1370	9.36
7	" 26-27	8.18	1240	8.12
8	" 27-28	"	1100	9.08
9	" 28-29	"	1240	9.55
10	" 29-30	"	1320	8.59
11	" 30-31	"	1090	8.12
12	March 31-April 1	"	1430	7.39
13	April 1-2	"	1310	6.20
14	" 2-3	"	1170	7.86
15	" 3-4	"	920	7.16
16	" 4-5	"	1600	9.08
17	" 5-6	"	1370	8.85
18	" 6-7	"	1100	7.65
1	April 7-8	3.18	1290	4.94
2	" 8-9	"	1400	3.28
3	" 9-10	"	790	1.62
4	" 10-11	"	780	1.23
5	" 11-12	"	1420	4.07
6	" 12-13	"	1360	4.12
7	" 13-14	"	820	2.27
8	" 14-15	"	900	2.27
9	" 15-16	"	860	2.87
10	" 16-17	"	1480	5.20
11	" 17-18	"	1380	4.30
12	" 18-19	"	1340	3.38
13	" 19-20	"	930	2.87
14	" 20-21	"	1300	2.95
15	" 21-22	"	1150	2.69
16	" 22-23	"	1420	2.77
17	" 23-24	"	980	2.21

TABLE XIX.

Case V - Psoriasis.

Day No.	Date 1934	DIET NaCl gm.	URINE Volume c.c.	URINE NaCl gm.
1	May 23-24	8.18	-	-
2	" 24-25	"	-	-
3	" 25-26	"	-	-
4	" 26-27	"	840	5.18
5	" 27-28	"	1270	6.79
6	" 28-29	"	980	6.15
7	" 29-30	"	1140	9.23
8	" 30-31	"	980	7.83
9	May 31-June 1	"	760	5.73
10	June 1-2	"	700	4.80
11	" 2-3	"	750	5.80
12	" 3-4	"	1000	7.81
13	" 4-5	"	930	7.66
14	" 5-6	"	1120	6.55
15	" 6-7	"	1200	7.55

TABLE XX.

Case VI - Psoriasis.

Day No.	Date 1934	DIET NaCl gm.	URINE Volume c.c.	URINE NaCl gm.
1	June 19-20	7.58	-	-
2	" 20-21	"	-	-
3	" 21-22	"	-	-
4	" 22-23	"	-	-
5	" 23-24	"	-	-
6	" 24-25	"	1380	6.23
7	" 25-26	"	1280	6.76
8	" 26-27	"	1170	5.23
9	" 27-28	"	1380	7.18
10	" 28-29	"	1470	7.17
11	" 29-30	"	1310	7.00
12	June 30-July 1	"	1660	8.68
13	July 1-2	"	830	3.70
14	" 2-3	"	1230	4.95
15	" 3-4	"	1840	10.16
16	" 4-5	"	1270	6.72
17	" 5-6	"	1170	6.27
1	July 6-7	2.58	-	-
2	" 7-8	"	-	-
3	" 8-9	"	-	-
4	" 9-10	"	-	-
5	" 10-11	"	-	-
6	" 11-12	"	-	-
7	" 12-13	"	1660	3.11
8	" 13-14	"	1140	2.16
9	" 14-15	"	1800	3.88
10	" 15-16	"	1340	3.14
11	" 16-17	"	1860	3.46
12	" 17-18	"	1210	2.65
13	" 18-19	"	1920	2.74
14	" 19-20	"	1480	2.86
15	" 20-21	"	1640	2.30
16	" 21-22	"	1540	3.23
17	" 22-23	"	1860	2.74
18	" 23-24	"	1800	2.49

TABLE XXI.

Case VII - Psoriasis.

Day No.	Date 1934	DIET NaCl gm.	URINE Volume c.c.	URINE NaCl gm.
1	June 24-25	7.58	-	-
2	" 25-26	"	-	-
3	" 26-27	"	-	-
4	" 27-28	"	-	-
5	" 28-29	"	1410	7.44
6	" 29-30	"	1730	7.68
7	June 30-July 1	"	1400	7.27
8	July 1-2	"	1170	5.37
9	" 2-3	"	1760	8.49
10	" 3-4	"	1390	7.70
11	" 4-5	"	1490	8.65
12	" 5-6	"	770	5.37
13	" 6-7	"	870	5.85
14	" 7-8	"	690	5.68
15	" 8-9	"	920	5.85
16	" 9-10	"	790	5.56
1	July 10-11	2.58	-	-
2	" 11-12	"	-	-
3	" 12-13	"	-	-
4	" 13-14	"	-	-
5	" 14-15	"	-	-
6	" 15-16	"	-	-
7	" 16-17	"	-	-
8	" 17-18	"	1500	2.33
9	" 18-19	"	1750	2.13
10	" 19-20	"	1480	2.05
11	" 20-21	"	1730	2.48
12	" 21-22	"	1380	2.33
13	" 22-23	"	2150	3.01
14	" 23-24	"	1520	2.67
15	" 24-25	"	1580	2.90
16	" 25-26	"	1550	2.90
17	" 26-27	"	800	1.87
18	" 27-28	"	910	1.50
19	" 28-29	"	1770	2.79

TABLE XXII.

Limits of urinary volume on diets of normal and low salt content (c.c. per diem).

No.	Condition	On Normal Salt Intake	On Low Salt Intake
I	Normal	1015 - 2540	880 - 2240
II	do.	-	780 - 1740
III	do.	840 - 1840	870 - 1600
IV	Psoriasis	920 - 1600	780 - 1480
V	do.	700 - 1270	-
VI	do.	830 - 1660	1140 - 1920
VII	do.	690 - 1760	800 - 2150

A study of Table XXII also suggests that the volume of urine is in no way affected by the amount of salt in the diet. This holds both for the normal cases I and III and the four cases of psoriasis. The volume of urine is of course bound up not only with the whole question of water metabolism but must be determined by the quantity of other solutes excreted in the urine. The excretion of phosphates and the type of phosphates excreted is one means of stabilising the H-ion concentration of the blood. This very involved subject is one which the author does not feel qualified to discuss.

The excretion of chloride by the kidneys even in a subject on a fixed daily intake of chloride and water seems to be so irregular that the attempt to obtain chloride balances was abandoned. It may however be said that on a chloride intake of

approximately 11-12 gm. per day in normal subjects considerably more chloride was excreted on an average than when the diet contained 5-6 gm. chloride.

In Case I on the seventh day of urine collection the excretion of chloride was 1.99 gm. while on the eighth day it was 7.31 gm. when the chloride intake was 5.21 gm. per day. Similarly in Case III while on low salt diet (5.63 gm. per day), the urinary chloride kept at a fairly constant level (between 2 and 3 gm.) from the third to the ninth day of collection and on the tenth day rose unexpectedly to 5.31 gm.

The cases of psoriasis showed a similar irregularity in chloride excretion. Case IV while on a salt intake of 3.18 gm. per day reached a fairly constant output of urinary chloride only after the twelfth day. It may be that the period of investigation was too short and stability might have been reached had the experiment been prolonged.

Case VII (psoriasis) maintained a fairly steady urinary chloride level of from 5.37 to 5.85 gm. from the eighth to the twelfth days while on a daily intake of 7.58 gm. sodium chloride. The variations when the dietary chloride was dropped to 2.58 gm. per day was however proportionately very much greater.

The results of this investigation suggest that at least for the periods of time dealt with in these subjects it is not possible to draw any conclusions about chloride metabolism from a study of the daily urinary chloride.

Chloride Excretion in the Faeces.

During the periods of urine collection the faeces were also saved. The beginning and end of each period of collection were marked off in the faeces by giving capsules containing carmine by mouth and rejecting stools passed before the carmine appeared in the faeces. At the finish of the period of collection carmine was given again and all stools collected up to the first one to be stained by the dye, which was rejected.

Analytical Method.

The whole collection of moist faeces was ground up into an even suspension with distilled water and diluted to a volume of 2 litres. To a flask containing 25 c.c. of suspension were added 6 c.c. N/20 silver nitrate and an excess of concentrated nitric acid. The flask was then heated on a steam bath for 3 to 4 days with further additions of nitric acid if necessary. At this suspension the solution was a light yellow colour when diluted with distilled water and filtered. The filtrate was then titrated with N/50 potassium thiocyanate, using iron alum as indicator.

TABLE XXIII

Excretion of Chloride in Faeces (gm. NaCl).

No.	Condition	No. of days	NaCl Content of diet.	NaCl Content of stools.
I (a)	Normal	11	124.34	0.99
(b)		8	41.67	0.64
II (b)	do.	12	69.29	1.56
III (a)	do.	15	168.65	2.22
(b)		10	56.30	1.62
IV (a)	Psoriasis	17	143.42	1.63
(b)		12	38.16	1.13
V	do.	12	98.16	1.05
VI (a)	do.	12	90.96	1.40
(b)		12	30.96	1.13
VII (a)	do.	12	90.96	2.16
(b)		12	30.96	1.71

The excretion of chloride in the faeces compared with the amount ingested appears to be insignificant (Table XXIII. The highest result was in Case VII (psoriasis) with an average daily excretion of 0.18 gm.

Chloride Excretion in Sweat.

This subject has already been considered in Part III of this thesis. The daily excretion of chloride in the sweat both in normal controls and in psoriasis at temperatures below 22°C. did not exceed 0.5 gm.

It can be stated therefore that in subjects at rest

in bed the excretion of chloride is almost entirely by the kidneys. During active prolonged exercise, at high air temperatures or more markedly when there is a combination of these two factors, the skin can however play a considerable part in the excretion of chloride.

SUMMARY.

(1) A decrease of 5 to 6 gm. per day in the intake of chloride resulted generally after a variable period in a diminution in the chloride excreted in the urine both in normal controls and in cases of psoriasis.

(2) There was no apparent relationship between the volume of urine passed in successive days and the daily level of urinary chloride either in the controls or in these psoriatics.

(3) The amount of chloride excreted in the faeces both in normal persons and patients with psoriasis was negligible.

(4) It was found to be impossible to induce a state of chloride equilibrium in periods of time varying up to twenty-three days.

(v) CLINICAL EFFECT OF LOW SALT DIET.

Levin and Silvers (1931) advised a low salt diet combined with sweat baths. The author has already shown that in psoriasis the chloride content of the sweat was normal. There was a slightly diminished output of chloride in sweat, but this was of a minor degree for which the kidneys could easily compensate. If then the regime of Levin and Silvers has any basis, it must depend on the diet alone.

It has already been shown (p. 66) that the lesions of psoriasis do not store up chloride in excess of the amount found in normal skin. Careful notes were however kept of the clinical progress in three patients while on low salt diet (IV, VI, VII).

Each of these cases had a daily warm bath after which he anointed himself with yellow vaseline. Apart from this no external treatment was used. Cases VI and VII remained on this regime only for the period of the experiments.

Brief notes only are given in these two cases, but Case IV is considered in greater detail as he continued with low salt diet for a total period of three months.

Case VI: J.C., age 31.

Psoriasis for 2 years. Present attack since December 1933.

19.6.34 (on admission). Nummular and gyrate psoriasis of

moderate severity involving scalp and all four extremities with scattered patches on trunk.

6.7.34 (after 17 days on diet of normal salt content). Patches slightly paler and scaling loss. Several new punctate and guttate lesions on thighs.

6.7.34. Low salt diet commenced.

25.7.34. Low salt diet stopped.

On the whole there was no greater improvement on low salt diet than on one of normal salt content.

There was a diminution in scaling and less marked erythema of the lesions. These effects could have been produced equally well by regular bathing and application of vaseline with no dietetic restriction.

Case VII: C.W., age 48.

Psoriasis since 1920. Present attack started in February 1934.

20.6.34 (on admission). Widespread psoriasis of limbs, affecting both surfaces. Large plaques on buttocks. Trunk only slightly affected. Palms and back of both hands show thick scaling. Pitting of finger nails. Few guttate and small circinate lesions on scalp and forehead.

10.7.34 (after 16 days on normal salt diet). All patches decidedly paler, especially on arms. No new lesions.

10.7.34. Low salt diet started.

20.7.34. Extensor aspect of arms practically clear. All

plaques on legs much paler and clear in centre. Large patch on buttocks shows little change. Palms still scaling. Several new punctate lesions on ankles and soles.

30.7.34. All lesions still paler, especially plaque in gluteal region. Patches on arms and legs very pale pink with slight scaling only. Scalp clear.

30.7.34. Low salt diet discontinued.

There was a decided improvement in this case. It has to be noted, however, that this had commenced before the low salt diet was started, although it was more marked while he was on low salt diet.

Case IV: J.McW., age 46. Unemployed clerk.

Psoriasis since 1919.

21.3.34. Admitted to Metabolic Ward. Normal salt diet commenced.

Numerous thick lichenified patches of psoriasis on trunk; largest in lumbar region and beneath left breast, spreading across xiphoid process. Large plaques on extensor aspects of both forearms and in outer aspects of calves - in latter situation rather congested with very little scaling. Numerous fresh punctate and guttate lesions on arms. Alopecia of frontal region and vertex. Remainder of scalp shows masses of thickly scaling psoriasis.

29.3.34. Several guttate lesions in upper third of abdomen.

3.4.34. New lesions on both shoulders and upper arms.

5.4.34. Profuse guttate eruption of back and anterior abdominal wall. Biopsy on forearm.

7.4.34. Low salt diet commenced.

24.4.34. No change in scalp. Patches on shoulders vary in diameter up to 1½ inches. Whole of lumbo-sacral region covered by sheet of psoriasis which extends up right side to level of tenth rib. Large patch 4 inches in diameter over lower dorsal vertebrae. Intervening skin shows numerous guttate lesions. Upper part of back free. Large patch transversely across lower end of sternum shows no sign of healing. Guttate eruption on anterior abdominal wall.

Little change in condition of arms.

Congested non-scaling patches on outer aspect of both legs varying in diameter up to 1½ inches.

26.4.34. Discharged at own request.

Continued at home on low salt diet with daily bath and application of vaseline. Saltless bread and salt free butter were specially obtained for him. Selarom (Bayer), a chloride-free salt substitute, was used to season his food.

9.5.34. Has had "influenza" during which some of smaller lesions disappeared.

Large patches on scalp, right arm, back and legs have hardly changed. Patch of psoriasis round biopsy scar.

23.5.34. No new lesions. Large patches on back, right arm and right leg still very congested and at times irritable. No sign of healing in centre of these.

20.6.34. New guttate lesions on upper part of back. Scalp, chest, lumbar region, right arm and leg as before.

11.7.34. (After 3 months on low salt diet). The larger plaques are of greater extent than in April. Hair covered part of scalp still thickly scaling. Some of the smaller lesions have faded but many new ones have appeared.

11.7.34. Low salt diet stopped.

The patient was treated for six weeks thereafter with the following ointment:

Ung. Acidi Salicylici
Ung. Picis Liquidi
Ung. Glyc. Plumbi Subacet.
Ung Hydrarg. Nit. Dil., āā ʒi

Sig. To be rubbed in thoroughly night and morning.

30.8.34. The smaller patches have cleared up entirely. There is still some congestion and infiltration of the large patch on lumbo-sacral region. No scaling visible. There are large areas of pigmentation on the arms and legs, over lower dorsal region and on outer side of calves - the sites of the large patches of psoriasis which have now cleared up.

This case has been reported in detail as it illustrates that in this patient three months' low salt diet had no effect on the condition, while six weeks on a well tried external remedy produced very marked improvement.

SUMMARY.

(1) Three cases of psoriasis were treated by means of low salt diet. The only local treatment was a daily warm bath and an inunction of the whole body with yellow vaseline.

(2) One showed improvement of no greater degree than had been obtained while on a diet of normal salt content.

(3) One case showed decided improvement which however had commenced while on normal salt diet.

(4) The third patient, a case of chronic widespread psoriasis, became steadily worse during three months that he continued on low salt diet. Local treatment of the lesions brought about great improvement in six weeks while on ordinary diet.

CONCLUSION.

There is no evidence that chloride metabolism is abnormal in psoriasis. Low salt diet is of no therapeutic value.

V. STATISTICAL ANALYSIS.

(From the Skin Department, Royal Infirmary, Glasgow).

The following pages contain a statistical survey of all cases of psoriasis attending the Out-patient Department of the Royal Infirmary, Glasgow, during the period 1924-1938 (inclusive). During the whole of this time Dr. J. Ferguson Smith was in charge of the Skin Department and, in the vast majority of cases, the diagnosis was made in the first instance either by him or by the First Assistant, Dr. George Harvey.

The figures are considered under three heads:

A. Frequency of psoriasis as compared with all dermatoses.

B. Sex incidence of psoriasis.

C. Familial incidence of psoriasis.

As far as possible care has been taken that there should be no duplication. Cases suffering from any type of skin disease, who had previously attended for treatment of the same condition during the period under consideration, are not again included.

In some patients who attend for the first time at the Skin Dispensary, the condition found is held to be of a medical or surgical nature and they are referred to the appropriate department. These cases are not included in the figures for total attendance. Where, however, a definite diagnosis of some dermatosis was made and the patient was referred to a physician, surgeon or specialist for additional advice or treatment, the case has been included.

A. FREQUENCY OF PSORIASIS AS COMPARED WITH ALL DERMATOSES.

Though statistics concerning the incidence of psoriasis have been published on several occasions in the U.S.A., it is not proposed to discuss these findings here, as it is well known that psoriasis is more prevalent in cold climates than in the sub-tropical conditions of one part of the U.S.A., the Southern States.

Figures given by investigators on the Continent of Europe are also not considered.

The author proposes to confine himself to the results of analyses made in the United Kingdom.

In London, Wilson (1864) gave the incidence of psoriasis as 7.3 per cent. In hospital patients the proportion of psoriasis to all skin disease was found by Abraham (1893) to be 9 per cent., by Radcliffe Crocker (1905) 7 per cent., and by Abraham (1906) 5.4 per cent.

The latest London figures are those of Fox (1938) from the Royal Northern Hospital. For the five years from 1931 to 1935, out of a total of 5,900 recorded new patients, 265 - that is 4.4 per cent. - were diagnosed as cases of psoriasis.

In Scotland, Jamieson (1894) gave the incidence as 8.4 per cent. McCall Anderson (1894) found that in Glasgow,

out of a total of 40,054 cases of all skin diseases, 3,430 (i.e., 8.6 per cent.) had psoriasis.

Guthrie (1938) gave the results arrived at for the ten years from 1924 to 1933 in the Royal Infirmary, Glasgow. In a total attendance of 39,963, a figure very near that of McCall Anderson, only 1,796 (4.5 per cent.) were diagnosed as cases of psoriasis.

It is interesting to note how closely the figures of Fox and Guthrie agree. From the available information it is not possible to explain the discrepancy, both in London and Glasgow, between their results and those given by earlier British investigators. Only Abraham (1906) gave a figure (5.4 per cent.) at all comparable with their findings of 4.4 and 4.5 per cent. respectively.

The analysis of cases attending the Royal Infirmary, Glasgow, has now been brought forward to the end of 1938. The results are contained in Table XXIV.

Out of a total of 63,423 patients attending the Out-patient Department for all types of skin disease, 2,749 had psoriasis. This is equivalent to a percentage of 4·3.

TABLE XXIV.

Incidence of Psoriasis as compared with All Skin Diseases.

Year	All Skin Cases	Psoriasis	Year	All Skin Cases	Psoriasis
1924	2,776	120	1924-31	30,086	1,378
1925	2,944	157	1932	4,771	194
1926	3,317	161	1933	5,070	224
1927	3,665	204	1934	4,905	184
1928	4,505	194	1935	4,616	218
1929	4,160	172	1936	4,791	199
1930	4,283	193	1937	4,721	180
1931	4,436	177	1938	4,463	172
	30,086	1,378	TOTAL	63,423	2,749

B. SEX INCIDENCE OF PSORIASIS.

Macleod (1933) stated that in the United Kingdom the incidence of psoriasis was equal in the two sexes while on the Continent of Europe the proportions affected were 3 males to 2 females.

Several analyses of sex incidence have been made by investigators in the United States of America, the Continent of Europe and the United Kingdom.

The results are collected in Table XXV Statistics limited to private patients are not included.

From the table below it appears that in the United States the incidence of psoriasis is equal in the two sexes, while on the Continent of Europe, three-fifths of the patients are males. In the United Kingdom, on the other hand, three-fifths of the patients appear to be females. The figures of only one British investigator, McCall Anderson (1894), show a marked deviation from this proportion. He found the incidence equal in the two sexes.

TABLE XXV.

Sex Incidence of Psoriasis in Different Countries.

Author (Date)	Total Cases	Males	Females	Percentage	
				Males	Females
(a) U.S.A.					
BULKLEY (1906) (New York)	1597	806	791	51	49
(b) EUROPE					
NIELSEN (1893)					
(i) Collected Data	2439	1482	957	61	39
(ii) Copenhagen	520	314	206	60	40
JORDAN (1931) (Moscow)	380	259	121	68	32
TOTAL (EUROPE)	3339	2055	1284	61	39
(c) UNITED KINGDOM					
ABRAHAM (1893)	355	133	222	37	63
ANDERSON (1894)	314	161	153	51	49
ABRAHAM (1906)	582	239	343	41	59
FOX (1938)	265	100	165	38	62
TOTAL (UNITED KINGDOM)	1516	633	883	42	58

Table XXVI gives the figures obtained from the Out-patient Department of the Royal Infirmary, Glasgow, for the fifteen years 1924 to 1938. Out of a total of 2749 cases of psoriasis, 1159 (42.2 per cent.) were males and 1590 (57.8 per cent.) were females. These percentages agree exactly with those found from an addition of the results given in previous British analyses. The numbers are sufficiently large to stand comparison

TABLE XXVI.

Sex Incidence of Psoriasis (1924-1938).

Year	ALL SKIN CASES			PSORIASIS			ALL OTHER SKIN CASES		
	Males	Females	Total	Males	Females	Total	Males	Females	Total
1924	1330	1446	2776	41	79	120	1289	1367	2656
1925	1461	1483	2944	60	97	157	1401	1386	2787
1926	1653	1664	3317	67	94	161	1586	1570	3156
1927	1840	1825	3665	80	124	204	1760	1701	3461
1928	2234	2271	4505	79	115	194	2155	2156	4311
1929	2068	2092	4160	74	98	172	1994	1994	3988
1930	2197	2086	4283	85	108	193	2112	1978	4090
1931	2156	2280	4436	68	109	177	2088	2171	4259
1932	2380	2391	4771	84	110	194	2296	2281	4577
1933	2446	2624	5070	92	132	224	2354	2492	4846
1934	2353	2552	4905	75	109	184	2278	2443	4721
1935	2337	2279	4616	109	109	218	2228	2170	4398
1936	2334	2457	4791	89	110	199	2245	2347	4592
1937	2280	2441	4721	80	100	180	2200	2341	4541
1938	2170	2293	4463	76	96	172	2094	2197	4291
1924-38	31,239	32,184	63,423	1,159	1,590	2,749	30,080	30,594	60,674

with Bulkley's figures from the New York Skin and Cancer Hospital and Nielsen's combined European statistics.

In 60,674 patients, suffering from all skin diseases except psoriasis, 49.6 per cent. were males and 50.4 per cent. females (Table XXVIA). The higher incidence of psoriasis in females is not therefore due to a preponderance of female attendances for skin diseases generally. In the other statistics quoted this point is not brought out. From the inquiries made in the United States and Europe it is not possible to say what are the relative proportions of males and females attending for other dermatoses.

The incidence of psoriasis in male patients as compared with all male patients attending the Out-patient Department for Diseases of the Skin was 3.7 per cent. and in female psoriatics as compared with all first attendances by females 4.9 per cent. As already stated (p. 86), the percentage for both sexes was 4.3.

TABLE XXVIA.

Sex Incidence

(i) Psoriasis:		(ii) All Other Skin Diseases	
Males	Females	Males	Females
1159	1590	30,080	30,594
1.0	1.4	1.0	1.02
As percentage of all cases (both sexes)			
42.2%	57.8%	49.6%	50.4%

C. FAMILIAL INCIDENCE IN PSORIASIS.

(1) HISTORICAL REVIEW.

Willan (1808), the father of British dermatology, described under the name of Lepra vulgaris the disease we now know as Psoriasis. Of it he said, "I am convinced by closely attending to a great number of cases ..... that an hereditary predisposition to it exists."

A minority of twentieth-century dermatologists however have disagreed with his conviction.

Pollitzer (1909) considered that heredity that affected one child and spared all the others must be characterised as capricious. He thought that heredity was of as little significance in psoriasis as in leprosy or scabies.

Knowles (1912) found only on six occasions in several hundreds that there was more than one case in a family. In the opinion of Gorbulev (1928), inheritance was of no significance. In only 20 out of 452 cases was the illness familial.

Kilroy (1921) considered that there was no evidence that the disease was more prevalent among the children of those having psoriasis than among the children of those who were free from it. However, Hoede (1932) found from a study of 537 cases that the incidence of psoriasis among the siblings, where one or other of the parents had psoriasis, was much greater than where both parents were free of the disease. In 45 cases where

the father was affected and 43 where the mother had psoriasis, the proportion of healthy to affected children, excluding the original cases, was 1 : 8.1. In 449 cases where both parents were free of psoriasis, the ratio of affected to unaffected siblings was 1 : 21.3.

Walker (1932) was no believer in the importance of heredity in psoriasis. "..... it is beyond question that one not infrequently comes across it in two or more members of the same family. This occurrence makes much more impression upon the observer than the many cases in which no such event was noted. As a matter of fact, not one in ten of my cases of psoriasis has had any traceable family connexion."

It is of interest that another eminent Scottish authority, McCall Anderson (1894), from a study of nearly 4,000 cases, should state, "That the disease is hereditary, however, any one who has any experience of it can verify."

Cockayne (1933) reviewed the literature in favour of hereditary transmission in psoriasis but unfortunately misquoted the figures for familial incidence given by von Heiner (1926) and Furst (1927). The findings of these two authors will be considered along with other references not given by Cockayne.

Nielsen (1893) found familial incidence in 28.8 per cent. of 306 psoriatics. He considered, however, that there was no proof that the origin of psoriasis in several members of the same family should be explained by heredity; it might just as well be ascribed to contagiousness. In my opinion, the

great rarity of conjugal psoriasis is a weighty argument against this explanation.

Kaposi (1895) and Crocker (1905) believed that psoriasis was hereditary in the sense of a familial tissue proclivity. Abraham (1906) obtained a positive family history in 23.8 per cent. of his cases. He considered that statistics did not lend weight to the hereditary theory but that there might be a family susceptibility to the acquisition of psoriasis.

Bulkley (1906) found that in 382 cases where accurate information was given, 65 (i.e. 17 per cent.) showed either anterior or posterior heredity. He thought however that hereditary influences were unimportant as generally there was only one child affected among many healthy ones.

von Heiner (1926) gave the familial incidence as 17 per cent. in 136 clinic patients, while in 46 private patients the percentage was 29. Fürst (1927) in 37 families discovered that 36 per cent. had psoriasis. The series of these two authors are too small for statistical purposes.

Nobl (1928) considered that psoriasis depended on hereditary and constitutional factors but needed some exciting cause to bring out the characteristic reaction of the skin.

The investigation by Hoede (1932) of 539 cases showed the occurrence of psoriasis in other members of their families in 39 per cent. From a study of 512 pedigrees, he discovered that in 190 families more than one member was affected with

psoriasis. Conjugal psoriasis was found five times only. One of these unions was childless and in another the only son aged five was still healthy. In the other three cases one out of one, one out of two and two out of six children had psoriasis.

(2) DIFFICULTY OF OBTAINING ACCURATE FAMILY HISTORIES.

It is more usual to get a positive family history from a patient who has had psoriasis for some time than in the case of a first attack. In such a case, a psoriatic may volunteer information about one or more affected relatives. The disease generally is so characteristic, that an intelligent patient who has had the condition for some time is usually able to diagnose it correctly, should another member of the family become affected.

On the other hand confusion may arise by the patient's considering a previous attack of squamous eczema or seborrhoeic dermatitis in a relative to have been psoriasis.

The difficulty of obtaining accurate histories even of their own illnesses from many patients of the hospital class is well known. This is reflected in the fact that statistics of the familial incidence of psoriasis show a higher percentage in private than in hospital patients.

In mild cases, where the disease remains localised on the elbows and knees for years, no treatment is undertaken in many cases, especially among males. Women particularly may have a natural reluctance to disclose to their relatives that

they suffer from a disease of the skin. Similarly, in those trades where food is handled, the psoriatic may hide his disability in case he should lose his employment. The tendency of the disease to affect covered parts aids in this concealment.

It is probable that some of the young children in a large family will later be affected but at the time of the enquiry they cannot be included. A case in a deceased relative or in one living in a different part of the country may be unknown to the patient. The constant emigration from the West of Scotland prior to 1914 has led to a considerable number of persons now of middle age having uncles, aunts and cousins in the Dominions and United States of whom they know very little.

Another difficulty is caused by the large numbers of young men killed in the War of 1914-18. Those who were predisposed to psoriasis might later have been affected if their lives had been prolonged.

Hoede (1932) noted that almost always there was a negative family history in cases born out of wedlock. This of course is largely due to the impossibility of obtaining proof of inheritance from the father's side. Sufferers from widespread psoriasis are apt to remain single, not only for aesthetic reasons, but also because they do not wish to transmit an incurable malady to their children. In illicit intercourse these scruples do not hold to any extent, so that psoriatics are illegitimate children oftener than is generally recognised. I have not attempted to inquire into this delicate question, so can offer no opinion on Hoede's views.

(3) PERSONAL INVESTIGATION.

For the five years from October 1934 to September 1939 a note was kept of all new patients who had a positive family history. In 134 of these cases, out of a total of 148, the relationship of the other members affected was also noted. Unfortunately in the case of grandparents and collaterals, the records state only in a few instances whether the relationship was on the paternal or maternal side.

It will be seen from Table XXVII that 148 out of 924 cases of psoriasis (16.0 per cent.) stated that other members of the family were affected. In males the percentage was 13.5 as against 18.1 in females. This difference may partly be explained by the well-known fact that the mother in a household generally knows much more about the family ailments than does the father.

TABLE XXVII.

Familial Incidence of Psoriasis.

	TOTAL CASES			POSITIVE FAMILY HISTORY		
	Males	Females	Both Sexes	Males	Females	Both Sexes
1934 (Oct.Dec.)	20	22	42	2	8	10
1935	109	109	218	17	15	32
1936	89	110	199	9	27	36
1937	80	100	180	12	16	28
1938	76	96	172	11	14	25
1939 (Jan.-Sept)	48	65	113	6	11	17
TOTAL (5 years)	422	502	924	57	91	148

Percentage of all patients with positive family history = 16.0
" " male " " " " " = 13.5
" " female " " " " " = 18.1

Below is noted the relationship to the patients of other affected members in the family in 134 cases.

	Males:	Females:	Total
Father only	10	21	31
Father and mother	1	-	1
Father and several brothers	1	-	1
Father and two sisters	1	-	1
Father and one aunt	1	-	1
Mother only	10	13	23
Mother and one brother	1	-	1
Mother and one sister	-	2	2
Mother and one cousin	1	-	1
One brother	5	4	9
Three brothers	1	-	1
One brother and one grandfather.	-	1	1
One sister	8	13	21
Two sisters	1	-	1
One sister and one aunt	1	-	1
One son	-	3	3
One son and husband	-	1	1
One daughter	-	5	5
Two daughters	-	1	1
Grandfather only	2	4	6
Grandmother only	1	2	3
Grandmother (maternal) and aunt (maternal)	1	-	1
One uncle	-	1	1
Uncle (maternal)	1	-	1
One uncle and one aunt	1	-	1
One uncle and one cousin	1	-	1
One aunt	1	3	4
One nephew	1	1	2
One niece	-	1	1
One cousin	1	2	3
Several cousins	1	2	3
2 members of family	1	-	1
	54	80	134

There were 2 cases in the family 113 times.

" " 3 " " " " 15 "

" " 4 " " " " 2 "

Several (number not stated) 4 "

Two instances of conjugal psoriasis occurred in this series where both parents and one son were affected. Excluding these two cases transmission of the disease was through the father in 34 cases and through the mother in 38 cases. In two of the latter the predisposition to the disease came from the maternal side but the mother herself was not affected. Unfortunately in 60 cases the records do not indicate whether the inheritance was from the paternal or maternal side.

Hoede (1932) in a much more complete investigation in which he compiled 512 family trees found the following results.

1	Psoriatic	in 322	families
2	Psoriatics	" 105	"
3	"	" 50	"
4	"	" 19	"
5	"	" 10	"
6	"	" 2	"
7	"	" 2	"
8	"	" 1	family
10	"	" 1	"

Out of 190 families in which there were two or more cases, 85 families showed more than two cases. In the author's analysis of the records of the Royal Infirmary only 21 out of 134 families had more than two members affected, and in his opinion a more thorough inquiry into the family history would reveal many more relatives who suffered from psoriasis. This

however is merely a personal opinion which has no data to support it.

This analysis shows that approximately one in every six cases of psoriasis knew of other members of the family who were affected. In the great majority only one other member was known to have psoriasis. From the findings of this inquiry it cannot be said that psoriasis is an hereditary disease. In a considerable number of cases, however, there appears to be a familial predisposition. What other factors are required to determine the onset of an attack in one predisposed to the disease is a question still requiring elucidation. The author believes that repeated slight traumata are of importance, e.g. the friction of clothing on the extensor aspects of arms and legs and on the buttocks. The improvement obtained in most cases by rest in bed tends to support this view. The scarcity of psoriasis among those born in tropical climates and especially among negroes points to lack of sunlight and of the protective pigment produced in the skins of tropical races as factors which may be of importance in the etiology of this dermatosis. No final opinion however can be given on these subjects.

(4) THE MODE OF TRANSMISSION OF FAMILIAL SUSCEPTIBILITY.

A small number of investigators have considered this question on Mendelian lines by studying pedigrees of affected families.

Marcuse (1911) studied through four generations the descendants of two brothers with psoriasis and one unaffected sister. He concluded that psoriasis can exist as a familial malady through several generations. The Mendelian laws of inheritance were not followed in the cases quoted. The diathetic character of psoriasis in the cases under consideration was very probable.

von Heiner (1926) published four family trees. Excluding the youngest generation, some of whom might still be affected, he found that half had psoriasis and half were free of the disease. He concluded that the inheritance was of an irregular dominant type. One of von Heiner's pedigrees showed a marriage between unrelated persons both suffering from psoriasis. The marriage of two heterozygous dominants should result in the children being homozygous dominants, heterozygous dominants and normal in the ratio of 1 : 2 : 1. There should be three abnormal siblings to one normal and all the children of the homozygous dominant should have the abnormality. From the above-mentioned union there were three sons of whom two were heterozygous, one with psoriasis and the other normal but his son had psoriasis. The third son was probably homozygous for all his four children had psoriasis.

Furst (1927) gave two pedigrees each of three generations showing eleven cases in one and nine cases in the other in which inheritance was dominant. Further family trees showing psoriasis in three successive generations confirmed this finding. Though proof of dominant type of inheritance was lacking in many cases, this was explained by the fact that psoriasis itself is not inherited but only the predisposition to the disease. There is no method of showing this predisposition when latent.

In addition to Furst's two pedigrees, Leven (1927-28) has published two family trees in which psoriasis behaved as a simple dominant. All four pedigrees showed about equal numbers of affected and normal siblings when one parent was affected, all siblings being normal when both parents were normal.

Cockayne (1933) stated that other published pedigrees all showed a preponderance of normal over affected siblings and transmission by apparently normal individuals. In these families dominance was irregular or incomplete. If however psoriasis were due to an inherited predisposition and in addition an external cause, Cockayne considered that the dominance might really be complete and regular. The majority of the siblings who were apparently normal and of the conductors would in this case have inherited the predisposition but would not have been exposed to the external cause.

Hecht (1930) obtained 32 family trees from questioning 450 psoriatics. He concluded that psoriasis depended on a special

predisposition of the skin which was hereditary but could remain latent for a lifetime. There must also be some exciting cause which might be of a traumatic, infective or nervous nature but was generally unknown. He thought that the inheritance of this predisposition was in a few cases dominant but was generally recessive. All but one of his pedigrees fell into one or other of two main groups: (1) in which both sexes were equally affected; (2) in males only though transmission also occurred through women. The tendency to psoriasis was common to all members of both groups but in women of the second group some factor was present which prevented the outbreak of psoriasis.

RugglesGates (1934) has pointed out simply the outstanding differences between dominant and recessive inheritance. If the condition appears in one or more of the children as well as one of the parents or his parents; or if in the whole pedigree every abnormal person has one parent (and one only) who shows the condition, the evidence of dominant inheritance is very strong. On the other hand the appearance of the condition on several occasions when both parents are normal would point to recessive inheritance. Both RugglesGates and Cockayne stress the value as evidence that an abnormality is recessive of an excess of consanguinous marriages resulting in the birth of abnormal children.

Hoede (1932), whose investigation is by far the most comprehensive so far attempted, refuted Hecht's findings. From a study of 512 pedigrees he could not find that inheritance was

confined to one sex. The incidence of consanguinous marriages was too low (only 2 per cent.) for a recessive defect. Only in very few families where both parents were healthy was more than one child affected. In 15 cases where one of the parents married for the second time psoriasis occurred twice in step-siblings - a most unlikely happening if the defect were recessive. He considered that psoriasis acted as an irregular dominant.

The consensus of opinion appears to be that if psoriasis or at least the psoriatic diathesis obeys Mendelian laws, it does so as a dominant. In the author's analysis only 16 per cent. gave a positive family history. It seems very probable that given facilities for a thorough study of the families affected this figure might be much higher. It seems very probable that there is familial predisposition to psoriasis inherited as a dominant. Now if an individual heterozygous for a dominant abnormality marries a normal person, as happens in the vast majority of cases of psoriasis who marry, half the children will be heterozygous for this defect and half will be normal. The latter can marry without fear of their children being affected or of passing on the defect to later generations. In the case of the heterozygous children if they marry half of their children should be normal. In small human families of course these rules are only very approximate. If however it is admitted that it is only a diathesis and not psoriasis itself that is inherited, the probability of psoriasis occurring

in a family of six children with one psoriatic parent can be roughly arrived at. Three of the children will not inherit the predisposition and so cannot develop psoriasis. The outbreak of psoriasis in the other three children appears also to be dependent on some exciting factor which may or may not come into play. This explains why only one child is affected in the majority of cases, though two or even three may develop psoriasis. In only one instance in our series were there three siblings who inherited the disease from their affected father.

In another family four brothers had psoriasis though neither parent was a psoriatic. Such examples however are rare.

Age of Onset. The information given in the Out-patient records does not include the age at which psoriasis first appeared. No useful purpose would be served by detailing the ages of the patients on their first attendance at the Royal Infirmary.

Season. No accurate information is available as to the month when the various attacks commenced. Some patients reported immediately while others had had prolonged courses of treatment either by their own doctor or at another hospital before appearing at the Out-patient Department of the Royal Infirmary.

Only in In-patients was a detailed history kept and the small number treated in the wards compared with the very large number of Out-patients (2,749) does not give the same scope for drawing accurate conclusions as to the seasonal incidence of psoriasis.

SUMMARY.

(1) A study was made of the Out-patient records of the Skin Department, Royal Infirmary, Glasgow, for the period January 1924 to September 1939.

(2) The incidence of first attendances for psoriasis as compared with all skin diseases was 4.3 per cent.

(3) Of 2749 cases of psoriasis 42 per cent. were males and 58 per cent. females. For all other skin diseases the number of male and female patients was approximately equal.

(4) A study of 940 cases of psoriasis attending for the first time during the period October 1934 to September 1939 showed a positive family history in 16 per cent.

(5) Psoriasis does not appear to be a hereditary disease. There does appear to be however a familial predisposition to this dermatosis in a proportion of cases.

(6) A discussion on the method of transmission of this psoriatic diathesis founded on a study of the literature is included.

CONCLUSION.

Psoriasis appears to be due to an inherited predisposition which may however remain latent throughout life. The appearance of the disease requires some additional exciting cause or causes. These precipitating factors are very numerous and may vary in the same patient in different outbreaks of the dermatosis. It seems very probable that this familial predisposition to psoriasis is inherited as a dominant. Abnormalities of metabolism are not considered to be of any significance in the etiology of psoriasis.

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TABLE II

COMPARISON OF SWEAT AND PLASMA IN NORMAL CONTROLS AND IN PSORIASIS

Concentration of Chloride (as NaCl) and Nitrogenous Constituents (mgm. per 100 c.c.)

	No.	Age	Average Bath Temp. °C.	SWEAT				PLASMA			CLINICAL CONDITION
				Chloride (as NaCl)	Total N	(Urea + NH_3) N	Ammonia N	Urea N	Chloride (as NaCl)	N-P. N.	(Urea + NH_3) N	
NORMAL CONTROLS	1.	26	52	295	—	—	—	—	585	—	—	Healthy male
			58	211	—	—	—	—	610	—	—	
	2.	28	56	339	60·2	18·2	4·6	13·6	558	33·2	16·1	do. do.
			53	275	64·7	37·5	3·8	33·7	580	28·4	16·3	
	3.	24	52	445	40·1	23·3	3·1	20·2	550	26·1	16·4	do. do.
			47	445	38·3	16·7	7·9	8·8	562	27·8	18·6	
	4.	34	49	435	41·4	19·5	1·9	17·6	603	23·5	12·5	do. do.
			52	433	50·5	22·4	2·8	19·6	620	33·0	16·7	
	5.	45	52	360	45·5	15·8	3·3	12·5	585	—	—	do. do.
			49	281	39·3	18·3	4·0	14·3	562	23·5	15·6	
	6.	18	50	298	55·5	30·6	3·2	27·4	597	—	—	do. do.
			50	340	44·8	28·9	6·8	22·1	576	27·8	17·1	
PSORIASIS	1.	23	53	363	50·7	18·1	4·7	13·4	562	31·8	18·6	Mild - localised on elbows and legs.
			54	374	50·2	21·4	8·8	12·6	597	26·5	17·3	
	2.	46	52	349	42·9	16·4	4·6	11·8	589	22·5	14·3	P. universalis.
	3.	35	50	245	34·7	22·1	5·3	16·8	586	28·6	18·2	P. nummularis - limbs
	4.	29	49	494	76·8	30·2	—	—	589	21·5	15·1	P. universalis
	5.	31	52	388	37·5	25·0	2·9	22·1	608	28·1	17·7	Nummular and circinate lesions on limbs
			53	338	42·9	26·1	3·9	22·2	603	22·2	15·8	
	6.	48	51	154	41·4	30·0	5·0	25·0	661	28·6	21·4	Scalp, sacral region, limbs, nails.
			53	180	—	26·7	3·9	22·8	647	29·4	18·7	
	7.	25	59	405	65·2	21·9	—	—	589	23·1	15·8	Nummular and gyrate.

TABLE V

DAILY EXCRETION OF TOTAL NITROGEN AND CHLORIDE IN URINE AND SWEAT

All values for intake, urine and sweat are in gm. per day. Figures for urine and sweat are average estimations for twenty-four hours.

Condition	NORMAL CONTROLS								PSORIASIS						
Subject No.	I		II		III		IV		V	VI		VII		VIII	
Age	17		26		22		26		46	31		48		35	
Experiment	A	B	A	B	B	A	B	A	A	A	B	A	B	A	
Surface Area (sq. m.)	1·52	1·52	1·82	1·82	1·64	1·65	1·79	1·75	1·81	1·75	1·72	1·73	1·73	1·72	
Av. room temp. (°C.)	17·2	16·1	15·0	16·9	16·7	17·2	16·7	17·8	17·2	17·9	19·0	17·6	21·9	17·7	16·5
NITROGEN															
Protein intake	71	71	75	75	75	75	75	75	71	71	71	71	71	71	71
Urine – total N	10·92	11·48	9·80	10·78	10·78	10·22	10·36	9·94	7·84	8·02	7·87	8·92	8·89	7·08	7·98
Sweat – total N	0·307	0·227	0·215	0·412	0·231	0·249	0·336	0·370	0·200	0·291	0·252	0·126	0·369	0·257	0·242
Sweat — total N/sq. m.	0·202	0·146	0·118	0·226	0·140	0·151	0·188	0·211	0·110	0·162	0·144	0·073	0·213	0·149	0·141
CHLORIDE (as NaCl)															
Intake	11·21	5·21	12·27	5·77	5·77	11·77	5·63	11·29	8·17	3·17	7·58	2·58	7·58	2·58	8·17
Urine	14·51	4·65	10·53	5·38	5·73	11·23	3·91	9·20	8·12	2·73	4·32	2·98	5·76	1·69	7·06
Sweat - total	0·483	0·219	0·151	0·298	0·395	0·405	0·265	0·325	0·195	0·266	0·418	0·097	0·426	0·136	0·322
Sweat — total/sq. m.	0·318	0·144	0·083	0·164	0·241	0·246	0·148	0·186	0·108	0·148	0·233	0·056	0·246	0·079	0·187

TABLE IX

Free HCl is expressed in units of N/10 NaOH

CASE No.	AGE yrs.	SEX	DURATION years	CLINICAL FEATURES	GASTRIC ANALYSIS — FREE HCl Fasting	30 mins.	60 mins.	90 mins.	120 mins.	TYPE OF CURVE
1.	30	M.	5	Polyarthritis. Psoriasis followed by exfoliative dermatitis.	0	0	6	5	16	Low Normal
2.	29	M	7/12	Extensor aspect of limbs, both thighs, lumbar region.	0	24	33	36	21	High Normal
3.	58	M	10	Generalised. Exfoliative dermatitis of face, trunk and arms.	10	0	0	6	12	Low Normal
4.	15	F	4	Generalised; nummular and circinate	13	0	14	25	30	Normal
5.	9	F	2	Acute guttate type.	25	0	0	10	18	Normal
6.	34	F	20	Acute guttate followed by exfoliative dermatitis	0	0	7	10	30	Normal
7.	15	F	7	Scalp. elbows, right buttock, hands. Very resistant to treatment.	6	25	32	42	40	High Normal
8.	31	M	9	Back, right elbow, knees. Tuberculous adenitis — scrofuloderma	0	4	22	22	15	Normal
9.	58	M	2/12	Scalp, sacral region, both arms.	0	0	18	4	0	Low Normal
10.	59	M	28	Scalp, chest, lumbar region, elbows, shins.	0	24	33	36	—	High Normal
11.	61	F	40	Back, abdomen, dorsum of hands, elbows.	0	0	0	0	0	Achlorhydria.
12.	13	F	4	Nummular on elbows and knees; guttate on shins.	8	0	28	35	21	Normal
13.	15	F	8	Guttate on arms, hands, shins; plaques on abdomen, buttocks, knees.	0	5	40	52	61	Hyperchlorhydria.
14.	19	M	2/12	Plaques on back; gyrate on legs; guttate on left elbow.	0	0	0	0	6	Hypochlorhydria
15.	48	M	15	Plaques on abdomen, buttocks, elbows, right thigh; scaling slight.	23	10	20	16	6	Normal
16.	74	M	?	Generalised; marked hyperkeratosis of soles.	0	0	0	0	0	Achlorhydria.
17.	18	M	5	Generalised guttate and nummular.	22	21	50	20	14	High Normal
18.	57	M	29	Large chronic lesions on elbows, knees, calves; circinate over sacrum	8	9	18	36	32	Normal
19.	52	M	24	Thickly scaling sheets on back; large plaques on scalp, abdomen, limbs.	0	0	8	12	—	Low Normal
20.	16	F	3	Nummular on scalp, back, limbs.	0	10	18	25	36	Normal
21.	20	F	4	Guttate and nummular on back, breasts, abdomen; pruritus	14	7	16	17	22	Normal
22.	57	M	3/52	Acute guttate on limbs, back, chest, abdomen.	0	0	18	31	13	Normal
23.	39	M	?	Small discoid on elbows and extensor aspects of limbs. Bronchitis	60	44	66	32	28	Hyperchlorhydria
× 24.	57	M	5	Acute generalised exfoliating type.	20	8	8	15	10	Normal
× 25.	67	F	1	Extensor surfaces - limbs; few lesions on trunk; pustular - fingers and toes.	23	8	23	35	32	Normal
× 26.	24	F	?	Generalised for 8 months - now exfoliative. Similar attack one year ago.	7	0	2	20	30	Normal
× 27.	35	M	Prior to 1914	Generalised; swelling - hands & feet; scarlatiniform exfoliation - palms & soles.	15	18	35	—	70	Hyperchlorhydria
× 28.	18	F	3/12	First attack. Face, front of chest, extensor surfaces of left arm and leg.	0	2	20	22	—	Normal
× 29.	26	M	4	Out - patient.	15	2	12	22	35	Normal
× 30.	69	M	2	Nummular — body and limbs; pustular - right hand and both feet.	0	0	0	3	—	Hypochlorhydria

× Patients of Dr. W. Herbert Brown — estimations not made by author.