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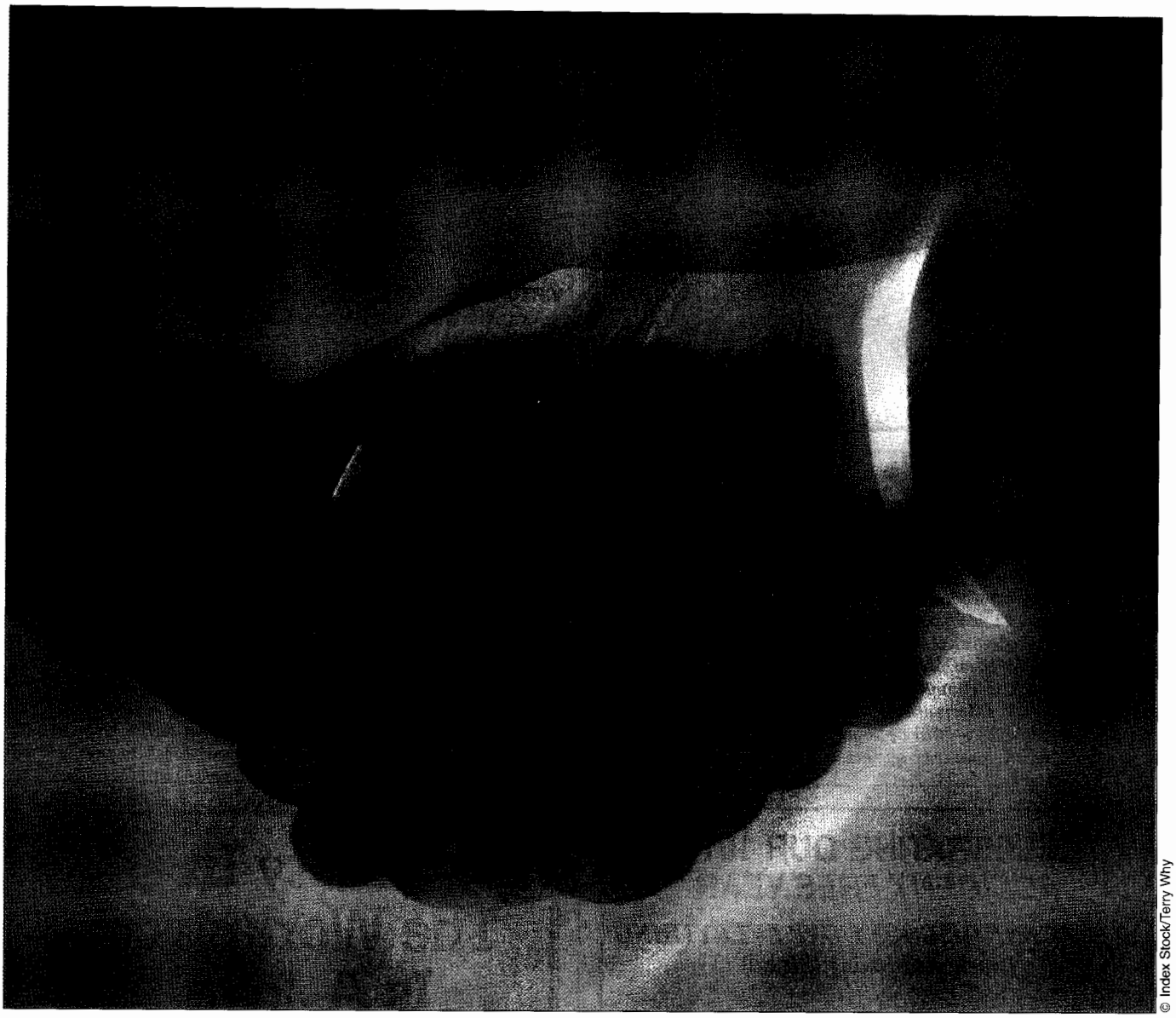

Virtual Reality Technology To Embrace Information Gap In Industrial Hygiene

Hygienists can manipulate information in three-dimensional exploration of hazards

By P.A. Hancock and Jill Lai

Safety professionals have witnessed a radical evolution in the changing nature of work in past decades. Work no longer means dealing exclusively with physical materials. Information is the currency of work today. Information manipulation has replaced materials handling as the manufacturing process for many modern workers.

Consequently, the physical demands on workers have greatly diminished, but mental demands have escalated to replace them.

This article examines how these changes influence the contemporary industrial hygienist and how projected changes will sway future industrial hygiene practice.

The major change in industrial hygiene during the next decade will be a shift from physics and physiology to psychology and sociology.

INDUSTRIAL HYGIENE'S CYCLE

Early industrial hygiene concerns focused on acute physical injuries. The majority of these problems came from heavy manufacturing industries. More recently, industrial hygiene has concerned itself with the recognition, evaluation and control of workplace hazards. Of particular concern are chronic diseases resulting from cumulative exposure to toxic substances and trauma as a result of repetitive physical activity.

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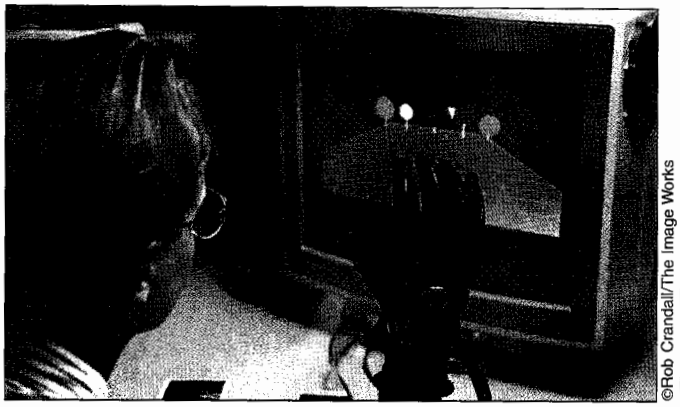

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Virtual reality setups have been developed for bigger arcades and entertainment centers, but industrial hygienists can look forward to industrial applications.

However, with the continuing rapid change in electronics, information technologies, manufacturing automation and chemical biotechnology, the psychological and social effects of technological innovations have become an increasing safety and health concern. In essence, the information age has prompted information-based workplace problems.

To fulfill its function, industrial hygiene must be attuned to these changes. The changes lead to a different perspective on health and safety. Information — the medium and the currency of future workplaces — will be represented by electronic media and supported by computer systems. Individuals will navigate and manipulate such electronic environments.

Data entry, data transfer, spreadsheet manipulation and data integration are common activities that information workers currently perform. However, the way this work is performed (via two-dimensional video display units with keyboard entry) will rapidly change in the near future. The agent of that change will be virtual reality.

VIRTUAL REALITY

Virtual reality is an approach to human-computer interaction which presents a three-dimensional, wraparound graphical "world." Typically, this world is projected on some head-mounted display so that as the individual moves and turns, the graphics world moves and turns exactly the same as the real world.

The individual wears a glove which appears as a hand in the virtual reality world. The glove can grasp, manipulate and move objects presented. The advantage of virtual reality worlds is that they are not bound by the same constraints as the real world. Objects can represent an infinity of possibilities and need not be constrained to real-world objects.

Interacting in a virtual reality world should be easier since it approximates what humans do in a normal environment anyway. One can take advantage of intrinsic perception and natural abilities developed in everyday use.

However, much work is needed before the capability can match the hype.

Nevertheless, virtual reality interaction is the clear avenue for future electronic work. Future industrial hygienists will

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need to function in this arena. Virtual reality will spur on industrial hygienists to address safety and health concerns of the information age. Instead of recognition, evaluation and control (the traditional approaches), industrial hygienists will focus on less traditional approaches of anticipating hazards, real-time monitoring of hazards and optimizing human performance at the physical, mental and social levels.

An industrial hygienist, for example, can review changes in a manufacturing process or a new facility at the design stage (already possible to some extent with computer-aided manufacturing and computer-aided design in architecture). They can then anticipate possible safety and health concerns that may arise with the introduction of new technologies and new materials. The concerns can be addressed before the change is implemented, which is far more cost-effective than attempting modification afterwards.

In addition, the real-time monitoring system used in virtual reality allows an industrial hygienist to take preventive measures as soon as any anomaly is detected. Specific problem areas where hazards arise are pinpointed. Data on biological monitoring can be incorporated into the environmental monitoring system, so biological responses can be correlated to specific environmental conditions.

Studies on the interaction of multiple factors can be conducted in virtual reality. Software is already available to financial analysts that allows them to manipulate stocks, economic conditions and other financial indicators through three dimensional models of colored geometric shapes. They are then able to see trends that cannot be seen in tools such as spreadsheets.

Similarly, studies on the interaction of multiple environmental factors and the resulting biological responses can be conducted. For example, one can simultaneously manipulate temperature, humidity, air exchange rate and other climatic factors to discover which combination will best enhance a worker's well-being and productivity. Virtual reality will allow training about a work process without exposing workers to the negative or even detrimental consequences of mistakes in the learning process.

Such scenarios are already reality with the use of simulated flight to train pilots.

If virtual reality achieves its anticipated capacities, such navigation and manipulation will occur in surrogate four-dimensional worlds. It will not be long before we look back on the visual display terminals and keyboards in much the same way we look at punched cards and paper tapes today.

If individuals are flying, driving or locomoting in general through these virtual information worlds, what will industrial hygienists do? Actually, industrial hygienists will be performing functions similar to those in the existing physical environment. However, rather than just detecting physical hazards, industrial hygienists will be looking for hazards posed by information. They will be detectives of the virtual workplace!

ELECTRONIC HAZARDS

Industrial hygienists have always attempted to reduce or even eliminate hazards posed by physical and chemical agents. In the electronic workplace, information itself may become the hazard. An example of a workplace hazard in electronic workplace is a computer virus.

Most of these viruses are made with either benevolent or malevolent inten-

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tions. They are intended to exert some effect on the information and/or the electronic equipment that supports computation. However, the long-term effect is on the human user. Consequently, information may have many characteristics analogous to harmful physical and chemical agents.

Physical agents pose hazards mainly through the excessive transfer of energy. Chemical agents pose hazards mainly because they impair, injure or destroy a cell, a tissue, an organ and/or a system in the body. Transferring excessive amounts of information may result in stress, which is an etiologic factor in prevalent diseases such as cardiovascular diseases. Erroneous information may impair, injure or destroy psychologically and socially, resulting in psychosomatic disorders.

Erroneous information may even result in misjudgment about a situation that leads to actual physical injuries in the real world that is enslaved to information derived from virtual reality. For example, if the monitoring instrument fails to indicate the high concentration of a certain hazardous chemical, a person may misjudge the safety of entering a confined space in a manufacturing plant area and may consequently be overexposed.

Information can also become hazardous through its interaction within psychological and social environments. In an era when "teamwork" is increasingly the objective of organizations, a person whose independence is interpreted as uncooperative may make accomplishing the assigned team task difficult or even impossible. This factor may be applied to a scenario of a company's financial planning team. For instance, a rumor about corporate financial conditions may result in anxiety and inability of employees to focus on the work.

Fear of new technology also leads to an increase of complaints about new equipment contributing to headaches. Evidence of such interaction between harmful agents and psychological and social environments are beginning to surface in the recent concerns on indoor air quality and ergonomics. In some cases, a positive simple change in the social environment can decrease the frequency of physical complaints as much as elaborate engineering controls.

WORKING WITH EXPERTS

Industrial hygiene has methods to recognize, evaluate and control physical and chemical hazards. Its applied scientists, the industrial hygienists, however, have yet to develop comparable means to recognize, evaluate and control information hazards. To develop such methods, they must work with professionals in other fields.

Industrial hygienists must understand the interaction of one type of information with another. For example, how will people react to the information on a new product design and to the information on a new manufacturing process at the same time? Such scenarios appear more and more frequently with the shorter and shorter product cycle.

When the two types of information are presented together, is the effect synergistic (where employees grasp both types of information with minimum psychological and social stress) or antagonistic?

With the changes in the nature of work and in workplaces, industrial hygienists should begin learning new perspectives and new skills. Industrial hygienists must develop a broad perspective on safety and health that encompasses biological and physical sciences as well as psychological and social sciences.

Industrial hygienists should understand and apply new technology such as virtual reality and new research methods in other disciplines to resolve safety and health problems in future workplaces. As industrial hygiene adapts to the information age and utilizes the new tools available, it promises to be an exciting diverse field for its practitioners in the future.

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