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HALOWAX ACNE ("CABLE RASH")

SPONTANEOUS ERUPTION IN MARINE ELECTRICIANS DUE TO CERTAIN
CHLORINATED NAPHTHALENES AND DIPHENYLS

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The present study is concerned with an eruption observed and studied in a series of marine electricians engaged in working with certain types of electrical cable in a large shipbuilding organization over a period of several years.

The first patient was seen on Dec. 31, 1941. The number of cases has gradually increased to a total of 52 at the time of writing. Many patients have been under constant observation for a period of one and one-half to two years. The studies on hepatic function to be described were based on a selected group of 25 patients who presented a more extensive involvement. New cases still are developing, and the study continues. A cooperative and free exchange of information with physicians elsewhere in the United States who are seeing and treating patients with this eruption has been maintained. This has been mutually helpful in the attempts to solve the problems presented and beneficial to the patients in the relief that it has been at times possible to afford them.

Halowax acne or "cable rash" is the general term commonly used to designate the eruption. It is by no means a new clinical entity. Soon after the introduction of tar and its derivatives into industry, acneform eruptions began to appear and were reported in the literature by early observers. Dermatologists and industrial physicians studied the causation, control and prevention intensively. Most of these studies have appeared in specialized publications, principally those devoted to industrial medicine.

Perna Krankheit was the term used to describe the condition by the German writers¹ at the time of World War I. This acneform eruption, identical with the clinical picture now appearing, occurred among workers on gas masks and on gas-proof clothing. It was caused by chlorinated naphthalenes.

Today chemically related substances (known by the trade name Halowax) are being used in considerable amounts on ships. Halowax is manufactured and compounded by the Halowax Corporation, a subsidiary of the Union Carbide and Carbon Company. It is a waxlike substance, a mixture of chlorinated hydrocarbons produced chemically by chlorination of naphthalene and diphenyl. This material is incorporated into electrical cables designed for specific purpose on naval vessels.

1. Teleky, L.: Die Pernakrankheit (Chloracne), *Klin. Wchnschr.* 6:845 and 897, 1927.
Koelsch, F., in Ullmann, K.; Oppenheim, M., and Rillie, J. H.: Die Schädigungen der Haut durch Beruf und gewerbliche Arbeit. Leipzig: Leopold Voss, 1926, pp. 303-343.

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It is a unique and invaluable material, possessing many essential and desirable qualities. Extremely resistant to physical wear, chemical corrosion (including sea water) and wide range of changes in temperature, it is, in addition, waterproof and ratproof. It strongly withstands heat and flame. Its value as an insulation for electrical currents is extremely high. Under heat it has a desirably high "flow point." By varying the degree of chlorination, materials of different plasticity may be obtained. The hardness of the Halowax is directly proportional to the percentage of chlorination. An average composition is 20 per cent pentachloronaphthalene and 80 per cent hexachloronaphthalene, to which as much as 20 per cent chlorinated diphenyl may be added. In such a mixture there may be a chlorine content of approximately 60 per cent. The content may be adjusted to as low as 30 per cent or as high as 80 per cent, depending on the physical characteristics desired.

Halowax is principally used in insulating wire for systems of intercommunication and for the de Gause system of rendering ships electrically neutral to magnetic mines. When in operation, a constant electric current of high amperage is (constantly) passing through cables strung through the entire length of the hull of the boat. This current, acting as a "flux," effectively counteracts and neutralizes the electric currents generated by the myriad of electric apparatus, including generators aboard modern ships, and the steel of the boat as it travels through the water.

The cables themselves are relatively flexible. They are not too bulky or cumbersome (and occupy comparatively little space) and are designed to facilitate ease of installation and connection. They are metal covered. The approximate diameter is about 3 inches (7.5 cm.). The cable consists of individual bundles of copper wire. Each bundle is coated with Halowax impregnated into asbestos. The bundle is then coated with a layer of cellophane. Surrounding this is woven an outer layer of rubberized fabric. This layer, in turn, has a rayon cover. By incorporating several such bundles together, the large de Gausse cable is formed. Naval and cargo vessels are so wired.

In making electric connections and attaching lugs, the cable and individual bundles are "skinned." By "skinning" is meant the cutting back of the outer covering and the individual covering of the bundles for several inches. The covering materials, including the Halowax, are removed and the bare copper is exposed. In this process Halowax particles, in the form of a fine gray powder, are emitted. A dust is generated. At times it may be necessary to heat the bundle ends to effect connections. In addition to the dust itself, the elements are exposed to the fumes that may be generated by the heat. Because the work is strung along the hull of the boat under construction, the spaces where work are necessarily close and confined. Ventilation is extremely difficult.

The acneform eruptions previously reported were observed among workers who, for the most part, were engaged in handling the chlorinated naphthalene derived from crude tar (tar camphor, naphthalene, white tar naphthalene) in the preparation of the synthetic wax plasticizing materials, usually in the molten or hot state, or when the product thus obtained was melted and various electrical apparatus (such as condensers and coils) were dipped into it for insulation.

In the present cases the eruption observed was in electricians handling finished product for the most part. Only rarely was heat used, and the exposure to any fumes so generated was slight. The latest method of connecting

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2. Schwartz, L.: Dermatitis *in*
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United States Treasury Department.
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3. Mayers, M. R., and Silverberg
Organ Chlorinated Hydrocarbons, J.
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1938, August 1938, p. 361; Effect up
Indust. Bull., New York State
4. Sulzberger, M. B.; Rostenberg
State J. Med. 34:899, 1934.
5. Jones, A. T.: The Etiology of
J. Indust. Hyg. & Toxicol. 23:

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observed among workers handling chlorinated naphthalene or naphthalene ($C_{10}H_8$) materials, usually in a molten state and various kinds of compounds into it for securing

electricians handling the cold wire, used, and the exposure to the connecting the wire

practically eliminates the use of solder and heat. An ingenious lug is used that firmly and securely attaches the wire to the points desired purely by mechanical friction and pressure.

Desirable descriptions of the lesions seen have been those reported by the American writers Schwartz,² Mayers and Silverberg,³ and Sulzberger⁴ and the British writer Thelwell Jones.⁵ Schwartz's detailed study and report published in 1936 clearly establishes his priority on this subject. It was the first to appear in the American literature. In his cases the rash was encountered both in workers handling the hot molten material, being thus exposed to the fumes, and in persons working with the cold electric wire and cable. Mayers and Silverberg's study was based on workers engaged in the manufacture of electrical condensers. Thelwell Jones observed the eruptions appearing in workers handling the crude naphthalene which it was chemically processed for use in industry. In both reports high degrees of temperature were involved and the concentration of fumes that the workers were exposed to was relatively high as compared with the present series. The writers described a variety of lesions. Mayers and Silverberg conveniently classified them into three main groups: (1) acneform eruptions with pustules, papules and large comedos; (2) vesiculoerythematous eruptions usually observed in *dermatitis venenata*; (3) simple erythematous eruptions with pruritus.

The eruption to be described and with which the present study is concerned has not been noted by these previous writers. With the onset of present world hostilities shipbuilding construction expanded enormously. Considerable amounts of Halowax began to be used, and Halowax acne or "cable rash" began to appear in various shipyards. As a result, renewed interest in the problem has arisen. Many electricians began to consult physicians not only for the rash itself but because of the disability produced. Time vital for the production of critical material was lost, because skilled electricians were obliged to do other kinds of work and new, untrained workers taught to do the work. When other workers learned of the rash, they were deterred from handling the cable. With the increasing employment of women in defense industries the situation may be further complicated.

INCIDENCE

Practically all workers in the department handling such cable tended to acquire varying degrees of "cable rash." The onset dated from a preliminary latent period of a few weeks to several months. The elements of hot weather and perspiration seemed to be definite predisposing factors. Many workers engaged in the late fall or winter did not begin to acquire any considerable number of lesions or have symptoms until the following spring and summer. Individual differences as to texture and coloring of the skin produced no appreciable variations as to

2. Schwartz, L.: *Dermatitis from Synthetic Resins and Waxes*, Am. J. Pub. Health 26:244, 1936; *Skin Hazards in American Industry: Part II*, Public Health Bulletin 229, United States Treasury Department, Public Health Service, 1936; *An Outbreak of Halowax Acne ("Cable Rash") Among Electricians*, J. A. M. A. 122:158 (May 15) 1943.

3. Mayers, M. R., and Silverberg, M. G.: *Skin Conditions Resulting from Exposure to Certain Chlorinated Hydrocarbons*, J. Indust. Hyg. & Toxicol. 20:244, 1938; *Effect upon Skin Due to Exposure to Some Chlorinated Hydrocarbons*, Indust. Bull. New York State Dept. Labor, August 1938, p. 361; *Effect upon Skin Due to Exposure to Some Chlorinated Hydrocarbons*, Indust. Bull., New York State Dept. Labor, September 1938, p. 425.

4. Sulzberger, M. B.; Rostenberg, A., Jr., and Sher, J. J.: *Acneform Eruption*, New York State J. Med. 34:899, 1934.

5. Jones, A. T.: *The Etiology of Acne with Special Reference to Acne of Occupational Origin*, J. Indust. Hyg. & Toxicol. 23:290, 1941.

susceptibility to the development of the eruption. Dry and oily complexions as well as diverse types of skins were included in the various nationalities included in the survey. All the workers were men. The age group extended from 18 to 63 years. In a few cases the workers' wives had a slight eruption resembling their husbands', probably from contact with work clothes and from laundering shirts and underwear.

Patch tests were of no value in anticipating persons predisposed to acquire "cable rash." This observation has been consistently reported by all previous writers.

DESCRIPTION OF THE CUTANEOUS LESIONS

In addition to the usual acuminate papules which result from the mechanical plugging of the hair follicles and the orifices of the sebaceous glands (folliculitis), which become secondarily infected to form pustules, furuncles and abscesses, a follicular hyperplasia of the sebaceous glands of the skin of the face occurs. Large black comedos appear in the follicular orifices as a result of the activity of the follicle. At times these cysts are large enough to suggest milia. These "comedo-like" lesions are found in almost countless numbers on the exposed portions of the body, especially on the face and forearms. In many cases less numerous similar lesions were found scattered on the arms, torso and legs. The most frequent sites where lesions were found on all patients and in greatest amounts were on the skin over the malar eminences, the circumorbital areas, the margins of the lobes of the ears and the mastoid regions. Frequently they extended into the hairline and into the scalp. The eyelids and lips were devoid of lesions. The skin of the nose was rarely affected and presented relatively few lesions. The dorsa of the fingers were frequently involved, as were the forearms.

SYMPTOMS

In addition to the lesions described, severe, persistent and at times almost intractable pruritus at the sites affected was a common complaint. The pruritus was most noticeable in those workers who had a superimposed or accompanying dermatitis in addition to the purely acneiform lesions. Occasionally it was severe enough to require use of a sedative to secure sleep. Heat and perspiration aggravated the symptoms. Burning and soreness of the eyes ("bloodshot") were a frequent complaint. Many of the men were engaged in electric work in close proximity to electric welders, and flashes from the oxyacetylene burners may have aggravated this symptom. There were considerable dust and metallic particles in the holds of the ships where the men were laying cable.

Lassitude was the next and most common complaint. It was felt that long hours, often an average of ten a day, together with the time required in traveling to and from work contributed to the fatigue of the men. Also many workers had been recruited from ordinary peacetime positions, often sedentary, and were employed after short intensive training courses. Ventilation to an adequate degree was impossible.

Other symptoms occasionally noted were anorexia, nausea, headache, vertigo, abdominal pains, impotence, loss of weight, insomnia, alopecia and distaste for food. Jaundice was never observed.

During the survey widespread publicity in the press to a small number of fatalities in plants processing the cable occurred. This factor definitely increased the number and variety of complaints.

In a few cases the worker's wives had a slight eruption resembling their husbands', probably from contact work with clothes and from laundering shirts and underwear.



Fig.

SYSTEMIC INVOLVEMENT

Some of patients with extensive cutaneous involvement were studied for systemic effects. In addition to clinical examinations, including fluorimetric tests for hepatic function and impairment were included. Complete blood count studies were made. No evidence of any visceral effect was obtained that could be ascribed to exposure to the chlorinated naphthalene and diphenyls. Particular attention was given to the possibility of hepatic damage (atrophy) and in suggesting the aplastic variety. No relation with "cable rash" or any internal disturbance was discovered.

DURATION OF THE ERUPTION

As many of the electricians continued working with Halowax cable, the eruption persisted and even extended in some instances. With the onset of winter, the institution of preventive measures described later and aggressive treatment, many were able to continue at their work and a decided amelioration of symptoms was effected. The eruption itself was improved in many in this group. In a majority of the patients the eruption persisted for as long as one and one-half years after treatment and total freedom from exposure. These patients are still being observed.

THERAPY

In addition to prophylaxis many measures were used to relieve symptoms and improve the eruption. These included various keratolytic agents, such as sulfur and salicylic acid, and antiseptics, such as resorcinol, sulfonamide compounds, ammoniated mercury and ichthammol. These were used in various ointment and liquid bases. Emulsions of both oil in water and water in oil types were used. The ointment bases included those ordinarily used, together with several of the more recent types incorporating wetting agents. Various soaps containing substances conceivably indicated for controlling and improving the eruption were tried. Among these were proprietary "antiseptic" and "germicide" soaps commonly found on the market; soaps containing pumice, marble and sulfur were also included. Various sulfonated oils were tried. Soaps containing trisodium metaphosphate were at times of value as detergents. Morris' recently suggested cleansing mixture incorporating oleic acid and butyl stearate has not had sufficient trial. A few related formulas were found of some value. Those consisted of 45 per cent sulfonated neat's foot oil, 45 per cent light liquid petrolatum and 10 per cent of a solution of gelatin (1 part of gelatin in 4 parts of water; 1 part of this preparation was added to 1½ parts of white granulated corn meal, with a trace of 0.5 per cent chlorobutanol as a preservative). Another detergent used consisted of sulfonated castor oil with a p_H of 7.2 and containing 50 per cent of oil content, together with 2 per cent of a wetting agent (aerosol OT dry, the dioctyl ester of sodium sulfosuccinate in 99 to 100 per cent concentration).

For patients with acute dermatitis wet compresses of commonly used medications were used to allay the symptoms. These included isotonic solution of sodium chloride, 3 per cent solution of boric acid, hot magnesium sulfate solution, solution of boric acid and salicylic acid (Thiersch's solution), and solution of aluminum acetate (Burrow's solution) 1:20 to 1:10. Solution of sulfurated lime (Vleming's solution) in varying concentration was found ineffectual and irritating. Sodium hexametaphosphate in 1 per cent concentration seems to merit further trial.

Röntgen and ultraviolet therapy in careful dosages were of distinct value in relieving symptoms and accelerating the restoration of a clearer skin. Solid carbon

- no expense spared
- work clothes provided.
- Frequent change of clothes
- individual lockers.
- showers

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occasionally beneficial. Attempts at removal of the hyperkerotic tape left on for varying periods were futile. Vaccines, autogenous, had no demonstrable value. Mechanical removal of the plugs in the of a comedo extractor or by facial massage was sometimes helpful. Attention to the fact that the substances in the follicles are lipid in the tissue by lipids. He suggested that a low fat diet would be eliminating these substances and possibly as a preventive measure. There has not been the opportunity for pursuing these studies.

PROPHYLACTIC MEASURES

To prevent the development of "cable rash" and ameliorate the symptoms in persons already affected, no expense was spared. Determined efforts to reduce the concentration of Halowax in the workers' environment were made. At the same time measures to promote rigid cleanliness of the skin were instituted. These preventive measures included ventilating by blower and exhaust fans, frequent change of clothing, both work clothes and underwear, individual lockers, and adequate facilities for securing and opportunities to secure a thorough cleaning of the skin during the work day. Frequent changes of clothing were stressed: hot water was provided, and the employees were given an opportunity to wash and take shower baths on the company's time. Coverall work uniforms were provided. Various protective creams were furnished to the workers, and they were instructed in detail as to how and when to use them. These creams were used alone or with some of the soaps recommended with them. The sulfonated oils aforementioned were used as substitutes for soap. The value of such creams has not been adequately demonstrated as a preventive measure as yet. Use of coveralls and other protective clothing devices, such as face masks, sleeves and trousers, is being continued. It has been found that they increase the amount of heat and perspiration and that the workers do not cooperate in using them. They seem also to aggravate the condition. Large doses of the entire vitamin B complex, a liberal intake of carbohydrate, adequate intake of fluids and ingestion of saline tablets to combat loss of salts were found to be of value in controlling symptoms due to fatigue. The excessive use of alcohol and tobacco was discouraged.

One possible means of attack of the problem is the ingenious suggestion of Sulzberger. This involves the discovery of some chemical neutralizer against the Halowax that could be applied to the skin of the workers before and during their work with the cable. Such a substance might be incorporated in the new "penetrasols" he and his co-workers have developed. Such "penetrasols" have been demonstrated to possess considerable powers of penetration into the hair follicles and ducts of the glands situated in the skin. This property is due to the wetting agents and fat solvents contained in them. If after a reasonable period no improvement was obtained, the worker was transferred to an entirely different position.

MECHANISM OF PRODUCTION OF LESIONS

Because of the high incidence of Halowax dermatitis among a relatively small group of persons, the negative results of patch tests and the absence of vesicular dermatitis as seen in contact irritations at the site of exposure seem unnecessary to assume a development of hypersensitivity to the wax.

6. Osborne, E. D.: Personal communication to the authors.

7. Hermann, F.; Sulzberger, M. B., and Baer, R. L.: New Penetrating Creams. *Science* 92:451 (Nov. 13) 1942.

primary irritation by the wax. Explanation of this eruption and borne out by the element. follicles and sebaceous glands. This occurs from mechanical condensation of the fumes emitted by perspiration and heat in the clothing. Schwartz and Tulipan stated that it contains any free chlorine. The radical itself has an irritating effect.

sum.

Synthetic wax (Halowax) is used by electricians handling certain types of cable. An increasing number of cases have been discovered or more effectively discovered in the near future unless suitable measures are taken. An evaluation of various types of synthetic wax has been made. The probable mechanism of action is the absence of systemic, vitamin B deficiency, and "dry" synthetic wax cable. The chronicity of the eruption is not evident. No evidence of internal absorption.

The cooperation of the following: U. S. Public Health Service, and Dr. H. E. D. Osborne, G. E. Morison.

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"rash" and ameliorate the environment were instituted. Blower and exhaust fan underwear, individual lockers, secure a thorough cleaning of clothing were stressed; but a opportunity to wash work uniforms were provided, and they were instructed to use alone or with oils aforementioned. Creams has not been. Use of coveralls and shoes and trousers, is being of heat and perspiration seem also to aggravate the complex, a liberal intake of saline tablets to combat edema due to fatigue. The

ingenious suggestion of a chemical neutralizer against the workers before and during work was incorporated in one of the studies. Such "penetration" of the wax into the hair property is due to the wax rather than a reasonable penetration to an entirely different

DISCUSSION

Among a relatively large group the absence of acne after exposure, it seems to be the wax. Rather than

Penetrating Vehicles

Primary irritation by the wax was believed to be the method of production. The explanation of this eruption offered by other investigators seems to be adequate and borne out by the elements involved being a foreign body reaction in the hair follicles and sebaceous glands due to the presence of these chlorinated naphthalenes. The wax is from mechanical plugging by the particles per se and from the penetration of the fumes emitted by the waxes in the cable. Rubbing, scratching, perspiration, and heat in the closed holds of ships were further predisposing factors. Schwartz and Tulipan stated that the fumes are not decomposed nor do they contain any free chlorine. They agree with other investigators that the chlorine radical itself has an irritating effect on the plugged follicle.

SUMMARY AND CONCLUSIONS

Synthetic wax (Halowax) dermatitis is a common cutaneous hazard in marine electrical handling certain types of electrical cables.

An increasing number of employees with this dermatitis may be anticipated in the near future unless suitable and adequate substitutes for these synthetic waxes are discovered or more effective means of prevention and therapy are developed.

An evaluation of various preventive measures is made.

The probable mechanism of the production of these lesions is discussed.

The absence of systemic, visceral and hemopoietic involvement in handling the synthetic wax cable is noted.

The chronicity of the eruption and its resistance to therapy are emphasized.

No evidence of internal absorption has been found in these cases.

The cooperation of the following persons made this study possible: Col. L. Schwartz, United States Public Health Service, and Drs. J. J. Brodzowski, J. Herradora, A. G. Cranch, J. A. Hickey, D. Osborne, G. E. Morris and M. B. Sulzberger.

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