treated with both topical and systemic steroids but
he relapsed when the oral prednisolone was reduced
to 5 mg daily. An alternative treatment was sought
as his condition was progressing. PUVA proved to be
ineffective in his case but PUVA cleared his lesions
after 4 weeks. Patient no. 2 was given PUVA initially
on one limb and then both limbs were irradiated.
Clearance was achieved again at about 4 weeks
(right leg 12 treatments, total 33.5 J; and left leg 22
 treatments, total 96 J because of the initial 4 weeks
of treatment alone). Neither patient had received
any other treatment (including vitamin C) when
PUVA commenced.

The mechanism of action of PUVA may be one of
immune modulation if the etiology of PPD is indeed
due to a combination of infection and allergy. Based
on recent immunohistologic findings, Aiba & Tagami
in their study of 8 patients with Shamb Reg's disease
think that the Langerhans' cells may play a
role in the pathogenesis of the condition (10). Per-
haps PUVA may be acting partially through its effect
on the Langerhans' cells (11) but its other effects
remain speculative. We believe that improvement
was not due just to pigmentation of the skin alone,
as UVB was unsuccessful in Case 1. Moreover, it
was unlikely to be a spontaneous remission because
in Case 2 the untreated leg remained unchanged
whereas the treated one improved after 4 weeks
of PUVA.

As far as we aware, this is the first successful use
of PUVA to treat PPD.

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Inflammatory Reactions from Organic Pigments in Red Tattoos

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Two different red pigments used for tattooing were
found to give rise to inflammatory reactions in the
skin. No inorganic component was found in the pig-
ments. NMR and MS analyses elucidated the molecu-
lar structures of two different organic compounds.
A bright red pigment was found to be an aromatic
azo-derivative, and a red-violet pigment was found to
be linear quinacridone. A strong exposure to UV-
light was reported in most cases prior to the onset of
the inflammation. **Key words: Azo-dye; Inflammation.**

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Allergic reactions caused by red tattoo pigments
have been known for a long time and have usually
been ascribed to mercury hypersensitivity caused by
cinnabar (mercury sulphide, HgS) (1, 2). Recently
inflammation in red tattoos has been seen in patients
who showed no sensitivity to mercury salts in epic-
The immediate reaction after tattooing is exuding local skin followed by a quick-healing, crusted sore. This normal reaction without complications and with subsequent healing was reported by each patient. Itching and oedema appeared with a lag-time of one month to two years in the red and red-violet tattoos. In 6 of the 9 patients the inflammatory reaction started after a strong UV-stimulation.

The inflammatory reactions in the red areas were constant but with periods of exacerbation with oozing resembling an acute eczema. In each of the patients all red or violet tattooed areas became swollen at the same time, followed by local severe itching or stinging. Between exacerbations the areas were less swollen with slight itching and scaling. Excision of the red parts of the tattoos was followed by total healing in all patients.

Tattoo pigments were obtained from a local tattooist.

¹H NMR (Nuclear Magnetic Resonance) spectra were recorded with a Varian XL 300 spectrometer (300 MHz). Mass spectra (MS) (electron impact and chemical ionization) were recorded with a Finnigan 400 and a Jeol JMS-SX 102 spectrometer. Thin Layer Chromatography (TLC) was run on silica gel with CH₂Cl₂ as mobile phase. Elemental analysis was performed by Analystjästet, Lund.

**Patch testing**

Patch testing was performed in standard concentrations using Al-test. All patients were tested with Cr, Ni, Co, Cd and Cu and with metallic mercury, and some of the patients also with mercury chloride (0.1% in water). Metallic mercury was tested in 0.5% conc. in vaseline. The tattoo pigments were tested as dry, pure substances. The materials were applied to the patient’s back for 48 h and the tests were read after 72 h.

**RESULTS**

**Epicutaneous tests**

No delayed allergic reaction was found in any patient. Epicutaneous testing with the red and the red-violet pigment was performed on five patients. All tests were negative.

**Histopathology**

Examinations of punch biopsy specimens were performed for all 9 patients in the swollen red parts of the tattoos. The pigments were found both extracellularly in macrophages which often lay close to dilated capillaries. In biopsies with red-violet pigment, both violet and red colours were found. No granulomatous reaction could be found. In inflammatory areas of the upper and middle dermis a perivascular infiltrate of lymphocytes was noticed. The infiltrates contained some histiocytes and a few plasma cells. Furthermore, in two patients a lichenoid picture was found showing distinct lymphocytic infiltrate in the dermis and some lymphocytes in the basal epidermis with liquefaction degen-
eration of the basal epithelium and some degenerative changes in the keratinocytes.

**Chemical analysis**

**Red pigment.** Punch biopsies as well as the original tattoo pigments were analysed by atomic absorption spectroscopy. No mercury, copper, nickel, cobalt, or cadmium was found. Elemental analysis showed a compound of organic origin (C 64.9%, H 4.32%, N 11.7%, O 15.9%, no sulphur was found and ashes were 4.3%).

**Spectroscopic analysis.** Both pigments showed very low solubilities in all lipophilic as well as hydrophilic solvents tested. 'H-NMR spectra of the red pigment in CDCl₃ showed a complex pattern in the aromatic region, and also a methyl signal at 2.68 ppm. 2D-NMR experiments showed this methyl group to be a part of an o,p-disubstituted toluene.

The mass spectrum of the red pigment showed a molecular ion at 426, corresponding to the formula C₅₂H₃₆N₄O₄, and the major fragments 334, 305, 290 and 234. The spectroscopic data suggested the structure 1 in Fig. 2, and this was confirmed by comparison with an authentic sample ordered from the supplier.

The trade-name of the red-violet compound was obtained from a local tattooist and the molecular structure was then confirmed by 'H-NMR (in DMSO-d₆) and mass-spectroscopy, and found to be identical with 5,12-dihydro-quin(2,3-b)acridine-7,14-dione or linear quinacridone, (structure 2 in Fig. 2).

**DISCUSSION**

Several types of adverse reactions to tattoos have been reported (5). Granulomatous reactions to light blue tattoo pigments, probably of cobalt origin, have been described (6, 7). Discoid lupus erythematosus has been found in areas with red tattoo (8). Photosensitive reactions in red parts of tattoos were correlated to the mercury sulphide content (9). To our knowledge no reaction to tattoo pigments of pure organic compounds of known molecular structure has been reported. The bright red pigment causing allergic reactions in our patients was found, by spectroscopic analysis, to be an aromatic azo-compound. This compound is marketed as Pigment Red 22 or Devil’s Red.

The red-violet compound was identified by NMR and mass spectroscopy to be linear quinacridone, also known as Pigment Violet 19 or Dark Violet. This compound is known to exist in three different phases; two bluish red and one violet. It has been shown by chemical studies that the pH and the solvent used determine the proportions of these three different phases (10).

Most patients who reacted to the red pigment stated that the reaction started after exposure to strong UV-stimulation. Photoallergic reactions to yellow cadmium sulphide pigment in tattoos have been reported (11). Aromatic azo-compounds such as Devil’s Red are known to react photochemically giving the more unstable cis-isomer as product. Aromatic azo-compounds are also known to evoke contact dermatitis (12). Whether the reactions in the red areas are of photoallergic or pure allergic nature has not yet been evaluated.

No patient showed positive reaction to the tattoo pigments on epicutaneous testing. Both tattoo pigments are extremely insoluble in all solvents tested, and thus no penetration through the epidermis is expected. However, when administered into the dermis as in the tattooing process, allergic reactions can occur.

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Cutaneous Vasculitis Induced by Food Additives

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A case of leukocytoclastic vasculitis in a 24-year-old woman is described. A severe eruption of vasculitis occurred after placebo-controlled oral challenge with 50 mg ponceau. The patient was asked to adhere to a diet free from food additives, and the vasculitis faded after a period of 2 months. Key words: Ponceau; Oral challenge; Diet treatment.

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Foodstuffs and food additives have previously been incriminated as a cause of purpura and cutaneous vasculitis, in a few patients together with urticaria (1-3).

A case of vasculitis induced by food colouring is presented.

CASE REPORT

A 24-year-old woman was seen because of a 6-month history of tender, reddish-brown lesions on the thighs and lower legs. Crops of new lesions occurred at irregular intervals. At the time of examination, she presented with a large number of infiltrated lesions with a symmetrical distribution on the thighs and lower legs. The lesions varied in size from a few mm to 15 mm in diameter. New lesions were bright red, while older lesions were various shades of yellow, brown or blue. A clinical diagnosis of allergic vasculitis was made, and a histological examination showed leukocytoclastic vasculitis (Fig. 1).

Extensive laboratory investigation showed no evidence of underlying disease, such as infection, blood dyscrasias or immunological abnormalities, including collagen diseases.

The patient suspected food items as the cause of the problem, and one eruption occurred after a meal which had included artificially coloured foods. A double-blind, placebo-controlled oral challenge was carried out with the following food additives: 50 mg sunset yellow, 50 mg tartrazine, 50 mg ponceau, 250 mg Na-propionate, 500 mg sorbic acid and 250 mg Na-benzoate. The substances were given in identical capsules, and the patient ingested one capsule per week.

The patient experienced a severe eruption of vasculitis 2 h after the ingestion of one capsule which, when the code was broken at the end of the challenge, was found to have contained ponceau. There was associated arthropathy of the ankles and fingers. The eruption (Fig. 2) faded after about one week. A less severe, similar eruption occurred after ingestion of the capsule seen to have contained tartrazine, while none of the other capsules caused any skin reaction.

The patient was instructed to avoid food additives, in particular the azo dyes, ponceau and tartrazine. She was...

Fig. 1. Leukocytoclastic vasculitis with perivascular infiltrates consisting mostly of neutrophils and nuclear dust. Fibrin deposits can be seen within and around capillaries and venules in the dermis (×125).

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