Face rashes linked with use of VDTs

A Norwegian study has tentatively linked mysterious facial rashes among Scandinavian office workers with electrostatic fields generated by video-display terminals (VDT's). Details of the research by Walter Cato Olsen of the Chr. Michelsen Institute in Bergen, Norway, were presented in Washington recently at a National Academy of Sciences symposium on VDT's and vision (SN: 8/29/81, p. 137).

According to Olov Östberg, who made the presentation, there have been roughly 100 cases reported in Sweden and Norway of VDT-workers developing rashes, another 10 or 12 "recognized cases" in Great Britain. Östberg, an occupational-health researcher with the Central Organization of Salaried (white-collar) Workers in Sweden, told SCIENCE NEWS that the reported outbreak of rashes "is not dramatic, so you may have to be aware of the mechanism before you notice it." But where it has been noticed, up to five of eight VDT-operators in a given office have been affected, he claims.

Olsen's study included 150 measurements. Sponsored by the Norwegian Directorate of Labor Inspection, and released in April, it looked at 10 offices (including some where rashes had been reported), 14 operators and 26 VDT units. Body-voltage readings for two members of the investigating team were also taken at all sites visited.

Rashes are characterized by itching, a slight redness and a few pale pimples. Symptoms develop after VDT-work periods ranging from a couple of hours to several successive days, and disappear within a day or two of work cessation, such as over a weekend. Investigation of 12 affected operators at Televerket in Bergen by A. Nilsen of the University of Bergen's dermatology department "established a probable connection between the facial rash and occupational activities" for half, Olsen says. Nilsen's work also suggests rosacea, perioral dermatitis, contact- and photo-contact dermatitis can be ruled out as causal factors.

VDT's based on cathode-ray tubes employ high voltages to generate the electric fields that accelerate their electron beam. It is the beam's excitation of phosphors on the viewing screen's inner surface that creates a VDT's images. Potential differences of 10^4 volts are common, and if the equipment is not deliberately shielded, Olsen says, "high voltages may extend into the air surfaces surrounding the units."

What's more, charge accumulation from static electricity may raise the electric potential of the human body several thousand volts above ground potential. "Having acquired a charge, the human body will discharge in a time that is related to the resistivity of the surroundings, which in turn is influenced by the humidity of the ambient air," Olsen explains. "If highly insulating footwear and floor coverings are in use under conditions of low humidity, the rate of charge dissipation will be minimal and elevated body potentials may be sustained over long periods of time."

Olsen notes that rash incidence fell in offices where measures were taken to prevent static electricity. Under the hypothesis that VDT operators in the presence of an electric field might function as electrostatic collectors of charged airborne particulates, he conducted field surveys to measure electric-field and aerosol-concentration characteristics under conditions reported to exist when rashes occurred. "If irritant fractions of the ambient aerosol could be shown to be precipitating at abnormal rates under circumstances when rashes occurred, a probable cause ... would be identified," Olsen claims. It might also explain the oft-reported eye irritation, he adds.

VDT screens carried a positive charge. Calculated electric potentials ranged from nearly zero to more than 10,000 V in extreme cases; the average was 2,250 V. The charge potential measured in VDT operators varied from −2,000 V to +4,000 V. Of 78 body-potential readings, roughly 30 percent were positive, 20 percent near zero and 50 percent of negative polarity. Twenty-four body readings exceeded 1,000 V, "and *all but one* of these represented measurements in areas associated with rashes," Olsen reports. The high voltages were distributed equally among confirmed rash-prone operators and others in the same area, including the investigators. Most body potentials were negative, in the range of −500 to −2,000 V (however, one rash-prone operator was consistently positive, with peak readings of 4,000 V when the humidity was low).

Using a piezoelectric mass analyzer, Olsen measured concentrations of suspended particulates. Charged particles move in the presence of an electric field, and Olsen found the particle-precipitation rate roughly proportional to the absolute value of the difference in voltage between the VDT screen and collection surface (such as a human face 50 centimeters in front of it). Particle-deposition rates exceeded 10^4 particles per millimeter per hour under conditions said to simulate those during rash outbreaks. Olsen claims, "This flux is at least a factor of 10 higher than the flux in the absence of an external field." Olsen adds that his data suggest any increase in deposition will be proportional to the strength of the field, independent of its polarity.

Olsen acknowledges several apparent inconsistencies encountered: For example, facial rashes normally occurred on the cheekbones and chin, not the central forehead and nose — places where the electric field intensity would be expected to be just as high. "One possible explanation," he posits, "may be that the field-enhanced deposition of aerosols in these regions ... is influenced by the air turbulence and humidity variations caused by breathing."

Another controversial element raised by symposium participants is why non-VDT workers in high-electric-field situations haven't reported similar problems. Olsen suggests the chemical makeup of the indoor air pollution, sensitivity of a worker's skin, and electric-field differentials caused by the specific equipment and workplace design will determine whether a rash occurs. □

Tooth decay puzzle dissolves away

At one time, dentists used to poke around to locate areas of tooth enamel that were softer than normal, especially between teeth and along the gumline. These areas, called white spots, were puzzling because the subsurface had decayed more than the hairbreadth-thick surface layer.

Now two researchers think they have found a mathematical and chemical model to account for the mystery. Their analysis also may have interesting implications for the environmental degradation of marble structures and for geological processes like the layering of sediments.

Reporting in the Aug. 28 SCIENCE, Edward L. Cussler of the chemical engineering and materials science department at the University of Minnesota in Minneapolis and John D. B. Featherstone of the Eastman Dental Center at the University of Rochester, present a model of what happens when an acid comes into contact with a highly porous solid. To calculate the dissolution rate for this situation, they assumed that the chemical reactions in the solid are much faster than the diffusion rate so the reactions reach equilibrium.

The equation they developed predicts that for some solid ionic materials, extra mineral would precipitate in the pores of a solid being dissolved by acid. Thus, although demineralization occurs at the solid's surface, remineralization can occur near this surface, and further demineralization can occur deeper inside the material. This matches what happens in tooth enamel when white spots form.

Cussler tested the predictions, initially using ordinary lab chemicals and grocery-store gelatin. He created a dilute suspension of an insoluble hydroxide in a gel, over which he poured an acid. In the case of calcium hydroxide and hydrochloric acid, within hours he saw a band of precipitate form just below the acid-gel interface. For a mixture of calcium hydroxide and silver oxide, nitric acid caused precipitation of calcium hydroxide near the interface but dissolution of solid mate-