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ON DERMATITIS CAUSED BY SYNTHETIC RESINS

By

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An outbreak of dermatitis among masons and washer women in Asplit tiling occurred in the summer of 1953 in a Finnish sulphite cellulose plant. As about 40 out of 130 workers were affected and about 600 workdays were lost, the insurance company required a detailed investigation to be made by the Institute of Occupational Health, Helsinki, into the specific causative agent involved and what could be done to prevent the dermatitis.

The working technic is briefly as follows:

The inner walls of towers about 10 m. high and 5 m. in diameter are first coated with tiles, after which the intervening spaces are jointed with "Asplit" tile glue, containing synthetic resin. Finally the tile wall is washed with water, cleansing powder ("Vim") and steel wool.

According to the information given by the manufacturer, the raw materials used for the resin are formaldehyde, furfural, phenol and cresol and the final product may contain these chemicals. Further a powder containing paratoluene-sulphochloride, among other substances, is mixed with the resin immediately before use.

As is seen in table 1, 37 out of 130 workers had acquired dermatitis probably owing to the work in question. Relatively few men were affected, while 33 (50 per cent) out of 64 female workers had acquired dermatitis. The higher incidence in the females depends mainly on the fact that they were

TABLE 1

		Males	Females	Lost workdays
Number of workers	130	66	64	
Cases of probable occupational dermatitis ...	37	4	33	573
Examined dermatologically	20			
Probable occupat. dermatitis	18			
Other dermatitis	2			

washing the surplus of the resin glue from the walls. In this work they were more exposed to the resin than the men when tiling and jointing the intervening spaces. In addition, washing with the alkaline cleansing powder would prepare the skin for the irritating action of the resin.

In most cases the dermatitis had already been cured before the investigation took place, and traces of it were seen in only 5 cases. Usually the face, neck and arms had been affected.

In table 2 the length of exposure before the onset of the dermatitis is seen. In the majority of 18 cases examined this was 2-4 weeks and in none less than 6 days.

In 8 cases the effect of re-exposure could be followed (Table 3). In all these cases the second and the later attacks of dermatitis developed after considerably shorter exposures, 2-3 days on an average.

Patch tests were performed in 20 cases, 18 of which were occupational. Table 4 shows the test substances and concentrations used. Luphen, which represents a brand of phenol-formaldehyde resin, was not included in the materials used by the workers. When some toxic reactions are excluded, only Asplit and Luphen resins caused positive reactions. These are summarised in table 5. The tests were performed with Asplit resin in 18 cases and with Luphen in 15 cases, resulting in 9 positive reactions with each resin. It is possible, however, that not all of the positive reactions to Asplit were allergic, although their appearance suggested this, for Asplit, in the

TABLE 2

	Length of exposure before the onset of dermatitis				Number of cases examined
	5 days	6-13 days	2-4 weeks	1 month	
Number of cases	—	2	15	1	18

TABLE 3

Length of exposure in successive attacks of dermatitis.

	I	II	III	IV
I. K.	ca. 28 days	4 days	3 days	2 days
M. Ke. ...	„ 28 „	3 „		
T. S.	„ 28 „	7 „		
S. R.	„ 28 „	3 „		
V. M.	„ 21 „	1½ „		
S. V.	„ 21 „	2 „	2 „	
K. J.	„ 7 „	3 „		
M. Ka. ...	„ 7 „	1 „	½ „	

TABLE 4

Concentrations used in patch tests.

Formaldehyde	4 %
Furfurol	25 %
Cresol	2 %
Phenol	2 %
Asplit resin	20 %
Powder containing paratoluenesulphochloride etc.	50 %
Luphen (a brand of phenol-formaldehyde resin) ...	33 %

TABLE 5

	Results of patch tests					Total number of cases tested
	+	+	—	—	—	
Asplit	+	+	—	—	—	18
Luphen	+	—	+	—	0	15
Number of cases	7	2	2	4	3	18

same concentration, tended to cause toxic reactions in normal subjects. On the other hand the reactions to Luphen were, as a rule, stronger and more clearly of allergic type, whereas the control subjects gave no reactions.

The high incidence of dermatitis, 50 per cent, in washers having had close contact with the resin and the positive reactions to the resins in many cases go to prove the etiological role of the resin in most cases. Washing with an alkaline cleansing powder, of course, was an additional irritating factor, and the possibility that some of the cases were mainly due to the washing cannot be excluded. In cases of this kind, however, restriction of the dermatitis to the hands and forearms would have been expected.

Many facts argue in favour of the allergic type of contact dermatitis. Among these are:

1. Dermatitis did not develop in the first days of work, but in most cases after an exposure of 2-4 weeks.
2. The length of exposure sufficient to cause dermatitis was shorter in recurrences, as is the case in allergic dermatitis, because of the time needed for sensitization of the skin.
3. The positive reactions to the resins.

The test results with various resins, in which the reactions to Luphen were stronger, seem to be paradoxical. Primarily one would expect stronger reactions to Asplit, the resin to which the workers had been exposed, than to Luphen. These resins, however, are evidently of the same type, and during the jointing process condensation goes further. Thus the possibility must be taken into consideration that Luphen in fact was closer to the stage of condensation in which the resin had the strongest sensitizing capacity. Theoretically it would be necessary to perform the tests with the resin in various stages of condensation. Schwartz, Peck and Dunn (1943) write "To determine the irritating chemical radical causing the dermatitis the actual composition of the resin and the stage of polymerisation should be known before patch tests can be performed intelligently. This information must be obtained from the manufacturers, as chemical analysis often fails in this

respect." In the present case, even this information was insufficient.

Besides the resin itself in various stages of polymerisation or condensation, the raw materials such as formaldehyde (Schwartz 1945) and phenol (Blumenthal & Jaffé 1924) may also cause dermatitis. In the present series, cases of this kind were not found, and patch tests with formaldehyde, furfural, cresol and phenol gave negative results.

For protection of the workers such measures had already been used as a blower system ventilation, rubber gloves, plastic sleeves, respirators and goggles. In addition, barrier creams had been given to the workers and the importance of personal cleanliness had been stressed. These measures had not been sufficient to decrease the incidence of dermatitis markedly. Therefore the constructor, after being informed of the actual cause of the dermatitis, decided to substitute some other type of resin glue for the phenol-formaldehyde resin.

As, however, in most cases of dermatitis the exposure time before the onset of dermatitis had exceeded two weeks, in a small contract of not more than 8 days the same glue was still used. For this job men only were taken on and only those who had not previously had dermatitis. No cases occurred during these 8 days.

During recent years the use of various plastic materials as raw materials in industry, building and other trades has increased enormously. As a natural result of this an increase in the incidence of dermatitis caused by these materials is also to be expected. In fact, Schwartz, Peck and Dunn mention that in one factory laminating plywood with about 800 employees, 600 cases of glue dermatitis occurred in the first six months of operation. These workers lost about 1500 workdays. In addition, many cases of dermatitis due to synthetic resins have been reported by these and numerous other authors. Phenol-formaldehyde resins and other formaldehyde resins seem to be the brands most commonly reported to cause skin trouble. Many other plastics, however, may also cause

dermatitis, and the number of brands with irritating or sensitizing properties is very probably still increasing.

In this paper the health problems involved in the manufacture and use of plastics will not be reviewed. This has recently been done by Harris (1953) and, as far as the toxicology of plastics is concerned, reference may be made to a monograph written by Lefaux (1952). In the present paper only the significance of the patch test 1. for determining the plastic which has caused the dermatitis and 2. for the collection of information on the sensitizing properties of various plastics to prevent dermatitis in a wider sense, will be briefly discussed.

This study once again shows that the patch test is often valuable in determining the sensitizing agent in plastic dermatitis, although there are authors who still tend to deny the practical significance of these tests (Harris). Without the patch test it is usually impossible even to know whether the raw materials or the intermediate or final products are the actual cause of the dermatitis.

Naturally with plastics, too, the patch test has its limitations. In part, these limitations are common to patch tests with all substances. These will not be discussed. In part, the limitations depend on the nature of plastics themselves.

1. Plastic dermatitis is not always allergic. It may also be toxic or due to occlusion of the skin pores by the plastic dust. In these cases no allergic reactions are to be expected.

2. The information obtained from the manufacturer is often insufficient and the chemical analysis is hard to perform and may also fail in this respect. Thus the chemical composition of materials used for testing is not always known.

3. The workers may be exposed both to the raw materials and to the intermediate and final condensation or polymerisation products. The resin may be sensitizing in one or more stages of condensation or polymerisation which are not included in the tests. This results in negative reactions.

To counteract the two last disadvantages it is desirable to perform tests with the resins in question in as many stages as possible. In this work the manufacturers could give valuable help, providing institutes interested in plastic dermatitis with complete series of the plastics produced by them, with chemical information on the type of the plastics. In a case of possible plastic dermatitis such plastics could be used for patch tests which are supposed to be chemically related to the plastics used by the patient. In this way the chemical composition of the causative agent may be indirectly determined.

In preventive work the prophetic tests and usage tests carried out on the part of some manufacturers are useful. This work, however, is not sufficient, and every effort is needed to decrease the incidence of plastic dermatitis or at least to prevent its increase. Effective international co-operation could do much in this respect. Some notable institutes and clinics and manufacturers from various countries should be called to collaborate in determining the actual causes of plastic dermatitis whenever possible. In this study patch tests with well planned series of various plastics would be helpful. The experience obtained would be pooled and, as far as possible, taken into consideration when developing new, less irritating plastics.

SUMMARY

An outbreak of 37 cases of dermatitis due to a synthetic resin "Asplit" among 130 tiling workers in a sulphite cellulose plant, is reported. About 600 workdays were lost. In most cases the patch tests were positive with "Asplit" and another resin of phenol formaldehyde type. The exposure period before the onset of the dermatitis was usually 2-4 weeks and in no case less than 6 days. In the recurrences it was reduced to 2-3 days. The possibility is stressed that besides the resins themselves in various stages of condensation or polymerisation, the raw materials may also cause dermatitis. The value of patch tests in the diagnosis and prevention of plastic der-

matitis is discussed. In view of the great increase in the incidence of plastic dermatitis, the need of effective international co-operation in this matter is emphasized.

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