played a wider fluctuation in the degree of O_2 saturation than did the one who was less active. During the chill, the patient was cyanosed; however, the level of O_2 saturation did not fall but as a rule rose by a few per cent. This was due to the hyperpnea which was associated with the chill and acted as a compensatory factor. Following the chill, the cyanosis, due principally to vasomotor changes, disappeared and the per cent. of oxygen saturation gradually fell as the temperature rose. The degree of fall seemed to depend upon the severity of the paroxysm. In one severe paroxysm, it was seen to fall to 70 per cent. When the paroxysm was mild, there was no appreciable fall and the resultant curve was similar to the preinoculation curve for that patient. As the temperature was returning to normal, the level of oxygen saturation rose and reached its original value, but did so some time before the temperature became normal.

Whenever the level of oxygen saturation fell considerably, as shown in Fig. 1, the administration of pure oxygen did not result in a return of the oxygen tension to the full 100 per cent. saturation obtained during standardization and prior to the onset of the paroxysm. There occurred an increase of but 5 to 10 per cent. Further, when 300 to 600 cc of red blood cells were introduced intravenously during the low period of saturation and this was followed by the administration of pure oxygen through the mask a slight elevation of oxygen saturation was effected but not a return to a full 100 per cent. saturation. The presence of some factor which was inhibiting full oxygenation of the blood hemoglobin might be proposed as an explanation of this phenomenon. The exact nature of this factor has not been clearly determined.

In these studies, several difficulties have been encountered. Whereas the continuous presence of the earpiece is well tolerated by cooperative patients for the first 2 or 3 hours, since the studies occupied from 5 to 6 hours it proved to be painfully irritating to even the most cooperative, when the temperature was high, at which time the threshold for pain is lowered. We have found that a little codeine and strapping of the earpiece to decrease its pull and jiggling will help to carry the study through. Colored patients were found to be unsuitable because of the effect of the skin pigment in decreasing the intensity of light reaching the filters and photoelectric cells, thus decreasing the sensitivity of the instrument. Observations on patients with falciparum malaria have not as yet been made because of the unpredictability of the paroxysms in this form of malaria. These studies, therefore, have been carried out solely in white patients with vivax malaria.

Further studies are in progress and a more detailed report of present and future observations will be made later.

YAN TIM WONG

THE RELATION OF HYPERSENSITIVENESS TO POISON IVY AND TO CASHEW NUT SHELL LIQUID[1]

PATCH test studies carried out during the past two years[2] have shown a remarkable biologic relation between hypersensitiveness to poison ivy and to a variety of compounds of phenolic structure, both synthetic and non-synthetic in origin. On the basis of chemical structure these substances may be classified conveniently as alkenyl or alkyl derivatives of catechol, resorcinol and phenol. Compounds of this type bearing normal unsaturated side-chains, frequently of 15 carbons, are typical of the noxious ingredients found in the "poisonous" members of the Anacardiaceae family, of which the best known in this country is poison ivy and its congeners. The active ingredient in the poison ivy plant is a catechol derivative with a normal 15-carbon side-chain in the 3-position, possessing an average unsaturation equivalent to two double bonds.[3]

Interest in the Anacardiaceae has increased with the growing commercial importance of many products obtained from various members of this universally distributed family of trees, shrubs and vines. In addition, large numbers of our Armed Forces, particularly in the Far East, are coming in contact with members of the Anacardiaceae, and the reports of disabling dermatitis from such sources are on the increase. It seems of value, therefore, to point out the chemical and biologic relation among the active ingredients found in the Anacardiaceae, with particular reference to persons already sensitive to the poison ivy plant.

Cashew nut shell liquid is one of the products from this family of plants that has found important commercial usage. This oily liquid is used as a raw material for the manufacture of certain resins and plastics which are incorporated in brake linings and insulating materials. The electrical properties of the latter are such that the material is of particular value in the insulation of the ignition system in airplane engines. However, the hazard of dermatitis from the raw oil, and in some cases even the finished resinous products derived from it, has been a problem of concern to handlers of these materials. Raw cashew nut shell liquid contains as its active ingredi-

[1] This study was made possible in part by a grant from the Irvington Varnish and Insulator Company, Irvington, N. J.

[2] H. Keil, D. Wasserman and C. R. Dawson, *Jour. Exp Med.*, 80: 275, 1944.

[3] D. Wasserman and C. R. Dawson, *Jour. Chem. Ed.*, 20: 448, 1943.

ents cardol, anacardic acid and a decarboxylated derivative of anacardic acid called anacardol. Cardol is a derivative of resorcinol with a 15-carbon unsaturated side chain (average of two double bonds) in the 5-position, whereas the other two compounds are derivatives of 2-carboxy phenol and phenol, respectively, with a similar unsaturated side-chain in the 3-position.[4] The monophenolic component isolated commercially is known as "cardanol."[5,6]

The problem of hypersensitiveness to cashew nut shell liquid and to its various fractions and derivatives has engaged our attention during the past year.[7] As a result of studies involving more than 150 patients, we have found that persons sensitive to poison ivy are also sensitive to cardol in practically all instances, and to the raw oil, anacardic acid, anacardol and "cardanol" in the majority of cases. Of the ingredients in cashew nut shell liquid cardol elicits the most intense group reactions by far. Contrariwise, all patients showing a negative patch test to poison ivy gave a negative response to the cashew nut shell liquid and its components.

The similar reaction to poison ivy and to the components of the cashew nut shell liquid indicates a group reactivity that is of considerable interest. Thus, cardol, anacardic acid and anacardol all bear the long unsaturated side chain in the position *meta* to a phenolic hydroxyl group, which is likewise true for the catechol configuration of the poison ivy ingredient. Hydrogenating the double bonds in cardol, as in forming tetrahydrocardol, has the effect of diminishing the incidence and intensity of group reactions. Likewise, hydrogenating anacardic acid and anacardol has the same effect in diminishing the incidence and intensity of group reactivity. On the other hand, resorcinol compounds bearing a moderately long saturated alkyl side-chain in a position *ortho* or *para* to a phenolic hydroxyl group, as in hexyl resorcinol, seem not to show this group reactivity. Likewise, when the side-chain is in a position *meta* to the phenolic hydroxyl group, we have found that the reactivity is dependent on the length of the side-chain. Thus, compounds bearing a short side-chain in the 3-position of catechol show only mild group reactivity, and in the 4-position no reactivity. This difference between the 3 and 4 position of catechol, even though both are *meta* to phenolic hydroxyl groups, should be stressed, since a number of biochemical products are catechol compounds with short-chain substituents in the 4-position, such as adrenalin and 3,4-dioxyphenylalanine.[7]

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[4] H. J. Backer and N. H. Haack, *Rec. Trav. Chim.*, 60: 661, 1941.

[5] M. T. Harvey and S. Caplan, *Ind. Eng. Chem.*, 32: 1306, 1940.

[6] D. Wasserman and C. R. Dawson, *Ind. Eng. Chem.*, 37: 396, 1945.

[7] After the manuscript for this article had been submitted to the editors of SCIENCE, there appeared in the June issue of *Industrial Medicine* (14: 500, 1945) an article by Dr. Louis Schwartz and collaborators dealing with the "Skin Hazards in the Manufacture and Use of Cashew Nut Shell Liquid—Formaldehyde Resins." Certain of the findings and conclusions made by Dr. Schwartz and his collaborators are not in agreement with those expressed in this article. Our criticisms of the article by Dr. Schwartz and collaborators have been submitted to the editor of *Industrial Medicine*.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

PRECIPITABLE TYPHOID SOMATIC ANTIGEN IN THE SERUM OF TYPHOID FEVER PATIENTS[1]

THE observations reported in this paper were made in 1940 and 1941 as part of a study of the mechanisms of pathogenesis of typhoid fever. The work was interrupted by more urgent war-time activities, and publication has been delayed. The selected data presented below are offered at this time because of its practical implications.

The presence of antigen of *Eberthella typhi* in the serum of a typhoid fever patient can readily be demonstrated near the onset of the disease by the simple procedure of layering a small quantity of the patient's serum on a like quantity of specific immune rabbit serum. In a positive test, a precipitate appears at the interface of the two sera.

MATERIAL

Immune rabbit serum: Specific antisera were available against the 0-907, Ty 2, Rawlins and Watson strains of *Eberthella typhi;* the somatic "O" agglutinin titers varied from 1:6,000 to 1:50,000, with flagellar "H" titers not exceeding 1:1,280. Although these high-titer sera were used for experimental purposes, it has been found that any specific immune rabbit serum, prepared by the injection of suspensions of *E. typhi,* is satisfactory if the "O" agglutinin titer is 1:2,560 or more. The serum should be col-

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