A Prognostic Study of Occupational Dermatitis Cases in a Chemical Works

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An examination has been made of the medical records of a group of white-skinned men, new starters in a works manufacturing dyestuffs and related chemicals. One thousand, four hundred and fifty-two such men started employment in the works in the five years 1955-59; 745 were employed as chemical process workers, 266 as chemical plant maintenance engineering workers, 335 as non-plant engineering workers, and 106 in various miscellaneous jobs. The process and plant engineering workers have considerable contact with chemicals; the non-plant engineering and miscellaneous workers have little or no chemical contact.

The numbers of men having one or more attacks of occupational dermatitis were 92 (12.35%) process workers, 20 (7.52%) plant engineering workers, 16 (4.77%) non-plant engineering workers, and two (1.88%) miscellaneous workers. The first attack of occupational dermatitis usually occurred within 12 months of starting in the works. Of the 130 first attacks of occupational dermatitis, 17 (13.1%) were caused by the mis-use of sodium hypochlorite (which is used as a means of cleaning the skin), 98 (75.2%) by other primary irritants, and 15 (11.6%) by cutaneous sensitizers.

One hundred and thirty men had their first attacks of occupational dermatitis and of these 85 (64.5%) had no recurrence, 32 (24.6%) had one recurrence, seven (5.4%) had two recurrences, three (2.3%) had three recurrences, two (1.5%) had four recurrences, and one (0.8%) had five recurrences. There was no evidence to suggest that the number of recurrences was related to the length of service. The data may be expressed as the number of recurrences per hundred average population of persons who have had an attack of dermatitis for each year after the first attack. In process workers the number of recurrent attacks for the year following the first episode was 37.8/100 average population, falling in the second to sixth years to 13.0 to 16.7/100. The number of men having a recurrence was 31.9/100 average population in the first year, and 5.3 to 7.7/100 in the second to sixth years. No recurrences occurred after the sixth year. In plant engineering workers the number of recurrences was 61.0/100 average population in the first year, and 7.7 and 7.8/100 in the second and third years. The number of men having a recurrence was 40.1/100 in the first year, and 7.7 and 7.8/100 in the second and third years. There were no recurrences after the third year. In non-plant engineers no man had more than one recurrence, so that the number of recurrences and the number of men having a recurrence are the same in each yearly period. The two rates are in the range 10.7 to 14.2/100 average population in the three years following the first episode of dermatitis, and 7.2 and 8.3/100 in the fourth and fifth years. There were no recurrences after the fifth year.

There were no differences in age at the time of the first attack of occupational dermatitis between those who developed a recurrence and those who did not.

In 17 men the first attack of occupational dermatitis was due to hypochlorite and of these three had one or more recurrences. Thirty-six of the 98 men whose first attack was due to other primary irritants had a recurrence, and six of the 15 men whose first attack was due to sensitizers had a recurrence.

A permanent change of work was necessary in 16 cases; all these men were found jobs within the works and none was obliged to accept work at a lower rate of pay. Four men are known to have left because of occupational dermatitis. The cases of occupational dermatitis in this works have a generally favourable prognosis.

In the United Kingdom occupational dermatitis causes more disability and loss of time from work

than any other single industrial disease, but few reports on the prognosis of this condition have been published. Bentley Phillips (1954) studied 139 patients one to four years after they were first

examined for occupational dermatitis. None was considered to have fully recovered, and in all cases compensation was still being paid. Hellier (1958) reported that 95 of 124 patients with industrial dermatitis seen by him for the Ministry of National Insurance suffered further attacks of dermatitis within four to six years of the first examination. In 73 of the 124 cases, earning capacity was reduced.

The cases reported in those papers were all sufficiently severe to need considerable periods of absence from work and to claim Industrial Injury Benefit. Calnan (1958) pointed out that such cases probably represent only a small fraction of the total number of workers who develop industrial dermatitis, and that the true prognosis of the condition may well be less gloomy than those papers suggest. He drew attention to the need for studies which analyse every case of dermatitis in a particular factory, and suggested that such studies would show a much higher incidence of the disease but a more favourable prognosis than reports from dermatological clinics or the Ministry of National Insurance. Newhouse (1961, 1964), in her reports on occupational dermatitis in the automobile industry, has demonstrated that the prevalence of this condition is indeed high. Engel and Calnan (1963) reported 65 cases of chromate sensitization dermatitis occurring in a group of 250 men engaged in wet sandpapering of primer paint on car bodies. One year later, 13 men had left the factory, 31 (60%) were found to be completely free of dermatitis, 16 had occasional relapses, and five had persistent chronic dermatitis. The author is not aware of any other follow-up studies of complete groups of workers. The present paper is a study of a group of men employed in a chemical works who have been followed for up to 10 years.

The Works

The study was made in a chemical works which produces a wide range of dyestuffs, dyestuff intermediates, rubber chemicals, and various miscellaneous products. A very wide range of different chemical substances is handled. The majority of these are aromatic organic compounds, which range from simple materials such as toluene or aniline to dyestuffs of complex structure. The works is an old-established one and the buildings and plant vary considerably in age; some parts date back to before the 1914-18 war, and others are quite new. In general, the standard of industrial hygiene is fair, although some of the older plants are not up to the standards achieved in more modern structures.

Process workers may have skin contact with

chemicals when charging materials to the reaction vessels or in the later stages of the processes in the course of filtration or drying procedures. Maintenance engineering personnel may have to work on the exterior or interior of plant and, in doing this work, have considerable skin exposure to chemicals.

Adequate wash-basins, showers, and baths are available for all workers, and soap and individual towels are provided by the works. Barrier creams are freely available in all departments. Work with dyes often leads to heavy staining of the skin. This staining can be removed from most body areas by simple washing with soap and water, but heavier staining, particularly of the hands, requires the use of sodium hypochlorite solution. Failure to adhere to the recommended technique for the use of this material may result in characteristic skin lesions, easily differentiated from other types of primary irritant dermatitis. A full range of protective clothing is supplied for all workers, and all such clothing is laundered by the works. Workers with minimum contact with chemicals are supplied with cap, overalls, gloves, and boots; those with greater chemical exposure receive a complete change.

The works employs about 1,100 hourly-paid men and about 40 full-time and 35 part-time hourly-paid women. Approximately 400 of the men are chemical process workers, 500 are engineering workers, and 200 work in other miscellaneous jobs. About 150 of the engineering workers are employed on plant maintenance work, where they may have considerable chemical contact. The remaining engineering personnel work in general engineering workshops or in various building and construction jobs. These men have much less chemical exposure as they handle mainly new or cleaned items of plant. The miscellaneous group is composed of men working on internal transport, in storage areas, in the canteen and in various cleaning jobs. They have little or no contact with chemicals. The women are almost all employed on canteen, laundry or cleaning work, where they have no contact with chemicals; a few, however, are employed in laboratories.

There is a well-equipped medical department in the works. The post of full-time industrial medical officer was created in January 1955, and complete medical records have been kept since that time. All applicants for employment are medically examined. A thorough examination of the skin is made, and those with a history, or signs, of constitutional eczema or of significant industrial dermatitis are not accepted for chemical work. Employees are encouraged to attend the works surgery if they develop any sort of skin disease, whether it is thought to be occupational or not, and

an attempt is made to advise and treat them. It is usual to obtain the agreement of a man's general practitioner before treating most non-occupational conditions. The importance of seeking early treatment is strongly emphasized. As an aid to the early detection of skin disease, the medical officer makes a weekly tour of the various plants and examines the skin of the hands, forearms, and face of men who handle chemicals. Each man is seen about every three weeks.

Men who develop an occupational dermatitis are usually treated in the factory medical department and very few go off work. Mild cases are usually allowed to remain at their normal work, but for all the more severe cases alternative work is arranged. Alternative work may comprise 'clean' jobs in the man's own department or may involve a temporary transfer to non-chemical work outside the department. If alternative work is necessary, the man's wage is maintained at its normal level so that such temporary transfer does not cause financial loss. Men with sensitization dermatitis, or who have repeated attacks of primary irritant dermatitis, are usually transferred permanently to another department. The wide range of different jobs in the works makes it possible to accommodate most of these men in suitable jobs.

The works is situated in an area where there has been very full employment for some time, and labour turnover has been high throughout the period of this study.

Methods

The data for this study were obtained by examining the medical records of all hourly-paid new starters who began their employment in the works in the five-year period beginning January 1, 1955 and ending December 31, 1959. The examination of the records was made soon after December 31, 1965, so that the follow-up periods ranged from six to 11 years. The number of persons available for follow-up in the eleventh year, however, is so small that in this paper information is not presented beyond the tenth year.

A total of 1,552 persons started work in the period. The records of 1,538 were traced; 1,489 were men and 49 women. One thousand, four hundred and fifty-two men were white-skinned, mainly British but some from other European countries, 32 were of negro stock, and five were Asians. No cases of industrial dermatitis or eczema were found in the 37 non-European men, and only one case of primary irritant dermatitis was reported in the group of

TABLE I

MALE NEW STARTERS: AGE AND TYPE OF WORK

Type of Work	No. of Men	Mean Age at Starting Work
Process	745	31.2 (4.7) ¹
Plant engineering		
Tradesman	152	31.5 (8.0)
Labourer	114	30.5 (6.5)
Non-plant engineering		
Tradesman and semi-skilled	149	32.4 (4.7)
Labourer	186	31.6 (6.1)
Miscellaneous	106	35.6 (8.6)
Totals	1,452	32.5

¹Figures in parentheses represent one standard deviation

49 women. No detailed analysis of these two groups is presented in view of their small size. The type of work performed by the 1,452 white-skinned men, together with the mean age of each group at the date of starting work, is shown in Table I.

This study is concerned only with occupational dermatitis and no analysis of other types of dermatoses is presented. Occupational dermatitis is defined as an exogenous, non-infective dermatitis, primarily caused, in the opinion of the Works Medical Officer, by external agents used at work. The definition includes both primary irritant and sensitization dermatitis. Most of the men presented with eczematous eruptions, but a smaller number presented with simple erythema of the skin without papule or vesicle formation.

The differentiation of occupational dermatitis from other forms of eczema is seldom easy, and the diagnosis can only be made after consideration of a number of factors. The accepted diagnostic criteria are listed by Bettley (1965). In this study a specific diagnosis was made in the majority of cases by the Works Medical Officer, but in a few cases differentiation between occupational dermatitis and the various types of endogenous eczema presented difficulties. Seventeen such cases were found; 14 were referred to a consultant dermatologist and a diagnosis of endogenous eczema was confirmed in all these men. After examination of the complete medical records of the remaining three men, the author has classified two as cases of endogenous eczema and one as occupational dermatitis. The one case classified as occupational dermatitis has been included in the analyses presented in this paper.

Cases have not been classified by degree of severity as the information recorded by different medical

officers is not uniform in all respects. No data are therefore presented on prognosis for varying degrees of severity.

Results

The numbers of men in the various occupational groups who had one or more episodes of dermatitis after starting in the works are shown in Table II. The frequency of dermatitis is highest in chemical process workers (12.35%) with a rate six times that of the miscellaneous workers who have little or no chemical exposure (1.88%). Engineering workers employed on plant maintenance work have a dermatitis incidence lower than that of process workers but higher than that in the non-plant engineering group. In both these groups of engineering workers, the skilled and semi-skilled group have a higher incidence than the labourers. The difference between frequency in process workers and

miscellaneous workers is statistically significant ($P < 0.01$); the differences between miscellaneous workers and plant engineering workers, and miscellaneous workers and non-plant engineering men, are not significant. The frequency in plant engineering personnel (tradesmen and labourers together) is just significantly different ($0.05 > P > 0.02$) from that in process workers. The differences between dermatitis frequency in tradesmen and labourers are not significant in either plant or non-plant engineering workers.

Crude frequency rates in different work groups may be complicated by differences in the rates of turnover and length of service of the men. Table III shows the proportion of the original population of new starters who were still employed in the works at various intervals after the date of starting work.

Only about 50% of new starters in each of the groups were still in the works 12 months after their starting date, and there is little difference between

TABLE II
FREQUENCY OF OCCUPATIONAL DERMATITIS IN VARIOUS WORK GROUPS

Type of Work	No. of Men in Group	No. of Men Who Contracted Dermatitis	Dermatitis Frequency (%)	Dermatitis New Cases/100 Average Population/Year
Process	745	92	12.35	5.89
Plant engineering				
Tradesman	152	13	8.56	3.24
Labourer	114	7	6.14	
Non-plant engineering				
Tradesman and semi-skilled	149	9	6.04	1.46
Labourer	186	7	3.76	
Miscellaneous	106	2	1.88	0.52
Totals	1,452	130	8.95	3.54

Significance tests, Dermatitis Frequency (%)

Process v. Miscellaneous workers $\chi^2 = 10.37$, $P < 0.01$

Process v. Plant engineering workers (tradesmen and labourers together) $\chi^2 = 4.65$, $0.05 > P > 0.02$

No other comparison between groups is significant

TABLE III
PROPORTION OF MEN REMAINING IN THE WORKS AT VARIOUS INTERVALS AFTER THEIR STARTING DATE

Type of Work	Total No. of New Starters	Percentage of Original Population still Employed in the Works after Service of								
		3 mths	6 mths	9 mths	1 yr	2 yrs	3 yrs	4 yrs	5 yrs	6 yrs
Process	745	80.7	62.4	56.7	50.5	40.7	29.3	21.1	16.5	14.5
Plant engineering										
Tradesman	152	85.5	58.5	49.3	48.0	34.2	25.7	24.4	23.7	23.0
Labourer	114	72.8	71.1	65.0	50.0	30.1	19.6	18.4	15.8	14.9
Non-plant engineering										
Tradesman and semi-skilled	149	80.5	65.1	59.7	54.4	45.6	34.9	30.2	30.2	29.5
Labourer	186	83.4	70.0	57.5	52.7	40.9	40.3	30.6	27.9	23.7
Miscellaneous	106	71.6	57.5	57.5	51.9	43.4	39.6	32.6	30.2	30.2

TABLE IV
INTERVAL BETWEEN START OF EMPLOYMENT AND FIRST DERMATITIS EPISODE

Type of Work	No. of Men who Contracted Dermatitis	No. of Men who developed First Attack in:					
		<3 mths	3-6 mths	6-12 mths	1-2 yrs	2-3 yrs	>3 yrs
Process	92	58	20	10	2	2	—
Plant engineering							
Tradesman	13	4	3	3	3	—	—
Labourer	7	3	1	2	1	—	—
Non-plant engineering							
Tradesman and semi-skilled	9	1	1	1	2	2	2
Labourer	7	3	1	1	2	—	—
Miscellaneous	2	—	—	—	1	1	—

Significance tests

Proportion of men developing dermatitis in less than 6 months

Process v. All plant engineers (tradesmen + labourers) $\chi^2 = 8.02$, $P < 0.01$ Process v. All non-plant engineers (tradesmen + labourers) $\chi^2 = 17.6$, $P < 0.01$ All plant engineers v. All non-plant engineers $\chi^2 = 1.09$, $P > 0.50$

groups in the number remaining after two years. The rate of leaving in those employed for more than two years does, however, show differences between groups; after this time the non-plant engineers and miscellaneous workers both have a somewhat lower rate of turnover than the process workers and plant engineering personnel. The data contained in Table III suggest that different turnover rates in the several work groups have little influence on the crude dermatitis frequency rates, as the majority (95%, *vide infra*) of men had their first attack of dermatitis within two years of starting work in the factory.

Differences between groups can be demonstrated in a manner largely independent of turnover rate by expressing the number of cases as a rate per hundred of average population per year. The average population per year was calculated by summing the actual time worked by each individual in the 10-year period and dividing by ten. For the purposes of this calculation tradesmen and labourers have been combined together in both plant and non-plant engineering groups. The dermatitis rates expressed in this way show differences between the work groups which are generally similar to those found in the crude frequency rates. Process workers (5.89/100/year) have a rate almost twice that of plant engineering workers (3.24/100/year), four times that of non-plant engineers (1.46/100/year), and 12 times that of the miscellaneous group of workers (0.52/100/year). These results are shown in the final column of Table II.

Table IV shows the time interval between the start of employment in the works and the first attack of occupational dermatitis. Of the 92 process workers who developed dermatitis, 78 (85%) were

affected within six months of starting and 88 (96%) within 12 months. In the 20 plant engineering personnel (tradesmen and labourers together) the corresponding numbers are 11 (55%) in six months, and 16 (80%) in 12 months. In the 16 non-plant engineers, six (37%) were affected in six months and eight (50%) in 12 months. The statistical significance of the difference between the groups was assessed by comparing the numbers of cases which occurred in the first six months of service. Significant differences were found between process workers and plant engineering men ($P < 0.01$) and between process workers and non-plant engineering personnel ($P < 0.01$). The difference between plant and non-plant engineers was not significant. The proportion of men who left work in the first 12 months of service is similar in all work groups (Table III), and it is therefore unlikely that differences in turnover influence the time course in the development of dermatitis.

The average age of the dermatitis subjects at the time of their first attack is shown in Table V. There is little difference in the average age of the men in the various groups, and comparison with the average ages of all new starters at the time of beginning employment in the works (Table I) shows that first attacks of dermatitis are not more frequent in the older workers.

First cases of dermatitis have been classified into three main categories; the results are shown in Table VI.

Cases due to hypochlorite are confined, with one exception, to process workers and plant engineering tradesmen. Primary irritants were responsible for the majority of attacks in all groups. Cases due to skin sensitizers were most frequent in the plant

TABLE V
AGE OF SUBJECTS AT TIME OF FIRST ATTACK OF
OCCUPATIONAL DERMATITIS

Type of Work	No. of Subjects	Mean Age at First Attack
Process	92	30.8 (6.2) ¹
Plant engineering		
Tradesman	13	34.8 (10.1)
Labourer	7	29.7 (7.3)
Non-plant engineering		
Tradesman and semi-skilled	9	31.6 (6.4)
Labourer	7	31.5 (8.4)
Miscellaneous	2	35.5

¹Figures in parentheses are one standard deviation.

engineering workers. Only one case of sensitization was found in the groups with small chemical contact—a non-plant engineering tradesman who became sensitized to traces of chemicals on plant equipment brought into the workshops for repair. No cases considered to be due to oils were seen in the engineering groups.

Exposed areas of the body were affected in all but three of the first attacks of dermatitis and in all of the recurrences. Of a total of 199 episodes of dermatitis, 54 (27.1%) involved the dorsal surfaces of the hands and webs of the fingers, 61 (30.7%) the wrists or forearms, 23 (11.6%) the hands and forearms, 42 (21.1%) the face or neck, and 16 (8.0%) the face, neck, and hands, wrists or forearms; two cases involved the abdomen and one the genitals.

Recurrences Table VII shows the numbers of men having one or more recurrent episodes of dermatitis. Cases from all work groups have been combined. Of the 130 men who had a first attack of

dermatitis, 85 (64.5%) had no recurrence, 32 (24.6%) had one recurrence, seven (5.4%) had two recurrences, three (2.3%) had three recurrences, two (1.5%) had four recurrences, and one (0.8%) had five recurrences.¹ The interpretation of data on recurrences of dermatitis in a study of this sort is complicated by men leaving, so producing a constantly diminishing population. In such a falling population numbers of recurrences may be related simply to length of service; if this were the case the average length of service after the first attack of dermatitis might be expected to be lowest in the no-recurrence group and highest in the groups with multiple recurrences. To test this hypothesis, the average length of service after the first attack of dermatitis has been calculated for each recurrence group. The results are shown in the lower line of Table VII. It will be seen that the average length of service after the first attack is not clearly related to the number of recurrences. Average service is lowest in the group having three recurrences, but the difference between this group and the group having no recurrence is not statistically significant ($P > 0.10$). Statistically significant differences exist between the one-recurrence group and the three-recurrences group ($P < 0.01$). In this comparison the group with the greater number of recurrences has a shorter average service, so that there is again no evidence to suggest that the number of recurrences is related only to the length of service.

The numbers and time course of dermatitis recurrences for each work group are shown in Table VIII. In this table, the numbers of recurrences in successive one-year periods from the beginning of the first attack of dermatitis are shown

¹See Appendix.

TABLE VI
FIRST DERMATITIS CASES CLASSIFIED BY CAUSE

Type of Work	Total No. of Episodes	No. of Episodes due to		
		Hypochlorite	Primary Irritants	Sensitizers
Process	92	15 (16.3) ¹	66 (71.8)	11 (10.9)
Plant engineering				
Tradesman	13	1 (7.7)	10 (77.0)	2 (15.4)
Labourer	7	—	6 (85.7)	1 (14.3)
Non-plant engineering				
Tradesman and semi-skilled	9	—	8 (89.9)	1 (11.1)
Labourer	7	1 (14.3)	6 (85.7)	—
Miscellaneous	2	—	2 (100)	—
Total	130	17 (13.1)	98 (75.2)	15 (11.6)

¹Figures in parentheses are percentages.

TABLE VII

NUMBERS OF MEN HAVING ONE OR MORE RECURRENT DERMATITIS EPISODES, AND AVERAGE LENGTH OF SERVICE IN EACH RECURRENCE GROUP, ALL WORK GROUPS COMBINED

No. of Men having a First Attack of Dermatitis	No. of Recurrences					
	0	1	2	3	4	5
130 (100)	85 (64.5) ¹	32 (24.6)	7 (5.4)	3 (2.3)	2 (1.5)	1 (0.8)
Average length of service for each group from beginning of first attack (weeks)	188.2	240.6	181.9	155.7	231.4	186.9

¹Figures in parentheses are percentages.

Significance of difference of means (length of service)

0 recurrence group v. 1 recurrence group, $t = 1.39$, degrees of freedom 117, $P > 0.10$ 0 recurrence group v. 2 recurrence group, $t = 0.76$, degrees of freedom 92, $P > 0.10$ 0 recurrence group v. 3 recurrence group, $t = 0.97$, degrees of freedom 88, $P > 0.10$ 1 recurrence group v. 2 recurrence group, $t = 0.62$, degrees of freedom 39, $P > 0.10$ 1 recurrence group v. 3 recurrence group, $t = 2.83$, degrees of freedom 35, $P < 0.01$

TABLE VIII

RECURRENCES IN SUCCESSIVE ONE-YEAR PERIODS FOLLOWING THE FIRST ATTACK OF DERMATITIS

Type of Work	Years following First Attack										Yearly Average for 10-year Period
	1	2	3	4	5	6	7	8	9	10	
Process											
Average population	68.9	51.4	38.25	30.7	25.6	18.7	13.8	9.5	6.3	6.1	26.9
No. of recurrences	26	8	5	4	4	3	—	—	—	—	5
Recurrences/100 average population	37.8	15.6	13.1	13.0	15.7	16.7	—	—	—	—	18.6
No. of men having a recurrence	22	4	3	2	2	1	—	—	—	—	3.4
No. of men with recurrence/100 average population	31.9	7.7	7.9	6.5	7.8	5.3	—	—	—	—	12.6
Plant engineering											
Average population	14.8	13.0	12.2	12.0	12.0	10.2	8.7	6.4	4.5	2.9	7.5
No. of recurrences	9	1	1	—	—	—	—	—	—	—	1.1
Recurrences/100 average population	61.0	7.7	7.8	—	—	—	—	—	—	—	14.7
No. of men having a recurrence	6	1	1	—	—	—	—	—	—	—	0.8
No. of men with recurrence/100 average population	40.1	7.7	7.8	—	—	—	—	—	—	—	10.7
Non-plant engineering											
Average population	18.7	15.7	14.1	13.8	12.0	11.3	10.7	6.7	5.9	4.0	11.3
No. of recurrences	2	2	2	1	1	—	—	—	—	—	0.8
Recurrences/100 average population	10.7	12.7	14.2	7.2	8.3	—	—	—	—	—	7.1
No. of men having a recurrence	2	2	2	1	1	—	—	—	—	—	0.8
No. of men with recurrence/100 average population	10.7	12.7	14.2	7.2	8.3	—	—	—	—	—	7.1

Tests of significance

(i) Yearly average for 10-year period

No. of men with recurrences

Non-plant engineering group v. Process group

 $\chi^2 = 1.54$, $P = 0.20$

Non-plant engineering group v. Plant engineering group

 $\chi^2 = 0.72$, $P = 0.40$

(ii) First year after first attack

No. of men with recurrences

Non-plant engineering group v. Process group

 $\chi^2 = 3.42$, $0.10 > P > 0.05$

Non-plant engineering group v. Plant engineering group

 $\chi^2 = 4.05$, $0.05 > P > 0.02$

and are related to the annual average population of men who had had an attack of dermatitis. This average population was calculated by summing the actual number of days worked by each individual in each successive year following his first attack of dermatitis. It should be noted that these average populations differ from those calculated for the whole population and used in compiling Table II.

In process workers the recurrence rate in the first year after the first attack was 37.8/100 average population; in the second to sixth years the rate showed little variation and was between 13.0 and 16.7/100 average population. The number of men having a recurrence was 31.9/100 average population in the first year, falling to a steady level in the range 5.3-7.7 in the second to sixth years. No recurrences occurred after the sixth year. The plant and non-plant engineering groups are both small, and inspection of the data showed that the tradesmen and labourers in each group had a similar recurrence pattern. No distinction is made, therefore, between tradesmen and labourers in Table VIII. Plant engineers showed a recurrence rate of 61.0/100 average population in the 12 months following the first episode, but the rate fell to 7.7/100 average population in the second year, and 7.8/100 average population in the third year. The number of men having a recurrence was 40.1/100 average population in the first year, and 7.7 and 7.8/100 average population in the second and third years. There were no recurrences after the third year from the date of the first attack.

In the non-plant engineering workers, no man had more than one recurrence in any yearly period, so that the number of recurrences is the same as the number of men having a recurrence in any year. The two rates vary between 10.7 and 14.2/100 average population in the three years following the first episode of dermatitis and are slightly lower at 7.2 and 8.3/100 of average population in the fourth and fifth years. No recurrences were found after the fifth year. One recurrence, within 12 months of the first attack, was found in the two miscellaneous workers.

In the first year the difference between the number of men having a recurrence in non-plant engineering and process worker groups is not significant ($0.1 > P > 0.05$). A comparison of plant engineering personnel and non-plant engineering workers in the first year shows a difference which is just significant ($0.05 > P > 0.02$) in the numbers of men having a recurrence.

The last column in Table VIII shows the yearly averages for the whole 10-year period for each group of workers. The number of recurrences for

process workers is 18.6/100/year, for plant engineering workers 14.7/100/year, and for non-plant engineers 7.1/100/year. The number of men having recurrences is 12.6/100/year in process workers, 10.7/100/year in plant engineers, and 7.1/100/year in non-plant engineers. The differences between the groups are not significant.

TABLE IX
AGE AT TIME OF FIRST ATTACK OF DERMATITIS:
MEN WITH NO RECURRENCE AND MEN WITH ONE OR MORE
RECURRENCES

Type of Work	Mean Age (yrs)	
	No Recurrence	One or More Recurrences
Process	32.2	29.3
Plant engineering		
Tradesman	32.8	36.8
Labourer	30.6	28.8
Non-plant engineering		
Tradesman and semi-skilled	33.6	30.8
Labourer	31.4	31.8
Miscellaneous	32.0	39.0

The mean ages at the time of the first dermatitis attack of the men who had no recurrence and of those who had one or more recurrences are compared in Table IX. There are no consistent differences between the average age of those who developed a recurrent attack of dermatitis and those who did not, and there is nothing to suggest that it was the older men in the population who were more likely to have recurrences.

In Table VI first dermatitis cases were classified by three main groups of causes. Table X shows the number of men in each cause group who had a recurrence. Of 17 men whose first attack was due to hypochlorite, three had one or more recurrences. Thirty-six of the 98 men whose first attack was caused by other primary irritants had a recurrence, and six of the 15 men whose first attack was caused by sensitizers had a recurrence. Ten of the men whose first attack was caused by a sensitizer, including all six having recurrences, were transferred to departments where they had no further contact with the responsible materials. Of the six men having recurrences, two had the recurrences prior to transfer. Three had recurrent attacks after transfer, and these recurrences were considered to have been caused by primary irritants. A fourth man had a recurrence after transfer when he accidentally came into contact with the sensitizing agent three years after his first attack. Thus the

TABLE X
NUMBER OF MEN IN EACH CAUSE GROUP
HAVING A RECURRENCE

	First Attack of Dermatitis due to		
	Hypochlorite	Primary Irritants	Sensitizers
No. of men with first attack	17	98	15
No. of men with a recurrence	3 ¹ (18%)	36 (37%)	6 ² (40%)

¹One man with recurrence due to primary irritants.

²Three men with recurrences due to primary irritants.

Tests of significance

Hypochlorite v. Primary irritants $\chi^2 = 2.49$, $P > 0.10$.

Sensitizers v. Primary irritants $\chi^2 = 0.04$, $P > 0.50$.

number of recurrences after transfer is four. The differences in recurrence rates between the three groups are not statistically significant.

A permanent change of department because of dermatitis was arranged for 16 men—13 process workers and three plant engineering workers (two tradesmen and one labourer). In all these cases the transfer was from one department to another, and none involved a change in the nature of the man's occupation. None of the men transferred was obliged to accept work at a lower rate of pay.

Examination of the records showed that only four men are known to have left because of dermatitis. Three of these men left on medical advice. One process worker was advised by a general practitioner to leave after one recurrence; one process worker left after two recurrences on the advice of a consultant dermatologist; one plant fitter was advised by the Works Medical Officer to leave after four recurrences and two inter-departmental transfers. The fourth man, a plant fitter, left the day after reporting a first episode of dermatitis because he did not believe that the condition could be cured if he continued to work in a chemical works. Many workmen have a fear of dermatitis, and it is recognized that other men may have left for similar reasons.

Discussion

The crude dermatitis frequency rate for the whole group of 1,452 male workers studied in this paper is 8.96/100. The rate for the group is similar to

that found by Newhouse (1964) in her study of a large automobile factory, where 7.7% of a large sample of manual workers were found to have industrial dermatitis. Newhouse examined the entire sample in a period of 10 weeks, and her study can be considered to show the dermatitis rate in a relatively fixed population over a very short period. The present study differs in that it reports the dermatitis rate in a constantly diminishing population over a much longer period. Direct comparison of the two rates is therefore difficult.

Squire, Cruickshank, and Topley (1950) reported the overall incidence of new attacks of dermatitis in manual workers in an engineering factory as 7.8/1,000 average population/year over a two-and-a-half-year period. The new attack rate for the present group over a 10-year period was 35.4/1,000 average population/year, almost four times the rate reported by Squire and his colleagues (1950).

Combining the non-plant engineering and miscellaneous workers of the present study makes, so far as the nature of work is concerned, a population roughly comparable with the general engineering workers of Squire and his colleagues. The new attack rate for this combined group is 12.1/1,000/year, which is still higher than that reported by Squire *et al.* Their findings are based on voluntary attendance at a factory clinic. Newhouse (1964) pointed out that the prevalence rate of occupational dermatitis cases in her survey was more than four times greater than the voluntary attendance rate at the factory surgery. In the works studied in this paper, the system of regular medical inspection of workers makes it unlikely that many dermatitis cases are unknown. The non-plant engineers plus the miscellaneous worker group of the present study and the general engineering workers of Squire *et al.* are similar; it may be that different practices in reporting dermatitis account for the different rates. Process workers (59.1/1,000/year) have a rate almost six times, and plant engineering workers (32.4/1,000/year) almost three times, the rate found in the miscellaneous plus non-plant engineering worker group. It seems likely that the large differences between these groups are caused by the considerable contact with chemicals involved in process and plant engineering work.

In this study, 95% of first episodes of dermatitis took place within two years of starting in the works, and first attacks tended to appear earlier in those groups having a greater exposure to chemicals. The finding of greater susceptibility to dermatitis in new starters confirms the findings of Newhouse (1961) and Squire and his colleagues (1950). In a factory where the labour turnover is high this phenomenon

can account for a considerable proportion of the total dermatitis incidence. It seems probable that the relative freedom from the disease enjoyed by the established worker is simply a result of his greater experience and consequent ability to avoid excessive contamination with dermatitic agents. Newhouse (1964) draws attention to the need for greater training in hygiene and the use of protective equipment in newly employed workers, and it is felt that there was a similar need in the works studied in this paper. A greatly improved training course for new starters has recently been introduced and this may have an effect on the incidence of dermatitis.

The age range of the population in this study was not great, and it was not possible to demonstrate any increased susceptibility of the older employees either to first attacks of dermatitis or to recurrences. Newhouse (1964) was also unable to demonstrate significant differences in the prevalence of dermatitis in different age groups.

Primary irritants were responsible for the majority of first attacks of dermatitis in this population. Cases due to hypochlorite have been classified separately as such cases could be considered to be a specific type of primary irritant dermatitis. The proportion of men who had a recurrence of dermatitis was similar in the group whose first attack was caused by primary irritants and the group whose first attack was caused by cutaneous sensitizing agents. Hellier (1958) found that only 14% of cases caused by primary irritants escaped further dermatitis, whereas 32% of cases caused by sensitizers remained clear. He attributes the difference to the latter patients' better chance of avoiding a specific sensitizer. In the present study the difference in prognosis between the patients whose first attack was caused by primary irritants and those in whom it was caused by sensitizers is much less marked.

The prognosis in the cases of occupational dermatitis analysed in this paper is very much better than that previously reported in the studies of Bentley Phillips (1954) and Hellier (1958). In the present study only 35.5% of the men had a recurrence, in contrast to 80% of the men and 67% of the women having recurrences in the group studied by Hellier. Hellier's patients were all claiming Industrial Injury Benefit and had long periods of absence from work and so were probably more severely affected than most of the cases in this study. Engel and Calnan (1963), in their study of men having sensitization dermatitis following work with a chromate-containing paint, reported 60% of the group to be free from dermatitis after one year.

A similar proportion of men had no further attack in the present study. The findings reported in this paper support the predictions of Calnan (1958) and show a high incidence of dermatitis but a not unfavourable prognosis.

In any constantly diminishing group, self selection may occur. In this study such a process might result in early leaving on the part of men with some sort of predisposition to recurrent dermatitis or fear of further attacks. The magnitude of any such self selection effect in this population cannot be assessed.

Men in this works are encouraged to report dermatitis in its early stages and to remain at work while their condition is treated. Permanent and temporary transfer to alternative work is used where necessary. The importance of encouraging men with dermatitis to remain at work is stressed by Hellier (1956), who draws attention to the loss of confidence and anxiety effects which may occur during a period of sickness absence and may delay recovery. In his opinion, the best way of avoiding these effects is for the patient to avoid going off work at all.

The process and plant engineering groups in this study have a similar pattern of dermatitis recurrences. The frequency of recurrences is considerably higher in the 12 months following the first attack, but in succeeding years recurrences are less frequent, and no recurrences occurred after the sixth year. The non-plant engineers had a fairly constant rate of recurrence during the five years following the first attack. The high recurrence rate in the first 12 months is seen in those workers who have considerable exposure to chemicals. These workers also have a higher first-attack dermatitis rate, and first attacks of dermatitis occur earlier than in the groups with less chemical contact. The cases of occupational dermatitis in this works have a generally favourable prognosis.

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REFERENCES

- Bettley, F. R. (1965). *Brit. med. J.*, **2**, 1340.
 Calnan, C. D. (1958). *Ibid.*, **1**, 396.
 Engel, H. O., and Calnan, C. D. (1963). *Brit. J. industr. Med.*, **20**, 192.
 Hellier, F. F. (1956). *Trans. Ass. industr. med. Offrs*, **6**, 11.
 — (1958). *Brit. med. J.*, **1**, 196.
 Newhouse, M. L. (1961). *Trans. St. John's Hosp. derm. Soc. (Lond.)*, No. 47, p. 139.
 — (1964). *Brit. J. industr. Med.*, **21**, 287.
 Phillips, B. (1954). *Practitioner*, **172**, 531.
 Squire, J. R., Cruickshank, C. N. D., and Topley, E. (1950). *Brit. med. Bull.*, **7**, 28.

No. of Recurrences	No. of Men Observed	Expected Nos. of Men	
		Poisson Distribution	Negative Binomial Distribution
0	85	77	86
1	32	40	28
2	7	11	10
3	3	2	4
4	2	0	1
5	1	0	1

Appendix

If all the 130 men who had a first attack of dermatitis had an equal chance of a recurrence, the numbers of men in each recurrence group might be expected to follow a Poisson distribution. If, on the other hand, there was an unequal probability of a recurrence, a negative binomial distribution is more likely. The frequencies of recurrences expected for each distribution have been calculated and are shown below.

The negative binomial distribution gives the better fit, suggesting that the 130 men had an unequal chance of a recurrence. The data contained in the lower line of Table VII show that there is no relationship between the numbers of recurrences and the length of service. It seems probable that the population had an unequal chance of recurrence because it is composed of men from all work groups together and the chemical exposure of the different groups is not identical.