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HALOWAX ACNE ("CABLE RASH")

A CUTANEOUS ERUPTION IN MARINE ELECTRICIANS DUE TO CERTAIN
CHLORINATED NAPHTHALENES AND DIPHENYLS

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AND

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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 Rille, J. H.: Die Schädigungen der Haut durch Beruf und gewerbliche Arbeit, Leipzig, Leopold Voss, 1926, pp. 303-343.

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 Gausse 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 itself 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 metallic outercovering and the individual covering of the bundles for several inches. The covering materials, including the Halowax, are removed and the bare copper strands 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 cable and bundle ends to effect connections. In addition to the dust itself, the electricians are exposed to the fumes that may be generated by the heat. Because the wire is strung along the hull of the boat under construction, the spaces where the men 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 naphthalenes derived from crude tar (tar camphor, naphthalene, white tar naphthalene) ($C_{10}H_8$) in the preparation of the synthetic wax plasticizing materials, usually in a molten or hot state, or when the product thus obtained was melted and various kinds of electrical apparatus (such as condensers and coils) were dipped into it for securing insulation.

In the present cases the eruption observed was in electricians handling the cold-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 the wire

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Its value as an insulating material is a desirably high one. It has a desirably high resistance to different materials of different nature. Its resistance is directly proportional to the thickness of the material. The resistance is 20 per cent per mil, to which as much as 20 mil mixture there may be added. It may be adjusted to suit the physical characteristics of the material.

or systems of intercommunication. It is electrically neutral to the current of high amplitude. It is strong enough to cover the entire length of the cable. It is relatively counteracts and neutralizes the effects of electric apparatus. It is as strong as the boat as it travels through the water.

They are not too bulky and are designed to be covered. The approach consists of individual bundles impregnated into asbestos.

Surrounding this is a turn, has a rayon covering, and a large diameter cable.

lugs; the cable and the cutting back of the bundles for several inches. The removed and the bare copper wire is in the form of a fine gray powder. It is necessary to heat the wire to the dust itself, the electric by the heat. Because the reaction, the spaces where the reaction is extremely difficult.

were observed among the chlorinated naphthalene white tar naphthalene (10-15 g. materials, usually on a small scale, was melted and various lugs were dipped into it for several minutes.

in electricians handling the cable. When heat was used, and the cable was cut, the method of connecting the cable

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.

Admirable 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 Jones⁵ observed the eruptions appearing in workers handling the crude naphthalene (tar) as 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. These 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 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. Marine 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* 26:586, 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 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 complicating dermatitis in addition to the purely acneform 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 the 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, headaches, vague abdominal pains, impotence, loss of weight, insomnia, alopecia and disturbance in taste. Jaundice was never observed.

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

eruption. Dry and oily complexions were noted in the various nationalities here. The age group extended from 15 to 45. The wives had a slight eruption resembling work clothes and from tanks.

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CUTANEOUS LESIONS

pules which result from the retention of the sebaceous glands. Folliculitis in pustules, furuncles and abscesses of the skin of the face occurs. Lesions as a result of the activity of the sebaceous glands are enough to suggest milia. These occur in numbers on the exposed portions of the face. In many cases less numerous on the torso and legs. The most frequent lesions in greatest amounts were on the face and arms, the margins of the lobes of the face extended into the hairline and the sides of the face. The skin of the face was covered with lesions. The dorsa of the fingers were covered with lesions.

SYMPTOMS

evere, persistent and at times throbbing is a common complaint. The pruritus was a superimposed or complicating factor in lesions. Occasionally it was severe enough to prevent secure sleep. Heat and perspiration and redness of the eyes ("bloodshot") were engaged in electric work in close proximity to the oxyacetylene burners may have considerable dust and metallic particles in the air. Working cable.

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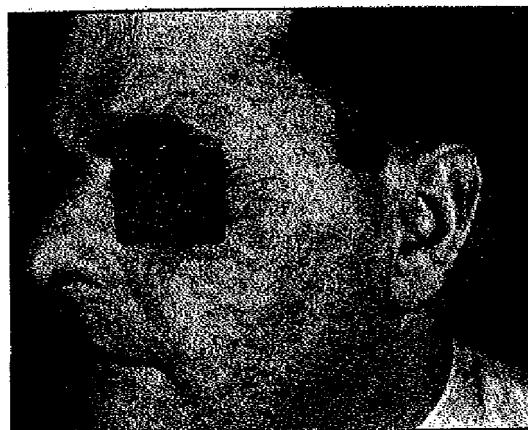


Fig. 1.—Halowax dermatitis.

SYSTEMIC INVOLVEMENT

A series of patients with extensive cutaneous involvement were studied for possible systemic effects. In addition to clinical examinations, including fluoroscopic study, tests for hepatic function and impairment were included. Complete hematologic 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 anemia suggesting the aplastic variety. No relation with "cable rash" or with any internal disturbance was discovered.

DURATION OF THE ERUPTION

As long as many of the electricians continued working with Halowax cable, the eruption persisted and even extended in some instances. With the onset of colder weather, the institution of preventive measures described later and aggressive local therapy, 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 minority 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 (Burow's solution) 1:20 to 1:10. Solution of sulfurated lime (Vlemminckx' solution) in varying concentration was found ineffectual and irritating. Sodium hexametaphosphate in 1 per cent concentration seems to merit further trial.

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

dioxide seemed occasionally beneficial. Attempts at removal of the hyperkerotic plugs by adhesive tape left on for varying periods were futile. Vaccines, autogenous and stock, had no demonstrable value. Mechanical removal of the plugs in the follicles by use of a comedo extractor or by facial massage was sometimes helpful. Osborne⁶ called attention to the fact that the substances in the follicles are lipid solvents, fixed in the tissue by lipids. He suggested that a low fat diet would be of value in eliminating these substances and possibly as a preventive measure. Unfortunately, there has not been the opportunity for pursuing these studies.

PROPHYLACTIC MEASURES

In order 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 one of the new "penetrasols" he and his co-workers⁷ 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 large group of persons, the negative results of patch tests and the absence of acute vesicular dermatitis as seen in contact irritations at the site of exposure, it seemed unnecessary to assume a development of hypersensitivity to the wax. Rather, a

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

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

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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. This occurs from mechanical plugging by the particles per se and from the condensation 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 electricians 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 "cold" dry 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. Brozdowski, J. Herradora, A. G. Cranch, J. A. Hooke, E. D. Osborne, G. E. Morris and M. B. Sulzberger.

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