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AN ELECTROMAGNETIC RADIATION SURVEY OF SELECTED VIDEO DISPLAY TERMINALS

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Visual display devices, particularly cathode ray tube displays, have been used quite successfully in military and commercial systems for many years. It is with contemporary information display procedures (i.e., graphics and data handling), however, that these visual display devices are finding their greatest application. Video display terminals (VDT) are making inroads into office managerial procedures with their ability to rapidly display letters, numbers, and other symbols. Although exact figures on the number of such devices are not available, it is estimated that between five and ten million units are currently in use.[1] The number is certain to increase within the next few years as the many advantages of the VDT become apparent.

In recent years, inquiries have been received from various user groups concerning the potential hazards associated with these devices. Many VDT operators complain of such symptoms as eyestrain, visual deterioration, headaches, changes in normal visual acuity and, in some cases, changes in color perception, dulling of sensation in fingertips, nausea, temperature and noise discomfort from equipment, and general fatigue. Recently, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Newspaper Guild and from a prominent newspaper facility to evaluate their VDT for possible electromagnetic radiation hazards to workers. This request was made after opthalmologic examinations revealed bilateral cataracts in two young newspaper employees using VDT.

Radiation is characterized as energy which is emitted, transmitted, or absorbed in wave or particulate form. Radiation waves consist of electric and magnetic forces which, when disturbed in some manner, produce electro-magnetic (EM) radiation. The known EM radiations are grouped into a spectrum arranged by frequency and/or wavelength. The spectrum includes the radio-frequency, microwave, infrared, visible, ultraviolet, gamma, and X-ray regions. The regions are not sharply delineated from each other and, in fact, often overlap.

In conducting a radiation survey, a working knowledge of the source and its characteristics is required. Basically, the VDT operates similarly to a television set. It contains a source of electrons (cathode) and a coated screen (anode) within a specially designed vacuum tube. Under high voltage, electrons are emitted by the electron gun and accelerated toward the anode. The gun scans the screen at a predetermined rate and projects electrons according to an electronically induced signal. When the electrons interact with the screen, which contains a phosphor material, visible radiation is produced and an image is formed.

Several types of electromagnetic radiation are produced in a VDT. X-rays can be generated by the cathode ray tube and the shunt regulator tube. Ultraviolet, visible, and infrared radiation are emitted

by the phosphor material. Radio-frequency radiation is produced by certain electronic components and circuits. Discussions with VDT design engineers indicated that the maximum radio-frequency radiation generated, including harmonics, should not exceed 250 megaHertz.

Since most regions of the electromagnetic spectrum have been implicated as being cataractogenic, it was necessary to monitor across a broad range of frequencies to insure identification of all electro-magnetic radiation emitted by VDT. Luminance measurements were made to document the levels in regard to eyestrain. This report will describe the equipment used, present results of all measurements, discuss the significance of the results with reference to accepted exposure standards, and present conclusions. Mention of company name or product does not constitute endorsement by the National Institute for Occupational Safety and Health.

Instrumentation and Procedure.

Since it was necessary to make measurements in many regions of the electromagnetic spectrum, several types of instruments were used. A brief description of each instrument used in the survey will be given, as well as measurement details.

An EG&G Model 580/585 spectroradiometer was used to detect ultraviolet, visible, and infrared radiation in terms of power per unit area as a function of wavelength. The expression used for such measurements is spectral irradiance, and the unit is watt per square centimeter per nanometer ($W \cdot cm^2 \cdot nm$). The values obtained are then summed to obtain the total irradiance for the optical region of interest. All measurements were made with this instrument at a distance of 15 centimeters from the face of the VDT screen. A collimating device was attached to the front of the detector and positioned against the screen face to minimize the effect of ambient light.

The instrument used to measure the luminance (brightness) levels of the VDT screen and surrounding luminous environment was a spectral mini-spot photometer. The value obtained with this instrument in footLamberts (fL) represents the luminance observed by an operator regardless of actual distance from the VDT screen face. All measurements with this instrument were made at a distance of one meter.

A Hewlett-Packard Model 5303B frequency counter was used to determine the frequency of radio-frequency (RF) radiation up to 525 megaHertz (mHz). To determine the near-field electrical component of RF radiation, it was necessary to use a special meter developed for NIOSH by the National Bureau of Standards, called an EDM-2 electric energy density meter. The EDM-2 reads out in units of Joules per cubic meter ($J \cdot m^3$) in the frequency range from 10-500 mHz.

The instrument used to measure the near field magnetic component of RF radiation was a Narda Model 8607 magnetic field detector. This detector indicated units of watts per square centimeter ($W \cdot cm^2$) in the 10-500 mHz region.

Measurements of RF radiation using the last three detectors were made by slowly scanning every accessible surface of the VDT with the detectors in contact with the housing.

Results of Measurements

Nonionizing Radiation. Using the equipment described in the previous section, radiation measurements of UV, visible, IR, and RF levels were performed on three VDTs located at the newspaper facility. The terminals surveyed were a Telco Model 140 located in a wire service department, a Harris Model 1500A located in a news department, and an Incoterm SPD 10/20 used in a business department. Results of the surveys are presented for each of these three terminals. The first two terminals had been used by the employees with cataracts. In addition, selected measurements were made on numerous other terminals on various floors of the newspaper building.

1. *Telco Model 40.* The face of the video tube used in this terminal is 19 cm wide by 33 cm high, uses a P-4 phosphor, operates as a 15-18 kilovolt (kv) tube potential, and is manufactured by Clinton Electronics, Rockford, Illinois. The terminal was located in a small room apart from other VDTs. The brightness of the tube was adjusted to a maximum and the screen filled with letters and symbols. All room lights were turned off during the survey; however, an unidentified source of electro-magnetic interference made measurements difficult on several instruments.

a. UV measurements: The UV spectral irradiance levels for the Telco VDT are shown in Table 1. Notice that all measurements between 200-370 nm were recorded as zero on the 10^{-10} ampere scale of the spectroradiometer. Due to the presence of electromagnetic noise in the area, it was not possible to use the most sensitive spectroradiometer scale. The integrated UV irradiance from 200-400 nm was 2×10^{-9} $W \cdot cm^2$.

b. Visible and IR measurements: No visible or IR radiation was detected using the 10^{-10} scale.

c. RF measurements: Certain positions on the screenface of the VDT were emphasized during the electric field survey with the EDM-2 meter. A maximum reading of $1.2 \times 10^{-6} J \cdot m^3$ was observed at the rear surface of the VDT. This RF value was about 25 times greater than the next highest reading. However, when the meter was moved 10 cm away from the rear surface, the RF value dropped to zero even when on the most sensitive scale of $3 \times 10^{-9} J \cdot m^3$. The magnetic field measurement using the Narda 8607 meter registered zero on its most sensitive scale of $2 \times 20^{-4} W \cdot cm^2$. On this particular VDT, no frequency higher than 2 mHz was recorded. Consequently, none of these readings have real significance, since these meters are not designed for measuring frequencies below 10 mHz.

TABLE I.

UV Spectral Irradiance Measurements in Units of 10^{-10} $W \cdot cm^2 \cdot nm$ Obtained From the Three VDTs Surveyed in This Study

Wave-Length (nm)	Telco 40	Harris 1500A	Incoterm SPD 10/20
200	0	0	0
210	0	0	0
220	0	0	0
230	0	0	0
240	0	0	0
250	0	0	0
260	0	0	0
270	0	0	0
280	0	0	0
290	0	0	0
300	0	0.01	0.09
310	0	0.02	0.17
320	0	004	0.30
330	0	0.05	0.55
340	0	0.08	0.87
350	0	0.11	1.18
360	0	0.12	1.80
370	0	0.14	2.03
380	0.7	0.15	2.06
390	4.8	0.74	2.91
400	14.6	3.65	7.30

d. Luminance measurements: On the Telco 40 VDT, the brightness values ranged from 1.5 to 2.5 fL for minimum and maximum luminance levels, respectively.

2. *Harris 1500A.* This VDT is one of the more common models used in the newspaper business. The video screen has a square viewing area of 25 cm x 25 cm, uses a P-31 phosphor, the video tube operates at a 23-33 kv potential, and is manufactured by Thomas Electronics, Inc., Wayne, New Jersey. As with the first VDT surveyed, the brightness control was adjusted to maximum and the screen filled with a typical message. Because of the size of the room and the numerous ongoing plant operations, it was not possible to eliminate ambient room light during measurements on this unit.

a. UV measurements: The UV spectral irradiance levels for the Harris 1500A are shown in Table 1. The integrated UV irradiance from 200 to 300 nm was zero, and from 300-400 nm was 5.1 x 10^{-10}W · cm², as measured on the most sensitive scale.

b. Visible and IR measurements: No visible or IR radiation was detected on the most sensitive scale of the spectroradiometer (i.e., 10^{-11} amperes).

c. RF measurements: A 27 mHz frequency was registered by the frequency counter at the surface of the unit. This signal was not detected when the counter was approximately 12 cms from the unit. The EDM-2 and the Narda 8607 registered zero on their most sensitive scale (3 x 10^{-9}J m³ and 1 x 10^{-4}W · cm², respectively) next to the VDT housing. All measurements were conducted in the same manner as with the Telco VDT.

d. Luminance measurements: The luminance values ranged from two to ten fL at the minimum and maximum brightness, respectively.

3. *Incoterm SPD 10/20.* This VDT has a tube face measuring 16.5 cm wide by 23.9 cm high, uses a P-39 phosphor, operates at a 12-14 kv potential, and is manufactured by Ikegami Electronics, New York City. All measurements were taken at maximum brightness with a filled screen in room light.

a. UV measurements: The UV spectral irradiance levels for the Incoterm VDT on the most sensitive scale are shown in Table 1. The integrated UV irradiance from 300-400 nm was 1.9 x 10^{-9}W · cm².

b. Visible and IR measurements: No visible or IR radiation was detected on the most sensitive scale.

c. RF measurements: a 20 mHz frequency was detected by the frequency counter when held in contact with the VDT housing on the right side. This signal was not detected when the counter was 10 cm from the unit. As in the case of the Harris 1500A, both the EDM-2 and Narda 8607 registered zero on their most sensitive scale during the Incoterm survey. All measurements were conducted in the same manner as described previously.

4. *Measurements made on other VDT Units.* RF and luminance measurements obtained on randomly selected VDT units at the newspaper facility generally confirm those values reported for the above three VDT units. All RF magnetic and electric field measurement made on these 22 units were zero on the most sensitive detector scale. In making measurements on a VDT on a higher floor, a RF level of 1 x 10^{-3}W · cm² was obtained. With the terminals de-energized, the reading still persisted. From this it was concluded that the source of radiation was not VDT-related. Since readings of the same magnitude were obtained in the adjoining computer area and at nearby windows, it was postulated that signals from nearby TV and radio stations were directly exciting the detectors.

Ionizing Radiation Measurement Results

Numerous x-radiation surveys have been reported on various VDT makes and models. The findings in every one of these surveys has revealed that x-ray levels emitted by VDT rarely exceed background. For example, in 1970 and 1972, Dr. Walter Mauderli made measurements on the same Harris 1100 VDT in Florida to determine if radiation levels increase as a function of VDT age.[2] His conclusions were: any aging effect, if it existed at all, ". . would have the tendency to shift the energy spectrum of the produced x-rays to lower values—thus reducing the penetrating power of the radiation." He also stated that no readings could be found which exceeded the natural background level. In 1973, Mauderli made a radiation survey on a Harris 1500 VDT and concluded that the unit has an x-ray output level at any accessible location which was below 0.02 mR · hr. Also, in 1973, the U.S. Department of Labor made x-ray measurements on two Harris VDT at United Press International's newsroom in New York City and found radiation levels on the order of background radiation.[3] In 1974, the State of Maryland made an x-ray survey on 74 different VDTs at the Baltimore Sun plant.[4] Their report stated: "In no case did the level found exceed the background radiation level. That is to say, the X-radiation produced by the VDTs was essentially zero."

NIOSH, in 1975, was asked to perform an x-ray survey at the same newspaper facility. The radiation results from this survey were obtained using a Victoreen Model 440 RF/C x-ray survey meter. This meter is shielded against response to RF radiation and measures low energy x-rays in units of milliroentgens per hour (mR · hr). Background readings taken at frequent intervals ranged from 0.16 to 0.70 mR · hr. Readings from an internal calibration source were also recorded to insure the meter was functioning properly throughout the measurements.

All measurements were performed by slowly scanning over the display screen, which was filled with letters and symbols, as in a normal operation. Approximately 20 per cent of the VDTs were measured on all six sides, with the remaining VDTs being surveyed on all sides except the bottom. The gross x-ray levels recorded ranged from 0.12 to 0.85 mR · hr. The unit with the highest momentary value recorded (0.85 mR · hr) was rechecked at the conclusion of the survey and a reading of 0.20 mR · hr was obtained. When these levels are compared with background readings, it is apparent that no measurable radiation was observed. Table 2 indicates the range of x-ray levels, in mR · hr, measured on the various VDT types.

TABLE 2.

X-Ray Exposure Levels for VDTs

VDT Type	*No. of units surveyed*	*Range of X-ray Levels (mR · hr Max.*	*Min.*
Harris 1500A	75	0.85	0.13
IBM 3270	39	0.25	0.12
Infrarex 1303	11	0.22	0.14
Background		0.70	0.16

In 1977, a major insurance company surveyed 67 VDTs at the same newspaper facility where measurements were made for this study.[5] The maximum x-ray level measured at the screen face from all these units was 0.2 mR · hr. The VDTs surveyed at that time were made up of the following models: Harris 1500A, Harris 1520, Data Speed 40, Data Disc 66121, and IBM 3277. The insurance company indicated that, since the background ranged from 0.1 to 0.3 mR · hr, no measurable x-ray radiation was being emitted.

No x-ray measurements were made during the present survey for two reasons. First, the x-ray results from the insurance company and NIOSH measurements indicate no x-ray emission on similar VDTs, both at the same and another newspaper plant; second, the results of x-ray measurements made by other groups indicated no occupational exposure when properly shielded, as specified by the manufacturers.

Discussion of Results

This section discusses results of pertinent electromagnetic radiation measurements and of medical examinations conducted at the newspaper facility.

Electromagnetic Radiation Results. The potential electromagnetic radiation hazards from the VDTs surveyed in this report may be evaluated by comparing the maximum observed reading in any of the regions with currently accepted standards. Table 3 summarizes this information. Observe that, in this table, all values reported are below current safety standards. The use of the symbol ND in the table indicates that energy levels were too low to be detected by the appropriate instrument on the most sensitive scale. All measurements were obtained with the detector probes in contact with the VDT screen face. This means that even these low "emission" levels must be further reduced by geometrical consideration in order to characterize the exposure at the eye position of the operator, typically 0.5 to one meter away. Thus, it is appropriate

to state that radiation levels 0.5 to one meter away from the VDT will be even lower than those values which appear in Table 3. Therefore, based on the above measurements, the current standards, and present knowledge of biological effects, the VDTs surveyed do not appear capable of producing cataracts or even present an occupational ocular radiation hazard.

TABLE 3.

Comparison of Maximum VDT Radiation Levels Measured at the Screen Face with Currently Accepted Standards

Radiation Region	Maximum VDT Measured Level	Occupational Exposure Standard	Reference
Ultraviolet	2×10^{-9} W · cm²	1×10^{-3} W · cm²	NIOSH CD[6]
Visible (luminance)	21 fL	2.92×10^{3} fL	ACGIH TLV[7]
Infrared	ND*	10^{-3} W · cm²	ACGIH TLV[7]
RF-Electric Field Strength	ND*	2×10^{2} V · m	ANSI[8]
RF-Electric Field Strength	ND*	5×10^{-1} A · m	ANSI[8]
X-ray	0.85 mR · hr**	2.5 mR · hr***	OSHA[9]

*Not detectable
**Includes background level
***Based on the average annual dose limit of 5000 mR divided by 2000 working hours per year.

Medical Results. The two workers with cataracts, one a 35-year-old male and the other a 29-year-old male, were interviewed and detailed occupational and medical histories were obtained. In addition, their medical records at the newspaper medical department were reviewed. Reports of ophthalmological examinations in 1977 by two ophthalmologists were also obtained. In addition, in the case of the 29-year-old male, reports were received of four ophthalmological examinations performed between November 1970 and February 1976 by an ophthalmologist who is now deceased. The duration of exposure to VDT units at the newspaper by the two workers had been approximately four months for the 35-year-old male and one year for the 29-year-old male. In addition, the 29-year-old worker was exposed during a three-month training period (approximately one hour per day for a few days each week) beginning late November 1975. Both of the ophthalmologists who examined the two workers in 1977 reported finding bilateral posterior cataracts. In addition, the 35-year-old male was noted to have evidence of some retinal degeneration. Attempts to obtain records of previous ophthalmological examinations on this worker have not been successful to date. However, the reports of the previous ophthalmological examination on the 29-year-old male showed the first indication of a posterior polar cataract in the right eye on February 26, 1976, a time coinciding with the onset of his continuous daily exposure to the VDT units. (As noted previously, there was a training period of brief intermittent exposure over about three months before he used the units on a regular basis.)

The cataracts found are compatible with those reported from exposure to radiant energy, but they are also compatible with those seen congenitally or those associated with other etiologies, such as diabetes or steroids. However, the workers' medical histories did not disclose any pertinent information to suggest any such etiologies for the cataracts. Since the survey did not indicate any significant occupational electromagnetic radiation levels, the etiology of the cataracts remains undetermined.

Estimates of the incidence of cataract in the United States by age and sex range from 330,000 to 900,000 cases per year.[10] With this many people estimated to develop cataracts, it would not be alarming to find quite a few people developing cataracts in a subset of VDT workers. At present, incidence estimates for bilateral cataracts are not available. Therefore, the above figures have to be viewed conservatively. Interestingly enough, the incidence of cataracts for women is considerably higher than for men.

Additional Discussion

Phosphors. Information can be viewed on a VDT because of the manner in which electrons interact with the phosphor coating present on the screen of a cathode ray tube. Phosphors are chemical substances which exhibit fluorescence (i.e., emit visible light) when excited by ultraviolet radiation, x-rays, or an electron beam. The amount of visible light produced by a phosphor is proportional to the amount of excitation energy. Every phosphor has a property that allows it to emit light for a very short time after the excitation energy has been removed. This particular property is called persistence, and is extremely important in viewing information presented on the screen. The spectra output of these phosphors is limited to a fairly narrow spectral range. Much of the work done in categorizing phosphor properties has been performed by the Joint Electron Device Engineering Council.[11] Their work confirms our findings that very little UV radiation can be emitted by the VDT. As explained earlier, the level of visible radiation emitted by the phosphors was below the detection limit of the spectroradiometer. Furthermore, the properties substantiate the fact that no IR radiation could be detected (since none is emitted). Finally, no measurements were observed which would suggest an increased radiation level of any type as a function of age of VDT. Not every phosphor made is classified in Reference 11; however, most of the phosphors used in VDTs are catalogued and referenced by the organization. Using that reference, a spectral energy distribution was made of all phosphors listed, as of November 1975. Only three phosphors emit in the IR, while 25 emit in the UV. All IR-emitting phosphors in the list produce considerably less than 20 per cent of the total optical spectrum in the IR. With the exceptions of P-15, P-16, and P-47, most of the UV emitting phosphors also produce very little of their total optical spectrum in the UV region (the average is 10-20 per cent). Such a list could be of value in possible averting any future concern associated with optical radiation.

Eyestrain. After reviewing the literature on VDT, it does ot appear that any specific occupationally-induced disease has, to date, been documented that implies the VDT as the causative agent. However, complaints of eyestrain (aesthenopia) often are voiced. Eye fatigue and associated symptomatology experienced by people working on VDTs may be similar to the fatigue encountered by workers in other occupations.[12] Many factors related to the worker, such as his visual acuity, the task to be done, the VDT itself, the work environment, and the background lighting, will affect the probability that an individual will experience the above symptoms. Obviously, work posture, equipment layout, age of worker, length of time spent on VDT, environmental lighting, presence of eye glasses or contact lens, use of anti-reflection coatings, and latent visual defects are a few factors which will affect the incidence of eye fatigue. However, with many VDTs in use, the number of complaints could be quite large. Attention should be focused in this area on more definitive studies. Some research has been performed by the Armed Services (i.e., air traffic controllers) and by VDT manufacturers. Two excellent reviews of this subject were prepared by Hart[13] and Ostberg.[14].

Other Measurements. Very little published information was available on

VDT radiation levels and measurement techniques prior to the NIOSH involvement. After obtaining the results presented in this report and discussing the related problems with many people, several additional measurement exercises to validate these results were conducted by non-government facilities. NIOSH has reports from two different facilities examining different VDT models. These reports essentially confirm the data presented in this report. A small difference exists in the numbers obtained in measurements, but in no case did any VDT unit come near exceeding the recommended standard. Frequencies were identified by using a frequency analyzer, with none being detected above a 250 mHz limit, as previously identified by NIOSH.

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TARGET INDUSTRY — MAIL BOMBS AND FIRE BOMBS

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In essence, the Postal Inspection Service is the law enforcement arm of the U.S. Postal Service. Postal inspectors have been involved in criminal investigations since the birth of the republic, which probably makes us the oldest federal law enforcement agency.

The Inspection Service exercises investigative jurisdiction over 85 federal postal-related statutes dealing with a broad range of criminal activities. Some of the major activities in which our inspectors are involved are:

1. All criminal activity involving the use of the mails with intent to defraud comes under the jurisdiction of the Postal Inspection Service. The mail fraud statute is one of the most effective prosecutive tools in fighting white collar and organized crime. Fraud schemes include such areas such as credit card frauds, insurance, banking, inheritance frauds, advance-fee swindles, franchise schemes, and many others.

2. The Inspection Service has jurisdiction in cases of burglaries of post offices, holdups of postal facilities, postal vehicles or mail carriers, and embezzlements by postal employees.

3. The illegal use of the mails for the trafficking of drugs, narcotics, and other controlled substances is a violation falling within the jurisdiction of the Postal Inspection Service. We work very closely with the U.S. Customs Service, the DEA, and local police in many of these cases.

4. Inspection Service has jurisdiction over the investigation and enforcement of the postal obscenity statute, which prohibits the sending of obscene material through the mails.

5. We also investigate extortion by mail, where there is a threat to injure a person's reputation or character.

In addition to the criminal investigations, the Inspection Service is responsible for the internal audit function of the Postal Service.

As you can see, the Postal Service does more than move the mails, and the Inspection Service has investigative responsibilities other than the mailing of letter or parcel bombs. Of the criminal activities our service is involved with, perhaps the most insidious and heinous is the mailing of bombs and explosive devices.

The chief postal inspector places the highest degree of priority on investigations which deal with the mailing of explosive devices or the placing of such devices upon postal properties, no matter what the motivation might be. He has asked me to assure you of the continued cooperation of the Postal Inspection Service in your efforts to protect your interests, as well as to assure you that we in the Inspection Service consider our mission to protect postal employees, the mails, postal properties, and postal customers from injury and destruction, a serious one.

I would be less than candid if I did not advise you that we in the Inspection Service had some reservations in preparing this presentation. If the Inspection Service has gained any insight in roughly 100 years of investigating the heinous crime of bombs by mail, it would be that there are no hard and fast rules as to the makeup and appearance of mail bombs. Our experiences with mail bombs have shown that physical appearance and makeup of these devices, be it a letter or parcel, are limited only to the imagination of the bomber.

In the past, mailed bombs have exhibited unique characteristics, and there are common sense procedures for handling and securing suspect mail. However, you should realize that although these identification characteristics and handling procedures have worked well in the past, there is no ironclad guarantee that they will always work in the future. It is in this context we present "Guidelines for Mail Bomb Security."

(Then followed a slide presentation on the identification and handling of suspect mail bombs.—Ed.)

Forest Industries Sessions

EMPLOYEE RELATIONS COMMITTEE SAFETY AND HEALTH PRESENTATION TO API EXECUTIVE COMMITTEE

By WILLIAM J. BREECE
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There was an API-administered safety and health program long before the Occupational Safety and Health Act. That pre-OSHA program included the development of industry standards, a handbook of safety procedures, and a network for communicating information about accidents and hazards.

When OSHA was enacted in 1970, the safety and health area came under the influence of federal and state bureaucracies which are still growing. Under the law, two separate federal agencies were established: OSHA (the Occupational Safety and Health Administration) located in the Department of Labor and responsible for setting and enforcing health and safety regulations; and NIOSH (the National Institute for Occupational Safety and Health) located in HEW, with responsibility for research and for developing proposed regulations to be refined and promulgated by OSHA. In some states, OSHA has delegated enforcement responsibilities to counterpart state agencies.

In recent months, OSHA has changed the emphasis in its entire program away from standards covering equipment and safety procedures toward employee health standards covering industry-related diseases, process chemicals, and the work environment. That change in emphasis has significant implications for the industry on a number of fronts:

1. Noise Standard. For the last few years OSHA has been attempting to reduce the workplace noise limit for 8-hour exposure from 90 dBA (the old Walsh-Healey standard) to 85 dBA. An API Noise Task Force made up of member companies' operating executives and staff experts has estimated that to implement the 85 dBA standard in our industry would require capital expenditures totalling $2.2 billion. EPA has intervened in the OSHA proceedings, arguing for a standard even lower than 85 dBA.

An additional and critically important issue related to the noise standard is whether employers will be allowed to meet the exposure requirements by providing personal hearing protection as opposed to costly and sometimes technically infeasible engineering or administrative controls. The battle over that issue still goes on, and our industry has a major stake in the outcome.

2. NIOSH Hearing Loss Study. On another front, NIOSH has instituted a study to evaluate the effects of non-steady state noise on workers in the paper industry. That study, to be conducted in the Cincinnati area, was initiated at the request of UPIU.

3. Mortality Study—Northwest. In the northwest, NIOSH has contracted with Stanford Research Institute to conduct a mortality study of workers in the pulp, paper, and plywood industries. This is an outgrowth of an earlier statistical analysis which suggested that paper and plywood workers in the state of Washington had a higher incidence of death from cardiovascular disease and from certain types of cancer than the general population.

4. Chemical Substance Standards. OSHA will be setting occupational health standards for an estimated 400 chemical substances used in our industry including, for example, sulfur dioxide, chlorine, ammonia, and formaldehyde. These standards will establish permissible exposure limits and will include requirements for monitoring and recording exposure levels, for handling, labeling, informing employees of possible health hazards, and conducting periodic physical examinations of employees to monitor the effects of exposure.

5. Toxic Substances Control Act. Another important new development is the Toxic Substances Control Act, which became effective on January 1, 1977. After an initial cataloguing of known chemicals, it will require chemical manufacturers to notify EPA before producing and marketing any new chemical substance, and to delay production for up to six months awaiting EPA action. An interesting and disturbing feature of this Act is that it requires EPA, after notification of a proposed new chemical, to publish immediately not only a description of the chemical but the manufacturer's plans for its intended use. These plans could include information that potential users such as our companies would regard as proprietary and confidential.

In addition to the obvious direct effects of these trends on operations, they will have important secondary effects on our companies:

Unions, including the UPIU, have shown increasing interest in occupational health. UPIU has employed a new staff person with full-time responsibilities for occupational safety and health. They have also produced a 20-minute movie on the effect of noise in the paper industry. At a recent meeting in Cincinnati concerning the NIOSH study of intermittent noise, not only UPIU but AWPPW and IWA were represented. Increasingly, unions at the local level have been demanding information about chemical exposures, and the UPIU at its recent convention adopted a resolution calling for all locals to do so.

In community relations, we've all seen the sensationalism that can build up around issues of occupational health, especially in small communities.

The increased emphasis on health in regulatory programs is also leading to changes in state workers' compensation laws extending benefits for occupational disease and increasing employer costs. Effective control of those costs will require improvements in the medical management of compensation claim cases within our companies.

In responding to all these developments, and in trying to influence the direction of government policy, various elements of API and some individual companies have been very active. The committees principally involved are the Safety and Health Subcommittee of the Employee Relations Committee, composed primarily of safety professionals but including some industrial hygienists and one medical director; and the Chemical Control Committee, composed of technical and legal people. Of course, the appropriate API staff officers have coordinated the activities of both groups, and especially their contacts with government officials.

Some individual companies have also been active in their own behalf, and several have used the ORC (Organization Resources Counsellors) Safety and Health Group in Washington as their agent in dealing with the government.

What are the accomplishments?

We have established a favorable image and a high degree of credibility for the paper industry through face-to-face meetings of our committees with the assistant secretary of labor for OSHA, with the director of NIOSH, and with other top officials. Dr. Yerg of American Can, a member of the Safety and Health Subcommittee, has been nominated for a seat on the National Advisory Council for Occupational Safety and Health.

The Chemical Control Committee, through its work with Congressional committee staffs, was effective in having the language of both Senate and House versions of the Toxic Substances Act changed to relieve processors of chemicals from most testing requirements. Originally, the legislation would have required processors (such as paper companies) to perform the same testing procedures as the manufacturers of chemicals.

A special task force of the Safety and Health Subcommittee has provided useful input to economic impact statements on the proposed standards for tin, lead, ammonia, chloroform, and other chemicals.

Representatives of the API Committees have met with NIOSH and have influenced the development of protocols and plans for the noise study in Ohio and the mortality study in the northwest.

The Safety and Health Subcommittee has also been involved actively with the Department of Labor in a complete rewrite of the basic general safety standard for the industry, known as P1.

There is no question that the industry is in a better position today because of these activities.

Looking to the future, the leadership of these committees is concerned about the industry's ability to meet the increasing need for effective interface with government on these matters, especially with regard to noise and the development of chemical standards.

They are frequently handicapped by a shortage of qualified people to testify at hearings, to attend meetings, and to gather needed information. There is limited data now available from member companies to gauge the potential impact of standards and to challenge government assertions. Gathering and organizing that data requires the time of skilled people. The perception of these API committees is that most companies are inadequately staffed to handle their own safety and health needs and also to carry their share of the industry effort. The principal burden so far has been carried by relatively few companies, and they cannot meet the developing needs without help.

Their plea, for the present, is that you and your counterparts in other major companies, assess the resources being applied to these matters in your companies, and assure yourselves that there is adequate qualified, technical staff (including chemical and medical personnel) not only to meet your internal needs, but to gather information at API request, to serve on ad hoc task forces, to participate in the API interface with government, and to develop needed educational programs. I might add that much of the data needed for these purposes will also be required or will be useful in your environmental compliance programs.

The committees are not at this point recommending additional API staff to deal with these problems, although the need for that may come quickly. In the meantime, they feel that the most cost effective program will be one in which member companies accept their responsibility to provide the required talent and information, and API through its existing staff uses those resources to accomplish industry goals.

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THE BACK INJURY — WHEN DID IT REALLY HAPPEN?

By JOE BEAN, CHCM
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When did the back injury really happen? This is probably a strange statement in some ways but when you analyze what we are really talking about, it becomes apparent that there is some reason to doubt some of the alleged job-connected back injuries as to the time they really took place. How many times have you seen an employee come in on a Monday, bent over and twisted, saying to you or your First Aid department, "I hurt my back, last Friday." When you ask him, "Well, did you report it to First Aid so that we could do something about it?" invariably they say, "No, it didn't bother me too much at the time, but it started hurting bad over the weekend." At this point you probably begin to wonder: did this person really hurt it on the job, or did he hurt it over the weekend? Chances are, after you look at a lot of alleged job-connected back injuries, you will find that the guy probably did begin to hurt somewhat while he was on the job at some time. But, is that really where it began or was it just simply coincidental with the fact that it was on the job when his back began to hurt? We find that people automatically assume that simply because it began to hurt while at work, that is the cause of it.

In looking at the overall statistics, especially in light of a ten-year study, we find that there are many other things that can cause back pain; in fact, it has been stated by several people who have become knowledgeable in the field of low back pain that most of the injuries are not truly back injuries; rather they are a simple process of degenerative disc disease, occasionally urinary tract irritations, and any number of other things that produce symptoms of pain in the low back.

To give you some idea of the magnitude of the problem as it affects industry in 1975 and in 1976 there were in excess of 600,000 alleged job-connected back injuries. You may be wondering why I keep saying "*alleged* job-connected back injuries." I put it that way because it has been shown that actually only four per cent of all of those alleged job-connected back injuries can be attributed to some specific incident, such as a slip, trip, or fall, or sudden blow to the back or a strain of some kind that you can say it happened at this time and in this particular case this is what happened.

In looking at first aid records at the mill where I work, I find that I haven't actually been able to discover, in the five years I have had the program, a back injury that actually happened when the person said it did. In order to clarify what I am talking about, a person comes into First Aid complaining of back pain and says, "Well, I was lifting something yesterday, so it must have happened then." But on close examination of this person's first aid history, going back to when the individual was hired, we indeed find that in every case we have examined thus far there is a history of low back pain, both on the job and off the job, and we can attribute not just one but maybe several possible causes as documented in our first aid records. We send this person off to a physician and he is diagnosed as acute lumbar sacral strain. What do they really mean? It means simply that the guy's back hurts, he has had a strain, and a lot of doctors—some that we use and some that you use—are inclined to attribute the injury or the suspected injury to the job. It is a cop-out, and in a lot of cases we find that the doctors simply take the patient's word for what happened.

In a recent case we sent a man to a physician, and the man dictated in one form or another his work activities that involved some back strain over the last five months. In reality the man, looking at his first aid record once more, had a history that went all the way back to 1963. The patient himself cannot say exactly when it happened.

To explore this in a broad spectrum, let me ask a few questions. How many of you will admit to being older today than you were last week or even yesterday? If you are willing to admit that you are somewhat older today than you were last week or even a year ago, you must also admit that the rest of your body is older too. You can look in the mirror and see that you are older than you were a year ago. You must recognize that your heart is getting older, your lungs are getting older, your entire body and indeed your spinal column or your backbone is getting older too.

There are two basic causes, as far as I am concerned, for low back pain. I am talking about the compensable type, the kind that we really should be addressing ourselves to, and they are these: As we get older our spine begins to wear out. From age alone we get some wear and tear on our back. The other is our work habits. You have the power to prevent a large portion of the back injuries that are taking place within your plants. First of all, your backs are going to hurt, your employees' backs are going to hurt as they get older, it is perfectly normal, but also by poor lifting habits we are abusing our backs. When I say we, I am talking about all people.

I mentioned a moment ago that most of the back pain and problem we have associated with back pain comes from the lumbar or the lower back region, and we know that most complaints in your plants will come from that same region. Most of your compensation costs go to support that same complaint, and it is truly the nation's number one industrial injury problem, but it is one that you can actually deal with in large measure if you understand what you are dealing with.

The spinal column disc incidentally is filled with a gelatinous fluid under extremely high pressure. Surrounding this disc are bands, like rubber bands, if you will. They wrap around the disc and keep it tight, and the disc is much like an innertube in a tire. Every time you bend over and straighten up or lift something incorrectly, you are getting a little tear in the outer bands, and for every time you lift something incorrectly in this fashion there is someone up there putting an "X" alongside your name.

Someday, perhaps in the simple act of picking up a piece of paper or a pencil off the floor, or reaching for a towel in your bathroom, or reaching for the soap in the dish you are going to be caught with tremendous pain. You are going to get the last tear you ever have. Twenty-five per cent of those who have not had back trouble are going to have back trouble tomorrow, the next day, next year, or sometime in the future unless you follow some very simple basic principles to prevent back trouble.

Let's talk about the physics of the situation. Your spinal column has a basic function: it supports your head, your shoulders, it supports your ribs, and as a side benefit, it supports some doctors. It is not intended to be a crane; however we use it for that. How can we prevent simple low back pain? At this point, I will just simply say, "Bend your knees." But I want to go beyond that and tell you why you should bend your knees, and then we will come back to it and tell you even more why you should bend your knees.

When you bend at the waist, you are actually flexing in the area between the lumbar 4 and 5 region of your back and you know very well, if you have handled back cases before, most of your complaints are going to be in the lumbar region and most of them are going to be a disc disturbance between L4 and L5. The reason you have all this trouble there is simply that you have a 10 to 1 ratio. For

everything you pick up, you are not actually picking up that weight when you bend at the waist; you are picking up 10 times that weight. The discs in the spinal column, on a normal healthy adult male of approximately 20 years of age, have a breaking strength of around 1500 pounds. That sounds rather substantial, I know. Suppose you have a weight on the floor that weighs 50 pounds and you bend from the waist, reach down, pick it up and straighten up—50 pounds. If, as I have said, it is a 10 to 1 ratio, that is 500 pounds. You say I have another 1000 pounds to work with there, but this is not true.

What we are leaving out is this: first of all, we are getting older. By natural age alone, the breaking strength diminishes.

There is another very important factor. Suppose we pick up a pen, which may weigh an ounce; so if we say 10 to 1 it weighs 10 ounces. You haven't picked up very much, but let's think about this for a moment. You have picked up the pen plus the trunk of your body. This is part of the weight, too, and assuming that your trunk weighs 100 pounds, you picked up 1000 pounds even if you didn't remove anything from the floor. One thousand pounds have been brought up without exerting any effort to pick up anything else from the floor.

Now we begin to see the seriousness of the problem, that we must deal with our own body in the form of a 10 to 1 ratio. People lift in the wrong way. They lift in the quickest way, not the simplest. The quickest way is to bend over at the waist and pick it up; it is all one movement.

The simplest way is to bend your knees. It is just as easy because it is simultaneous. When you bend down and bend your knees you are not using just one fulcrum. There are toes, ankle, knee, hip, elbow, wrist, perhaps even a seventh wedge, the shoulder. In addition to that, we are using the muscles down in the lower portion of our leg and the two strongest muscles in your entire body in the upper portion of your leg. All that down one side, times two, because you are using both sides. You can see the tremendous difference and the potential lifting power a body has when it is used correctly.

I recognize today that bending your knees is almost a cliche, it has been used so much. In fact, it has been used so much and talked about at such great lengths in industry over the last 30 years that it really is a cliche.

You have heard the straight back, bent knees method is by far the best way to lift. But I am afraid that we have heard it so long and it has become so routine that we ignore it. This is born out by statistics. There has been no appreciable change in the number of alleged job-connected back injuries. We must recognize that people are not bending their knees and they are not lifting correctly either on the job or off the job. And you know when someone working with you or for you comes in and says, "I hurt my back on the job," what he is really saying is, "I hurt my back, I am saying it is on the job, and I want to know when the compensation gets started, what you are going to do for me and when you are going to do it."

When we accept the fact that there was something like 630,000-plus alleged job-connected back injuries in 1975 we must accept the fact that there is tremendous compensation cost. Compensation costs were in excess of one billion dollars. There doesn't seem to be an appreciable decline anywhere. It costs money from your compensation rates, or if you are self insured, as we are, it is a tremendous expense, but that is only one consideration. Granted, it is a tremendous one, and when you take dollars off the front end of your net profit in a manufacturing situation it is tremendous.

But there is one factor that we haven't talked about in this. Of all of the cases that I have ever had the occasion to work, from the standpoint of picking someone up who has a back injury, these are the most painful ones I have ever witnessed. I must in all frankness say that they have been more painful to the point that I have never seen anyone in more pain,

regardless of the injury they have had, and I would have to include arm and finger amputations and heart attacks.

Imagine, if you will, all of a sudden while you are bent over or straightening up you have the equivalent of 40,000 volts of uninsulated electricity jolting down your left leg or your right leg, whichever side that disc may be leaking from, and you all of a sudden are on the floor in agony. I have picked up people who were cursing and screaming and pleading for relief when there was no relief there for them until we get them to the hospital. It has to be the most excruciating pain I suppose that one can endure. I have picked up people in the mill ambulance, using the backboard, never taking them off the backboard all the way to the hospital. I would have their trousers up about the knees grasped up in a fashion, holding their knees up trying to give them some relief, trying to keep them from toddling around somewhat in the back of the ambulance. Nowhere have I seen such pain exhibited as I have in these particular cases. It is preventable, to a certain degree.

I mentioned a moment ago that some 25 per cent of you are going to have back trouble. Think back for a moment—did you ever jump off a barn with an umbrella when you were a kid? Did you ever do a lot of horseback riding? As an interesting sidelight, the method of doing sit-ups, even the simple act of doing sit-ups which everybody had to do back in the P.E. classes, you put a strain upon that back, you paid a price. Some P.E. programs in some schools have eliminated the sit-ups in the old fashioned way because of this one problem.

For a moment we will look at what actually takes place when someone has gone beyond the simple lumbar sacral strian and a disc begins to leak. You have heard the saying, "The guy has got a slipped disc." There is no such thing as a slipped disc. It is not going anywhere. The disc and the fluid inside, what is left of it, simply are obeying the laws again of the physics of the matter. As it begins to leak down it spreads out and in turn allows these spinal segments to get a little closer together until all of a sudden it is "POW" and you have a ruptured disc or you have one that has leaked down sufficiently that all of a sudden you are in tremendous agony, and the back muscles just knot up. As you are well aware, one of the basic things you do for back trouble is to start out using muscle relaxants. You get an irritation there and your back muscles tend to reflex and tighten up to protect that thing. It is a natural defense mechanism, although an incorrect one. These muscles tighten up, and as the patient tries to move and get more comfortable again, these muscles try to compensate for it and again it makes the situation worse, so the first thing they have to do to relieve the situation is give muscle relaxants so the spinal column can be freed somewhat.

The cause of the irritation is that your body will begin to build arthritic spurs to bridge this gap that is beginning to diminish here. This again is a natural defense mechanism; this again is an incorrect one. The body is rebuilding and trying to protect this injured disc, and there is really nothing you can do for it because once it is done there is no turning back, there is simply no turning back. You can build the muscles up, you can manage the situation, but there is no blood flowing to the disc or to the spinal column in this particular section, that will allow it to rebuild.

What I am really saying is this: once you get back trouble it never gets better; it gets worse, or you can manage it. I know a person who has had a mildly ruptured disc for years. This particular person plays tennis, he plays golf, he does all of these sporting activities. He manages his condition and he exercises and he maintains good muscles in his back, but most people recognize the fact that it gets worse and they tend to let it get worse, and really it becomes a situation where the patient himself feels like he is never going to get any better, and although that is a psychological outlook it is a fact—he

is not going to get better.

What we must do to help this situation, and I am talking about you, I am talking about me, is to prevent the back injury. We can do it if we remember that the back is not made to lift with, the spinal column is not intended to be a crane. We know that man has had back trouble since he first stood erect. It is not my intention to try to make you believe that I believe that man descended from apes, this is not the case in my judgment. We know for a fact that man at one time did walk about on his all-fours, and that when he finally stood up, he began to have back trouble. Man is the only animal that has back trouble and he paid a price for standing up. He paid it with low back pain, with cervical back pain, with varicose veins, with hemorrhoids, with phlebitis, and so on.

You can prevent, for the most part, low back pain and back injuries by simply bending your knees. It is so simple that we tend to ignore it, but it can be done, and indeed you owe it to yourselves, to your family, to the people that you work with to keep on stressing that they can prevent the unnecessary back injury by simply bending their knees when they lift. The needless pain and suffering that goes with the back injury can for the most part be eliminated if we simply bend our knees. When you lift, bend your knees.

In summary, remember that the largest single item of job-connected or allegedly job-connected injuries comes from the back injury. It is so overwhelming that this country spent over one billion dollars in compensation costs in 1975 and in 1976. The injury, in terms of pain to the individual, is beyond description. Low back pain or the low back injury for the most part, if it is truly job-connected, and if it fits in to that four per cent category, can be prevented, and you have it in your power to prevent it by insisting that your people, when they lift, bend their knees.

THE OTHER HEARING PROBLEM PRODUCED BY EXCESSIVE NOISE EXPOSURE

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It is common knowledge that constant exposure to excessive levels of noise will produce hearing loss. Even though many know of this problem, they are nevertheless reluctant to take the necessary protective measures to prevent damage to their hearing mechanism. Some seem to feel that, inasmuch as aging will also cause hearing loss, it is a waste of effort to protect against loss of hearing from excessive noise. What they fail to realize is that so often a 30-year-old worker can easily have 65-year-old ears—and what will his hearing be like when he really reaches 65? Just because we are very likely to lose some of our hearing as we get older does not mean that one should accpet the inevitable, the production of aged ears, at an earlier age. These insults are additive, and the accumulation of noise damage plus aging can lead to a far greater handicap than that due to aging alone.

The loss of hearing ability is something that most people cannot imagine. It is easy to imagine what it is like to be blind; we have only to close our eyes. But we cannot in a like manner turn off our hearing. We do not have an on-off switch for hearing. We only come to really know what a serious matter hearing loss can be when it is too late. And why is hearing loss a serious matter? Because it is primarily, if not exclusively, through hearing that we are able to communicate with our fellow man. Without the ability to communicate, we immediately encounter all kinds of problems, the extent of which is impossible to develop here. Think about it—imagine not being able to understand the spoken word! Imagine not being able to appreciate music! Think of the void in which one would live if one could not exchange ideas, thoughts, and wishes.

With hearing being so important, it is interesting that the initial effects of excessive noise exposure can easily go undetected. Hearing damage due to noise overloads starts in the high frequencies and then gradually and systematically works downward into the lower frequencies. Since we use our hearing mostly to receive speech sounds and since those sounds only extend upward to 3000 to 4000 Hz, the loss of higher frequencies is most apt to escape our detection. In the beginning, the human can hear to about 20,000 Hz or even more. If it is in that frequency region that acoustic damage first starts then it is easy to understand that excessive damage can escape detection. Regular hearing tests do not test above 8000 Hz; often, routine hearing tests do not go above 4000 Hz, so that even where hearing tests are performed on a survey basis it is still possible to miss a great deal of hearing damage. In those industrial areas where sound levels are necessarily high, it would be very important to test the high frequency hearing of workers. The one commercial company offering high frequency hearing testing equipment has not received the attention it should.

The Other Hearing Problem

As if the loss of hearing ability is not serious enough, there is another effect which can be more serious, and that is

ringing in the ears or tinnitus. Imagine a loud, piercing, screaming, shrill ringing in your ears that is constantly present—a ringing that goes on 24 hours a day, day in and day out. Not only is tinnitus extremely disruptive, but it interferes with almost all normal life activity. It has led to loss of job, disruption of family life, divorce, and even suicide. In its severe form it is one of the most debilitaitng afflictions known to man. And it has a very high probability of accompanying hearing loss produced by noise overloads.

We have a tinnitus clinic at the University of Oregon Medical School in Portland, Oregon where the study of tinnitus is conducted. Because the lumber industry is prevalent in that region, we see lots of patients with hearing loss and tinnitus. H. H., one of the first patients to come to our Tinnitus Clinic expressed the problem very well. He said: "They told me I might lose a little hearing, but since that happens from aging anyway I did not bother about wearing ear plugs or hearing protection. If, however, they had told me about this ringing I have, I would have done anything to prevent it."

H. H. has a high frequency hearing loss in both ears. Before discussing his tinnitus, one comment about his kind of hearing loss is in order. Because his hearing loss is primarily high frequency loss, he had little trouble hearing and understanding speech. That is, providing there was little or no background noise, he could understand speech. In the presence of other conversations and other noise, he could not understand speech, and no one had explained this to him. Since so many social situations include multiple conversations and lots of background noise, patient H. H. had long since given up going to restaurants, taverns, church socials, and the like. Indeed, he was well on the way to becoming a recluse for whom life offered little pleasure—and at the age of 35! And then when the ringing started he felt that everything had turned against him.

The frequency of 1400 Hz produces a tone which nearly matches that which he constantly hears as his tinnitus. Also, his tinnitus is located within the region of the hearing loss. Because the hearing loss and the tinnitus were in the same region, and because the tinnitus was not of too high a pitch, we were able to effect a great deal of relief for this patient. He was fitted with two hearing aids which were adjusted to emphasize the higher and not the lower frequencies. In this way he was now able to hear normal ambient environmental noises so as to mask or cover up his tinnitus sounds. Needless to say, his everyday hearing was greatly improved so that he cound hear speech even in most noisy situations.

Patient H. H. also began to religiously protect his hearing while at work. One almost guaranteed way to make tinnitus worse is exposure to loud sounds. The story of patient H. H. has a happy ending, but since his problem could have been prevented, what a shame it happened at all.

In industrial and military situations where sound levels are excessively high one often hears the terms "tough ears and tender ears." Whether or not there is such a sharp dicotomy is doubtful. It is true, however, that people vary in their susceptibility to noise damage. With careful attention, one could probably find a continuum of susceptibility to excessive noise. Interestingly enough, we see some patients with essentially normal audiograms who are nevertheless afflicted with tinnitus. Some of these patients have been exposed to acoustic overloads but have not experienced hearing loss—at least, not as presently measured. Regardless of how the tinnitus was produced, these patients presented the problem of what to do for their tinnitus. Obviously, we could not fit them with hearing aids, as we had in the previous case. For these patients, we undertook to provide a different from of masking. To do this, we deliberately introduced a narrow band of noise into the offending ear. The volume of the masking noise was increased by the patient until their tinnitus was completely

covered by the external sound. The masking device was built into a hearing aid case so that it could be owrn behind the ear like a hearing aid. In this manner, the Tinnitus Masker, as we came to call it, could be used on a daily basis. To date, there are several hundred patients wearing Tinnitus Maskers and experiencing complete relief of their tinnitus. We emphasize the word "relief," because masking only covers up tinnitus—it does not cure tinnitus. Masking of tinnitus is much like the use of aspirin to relieve pain; the distress is gone, but the cause is still present.

The Tinnitus Masker was not effective in all cases of tinnitus where it was appropriate to try the masking device. Gradually we came to realize that where the pitch of the tinnitus was too high, the use of the Tinnitus Masker would produce less than total relief and in some few cases made things worse. As it turned out, the problem was a technical one. The Tinnitus Maskers had been built from hearing aid components, and the sound-producing transducer used in hearing aids produces little acoustic energy above about 4000 or 5000 Hz. Thus, if a patient had tinnitus at, say, 7000 Hz or 8000 Hz the Tinnitus Masker simply did not produce enough energy in that region to mask the tinnitus.

The majority of patients have tinnitus within the region of 2000 to 4000 Hz. But there are some at higher frequencies of 5000 to 7000 Hz. In the rare case of even higher pitched tinnitus, we believe that the sound of the Tinnitus Masker can trigger or exacerbate the patient's tinnitus. Because of this effect we have urged the construction of maskers capable of producing more energy in the higher frequencies. The Tinnitus Maskers are made by the Vicon Hearing Instrument Company of Colorado Springs, Colorado. They have expended a great deal of effort and have been successful in developing two new high frequency maskers. One of these can be worn behind the ear, as is the regular unit. The other, which is capable of frequencies even above 10,000 Hz, is built into a set of earphones. With these high frequency masking units we anticipate helping more tinnitus patients in the future.

When Neither the Hearing Aid or the Tinnitus Maskers Work

Like most things involving humans, tinnitus patients do not neatly divide themselves into two precise groups. For example, we have found tinnitus patients with a hearing loss for whom the hearing aid was inadequate. Typically, these patients experience improved hearing but less than complete relief of the tinnitus. When these same patients were tried with a Tinnitus Masker, it, too, failed to provide complete relief of the tinnitus. It appeared on the one hand that there was insufficient high frequency ambient noise in the normal environment for the hearing aid to work. On the other hand, when we deliberately introduced high frequencies with the masking device, the patient's hearing was not adequate to receive it. The solution was obvious—a combination unit, a hearing aid plus a masking device. Such a unit, called the Tinnitus Instrument, was developed for us and is now successfully in use.

The Tinnitus Instrument requires a great deal of effort for proper adjustment and a great deal of attention from the patient. The Tinnitus Instrument is fitted and adjusted according to the patient's hearing ability. It is then the task of the patient to regulate the gain of the hearing aid and the volume of the masking portion so as to achieve a proper balance which will provide masking of the tinnitus and adequate hearing.

Directions for the Future

There is one dramatic effect of masking which has not yet been mentioned. It is the condition of what we call "residual inhibition." In many cases, tinnitus can be masked so that the patient is totally unaware of it. In that situation, when the masking sound is removed the tinnitus does not immediately return. Instead, there is a brief blank period of no tinnitus,

then it reappears and gradually grows back to its full and usual extent.

The awareness of tinnitus is reduced from 100 per cent to 0 per cent by the masking sound. That masking sound is then maintained for a set period of time. We characteristically use one minute of masking for testing in the clinic. After 60 seconds of masking, the masking sound is removed and there follows a tinnitus-free period lasting about 20-30 seconds, after which the tinnitus reappears and gradually increases over the next 30-40 seconds to its normal level.

The interesting point is that not all tinnitus patients display residual inhibition. For some, removal of the masking sound produces an immediate reappearance of the tinnitus. Does that mean that there are several kinds of tinnitus? One kind that displays residual inhibition and another kind which does not? Or does it mean that the masking we selected was improper for those cases failing to show residual inhibition? We tend to believe the latter, and for this reason: Patients wearing hearing aids usually hear the tinnitus immediately upon removal of the hearing aids, although the tinnitus was completely masked when the hearing aids were in use. Patients wearing Tinnitus Maskers often report extended periods of residual inhibition upon removal of the units. In some cases, the residual inhibition can be a matter of hours and in a few even lasting for days. We believe the difference lies in the fact that the Tinnitus Masker produces sound more nearly restricted to the frequency region of the tinnitus. Tinnitus can be masked by sounds which are very unlike the tinnitus if those sounds are but loud enough. It is our belief that residual inhibition depends upon efficient masking restricted to the frequency region of the tinnitus. Clearly, one of the directions of our future efforts will be to improve upon the incidence and duration of residual inhibition.

Tinnitus and Risk of Exposure to Noise

In closing, let us return to the notion of "tender" and "tough" ears. A great deal of work has been expended in the past to develop procedures for picking out in advance tender and tough ears. Measures of temporary hearing loss were found to vary from person to person, all being exposed to the same acoustical overload. This procedure held high promise for the needed predictor of tender vs. tough ears, but it failed.

It is the case tht the incidence of tinnitus varies greatly for individuals presumably exposed to the same auditory insults. A temporary form of tinnitus can be induced by controlled noise levels. Thus it is an interesting question to speculate whether those who easily acquire tinnitus are also the ones who have tender ears? Studies of tinnitus, coupled with measures of hearing thresholds, including those high frequencies above 8000 Hz, may come to produce screening procedures which will indicate the high risk individuals.

RESPIRATORY ABNORMALITIES AND APPROPRIATE CONTROLS

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Working with wood conjures up a picture of healthful exercise in a clean environment and of robust individuals in the pattern of Paul Bunyan. "It ain't necessarily so," although it most commonly is. There are at least three, and possibly more, types of deleterious respiratory effects associated with wood work. The one which I became aware of first was bronchial asthma. Asthma is, of course, a hypersensitivity reaction which may occur in response to any one or any combination of a host of materials. It is very commonly produced by inhalation of an allergen. The first case of which I am aware was reported in 1949[1] in an English cabinet maker with a number of years of experience before he began work with some South African varieties of wood. He sought treatment when he became largely incapacitated by respiratory difficulty. In this instance, skin tests showed strong specific reactions to Western Red Cedar (Thuja Plicata) and Kejaat (Pterocarpus angolensis) and appropriate treatment with extracts of these woods desensitized him. This seems to have been in some ways an atypical case.

There have since been a number of reports in the literature which have implicated a number of other wood dusts or other parts of trees in the production of similar conditions. Woods which have been implicated are oak, mahogany, western red cedar, boxwood, cottonwood (which may cause hay fever) and balsam fir.[2-7] The species which has been studied the most is western red cedar.[8] In this study from British Columbia, 22 woodworkers were seen who had respiratory symptoms after exposure to the dust of western red cedar. Eighteen of them reacted with asthmatic attacks or asthma and rhinitis to the inhalation of extracts of western red cedar. The asthmatic reaction might be immediate or delayed for several hours after the inhalation test, or both. Only three of these people reacted to skin tests with the wood extracts. None of them showed signs of any respiratory condition other than obstructive bronchial disease or rhinitis. As part of the study, plicatic acid was extracted from the cedar wood and demonstrated to be the specific antigen producing the asthma.

There is no real indication of how common hypersensitivity to wood dusts may be, partly because only a small minority of the cases of any condition seen find their way into literature reports and, more importantly, because asthma is not really an uncommon condition in the general population. It is probable that most cases of asthma due to wood dust are never properly diagnosed, especially since skin tests as commonly used in allergy testing seem to be of relatively little value in the diagnosis of respiratory sensitivity to wood. On the brighter side, it seems that these conditions are reversible on cessation of exposure, although it may take several months. Some individuals may be desensitized by treatment with the appropriate wood extracts, and symptoms may be controlled in some individuals by medication. Since there is no very strong dose/response relationship in people who have become sensitized and symptoms can be elicited by inhalation of the dust or extracts of the dust even in very small amounts, it is not likely that dust control measures will be of much value for people who are sensitive. Dust control might help to prevent new sensitizations. One thing which seems certain is that direct irritation by the wood dust is not the cause of these

conditions, and no cases which were not reversible either on cessation of exposure or by treatment have yet been reported, in contrast to the situation with the next group of conditions.

The type of respiratory problem which arises from things living on the wood seems to be rather more common than that arising from the wood substance. This is a pneumonitis which has been variously called farmer's lung, baggassosis, pigeon breeder's disease, maple bark disease, wood-pulp worker's disease, and sequoiosis, depending upon the immediate source. It was apparently first reported in woodworkers in 1932[9] as a severe bronchial asthma due to fungus spores found in maple bark. It happens that, at that time, the term asthma was used for a number of respiratory conditions which are not now considered to be asthma and this was one of those conditions. Asthma is now considered to be only obstructive bronchial conditions; that is, conditions which produce trouble in exhaling. It was recognized rather soon that this condition was an interstitial pneumonitis with granuloma formation [10, 11] which can be visualized on a chest x-ray and that the spores of the various fungi can, under the correct conditions, be seen in and cultured from lung sections. In Maple Bark disease the particular fungus is cryptostroma corticale. The fungi causing other diseases are alternaria in wood-pulp workers' disease,[12] thermopolyspora polyspora in farmer's lung[13] and probably a graphium or auerobasidum pullulans in sequoiosis. The things to really remember about these conditions are that they are all produced by breathing the dust from moldy wood, they can all be highly disabling because of the cough and shortness of breath which they produce, and they all can produce irreversible and sometimes fatal changes in the lung. The lung changes are not always permanent. If the individual is removed from the exposure early in the disease, before scar tissue has formed in the lung, the condition will reverse itself and the offending spores will be cleared out.

These conditions, both the asthma and the pneumonitis, are caused by dust in the environment, so the obvious control is to remove either the person or the dust. The first option should not be interpreted as meaning only finding the affected person a new job. That is self-defeating, because it amounts simply to spreading the risk to more people, many of whom will probably be susceptible. Viable options in many instances are such things as putting a chipper or debarker operator in an enclosure ventilated with filtered air or with air from an uncontaminated source.

Control of the dust need not be concerned with sawdust or shavings; they are not inhalable. The dust which does the damage is that which penetrates to the most remote parts of the lungs, the respiratory bronchioles, alveolar ducts, and alveoli. The particles are ten microns (0.0004 in.) or less in diameter and quite invisible to the naked eye. On jobs where water is not a problem, as debarking or chipping, this dust can be controlled by doing the cutting under a spray of water containing a wetting agent so that the dust is trapped in water droplets. For operations which must be done dry, such as planing, sanding, and sawing, the only available dust control is an enclosing ventilated hood, but at least on these operations, with the exception of headsaws, there is no problem of fungus spores.

There have been, in addition to the diseases I have mentioned, several reports in the literature of excessive cancer in certain groups of woodworkers. These have been concerned primarily with an excess of sarcoidosis in wood workers in the eastern half of the United States.[15] This has been attributed, on the basis of less-than-conclusive evidence, to exposure to the pollen of pine species growing east of the Rocky Mountains. The thing which has been established is that workers in the wood industry in upstate New York have about twice the normal chance of dying of Hodgkin's disease. What has not been really established is the relation of this statistic to occupation. It would be a useful exercise for the wood products industry to make a definitive, retrospective study of the possible connection between the disease and occupation. At this moment, the cause or causes of Hodgkin's disease are not known, except for the hypothesis that some of it may be occupational. That hypothesis is mostly based on the study of secondary sources of information.

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Textiles Sessions

EMPLOYEE REHABILITATION — REDUCING INDUSTRIAL INJURY COST

By W. T. WILEY, JR.
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Some wit once observed that "The only difference between a rut and a grave is their dimensions." His observation is not without significance.

It is so easy to allow oneself to get in a rut, to lose one's zest for action, to permit the humdrum of existence to become a life style. Then all our enthusiasm is gone and, in a sense, the grave is our portion all too soon.

We remember a man who had lost his job and to whom we were expressing sympathy for his misfortune. After listening to our condolences a bit, he looked up and said, "But remember this: I'm not dead." He had not given up. He held on to his ambition to succeed. He had no intention of falling into a rut of despair.

For us, then, a moral can be cited. To enjoy life to its fullest, one must never lose his enthusiasm. One must never allow the discouragements which come to everyone to take charge of things, for, as the saying goes, "The only difference between a rut and a grave is their dimensions."

You look at me and say, "Now, that's a nice little story, but what in the world has that got to do with reducing industrial injury costs?" And I say to you, it has a lot to do with reducing injury costs. Not only that, but it has a great deal to do with how our behaviors are regarding anything in which we are involved.

But let's keep our thoughts and remarks centered around safety and how we can go about reducing injury expenses. It is so easy to get into a rut as far as industrial safety is concerned. Oh, it is no doubt that we are using all the catchy little phrases concerning safety that we ought to be using, or using all the cute little safety posters—why, we've even gone so far as to include hourly employees on our plant and office safety committees. And Lordy, mercy! We even showed a 12-minute safety film to all our fork lift drivers. Please, don't think I'm making light of all these things. These are all absolutely necessary ingredients that make up a good, ongoing safety program—these and a lot of other innovative ideas I'm sure every company has used to ensure that there is a keen awareness of every employee that safety is no accident. See, there's another one of those catchy little phrases.

Sure, it's easy to say the way to reduce industrial injury costs is, simply, don't have any injuries and accidents and it won't cost you anything! That's generally what we all say; at least, we do.

But, what do you do when you have an injury, particularly when it is a lost time injury? Do you do what we used to do: "Boy, I knew old Lennie would get hurt sooner or later, I've told him time and time again, don't be a lint picker. But he wouldn't listen. Now he'll be out of work for at least 6-8 weeks, maybe even longer, cause I sure don't have any light work for him to do, and I don't want him back in here until he can do his regular job."

Does this sound familiar to you? We know right now our injury costs are off to a flying and painful start. We all are fully aware of how much accidents cost us, not to mention how they psychologically affect us and the employees and their families.

This is about the point when we realize that we are in a rut. Sure, we think we're doing everything we know how to do about safety, and we've been working hard. Initially, we started trying to pinpoint all the hidden costs—costs that can't be measured, such as employee

morale, fellow employees' morale, off-quality, employment replacement, etc., as well as soaring medical costs and the cost of workmen's compensation. We were convinced that when an individual was hurt we needed to do something more. We had an obligation from the employee's standpoint to help him get back to gainful employment, in addition to reducing our injury costs.

How do we do it? The first thing we did was assess our present system. We tried to evaluate everything we were doing. We realized also that medical costs were ballooning, and obviously this gave added impetus to our desires to make some changes. Then someone asked the question, "Why can't we bring Lennie the Lint-Picker back to work? Not put him doing some meaningless task or counting flies on the wall, but something less than his regular job." Good question. Why shouldn't we, with the doctor's approval, rehabilitate Lennie on the job rather than having him lay around the house waiting for 100 per cent capacity and then return to work.

Beginning with this as our premise, we decided to pick one of our plants as a pilot plant and received total cooperation and support from the management with the proposed rehabilitation program.

The first thing we did was have line management pick some jobs in their department that they thought could be used as rehabilitative jobs. Industrial engineering wrote job descriptions, elaborating on requirements such as lifting, bending, sitting, standing, and stooping, and the approximate amount of time required in each function. They rewrote the descriptions in a manner that laymen could understand and included illustrations picturing the tools or equipment with exact weight and dimensions.

The next thing was to develop a list of doctors and attorneys who have been involved in our workmen's compensation claims. Armed with our new enthusiasm and philosophy about rehabilitation, we started visiting our doctors and attorneys, especially those who were defending the plaintiffs.

We realized at the outset when we were developing the premises for our rehabilitation program that this thought was about a 180° turn from where we were. It was not so much that we didn't care about rehabilitating injured employees or that we hadn't thought about their needs and desires. We had continued in our same old rut of accepting the erroneous premise that there is no such thing as "light work" in the textile industry. The error in this thinking is that you become hung up on the light work principle and not in thinking that light work or, better still, re-engineered jobs could be and are rehabilitative.

By continuing in the old rut, you very often chance the consequence of meeting ol' Lennie-Lint-Picker in court, because he usually is exposed to some very smart and wise family counsel who tells him, "You'd better get a lawyer."

It's really exciting to go into an attorney's office who has been on the other side of the fence from you and explain to him that you don't plan to see him in court tomorrow or the next day because your employees will have a job from now on when they are injured. Obviously, that statement isn't totally accurate because there will always be someone who is legally or physically totally incapacitated. The intent, however, is to assure employees that they will have a job.

The response from the doctors we went to see was overwhelmingly favorable. When they saw that efforts were being made to truly aid injured employees in a speedy recovery, they were quick to accept our proposals and willing to work with us in modifying the jobs we had selected as rehab jobs to fit the limitations of our injured employees.

Now, there is only one big hurdle left to clear: You must convince your employees that what you are trying to do is for their best interest. Psychologically, seeing an employee come hobbling into a plant can have a negative effect on some employees but a positive effect on others. Employees need to be informed of what the com-

pany's trying to do and why. All employees need to know and be aware of the fact that you need to provide a safe place to work and that they and you must work together as a team in reaching that goal. But they must also know that in the event they do become injured that they will still have a place on your payroll and that you will help them through their rehabilitation period.

One incentive that we use is to provide the employee, who has been released by the doctor, a rehab job that pays him more than he would receive on workmen's compensation but less than what he would receive if he were performing his regular job. We have discovered a couple of things by doing this. It aids in helping the employee in maintaining his sense of belonging. He also feels that even though he is temporarily handicapped, he is still making a contribution to his job and his fellow employees. Most of all, he is not lying at home feeling sorry for himself and worrying the heck out of his wife.

Converse to this line of thought, we have on occasion the employee with an injured back—you feel, and so do his fellow employees, that he is the proverbial malingerer. Most doctors will tell you that back pain is a fact of life. That it is sometimes mystifying when one tries to pinpoint a specific ache or pain that it is nearly impossible to prove or disprove. This we know and understand. But with the doctors who know and understand the rehab program, we have had a good deal of success in getting these employees back to work and again into gainful employment.

With this type of program and the rigid job descriptions that are used, it is absolutely necessary that all management employees, particularly the front line supervisor, be committed to giving it their fullest support and cooperation. Once the coordinator of the program, the doctor, and the supervisor have agreed on a particular rehab job, the description of that job must be followed to the letter. Nothing may be added to the job without approval of the coordinator and the doctor. This in itself may be one of the most important points of emphasis in helping the employee know that we are looking out for his best interest.

We are not suggesting that we have established "walking wounded wards" nor do we ever intend to do that. We are suggesting in fact that the majority of people don't like to be hurt or in pain and that the more we can do to help them to a safe and speedy recovery the more likely we are to have a happier employee and a less costly injury.

One area of caution is that you must be careful to rehabilitate only those injuries that occur on your premises. You must be extremely careful in accepting accidents. The most invaluable manager that a company can have is an industrial nurse. She alone can reduce your injury costs, but she should be used as your rehabilitation coordinator. She is not only well-trained but has been blessed with the ability to find out the truth when talking to employees about injuries. Maybe it's her white uniform that establishes credibility—who knows? Regardless of the reason, she is invaluable to our total safety program.

The difficult part in measuring the success of any given program is determining what and how to measure it. What is the baseline? How much has this program cost you to implement? How much money has it meant to the bottom line?

Fortunately, I am not a cost accountant and I don't have to figure things like that, but we are managers and we do have bottom line measurements. When you undertake any program you first of all assess where you are and where you are trying to go. In undertaking a rehab program you must: Assess your present safety program; review present and past medical costs; review workmen's compensation laws; review state rehabilitation programs; review independent rehabilitation programs; review employees' attitudes toward safety; review management's commitment to safety. Once the above areas have been examined, you should have the base from which to build your own rehab program.

Let's review the purpose of a rehab program. The company's first responsibility is to maintain a complete accident prevention program to prevent accidents, thereby reducing injuries. However, being realistic, we realize that it is virtually impossible to reduce accidents to zero. Therefore, we have initiated the company rehabilitation program for four primary reasons:

1. To assist the employee involved in an on-the-job injury to return to gainful employment at the earliest possible date.
2. To assist the employee in regaining his full productive capacity in direct relationship to his physical, mental, emotional, and social improvement, with special consideration in the area of family situations.
3. To assist the employee to regain his self-esteem and recognition through using work as a therapeutic goal.
4. To assist the Bibb company in realizing the profits necessary to continue in business.

There is no way that I personally can tell you how much money you will save by initiating a rehabilitation program in your particular operation. But I do know that it can save you money. Most importantly, it enhances the morale of your employees, and if that purpose is served you will have a better and more profitable company.

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National Safety Council

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