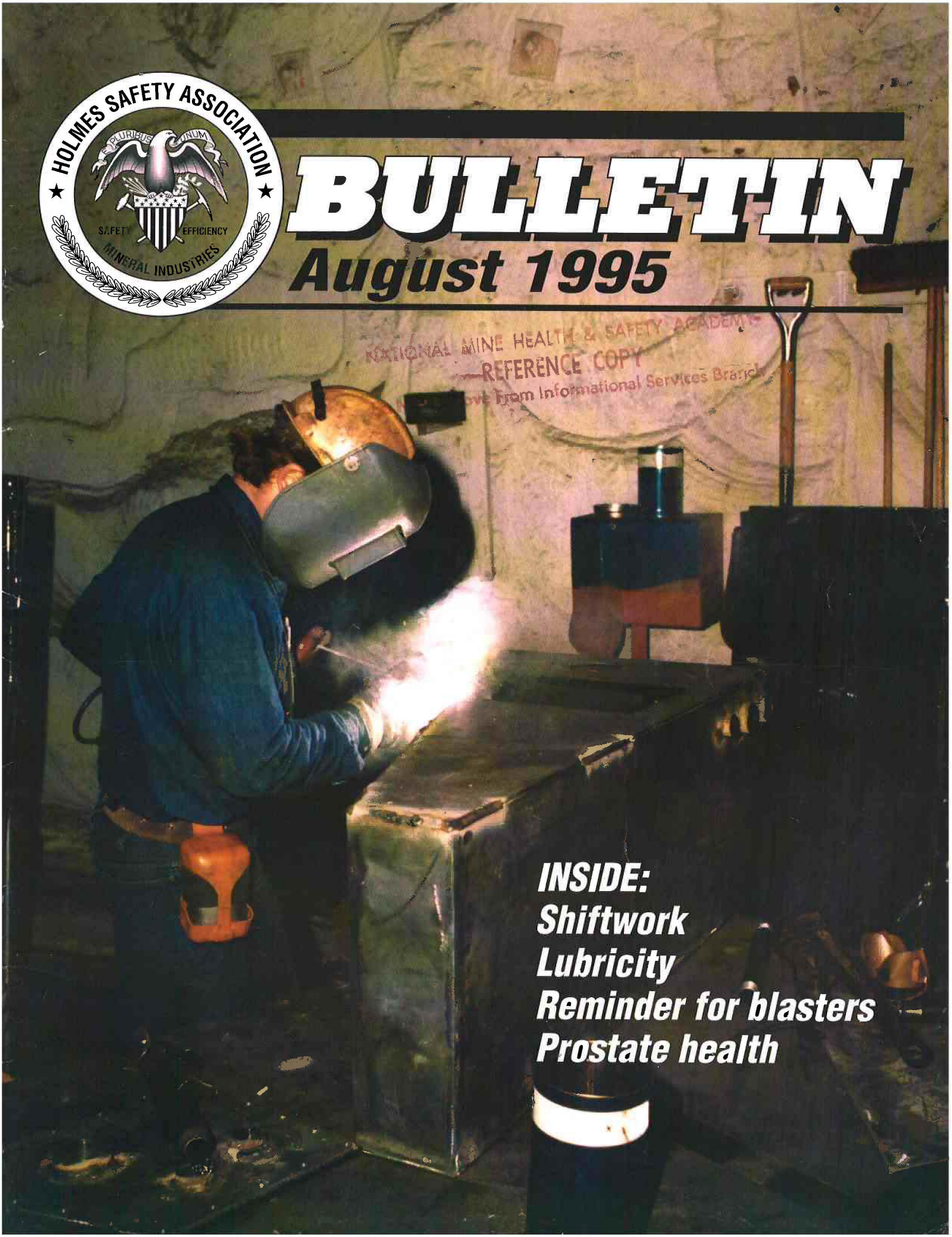
HOLMES SAFETY ASSOCIATION
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BULLETIN
August 1995
NATIONAL MINE HEALTH & SAFETY ACADEMY
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From Informational Services Branch
INSIDE:
Shiftwork
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1994-1995

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Cover photo of the Joy 14CM10 continuous miner courtesy of ***Joy Technologies Inc.*** *We welcome* ***any*** *materials that you submit to the Holmes Safety Association Bulletin. We especially need color photographs (8" x 10" or larger—color negatives are acceptable) for our covers. We cannot guarantee that they will be published, but if they are, we will list the contributor(s).*

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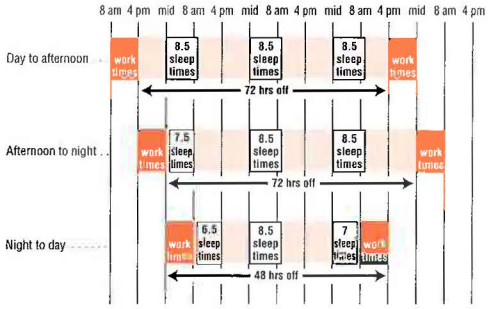

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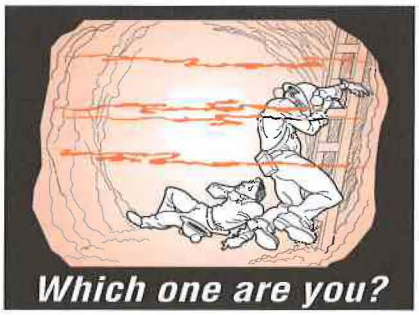

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The Holmes Safety Association Bulletin contains safety articles on a variety of subjects: fatal accident abstracts, studies, posters, and other health and safety-related topics. This information is provided free of charge and is designed to assist in presentations to groups of mine and plant workers during on-the-job safety meetings.

PLEASE NOTE: The views and conclusions expressed in "HSA Bulletin" articles are those of the authors and should not be interpreted as representing official policy or, in the case of a product, represent endorsement of the Mine Safety and Health Administration.

KEEP US IN CIRCULATION—PASS US ALONG

2

Shiftwork: a guide for schedule design

By James C. Duchon[1]

Abstract

Based upon the perturbed performance, increased or more serious accidents, lowered production, higher absenteeism, health problems, familial problems, low morale, and job dissatisfaction due to working nights and shiftwork, the U.S. Bureau of Mines has analyzed shiftwork schedule design at mining operations. The purpose of this paper is to discuss in practical terms what mining companies can do if they are considering changes in their shiftwork practices. It is not the intent of this paper to persuade management or any workers that they should change their shiftwork schedule.

This paper discusses various design considerations or dimensions that may vary. These dimensions are (1) fixed versus rotating schedules, (2) speed of rotation, (3) direction of rotation, (4) length of shift, and (5) starting time of shift. Also, extended workdays and other management considerations, such as training and evaluation, are discussed.

Introduction

In the mining industry, the proportion of employees working shiftwork is increasing. Data from the U.S. Bureau of Labor Statistics indicate that in 1991, 28.4 pct of all mine employees worked evening, night, or rotating shifts, as compared with 21.9 pct in 1985. Further, the percentage of miners working shifts other than straight days is considerably larger than the combined average of all U.S. industries (17.8 pct).

There are several practical reasons why shiftwork in mining is prevalent, including (1) the increased demand for goods and services combined with limited overhead; (2) the need to maximize costly equipment for quick capital recovery; (3) the need to take advantage of lower utility costs at offpeak-hour utility rates; and (4) the need to keep equipment running continuously because of high startup costs.

It has been demonstrated in published studies that workers in various industrial groups, such as mining, power, chemical, nursing, factory, and oil refineries, have displayed perturbed performance, increased or more serious accidents, lowered production, higher absenteeism, health problems, familial problems, low morale, and job dissatisfaction due to working nights and shiftwork (*1-10*).[2]

An excellent review of these effects can be found in a recent document completed by the U.S. Congress, Office of Technology Assessment (*1*). It is easy to understand, therefore, why there is a growing interest among all industries, including mining, to examine shiftwork interventions.

A discussion of alternative work schedules provided other reasons why there is a recent trend in the United States toward new and better schedules (*11*). For instance, an increase in relative affluence creates a climate where many of life's privileges and comforts have become necessities. Employees are examining alternative schedules consistent with this. Also, cultural changes, changes in employment rates, an aging work force, labor force participation, and a shift to service work all contribute toward this move to seek alternative schedules.

For these reasons the U.S. Bureau of Mines (USBM) has been involved in research on various shiftwork issues to enhance the safety of the mine worker. The purpose of this paper is to discuss in practical terms what mining companies can do if they are considering changes in their shiftwork practices. It is not the intent of this paper to persuade management or any workers that they should change their shiftwork schedule. In many cases, current work scheduling practices are used successfully. Changes in such situations may, in fact, worsen their situation in spite of all good intentions.

Ergonomic considerations of schedule design

The perfect shift does not exist. Figure 1 illustrates that there are three ergonomic considerations for any schedule that are associated with various causes and effects, such as production, absenteeism, accident rates, worker fatigue, and morale. These considerations include

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[2] *Italic numbers in parentheses refer to items in the list of references at the end of this article.*

biocompatibility, sociocompatibility, and job compatibility. A comprehensive assessment of any schedule, therefore, must consider each of these components. While each of these considerations are interrelated, they will for the sake of simplicity be discussed and treated independently.

Biocompatibility refers to how a schedule conforms or does not conform to human physiology that may affect performance. It is well known that humans have innate "biological clocks" that control certain physiological functions. Circadian rhythms are those functions that have an approximately 24-hr cycle, such as the excretion of human growth hormone and cortisol potassium, variation of body temperature, and sleep-wake cycle. The sleep-wake cycle refers to the body's natural tendency to maintain wakefulness during the daylight hours and sleep during the night. There are two observable consequences that can occur as a result of disrupting the sleep-wake cycle. First, remaining awake at night results in fatigue or a feeling of being tired. This fatigue occurs even when "enough" sleep is taken prior to the night shift. Fatigue occurs at night because of a physiological push for sleep manifested by sleepiness, performance deficiencies, lowered body temperature and heart rate, and other signs associated with a need for sleep. When body temperature is used as an indicator of alertness, the trough of this cycle tends to occur at approximately 3:00 am for an individual who is not adjusting to a different schedule or time zone.

A second situation related to circadian rhythms is referred to as occupational jet lag. Just as our bodies adjust to different time zones during travel, so too must our bodies adjust to rotations from day or evening shifts to night shifts. Fatigue, malaise, disturbed sleep, and general flu-like symptoms occur as a result of circadian rhythm desynchronization and physiological adjustment to the new shift (time zone). Such a biological adjustment to new time zones may take from 3 to 10 days, whereas adjustment to a night shift may take longer or may never occur because of conflicting day-night cycles, i.e., working during the night and sleeping during the daylight hours, as well as conflicting social and family cues on workdays and

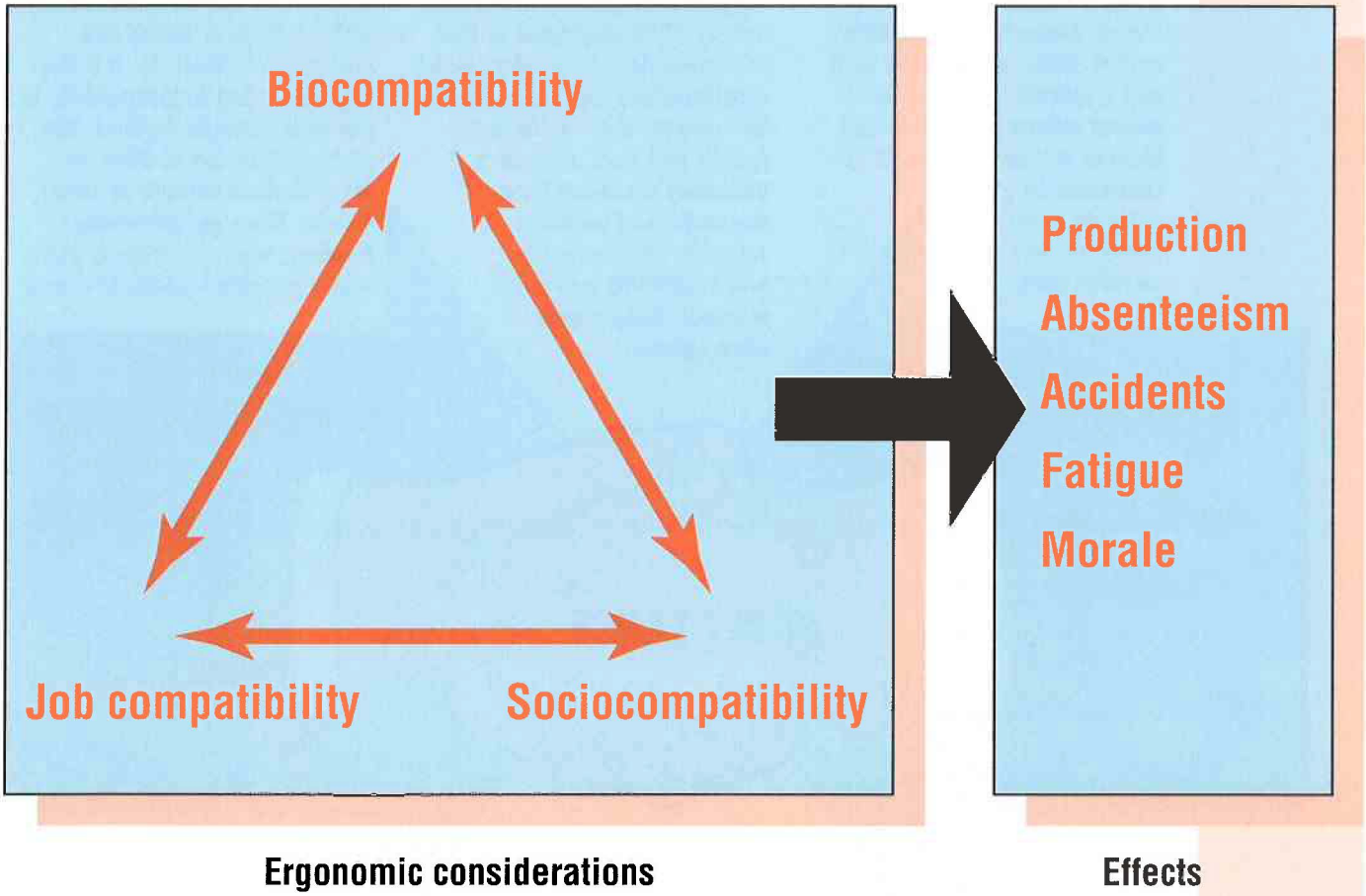

Figure 1.—Ergonomic considerations and effects of shiftwork schedules.

off days.

Sociocompatibility refers to a compatibility between work schedule design and social-family life schedules. This design consideration is perhaps the most critical aspect from the perspective of the shift worker. The norm in our society is an 8-to-5, Monday-through-Friday schedule. Deviation from this could potentially create social conflict. For many workers, the most disliked shift in this respect is the evening shift. Working between 3:00 pm and 11:00 pm precludes a satisfactory family-social life. Working weekends, an unavoidable consequence of continuous operations, is a major source of social incompatibility.

Job compatibility refers to how a schedule conforms with or competes with job or organizational demands. For instance, certain companies or industries require training days to be built into a schedule. Some underground mining companies have blasting periods that should be considered in a schedule. Such things as need for weekend work, need for equal personnel across the 24-hr day, commuting times for employees, union regulations, exposure to harmful environmental agents, etc., should be considered in the choice of schedule design. Any schedule that involves evening, night, or rotating shifts will create problems for some people.

Management-labor differences

The focus of "important" schedule considerations can be different depending upon one's perspective. Figure 2 illustrates the concerns management and labor typically consider critical in a "good" schedule. Traditionally, management tends to emphasize issues of job compatibility, while labor tends to emphasize issues of sociocompatibility. This is not to say that management ignores the welfare of its employees or that employees do not consider the job considerations that are necessary for company survival. In fact, insight into each position is ultimately necessary for a successful and workable schedule. Until recently, biocompatibility issues in schedule designs were often ignored.

However, research in the past 10 years has evaluated human sleep, biological rhythms, nutrition, etc. in relation to shiftwork schedules and has offered important considerations that should be of value to all parties.

Recommendations

While there are virtually unlimited schedule designs, there are limited dimensions of the schedule that can vary. These dimensions are (1) night and evening shift, (2) fixed versus rotating shifts, (3) slow or fast rotation schedules, (4) forward or backward rotation, (5) early or late shift start times, and (6) length of shift. The following is a discussion of each of these.

Night and evening shift

As mentioned earlier, working night shifts has been associated with a variety of health and performance measures. It is the night shift that is incompatible to our body's natural rhythms. The night shift is also disliked by many workers because of social factors. There are situations, however, where individuals prefer working nights because of certain

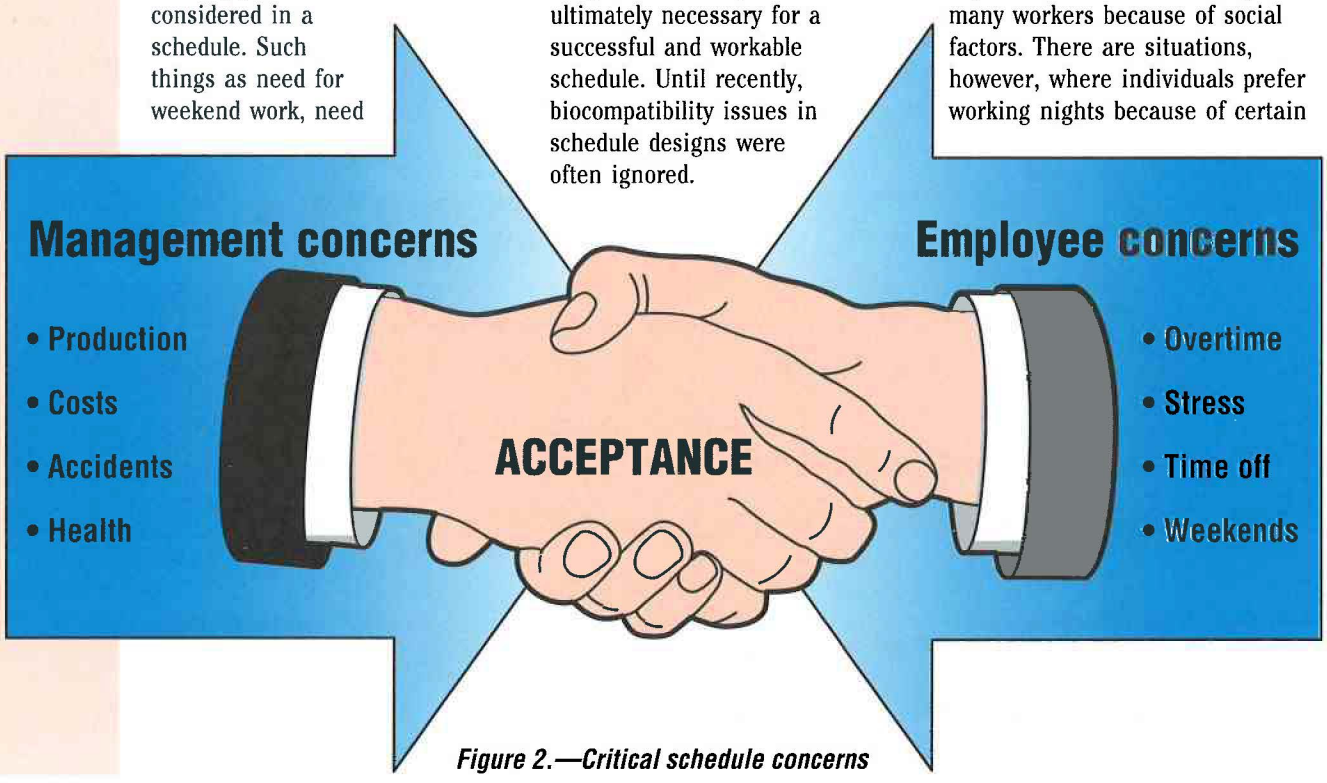

Figure 2.—Critical schedule concerns

benefits, such as pay differentials and less pressure or less supervision at work. Working nights also allows for more parental involvement in child care and the associated cost savings.

Considering only the criteria of adequate sleep, the evening shift is for most people the perfect shift. Virtually all studies have indicated that the evening shift is associated with the greatest sleep length when compared with the day or night shift. Nevertheless, it is the evening shift that is the least preferred by workers. Clearly, this dislike for the shift is due to issues of sociocompatibility.

Recommendations:

1. Before anything else, an employer should consider the possibility of decreasing use of night shifts.
2. The use of overtime should be avoided for workers on night shifts. Many workers nap prior to the shift and begin sleep immediately following the night shift. Therefore, any overtime may eat into the worker's total sleep length, which is already shortened.
3. When night shifts are used, several special precautionary measures should be taken. These are:
   a. Longer or more frequent mandatory rest breaks when work is between midnight and 6:00 am.
   b. Physically or mentally difficult assignments should be left for the day or evening shifts.
   c. Ample opportunity for a hot and healthful variety of foods via machine or food cart should be made available to these "offshift" workers.
   d. Lunch breaks should occur at a consistent time of the night shift, i.e., meals should be eaten at approximately the same time each night.

Fixed versus rotating shifts

Fixed or permanent shifts are more common in Monday-through-Friday, 24-hr operations. In these 5-day operations, three crews each working day, evening, or night shifts can cover a 24-hr operation with either permanent or rotating shifts. However, in **continuous operations,** utilizing 8-hr shifts, where each job totals 168 hrs per week (24 hrs/day times 7 days/wk), a minimum of four crews is needed to cover all three shifts. Therefore, at least some shift rotation is typically required. The question then becomes, Should the use of permanent shifts be minimized or maximized when possible? Table 1 shows one of the most commonly used schedules in continuous operations. This schedule maximizes rotating shifts by requiring all workers to rotate on a weekly basis. In contrast, table 2 shows a schedule that utilizes three fixed crews (1, 2, and 3) and one rotating or "grasshopper" shift (crew 4).

One argument in favor of using fixed shifts, such as permanent days, evenings, and nights, is to allow workers on the night shift to "adjust." However, research has consistently shown that night workers never completely adapt to that shift. Nearly all night permanent shift workers revert to a "normal" day schedule on their days off. They are, therefore, constantly rotating their work-sleep cycles in spite of having a fixed shift. Several studies have indicated that permanent night workers, as do rotating shift workers, tend to sleep several hours less before the night shift than any other shift. Working consecutive night shifts, therefore, may result in a cumulative "sleep debt." A summary of the pros and cons of fixed versus permanent shifts is as follows:

Advantages of Fixed Shifts:

1. Often allows workers to choose the evening or night shifts. These shifts are actually more sociocompatible for some workers.
2. Allows a large percentage of employees to avoid the night shift altogether.
3. Less disorienting since rotation among the other shifts is not required.

Table 1.—Schedule consisting of four-crew, 8-hr, 7-day backward rotating "Southern Swing" pattern

Crew-week	Mon	Tues	Weds	Thurs	Fri	Sat	Sun
1	—	—	E	E	E	E	E
2	E	E	—	M	M	M	M
3	M	M	M	—	—	G	G
4	G	G	G	G	G	—	—

E = Evening shift G = Night shift M = Morning shift Dashes indicate off days

Advantages of Rotating Shifts:

1. A "fair" schedule. No preferences given to individuals for the favored shifts.
2. Minimizes the exposure to the night and evening shift to any particular group of employees by "spreading out" the exposure among all employees.
3. If rotations are fast (see next section) then there may be less physiological disruption of

circadian rhythms, i.e., occupational jet lag would not be an issue.

Recommendations:

1. The primary consideration should be the possibility of the reduction of the work force on the night shift.
2. Unless the night shift and the evening can be filled by workers voluntarily choosing to work permanent shifts, rotating shifts are recommended.

Slow or fast rotation schedules

Rotating shifts can differ with respect to how quickly workers rotate from one shift to another, or the number of contiguous days on each shift. In U.S. mining operations, rotations tend to be as short as 1 week and as long as 2 or more weeks on the same shift. It is not typical to find "rapid" rotations of 1 or 2 days, as is found in some service industries or as is typical in the European community. The rapid rotation will be discussed below.

There are reasonable hypotheses for suggesting either the 1 week, or the slower rotation cycles of 2 or more weeks. On the one hand, it can be argued that it is more advantageous to work shorter stretches of nights to avoid a cumulative sleep deprivation that may occur with too many contiguous night shifts (*12*). On the other hand, it can be argued that a slower rotation has the advantage of letting workers adjust to night shifts, thereby lessening the negative effects of night work (*13*).

The USBM conducted a study to determine whether or not there is an advantage to working the second week of a 2-week cycle, as would be indicated by reports of more positive health, mood, and sleep items on the second week as compared with the first week (*14*). Forty-two workers at a surface mine in the Midwest filled out the work, food, and sleep diary for 4 to 6 weeks. They rotated every 2 weeks, going from days to nights to evenings with all weekends off. The dependent measures were defined as (1) health, the daily frequency of reported symptoms; (2) mood, based on a self-evaluation of four descriptors—alert, sleepy, grouchy, and relaxed; (3) total sleep length; and (4) sleep quality. Results indicated that on the second week of the night shift, workers reported significant improvements in all four mood descriptors for the second half of their shift. Also, sleep quality as measured by awakenings during sleep improved on the second week of the night shift. None of the variables showed a worsening on the second week of nights. These results do not support a "cumulative trauma" effect for the schedule stud ied in this paper. On the basis of this study, it could be recommended that 2-week cycles are superior to 1-week cycles.

However, a truly fast rotation schedule, rarely used in U.S. industries, is common in European countries. Table 3 shows a typical fast rotating schedule.

Table 2.—Schedule consisting of 6-day-on and 2-day-off pattern, repeating every 8 days.

Crew-week	Mon	Tues	Weds	Thurs	Fri	Sat	Sun
1[1]	M	M	M	M	M	M	—
2[1]	—	—	E	E	E	E	E
3[1]	G	G	—	—	G	G	G
4[2]	E	E	G	G	—	—	M

E = Evening shift G = Night shift M = Morning shift Dashes indicate off days
[1] Fixed [2] Grasshopper shift, rotating every 2 days

Table 3.—Rapid rotation schedule often used in European work systems[1]

Crew-week	Mon	Tues	Weds	Thurs	Fri	Sat	Sun
1	M	M	E	E	G	G	G
2	—	—	M	M	E	E	E
3	G	G	—	—	M	M	M
4	E	E	G	G	—	—	—

E = Evening shift G = Night shift M = Morning shift Dashes indicate off days
[1] This schedule requires four crews working a repeating 2-2-3 pattern. For instance, crew 1 works 2 days, 2 evenings, 3 nights, 2 off days, 2 day shifts, 2 evening shifts, etc.

Experts agree that there are several advantages to fast rotating shifts (*15-17*). First, individuals do not have time enough on any shift to adjust his or her circadian rhythms, thereby avoiding the physiological dyschrony associated with working stretches of night shifts. Second, working only two or three consecutive nights does not allow a sleep debt to occur, which is associated with working several consecutive nights. Third,

short stretches of nights allow for more regular social contacts.

Recommendations:

1. On a rotating schedule, it is recommended that schedules have 2 weeks of a particular shift (with days off), as compared with 1 week. Table 4 shows an example of a schedule for an eight-worker continuous operation, utilizing 2-week rotations.

2. A fast rotation, such as the one shown in Table 3, may be considered as an alternative for those groups of workers wanting to avoid long stretches of night shifts.

Table 4.—Crewless schedule consisting of 2 contingent weeks of nights[1]

Crew-week	Mon	Tues	Weds	Thurs	Fri	Sat	Sun
1	—	M	M	M	M	M	M
2	M	—	—	M	M	M	M
3	M	M	M	—	—	M	M
4	E	E	E	E	E	—	—
5	—	G	G	G	G	G	G
6	G	—	—	G	G	G	G
7	G	G	G	—	—	E	E
8	E	E	E	E	E	—	—

E = Evening shift G = Night shift M = Morning shift Dashes indicate off days

[1] *This schedule requires eight shift workers covering two positions around the clock. The shift workers are placed at 1-week intervals in an 8-week cycle.*

Table 5.—Schedule consisting of four-crew, 8-hr, 7-day forward rotating pattern

Crew-week	Mon	Tues	Weds	Thurs	Fri	Sat	Sun
1	—	—	M	M	M	M	M
2	M	M	—	E	E	E	E
3	E	E	E	—	—	G	G
4	G	G	G	G	G	—	—

E = Evening shift G = Night shift M = Morning shift Dashes indicate off days

Forward or backward rotation

One popular suggestion offered by shiftwork experts is to prescribe schedules that rotate in a forward direction. Rotating from a day to evening to night shift (table 5) is preferred over rotating from a day to night to evening shift (table 1). Unfortunately, there are virtually no published studies that have systematically reversed ONLY the direction of the shift rotation in a mining or industrial setting that would show the benefit of such an intervention. There are, however, a few studies that have made shift changes, which have included direction of rotation as one part of the total change. For instance, the most widely cited study is the intervention study at Great Salt Lake Minerals (*10*). In this study, the group that changed to a forward direction AND went from a weekly to a 21-day rotation schedule improved on measures of health, production, and turnover.

There are two viewpoints as to why there may be benefits using a forward rotating schedule:

Premise 1: First, Knauth and Rutenfranz (*16*) state that for a discontinuous three-shift system with a five-shift, two-days-off pattern: (1) a forward rotation produces a 72-hr-off period between a day and evening shift, a 72-hr-off period between an evening and night shift, and a 48-hr-off period between a night and day shift, and (2) a backward rotation produces a 56-hr-off period between a night and evening shift, a 56-hr-off period between an evening and day shift, and an 80-hr-off period between a day and night shift. The shorter the off period, the less time for rest and recovery. Therefore, they conclude that since a forward rotation produces only one short, between-shift interval and a backward rotation produces two short, between-shift intervals, the forward rotation is recommended.

Premise 2: A second and more popular reason for prescribing the forward rotation relates to circadian rhythms that are disrupted during phase advances or delays. Since humans have circadian rhythms that are over 25 h, it is easier to phase delay than to phase advance. Phase advances merely refer to adjustment of our circadian rhythms to earlier clock times. Phase delay refers to adjustment to later clock times. Research has shown that transmeridian air travelers have a much easier time adjusting to westward travel ("phase delay" or

forward rotation) as opposed to eastward travel ("phase advance" or backward rotation) (*18-20*). Based on this research, many authors have recommended that shift rotation schedules take advantage of this finding by constructing schedules with forward rotations to hasten adjustment to each new shift (*10, 16, 21-22*). Unfortunately, no single study has compared the patterns of adjustment or completeness of adjustment for a group of shift workers who have rotated in each direction with all other factors being equal. In fact, no study has demonstrated complete circadian adjustment for shift workers rotating in either direction.

The USBM challenged these viewpoints using an analysis based upon sleep times taken from survey data and attempted to evaluate the argument that forward rotations are BETTER than backward rotations. The primary concern in rotating shiftwork is rotating onto and off of the night shift. Therefore, each between-shift interval prior to or subsequent to a night shift was scrutinized. This paper is based on sleep timing only. Other factors that could influence adjustment, such as eating and social behaviors, internal biological functions, and rhythms should not be ignored.

Night shifts are typically considered either the first or third shift, depending upon the placement within the overall schedule. For instance, in a Monday-through-Friday workweek, a night shift is the first shift if it begins at or about Sunday night and ends Monday morning. However, a night shift is considered the third shift if it begins late Monday night and ends early Tuesday morning.

It was shown that when nights are the third shift, the recovery interval after the night shift on both the forward and backward rotations are "short" intervals (figs. 3-4). However, the forward rotation contains only one full night's sleep and two shortened sleep times. Further, the day shift follows this, which could itself contribute to sleep deprivation. On the backward rotation, the recovery interval after a night shift contains two full night's sleep, following a shortened day sleep. The next afternoon series could actually help in recovery since these shifts are associated with the longest sleep lengths of any shift.

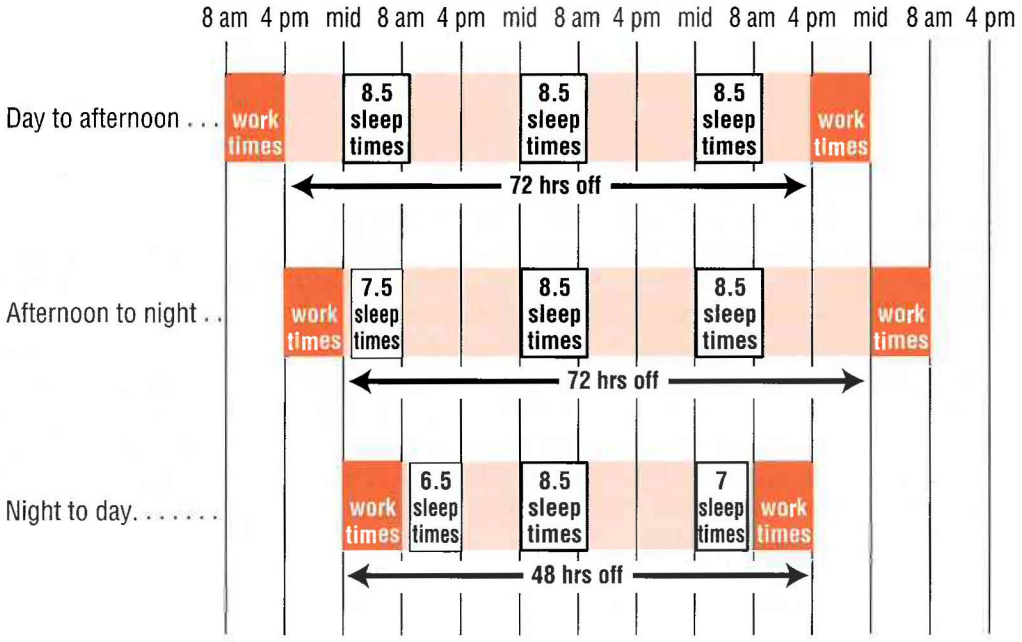

Figure 3.—Forward rotation with night as third shift. *mid = midnight*

When nights are the first in the series, the recovery intervals after a night shift are relatively long for both forward and backward shifts. However, the backward rotation contains a potential for three full night's sleep, as opposed to only two full night's sleep for the forward rotation.

Therefore, when primary importance is placed upon recovery from night shifts, if nights are the third in the series, the backward rotation is the most desirable.

The amount of sleep and time off **prior** to working a series of night shifts was also inspected (figs. 3-4). Ideally, individuals who are well rested will have a better chance of adjusting and coping with their night shifts. Where nights are the third in the series, both the forward and backward rotations have a long between-shift interval prior to the night shift, 72- and 80-hr, respectively. Both allow three separate sleep periods to recover from the night shift.

Where nights are the first in

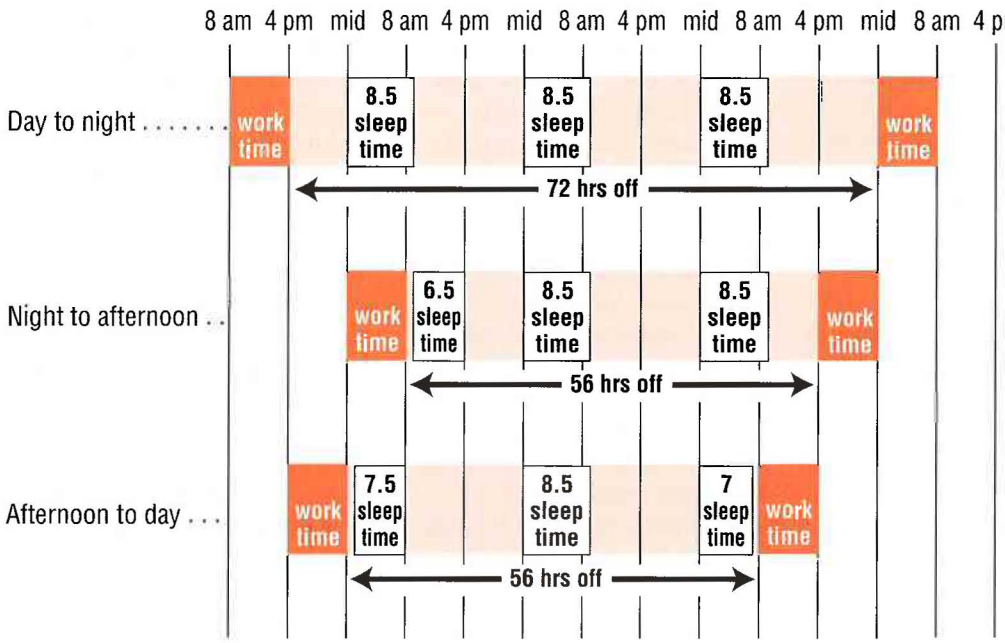

Figure 4.—Backward rotation with night as third shift. *mid = midnight*

the series, both the forward and backward rotations have a "short" between-shift interval, 48-hr and 56-hr, respectively. The day-to-night shift change on the backward schedule and the evening-to-night shift change on the forward schedule have only two nighttime sleep periods.

Therefore, when analyzing sleep behaviors prior to night shifts, having nights as the third shift for both forward and backward shifts are more desirable than having nights as the first shift.

Perhaps the more popular reason for promulgating the forward rotation is its apparent consistency with the idea that it is biologically quicker to adjust when rotating in the forward direction than in the backward direction. Forward rotations have been compared with east to west travel, where sleep-wake cycles are phase delayed; i.e., sleep occurs later than what has been typical for an individual. Just looking at work start times, it appears that workers are phasing in a forward direction; i.e., day to evening to nights. However, when looking at the sleep-wake cycles of actual workers, they are not consistently rotating forward.

Based upon typical sleep times, the number of phase advances and phase delays are exactly equal for forward and backward rotating shift workers. Adjustment, therefore, should be the same for both conditions.

Recommendations:

1. Where the speed of rotation is relatively slow (i.e., 1 week or more), the preferred direction of rotation is linked to the amount of time off between changes. The amount of time off is related to the position of the night shift, first versus third. An analysis of time off and typical sleep periods indicates that the backward rotation with nights as the first shift may be more conducive for recovery from a stretch of nights. However, a backward rotation with nights as the third shift offers the best opportunity for sleep in preparation and recovery from the night shift. In general, it is suggested that there should be at least 56 hrs between the last of a series of night shifts and the next of a series of shifts.
2. For fast rotations, as shown in table 3, forward rotations are recommended.

Early or late shift start times

Various factors can influence a preferred start and end time. In the realm of job-compatibility, certain factors should be considered. For instance, daily blasting schedules are often coordinated with shift start times for underground mines, since evacuation of the mine is necessary. Sociocompatibility issues involve such concerns as driving through rush hour and being home at particular times to coincide with meal times or child care. Biocompatibility issues include such concerns as sleep quality and sleep length, as well as individual differences such as morning and evening types. Morning types or larks are those individuals who tend to prefer to go to bed early and wake up early. Evening types or owls are those individuals who prefer to go to bed late and wake up late. This factor may be an important consideration as the work force ages. Older workers are associated with being morning types.

In general, research has shown that when working a day shift, sleep length decreases with earlier work start times. Also, sleep taken

between night shifts are of shorter duration the later the work times start and end. Therefore, to maximize sleep length before the morning shift, the shift should not start too early. However, to maximize sleep length after a night shift, the shift should not end too late.

Knauth and Rutenfranz (*16*) discussed studies of start times in various industries. In a coal mine, an experimental change on the day shift from a 6:00 am to a 7:00 am start time was associated with a 23.8 pct accident rate decrease. Similar findings of later start times being associated with fewer accidents or error rates have been found with bus drivers and train drivers. The study also suggested that earlier start times on a "late shift," between 1:00 pm and 4:00 pm, was associated with more frequent accidents.

Recommendations:

1. On a one-shift system (i.e., a day shift), a 7:00 am to 9:00 am start time is suggested.
2. For 24-hr operations, it is suggested that a 7:00 am, 30 min start time be employed. A later start time will hamper the ability of night shift workers to get adequate sleep.
3. Ideally, a flexible start time should be used if possible. This allows for individual preferences and differences.

Length of shift

There is very little doubt that "extended workdays," regular shifts of 10 or 12 hrs, maintaining an approximately 40-hr week, is a very popular alternative among the work force because of the significant increase in days off, including weekends, especially when compared with traditional rotation schedules of working seven straight shifts or having only one weekend off every 4 to 6 weeks.

While the popularity of extended workdays has been on the increase, there are some serious concerns by management, workers, unions and various governmental policy-makers that working 10- or 12-hr days may create an added risk of accidents and health problems (*23*). Unfortunately, there is very little objective information available regarding the nature and degree of safety and health risks associated with the application of extended workday schedules (*1, 24-25*). As a consequence, when it comes to questions of designing and managing extended workdays, decisionmaking by management must now proceed on limited information.

Health and safety issues are not important considerations for the implementation of 12-hr shifts in relatively safe workplaces such as white collar settings. However, in labor-intensive and environmentally stressful conditions as in mining, where accidents and health are major concerns, or where safety is a public concern as in the nuclear power industry, the application of long workdays must be carefully analyzed. Since all indications are that the application of extended workday schedules by U.S. industries will become increasingly widespread over the decade, it is imperative that a careful and comprehensive evaluation of safety and health risks associated with such schedules be initiated. In a report requested by the House Committees on Appropriations; Energy and Commerce; Science, Space, and Technology; Veterans Affairs, and the Senate Subcommittee on Science, Technology, and Space of the Office of Technology Assessment, it was stated that there is "...a compelling need for more studies of the interactions between work schedules and safety in the workplace." (*1*, p. 18).

The change from an 8-hr rotating shift to a 12-hr rotating shift implies several critical schedule differences (*26*). Below are the crucial similarities and differences between 8-hr rotating shifts and 12-hr rotating shifts. These are the factors that could make a difference in workers' tolerance to their schedules:

1. Length of the workday.—An extended workday is typically considered a 10- or 12-hr workday, while still maintaining an approximately 40-hr workweek. Table 6 shows an example of "2-3-

Table 6.—Schedule consisting of two-three-two,[1] every other weekend off, 12-hr shift pattern.

Crew-week	Mon	Tues	Weds	Thurs	Fri	Sat	Sun
1	—	D	D	—	—	D	D
2	D	—	—	D	D	—	—
3	—	N	N	—	—	N	N
4	N	—	—	N	N	—	—

D = 12-hour day shift N = 12-hour night shift Dashes indicate off days

[1] This schedule is the continuous pattern of the days on-days off sequence; i.e., two shifts on, followed by 3 days off, followed by two shifts on, followed by two shifts off, etc.

[3]This schedule is the continuous pattern of the days on-days off sequence; i.e., two shifts on, followed by 3 days off, followed by two shifts on, followed by two shifts off, etc.

2 every other weekend off" extended workday schedule.[3]
2. Amount of time off between workdays.—Extended workdays typically have less off-time between shifts. This would have implications for physical recovery from fatigue and potentially less time for sleep.
3. Length of the workweek.—Extended workweeks typically have shorter workweeks at the expense of longer workdays. This could have implications for adaptation of circadian rhythms or less cumulative fatigue across a workweek (*27*).
4. Amount of time off, i.e., length of "weekends."—Extended workdays usually allow more days off. This would have implications for recovery from fatigue or sleep deficit.
5. Speed of rotation.—U.S. shift workers usually rotate slowly, 1 week or more on any one shift. Extended workdays usually require faster rotations, 2 to 4 consecutive days, which would have implications for adaptation to circadian rhythms.
6. Time of day.—Both 8-hr schedules and 12-hr schedules can involve around-the-clock operations. Therefore, working the night shift will still be an issue in extended workdays.

The USBM conducted a study designed to examine the safety and health implications of extended workdays at an underground copper, lead, and zinc mining operation (*28*). Measures were taken before and after a change from the old 7-days-on, 2-days-off, 8-hr continuous schedule to the new 4-days-on, 4-days-off, 12-hr continuous schedule. These measures included (1) behavioral performance measures to analyze perceptual-motor changes, (2) continuous heart-rate monitoring and aerobic capacity to measure physical fatigue, (3) pulmonary-respiratory measures to examine air contaminant exposure, and (4) a variety of self-report questionnaires to measure perceived adaption and satisfaction with the new schedule. A control group consisting of 5-days-on, 2-days-off day shift workers at the same mine was also included.

Survey results indicated an overwhelming support for extended workdays at the underground copper, lead, and zinc mine (*28*). However, self-reported mood scales and the Stanford Sleepiness Scale indicated that workers on the 12-hr night shift experienced more sleepiness and lowered energy-alertness levels after the eighth hour into their shift. The 12-hr shifts did not seem to be associated with a decrease in most measures of performance across the shift. Only on one measure of physical endurance task (tapping lapses) was there a decrease in performance across the shift for the 12-hr night shift. Most of the physiological and pulmonary data indicated few differences between the 8- and 12-hr shifts.

In this study, because of the remote location of the mine, the workers on 12-hr shifts were expected to lodge at the minesite during their 4-day shift week. This undoubtedly had a beneficial effect on the sleep and rest between shifts. This was confirmed by the diary data that indicated improved sleep quality and no lessening of sleep length, as compared with the workers' 8-h schedule.

Based upon the overall acceptance of the new schedule by the workers and lack of evidence to suggest serious performance decrements, it was recommended that the mine retain the 12-hr schedule, with certain precautionary measures to ensure the safety of the workers. Such measures included maintenance of the on-site lodging for 12-hr workers, continuous observation and evaluation of group and individual adjustment, and customizing work tasks and work breaks to accommodate longer work hours.

In an area fraught with inconsistencies, there are several valid comments that can be safely made: (1) workers tend to embrace the use of extended workdays; (2) in spite of item 1 above, some studies in some industries have shown performance and/or safety decrements associated with extended workdays; and (3) more research on extended workdays is needed, especially for companies and industries considering the use of extended workdays where safety is of major importance. These conclusions underscore the need for caution by companies using or considering the use of extended workdays. Based upon this review, it is recommended that the use of extended workdays be accompanied by special efforts to create safe working conditions. Also, since no *a priori* predictions from prior research can be made with certainty about the probable consequences of introducing 10- or 12-hr shifts into a mining company, evaluation of each miner should be made on a periodic basis.

Recommendations:

The use of extended workdays is recommended provided that certain precautions are considered. These are:
1. Extended workdays should not be considered where the frequency of accidents or near-miss accidents are at unacceptable levels. The use of extended workdays should not be expected to reduce the likelihood of accidents.

2. Extended workdays should not be considered for jobs that require extremely high physical workloads. For example, the American Industrial Hygiene Association recommends a workload not to exceed one-third VO2max (maximum aerobic capacity) for an 8-hr workshift. While similar recommendations have not been made for extended workdays, this standard should be strictly enforced.
3. Job sharing and cross training should be considered where extended workdays are used. Since vigilance, boredom, and mental or physical fatigue can lead to errors, changing job tasks may alleviate these stressors.
4. Workers should not be expected to work overtime on extended workdays. Working on scheduled days off is not recommended.
5. If extended workdays are used, regular evaluation and assessment should be undertaken. For instance, survey methods have been developed by the USBM to evaluate schedules before and after changes are made (*29*). Also, long-term monitoring of health, accident, and production effects should be considered.
6. Hybrid schedules that utilize both 8- and 12-hr shifts should be considered. Table 7 is an example of a schedule utilizing both 8- and 12-hr shifts.

Management considerations

Changing a schedule: Equally important to the new schedule itself is how the process of choosing a schedule is carried out. There is not a single method that has been shown to be the best. A prescription for failure is for any one manager to take it upon himself or herself to decide upon a schedule and implement it without consulting those workers who would be affected by the change. This method, although seemingly efficient, sets up the potential for suspicion and inaccurate assumptions that could lead to possible rejection of the schedule, regardless of how good it is.

The following steps are recommended as one way that has proven effective:
1. Construct a company-wide shiftwork committee.
2. Evaluate work problems and worker needs. Social requirements of a schedule can be determined at this time. Focus groups or surveys can be used at this step.
3. Determine operational requirements.
4. Design alternative work schedules that consider the information from steps 2 and 3.
5. Evaluate alternative work schedules. This evaluation is based upon the opinions of the shiftwork committee, experts in the field, and/or other workers.
6. Choose three alternatives for a vote.
7. Make the shiftwork change.
8. Evaluate the change 6 months, 1 year, and every year thereafter. If the presurvey was used for evaluation, a postsurvey can be used as a basis of comparison. Inform the work force of the results of the evaluation.
9. Decide to keep or reject the schedule.

Training and followup:

Offer training to the shift workers in ways to cope with shiftwork. Involve family members in this training.

Summary

For the vast majority of the work force, any schedule that involves hours outside the parameters of a "normal" schedule (i.e., 9 to 5), will involve sacrifice and physical and psychological distress. There seems to be, however, schedules that are better than others. This paper presents various aspects of schedules that have been studied and reported upon. The literature is full of studies and reports of actual work settings that have changed schedules with positive outcomes. Shiftwork practice is an ergonomic consideration, where the fit between the worker and workplace may have serious consequences caused by job, sociological, and biological compatibility.

Table 7.—Hybrid schedule consisting of both 8- and 12-hour shifts.

Crew-week	Mon	Tues	Weds	Thurs	Fri	Sat	Sun
1	E	E	E	E	E	—	—
2	—	M	M	M	M	M12	M12
3	M	—	—	—	G	G12	G12
4	G	G	G	G	—	—	—

E = Evening shift G = Night shift G12 = Shifts from 7 pm to 7 am M = Morning shift
M12 = Shifts from 7 am to 7 pm Dashes indicate off days

References:
1. U.S. Office of Technology Assessment (Congr.). Biological Rhythms: Implications for the Worker. U.S. GPO, Sept. 1991, 249 pp.
2. Andlauer, P. Shift Work. Ch. in Encyclopedia of Occupational Health and Safety, Volume II. Int. Labour Off., Geneva, Switzerland, 1972, pp. 2023-2027.
3. Carpentier, J., and P. Cazamian. Night Work: Its Effects on the Health

and Welfare of the Worker. Int. Labour Off., Geneva, Switzerland, 1977, 85 pp.

4. Walker, J. Social Problems of Shiftwork. Ch. in Hours of Work, ed. by S. Folkard and T. Monk. Wiley, 1985, pp. 211-225.

5. Johnson, L. C., D. I. Tepas, W. P. Colquhoun, and M. J. Colligan (eds.). Biological Rhythms, Sleep, and Shift Work. Spectrum Publ. (New York), 1981, 618 pp.

6. Reinberg, A., N. Vieux, and P. Andlauer (eds.). Night and Shift Work: Biological and Social Aspects. Pergamon, 1981, 509 pp.

7. Rutenfranz, J. Occupational Health Measures for Night- and Shift Workers. Ch. in Journal of Human Ergology 11. Cent. Acad. Publ., Tokyo, Japan, 1982, pp. 67-86.

8. LaDou, J. Health Effects of Shift Work. West. J. Med., v. 137, 1982, pp. 525-530.

9. Moore-Ede, M. C., and G. S. Richardson. Medical Implications of Shift-Work. Annu. Rev. Med., v. 36, 1985, pp. 607-617.

10. Czeisler, C. A., M. C. Moore-Ede, and R. M. Coleman. Rotating Shift Work Schedules That Disrupt Sleep Are Improved by Applying Circadian Principles. Science, v. 217, 1982, pp. 460-464.

11. Cohen, A. R., and H. Gadon. Alternative Work Schedules: Integrating Individual and Organizational Needs. Addison-Wesley Publ., Reading, MA, 1978, 137 pp.

12. Folkard, S., D. S. Minors, and J. M. Waterhouse. Chronobiology and Shift Work: Current Issues and Trends. Chronobiologia, v. 12, 1985, pp. 31-54.

13. Winget, C., L. Jughes, and J. LaDou. Physiological Effects of Rotational Work Shifting. J. Occup. Med., v. 20, 1978, pp. 204-210.

14. Duchon, J. C., and C. M. Keran. The Adjustment to a Slowly Rotating Shift Schedule: Are Two Weeks Better Than One? Paper in Proceedings of the Human Factors 34th Annual Meeting (Orlando, FL, Oct. 8-12, 1990). Hum. Factors Soc., 1990, pp. 899-903.

15. Knauth, P. The Design of Shift Systems. Ergonomics, v. 36, Nos. 1-3, 1993, pp. 15-18.

16. Knauth, P., and J. Rutenfranz. Development of Criteria for the Design of Shift Work Systems. J. Hum. Ergology., v. 11 Suppl., 1982, pp. 337-367.

17. Eastman Kodak Company. Ergonomic Design for People at Work. Von Nostrand Reinhold, New York, NY, v. 2, 1986, 603 pp.

18. Klein, K. E., H. M. Wegmann, and B. I. Hunt. Desynchronisation as a Function of Body Temperature and Performance Circadian Rhythm as a Result of Outgoing and Homecoming Transmeridian Flights. Aerospace Med., v. 43, 1972, pp. 119-132.

19. Klein, K. E., and H. M. Wegmann. The Effects of Transmeridian and Transequatorial Air Travel on Psychological Well-Being and Performance. Paper in Chronobiology: Principles and Applications to Shifts in Schedules, NATO Advanced Study Institutes Series D: Behavioral and Social Sciences, No. 3. Sijthoff & Noordhoff, The Netherlands, 1980, pp. 339-352.

20. Hauty, G. T., and T. Adams. Phase Shifts of the Human Circadian System and Performance Deficit During the Periods of Transition: I. East-West Flight. Aerosp. Med., v. 73, Dec. 1966, pp. 668-684.

21. Coleman, R. M. Wide Awake at 3:00 am W. H. Freeman and Co. (New York), 1986, 184 pp.

22. Dirken, J. M. Industrial Shift Work: Decrease in Well-Being and Specific Effects. Ergonomics, v. 9, No. 2, 1966, pp. 115-124.

23. Kogi, K. Job Content and Working Time: The Scope for Joint Change. Ergonomics, v. 34, No. 6, 1991, pp. 757-773.

24. Volle, M., G. R. Brisson, M. Perusse, M. Tanaka, and Y. Doyon. Compressed Work-Week: Psychophysiological and Physiological Repercussions. Ergonomics, v. 22, No. 9, 1979, pp. 1001-1010.

25. Kelly, R., and M. Schneider. The Twelve-Hour Shift Revisited: Recent Trends in the Electric Industry. J. Hum. Ergology, v. 11, 1982, pp. 369-384.

26. Tepas, D. T. Flexitime, Compressed Workweeks and Other Alternative Work Schedules. Ch. in Hours of Work, ed. by S. Folkard and T. Monk. Wiley, 1985, pp. 147-164.

27. Wilkinson, R., S. Allison, M. Feeney, and Z. Kaminska. Alertness of Night Nurses: Two Shift Systems Compared. Ergonomics, v. 32, No. 3, 1989, pp. 281-292.

28. Duchon, J. C., C. M. Keran, and T. J. Smith. Extended Workdays in an Underground Mine—A Work Performance Analysis. Hum. Factors, v. 36, in press.

29. Duchon, J. C. Evaluation of Two Work Schedules in a Mining Operation. Paper in Trends in Ergonomics/Human Factors V, ed. by F. Aghazadeh. Elsevier, 1988, pp. 151-160.

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Every move it makes

Underground storage is one disposal option for waste leftover from nuclear weapons research. Engineers pre-paring to put such materials in the earth are using U.S. Bureau of Mines (USBM) monitoring technology designed to protect workers who take coal out.

The Department of Energy has installed a USBM automated ground control management system at its Waste Isolation Pilot Plant near Carlsbad, New Mexico. The system is monitoring the stability of the underground repository that will someday hold tons of low-level radioactive wastes.

The system, which combines the latest sensor technology with "smart" computer analysis techniques, can continuously collect and evaluate data from up to 15,000 instruments. It provides an around-the-clock assessment of the structural integrity of the underground rooms, drifts, and shafts at the storage site.

The USBM devised the real-time monitoring system to keep track of ground conditions in longwall coal mines where the rapid pace of mining can quickly create new hazards. Measuring ground pressure changes, strata movements, and other parameters during mining can help engineers detect potential problems with roof support and identify ways to protect miners from cave-ins.

Use of the system at Cyprus-Amax Coal Company's Foidel Creek Mine in Oak Creek, Colo., allowed mine managers to monitor and respond to changing ground conditions during the development and mining of six longwall panels. USBM scientists are now working with Drummond Coal to install the monitoring system at the company's new Shoal Creek Mine located near Birmingham, Ala.

Reprinted from the May 1995 issue of the U.S. Department of Interior's Bureau of Mines' ***TIPSHEET.***

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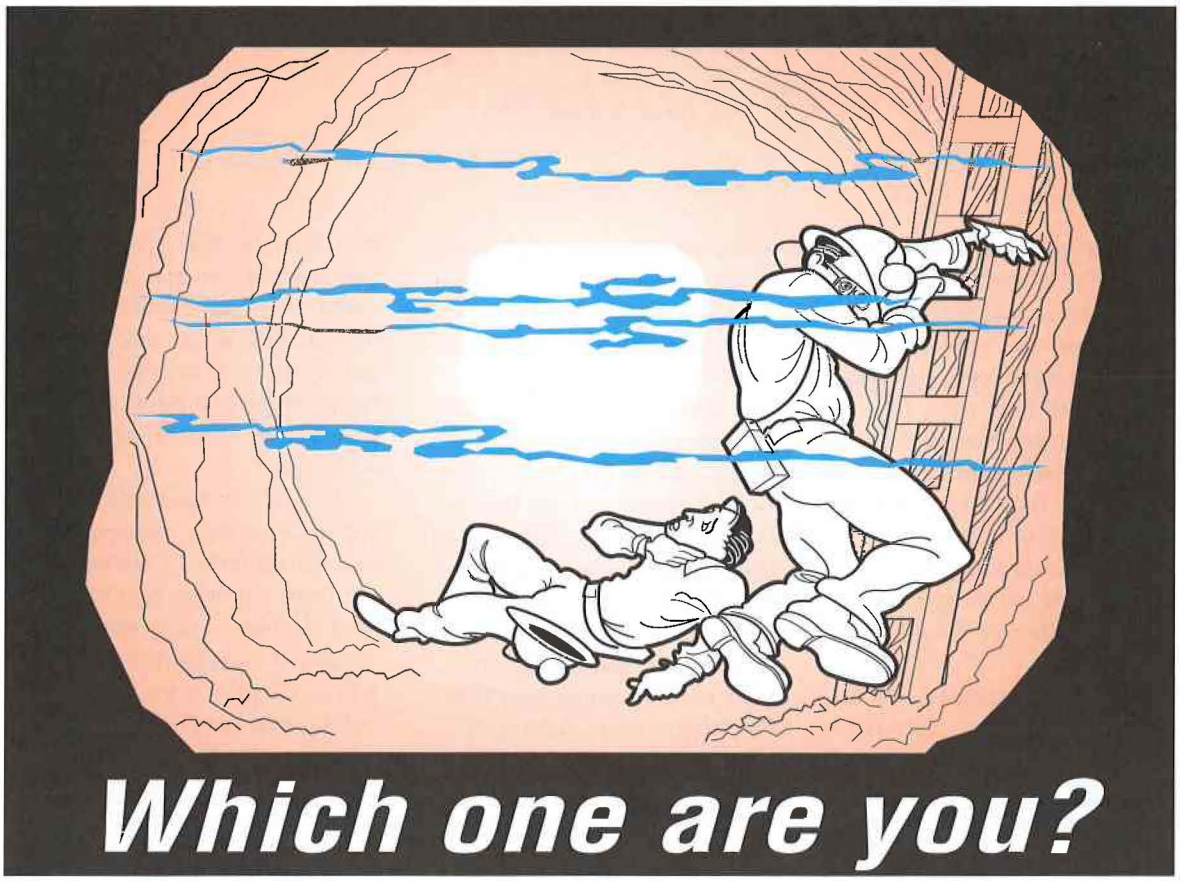
Make sure that you will ALWAYS be with them by... WORKING SAFELY



Which one are you?

After cleaning a storage tank, two men climbed out, removed their personal protective equipment, and began to gather their tools. One man went back in to retrieve a forgotten tool. When the second man saw him go in without his respirator, he called to him, then looked in and saw him collapsed on the bottom. Without stopping to think, he grabbed a respirator and rushed to aid his friend. He collapsed before he could put on the respirator. A third man saw the hatch open and peered in. When he saw the two men, he called for help. An emergency team arrived and retrieved the two men. Both were dead. However, the third man had succeeded in preventing one fatality—his own. If you faced a similar situation, would you react like man two or man three? It is human nature to try to save a co-worker; but you can't help anyone if you are incapacitated yourself. Before entering any confined space you **must** have proper training in safe entry procedures. Unseen life-threatening conditions may exist or develop quickly in any confined space, no matter the size, or how innocent looking.

What is a confined space?

It is any space with difficult entry/exit, which is not intended for regular occupation, and which presents *potential* hazards—safety hazards (engulfment, mechanical, electrical, etc.) and/or atmospheric hazards (oxygen deficient, toxic, or flammable). Any questionable area, on the job or off (e.g., a well or a trench), should be treated as a confined space and all precautions taken until proven safe. In the workplace, the confined space hazards that exist must be identified and clearly marked, and entry procedures developed, communicated, and enforced.

What can you do?

Know what confined spaces exist in your workplace and be aware of their danger. Be sure you understand and—without exception—**follow** your company's confined space entry procedures. The **Cardinal Rule** in confined space entry is ***always*** assume a hazard exists—never enter until tests for hazards have been done, and enter only with proper equipment, following safe work practices. And don't attempt a rescue without proper training and equipment, or you could become a victim yourself.

Reprinted from the March/April 1995 issue of Ontario [Canada's] Natural Resources Safety Association's ***Health & Safety RESOURCE.***

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Lubricity: secret weapon in productivity battles

by Richard Kuster

Coal mining has become incredibly capital intensive. Cost for modern equipment such as longwall systems, conveyors and systems to move men, materials, and minerals have risen as equipment sizes have grown and technology has improved.

As these costs have risen, so has the need to improve productivity. Two ways this can be accomplished are through longer equipment life and lessened downtime.

One often overlooked way to achieve both of these objectives is through proper lubrication technology. Modern synthetic formulations for gear lubricants and hydraulic fluids constantly outperform petroleum-based products. Forward-thinking operators are finding increased uses for synthetics in the coal mining industry.

Synthetics have reduced wear on longwall gearboxes, extended oil change intervals and raised running speeds on coal conveyor belts. Synthetics have also reduced instances of premature gear and bearing failures and have even worked to extend the life of badly damaged equipment. In one recent instance, synthetic lubricants protected a longwall gearbox for nearly three weeks after a water tube burst inside the gearbox.

The secret of the synthetic lubricants' success is the property of lubricity. Substances in the synthetic formula form tenacious films on all metal parts, as soon as the lubricant is added. If the bulk oil film fails—driven off by heat, lack of clearance, pressure or contaminants—lubricant protection can be lost. Lubricity, however, prevents metal-to-metal contact in those instances.

All machined metal surfaces—no matter how smooth—have high spots and low spots. When the high spots of adjacent surfaces touch, friction can raise the surface temperature to extreme levels. This thins the oil, which allows for more contact. And, their heat increases, which can cause the surfaces to weld and then tear apart. This torn metal becomes a site for accelerated fatigue wear—leading to increased problems and, ultimately, to failure.

The film formed by lubricity will prevent metal-to-metal contact, reduce friction wear, combat increased oil temperatures and reduce the effects of attacks by water and secondary wear caused by partially damaged surfaces.

Synthetics provide advantages both above and below ground. In both locations, longer life and better protection are the key benefits. Above ground, there is another major plus.

All petroleum lubricants contain wax, which crystallizes at low temperatures. It is the wax crystals that make cold oil into a solid mass, difficult to move and ineffective at providing lubrication.

So, engines are hard to start. Transmissions and hydraulic systems require long warm-up times. And, the chances of increased wear or premature failure become much greater.

With no wax in them, fully synthetic lubricants routinely have pour points as low as 70°F (57°C) This lets engines start quickly and easily and eliminates the need for transmission or hydraulic warm-ups. Synthetic gear lubes flow easily during cold starts, as if they were already at operating temperatures.

As synthetic lubricants have become more widely known, the coal mining industry has begun to use them. Synthetic gear oils have been recommended by original equipment manufacturers such as a large maker of mine wheel truck motors, who has prescribed a synthetic ISO 220 gear oil. In other cases, mine operators have begun to use synthetics for the problem applications: hot-running gear boxes, old or damaged equipment, hard-to-service equipment and other places where they want to prevent downtime and increase output.

At Gard Corporation, we have been working with a number of mine operators. Our test programs have shown them how to reduce unscheduled shutdowns and have increased operating speeds. Gard synthetic lubricants have been increasing uptime and have had a positive effect on the productivity of each operation. As a result, they are using more and more synthetics in more and more applications. And finding that each additional application rapidly provides increased benefits.

Richard Kuster is Synthetic Lubricants Product Manager for Gard Corporation, 1-800-829-4273, ext. 15.

*Reprinted from the April 1995 issue of Acquires' **COAL TODAY**.*

A safety reminder for blasters

The theory:

For years, it has been widely accepted that flyrock is by far the most dangerous and most common hazard in blasting. Statistics from the Bureau of Mines confirm that in blasting the two greatest threats to personal safety are: (1) failure to adequately clear the blast area, and (2) excessive flyrock. Two recent incidents in Kentucky coal mines show that this is indeed still the case.

The facts:

On December 6, 1994, a blast detonated on Cockrell's Fork Mine threw rocks off the permit, down a steep slope, and into a residential area located 800 to 1,200 feet from the blast. Baseball size rocks struck four houses and several vehicles parked in the area. The damage to the homes consisted of holes in the roof, dented gutters and siding and some interior damage to ceilings and doors. The vehicles suffered various broken windows and sheet metal dents.

Fortunately, no one was injured in this incident. However, several people were in the houses at the time these were hit and a four year old girl narrowly missed being struck by a rock that come through the roof.

Both the Kentucky Department of Mines and Minerals and the Department for Surface Mining Reclamation and Enforcement investigated the incident. A citation was issued for violation of the flyrock law and all blasting on the permit was suspended until blast plans could be drawn up and approved for all areas of the mine. These blasting plans were to be designed to reduce the possibility of a recurrence of the flyrock. On January 11, 1995 the department lifted the suspension in the final area of this permit.

On December 27, 1994, Jesse Sublett, a licensed and certified blaster, was injured in a surface coal mine blasting accident. Mr. Sublett, an employee of Dyna-Blast Inc. of Madisonville, was working as blaster-in-charge on a permit operated by Winn Construction near Livermore in McLean County. Mr. Sublett sustained a broken left leg when he was struck by flyrock from a blast he had initiated.

The Kentucky Department of Mines and Minerals investigated the accident and found the following: Mr. Sublett was 472 feet away from the shot when he detonated it, and was using only his pickup truck as cover. Some clods of clay were thrown in his direction and he could not avoid being hit in the left thigh.

Mr. Sublett was cited by the department for failure to detonate a shot at a safe distance or under sufficient cover.

The sermon:

Without minimizing the seriousness of either of these incidents, we can say that it was indeed fortunate that the only injury sustained was a broken leg. However, this was simply a matter of favorable luck. Both accidents could have had much more severe consequences had the trajectory of the flyrock been slightly different.

For that reason, it is imperative that blasters always assume the worst case scenario and take extra care when planning, drilling and loading a shot in order to prevent it. A blaster must protect everyone on the job, including himself, by adequately clearing the area. He must thoroughly examine his blast design and make sure it is being followed in the field by the driller and the blasting crew. There is a tendency in a mine to take blasting for granted, especially when everything has gone well in the past. As soon as the blaster makes an assumption that he has no problems and lets down his guard even once, he is inviting enormous troubles into his world.

Reprinted from the Volume IV, 1994 issue of Kentucky's Department of Mines and Minerals ***Bulletin****.*

'A Team' trains to rescue trapped coal miners

COULTERVILLE, IL—It's every coal miner's worst nightmare: a fire or an explosion hundreds of feet underground, where no one can hear you scream.

The 'A-Team,' an expert squad of six men and one woman from the Illinois Department of Mines and Minerals (IDMM), wants miners to sleep a little easier. The state's mine inspector rescue team is responsible for going anywhere at anytime to save a trapped miner.

"Coal miners have a special camaraderie," said Mary Jo Bishop of Harrisburg, who joined the team in 1991 after a dozen years as a miner. "When you hear about something happening at a mine, it doesn't matter if it's a mine you've been at or a mine half way across the country, it strikes home."

Bishop and her teammates, besides being state safety inspec-

tors, have mastered rappelling, first aid, firefighting, and handling of hazardous materials. Each has at least a decade of coal mining experience, although most have much more.

When they go underground, members each wear a $5,000 self-contained breathing apparatus. The backpack device recycles exhaled air for four hours. Dressed in gray jumpsuits and face shields, the team looks like astronauts. The environment they enter often is as treacherous as any lunar landscape.

Despite the danger, don't dare compare these folks to Rambo. A sense of adventure helps, but teamwork and safety are paramount, they say.

"There's nothing romantic about it," said team captain Jim Steiner of Sparta. "You don't just don an apparatus and go running in there like Superman, because you aren't Superman. It takes a group of people who are going to work together to make it successful."

One of the team's showcase operations was helping rescue four miners trapped in a fluorspar mine in Hardin County three years ago. A truck had caught fire, blocking the mine's only exit.

"We had no communication. We knew there were four men in the mine, but we didn't know their condition," said team supervisor Don McBride, a Centralia native. "We went in with six people. The exit was smoke-filled. There was no way out. Luckily, the men had found a clean air pocket. I'm glad they kept their heads or we would've had four fatalities."

The team isn't the only one in Illinois, but it's the only one trained in both underground and surface rescues and the only one made up of fulltime state employees. It also responds to emergencies at state parks, where people occasionally get lost in caves.

IDMM contracts with coal miners to staff other teams in Du Quoin, Benton, Elizabethtown, and Springfield.

Some mines have their own teams. Federal law requires every mine to be within two hours of a mine rescue station, McBride said.

At the Zeigler No. 11 mine near Coulterville recently, the state team went 215 feet underground to try their breathing equipment for the first time. Steve Thompson, an Old Ben Coal Co. foreman, watched as they swiftly carried a stretcher through the gloomy, dusty shafts.

"I think the majority of coal miners like what these guys are doing," said Thompson. "It' s appreciated."

Just in case anybody gets complacent, there's trainer Joe Gladson of Benton, the team's crusty drill sergeant, who has 45 years of mining experience.

Gladson has seen the terror that can erupt from the mines: He was on a rescue team that responded to the 1951 New Orient Mine No. 2 explosion in West Frankfort, when 119 miners died. Many of the victims were his friends.

SAFETY REMINDER

If you can't stand the heat...

New compensation claims are made specifically for heat stress. However this hides the fact that heat is a contributing factor to many injuries. When you are hot and uncomfortable, you pay less attention, work less efficiently, and have more accidents.

The two most serious stages of heat stress are heat exhaustion (heavy sweating, headache, dizziness, weakness, nausea) and heat stroke (no sweating, disorientation, delirium, convulsions). They result from dehydration and salt depletion as your body sweats to lower its internal temperature. Heat stroke occurs when body temperature exceeds 105° F and can cause death without immediate medical attention.

There are several ways to prevent the severe stages of heat stress:

Drink plenty of fluids. When working in hot conditions your body can lose up to one quart of fluid *per hour*. Do not rely on thirst to tell you when or how much to drink. Drink large quantities before you begin to work [this is called hydration] and at least one cup every half hour while you work. Drink cool water or other non-carbonated fluids. Do not drink milk, undiluted fruit juices, or any form of alcohol, which actually causes your body to lose fluids.

Increase your salt intake slightly. The amount of salt in a small bag of chips is more than enough. Do ***not*** take salt tablets.

Cool your body. Wetting your head and neck to increase evaporation helps. Get away from sources of heat (engines, the sun, etc.) periodically. Take breaks in as cool a location as is available.

Most important, listen to your body. It needs up to two weeks to acclimatize itself to working in hot conditions. Don't over-exert yourself. Studies have shown that workers who were allowed to pace themselves spontaneously maintained their internal body temperature below 98° F. So if you can't stand the heat... don't! Take a break.

Reprinted from Ontario [Canada's] Natural Resources Safety Association's July-August 1994 issue of ***Health & Safety RESOURCE.***

After a diagnosis of prostate cancer, then what?

By Rick Weiss

For most of the 244,000 American men who will be diagnosed with prostate cancer this year, the news will be a staggering surprise. Most tumors are discovered in men who feel fine, during a routine cancer screen or, less frequently, in the course of another procedure, such as surgery for benign prostate disease.

But many of these men will be even more surprised to learn that there is no tried and true treatment path for them to follow. Surgery, radiation, hormone therapy and "watchful waiting" (doing nothing for now), all are options. But the relative benefits of each remain largely uncertain.

"Any treatment you choose will look good for five years and maybe even 10 years," said William R. Fair, chief of the urology service at Memorial Sloan-Kettering Cancer Center in New York. "But longer term results are unpredictable and often disappointing."

Adding to the confusion, side effects of various treatment options vary tremendously, from the total lack of problems associated with watchful waiting to the moderate ill effects of radiation therapy to the significant risks of incontinence and impotence that come with prostate surgery (called radical prostatectomy).

And because clinical studies of various therapies have included different kinds of patients different lengths of follow-up and different indicators of success or failure, it is almost impossible to compare them directly.

"The literature can tell you everything or nothing, depending on your bias," said John Wasson, a professor of medicine and director of Dartmouth College's Center for the Aging.

Still, there *are* some generalities that can help the decision-making once a diagnosis of prostate cancer has been made. Remember that it's always a good idea to get a second and perhaps a third opinion before settling on a plan of action—or inaction.

Watchful waiting

There are two groups of men for whom no action is often the best action: men who are older than 70, and men whose cancers have already spread to other parts of the body (usually the seminal vesicles or the pelvic bones) yet who have no symptoms.

Most prostate tumors are very slow growing— one reason why

The prostate at a glance

The prostate is a male sex gland at the base of the penis, just below the bladder and in front of the rectum. It surrounds the urethra, the tube that drains urine from the bladder. The prostate produces the liquid portion of semen, the fluid that carries sperm through the penis when a man ejaculates during sexual climax.

The normal prostate, about the size and shape of a walnut, grows with age. That growth can be benign or cancerous. Benign enlargement of the prostate can cause trouble with urination and may require surgical treatment. More than 300,000 of these operations are done each year. Cancer of the prostate can grow so slowly as to be harmless in an older man, or it can spread outside the prostate and become life-threatening.

- Prostate cancer is the most common non-skin cancer in American men. Among cancers, only lung cancer kills more men.
- Expected new cases this year: 244,000.
- Expected deaths this year: 40, 400, or 110 a day.
- At particular risk: Men over 50; African American men over 40, men with a family history of the disease.
- Detection: Digital rectal exam (DRE) and prostate-specific antigen (PSA) blood test.
- Five-year survival: 80 percent overall, 94 percent when there is no evidence the cancer has spread beyond the prostate.
- Warning signs: Difficult, frequent or painful urination; blood in the urine; persistent pain in the lower back, pelvis or upper thighs. These symptoms do not necessarily mean cancer, but none should be ignored.
- Causes: Unknown.

standard chemotherapy cancer drugs, which specifically kill rapidly dividing cells, do not work well against prostate cancer. This means that most men in their seventies can avoid the hassles of treatment and succumb to something else before their prostate catches up with them. In fact, most surgeons will not perform prostatectomies on men older than about 70 unless there is good evidence—a family history of centenarians, for example—that they're likely to live more than another decade.

"The rule I use half-jokingly," Fair said, "is that I don't recommend radical prostatectomy for a man over 70 unless he comes in with his father."

Some experts also recommend that men with metastatic disease (prostate cancer that has spread) delay for as long as possible the medical and psychological traumas of therapy. No treatment is curative against this stage of the disease, so it can make sense to hold off until bone pain or other symptoms necessitate the start of palliative treatments.

Some doctors and patients feel that watchful waiting is a viable option for many other men who might normally end up getting surgery or radiation. They note that no study has clearly demonstrated an increase in life span with radical treatment (the National Institutes of Health has started such a study, but it will be years before results are known), and most prostate tumors grow too slowly to be of any consequence.

Others, however, argue that until doctors learn how to differentiate between slow growing and fast-growing prostate tumors, the best bet for men under 70 with localized disease is to get treated.

Surgery

Radical prostatectomy is by most accounts the "gold standard" for treatment of tumors that are localized to the prostate itself. The vast majority of men whose prostate tumors have not spread, or whose cancer has spread to a few lymph nodes but is not an aggressive or fast-growing variety, remain cancer-free 10 years after surgery.

The number of such surgeries nationwide has skyrocketed in recent years, increasing almost six-fold between 1984 and 1990, according to the National Cancer Institute. But many of these surgeries are unnecessary. That's because many cancers are mistakenly diagnosed as localized when in fact they already have grown to the point where prostate surgery is of no use. Many of these men now have to deal with the surgical complications of incontinence, impotence or both when they could as easily have opted for watchful waiting.

"When men come in for surgery, using all the state-of-the-art stuff like CT scans and ultrasound and PSA tests and the doctor feels that based on all this that the tumor is localized and he can remove it all, still he's wrong 50 percent of the time," said Warren D. Heston, director of the George M. O'Brien Urology Research Center at Memorial Sloan-Kettering. In those "understaged" cases, Heston said, tests in the weeks or months after surgery indicate that some cancer cells remain, which means that the procedure has almost certainly been in vain.

Heston and his colleagues hope to better those odds with a novel treatment now under study. For three months before surgery, they give patients drugs that block the male hormones upon which prostate tumor cells thrive. The idea is to shrink the main tumor and starve nascent metastatic cells to increase the odds that the surgeon can "get everything" when it is time to operate. At a cancer meeting in Toronto in March, the researchers reported promising results indicating that men given the hormone therapy were 30 percent more likely than others to have their tumor confined to the prostate when surgery was performed.

There are two basic approaches to performing a prostatectomy; The surgeon can enter through the abdomen between the navel and the pubic bone, or through the perineal area between the scrotum and the rectum. In either case, the surgeon must remove the prostate and the segment of the urethra that runs through it. In doing so, one or both of the nerves that control penile erections may be cut, leaving the patient impotent. Depending on how well the urethra heals, the patient may also end up with varying degrees of urinary incontinence.

Surgeons have become much better at performing Nerve-sparing" surgery, leaving patients with the ability to have erections after their prostate has been removed. The problem is that prostate cancer, when it occurs, tends to colonize many different parts of the gland, not all of them obvious. If the surgeon steers clear of those critical nerves, some hidden cancer cells may be left behind.

Patrick Walsh, the urologist-in-chief at Johns Hopkins University who pioneered the nerve-sparing technique, said men should remember that the most important goal of prostate surgery is to eliminate the cancer, since most recurrences ultimately prove fatal. Indeed, he ranks sexual potency as third in

Why a walnut? Or, a gland by any other name

By Don Colburn

Walnut, chestnut, golf ball or plum? Since most men—unless they happen to be urologists—have never actually seen a prostate gland, experts usually try to describe it in terms of something they have seen.

That's why nearly every newspaper article ever published about the prostate includes the word "walnut."

Is it really the size of a walnut? Like seemingly everything else about the prostate gland, the question is more complicated than it sounds.

'Walnut is about right," said Peter Scardino, chairman of urology at Baylor College of Medicine in Houston. "But that's the prostate of a young man."

Trouble is, the main reason newspapers print articles about the prostate is that the thing won't stay the same size after age 40.

"On average, it doubles in size by age 60, but it's all over the scope," Scardino said. "We've seen prostates of 500 grams, the size of a softball."

Even the walnut is no simple standard.

"English walnuts or black walnuts?" asked Sam Keiper, vice president of Diamond Walnut Growers Inc. in Stockton, Calif. California's English walnuts, he noted, tend to be bigger than the Eastern black walnuts. They average about an inch-and-a-half long and an inch and-a-quarter wide, he said, and weigh about 20 grams in the shell.

While the walnut remains the mass media's analogy of-choice for the prostate, competing entries have appeared. An American Cancer Society publication says the prostate is "about the size of a chestnut." And the Congressional Office of Technology Assessment, in a report released today on the cost effectiveness of prostate screening in older men, refers to the prostate as a "golf-ball sized gland."

That would make it bigger than a walnut. A regulation golf ball, said Frank Thomas, technical director of the U.S. Golf Association, cannot be smaller than 1.68 inches in diameter or heavier than 1.62 ounces--about 44 grams.

"Maybe a large walnut," suggested Baylor's Scardino.

"More like a plum," said John H. Lynch, chief of urology at Georgetown University Medical Center.

Plum or walnut, Lynch cautioned, the analogy works only for the youthful prostate. "Yours," he added upon learning his questioner was in his late forties, "is probably bigger than that right now."

importance after complete removal of all tumor cells and careful repair of the urethra to maintain urinary continence. The hassle of daily urine leakage and the need in some cases to wear absorbent pads is a far greater drawback than impotence, he said, especially given the availability of drugs and devices to help men have erections.

The incidence of incontinence, impotence and cancer recurrence after prostate surgery varies from survey to survey. In one large study cited in the National Cancer Institute's PDQ computer database of cancer treatment information, more than 60 percent of men reported some problem with incontinence after prostatectomy. About half of them reported routine use of absorbent pads or clamps. About 60 percent reported having no erections since surgery.

But in other studies, more than 90 percent of men had no urinary incontinence (the problem was more prevalent in men over 70). And in one study of 503 men at Johns Hopkins, potency was maintained in 68 percent of men overall, including 91 percent of those under 50, 75 percent of men 50 to 60, and 58 percent of men 61 to 70.

Data on cancer recurrences also vary; studies show from 70 percent to more than 90 percent of patients remain cancer-free 10 years after surgery in cases where the original cancer apparently was confined to the prostate.

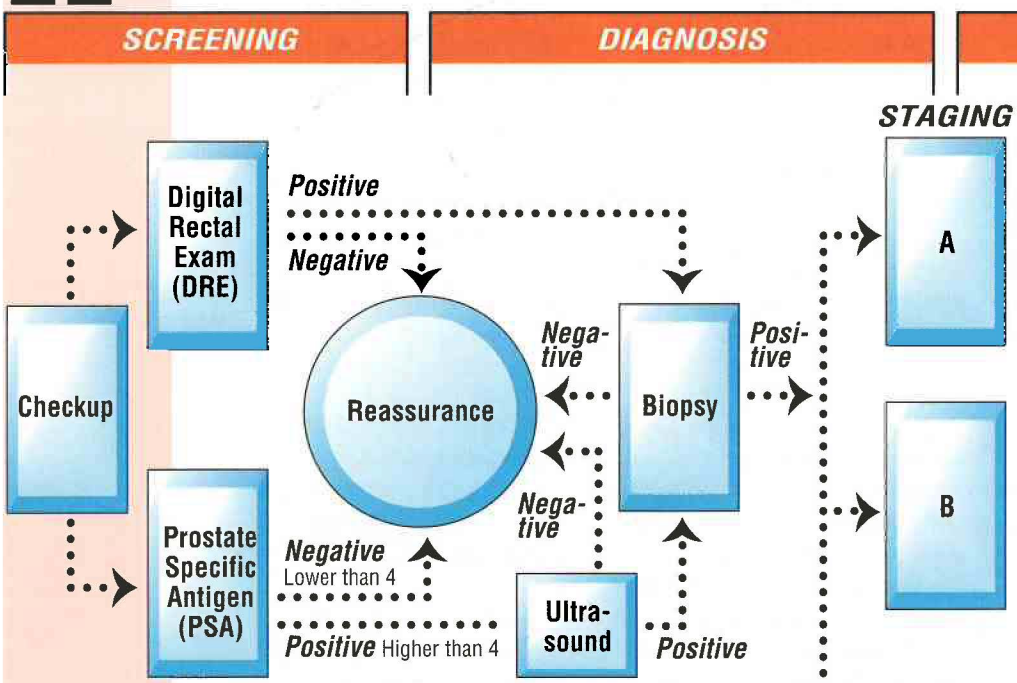
Radiation

By most measures, radiation therapy is about as effective as surgery when tumor cells are confined to the prostate or its immediate vicinity, and it is equally ineffective for cancer that has spread.

The main advantage of radiation over surgery is its relative simplicity. Patients typically get brief daily treatments for several weeks, without the pain and slow recovery that comes with surgery. Side effects are less common in the short run (the most common being bowel problems), although some do arise in the weeks or months after treatment, as tissues damaged by the radiation break down and form scars. Impotence, for example, is uncommon immediately after treatment but may appear a few years later. Other long-term problems can include painful

Continued on page 23

22 The prostate: diagnosis & treatment



NOTE: This is a general guide and may not apply in individual cases. "Reassurance" may include follow-up care.

THE DIAGNOSIS OF PROSTATE CANCER often begins with a medical checkup, whether or not the patient has symptoms. The main diagnostic tools are the digital rectal exam and the PSA blood test. A suspected diagnosis of cancer must be confirmed by a tissue sample called a biopsy. The value of early detection in prostate cancer remains uncertain because the tests are imperfect and can lead to unnecessary treatment. Many prostate tumors are slow-growing, and no rigorous study has yet demonstrated that, as a group, men treated early live longer. Many physicians, however, believe that prompt diagnosis and treatment can save lives. There is also agreement that the decision about how—and whether—to treat a diagnosed cancer of the prostate should be made jointly by doctor and patient after full discussion of the possible benefits and risks. Screening of men without symptoms is especially controversial. The American Cancer Society recommends that men have a digital rectal exam after age 40 and PSA test after age 50 as part of their regular medical checkups. The National Cancer Institute has not issued a recommendation.

VERY EARLY Tumor is confined within the prostate and too small to be detected by DRE. Usually found during surgery to relieve benign disease, or with elevated PSA.

Treatment Usually none ("watchful waiting"); sometimes surgery (prostatectomy) or radiation .

5-year survival Above 90 percent.

LOCALIZED Tumor still confined to the prostate but large enough to be felt during DRE. May or may not cause symptoms.

Treatment Watchful waiting, surgery or radiation, depending on how fast-growing it appears and the age of the patient.

5-year survival 85 percent (for small tumors confined to one side).

REGIONALIZED Tumor has spread from the prostate to nearby tissues, often blocking the urethra. Detectable by DRE. Symptoms include painful or frequent urination and blood in the urine.

Treatment Prostatectomy, radiation or hormonal therapy to block testosterone, the male hormone that fuels prostate cancer; or a combination of those.

5-year survival 48 percent.

MIASMATIC OR ADVANCED Tumor has spread to the pelvic lymph nodes or other parts of the body, such as the bones, liver or lungs. Symptoms include bone pain, fatigue and weight loss in addition to difficult urination and blood in the urine.

Treatment Hormonal therapy or watchful waiting. Radiation also is used to treat bone pain.

5-year survival 21 percent.

NOTE: This simplified ABCD scale is one of several prostate tumor staging systems.

Continued from page 21

urination and diarrhea.

Some studies have suggested that radiation may not control prostate cancer quite as thoroughly as surgery and that after 10 or 20 years the cancer may be more likely to reappear. For this reason, some radiologists will not use the approach in men younger than their late fifties. On the other hand, radiation often is preferable for men in their seventies.

"For someone in his seventies," Walsh said, "I think radiotherapy is best because side effects are less than from surgery."

In addition to standard "external beam" radiation, a growing number of doctors are using newer methods of irradiating prostate tumors. One method, called interstitial brachytherapy, involves the implantation of stainless steel radioactive "seeds" smaller than grains of rice directly into the prostate. The seeds, loaded with iodine 125 and palladium 103 and injected through a syringe-like device, blast the prostate with radiation doses higher than would be possible by external beam techniques, since the radiation does not have to pass through surrounding tissues on the way to its target.

Brachytherapy is relatively new, so no one knows for sure if it will prove as curative as external beam radiation or surgery. The approach has the advantage of being a onetime treatment (unlike the 30 or so radiation sessions typical of external beam radiation) that can be performed on an outpatient basis.

"The patient is awake and if he so chooses can actually watch on the monitor," said Michael S. Porrazzo, a radiation oncologist at Washington Hospital Center, one of three Washington area hospitals that offer the treatment. However, Porrazzo conceded, "no one has ever taken us up on that."

Another promising variation is "three-dimensional conformal therapy," now available in a few specialized cancer centers. This technique uses multiple X-ray images and sophisticated computer programs to identify the precise three-dimensional contours of a tumor. The device calculates the best way to aim multiple beams of radiation to cause minimal damage as they pass through the body, but maximum destruction when they converge at the tumor site. Side effects are generally less severe than with traditional external beam radiation, but some doctors are concerned that such perfect aim has a disadvantage: the possibility of missing hidden cancer cells that were not specifically targeted.

Cryotherapy

Cryotherapy is an experimental method for freezing prostate tumor cells to death. It involves a special catheter super-cooled with liquid nitrogen, inserted through the urethra. After years of mostly failed experiments, the technique is experiencing a renaissance due to the recent development of an ultrasound device that can be inserted into the rectum, allowing the urologist to visualize the prostate during the procedure and improve aim.

Some hospitals reserve cryotherapy as a "last gasp" effort in patients whose cancers have not responded to more traditional methods. But others now offer cryotherapy as a substitute for radical prostatectomy or radiation, especially when the cancer seems small and easily targeted.

Side effects appear to be less severe than from surgery, with hospital stays often limited to just a couple of days and lowered odds of ending up incontinent or impotent.

Hormone therapy

For men with advanced prostate cancer (cancer that has spread to other parts of the body) there is only one approach of any value: castration, either by drugs or surgery, to cut off the supply of male hormones that nourish prostate tumor cells. Castration is not a cure for cancer, but it often adds years to a man's life.

Currently there is no consensus among doctors about which of the many approaches to castration is best, or even when the therapy should be initiated. Some recommend it soon after diagnosis, figuring the earlier the tumor is starved of its growth hormones the better. Others, noting that prostate tumors invariably learn how to overcome their dependence on male hormones, recommend waiting until symptoms such as bone pain emerge, sometimes many years after diagnosis. Also of concern are the side effects of castration, including loss of libido, impotence, breast enlargement, hot flashes and diarrhea. In addition, drugs are expensive. Some of the most commonly used drugs cost hundreds of dollars a month, and must be taken for the rest of one's life.

A man who opts for castration can choose surgical removal of the testicles, which is very effective but has the medical and psychological disadvantage of being irreversible. Or he can use any of several drugs that either prevent the production of male hormones such as testosterone or that block the effects of these hormones on prostate tissues.

Reprinted from the Tuesday, May 25, 1995 issue of the ***Washington Post Health magazine—The Prostate: an owner's manual.***

THE LAST WORD...

Be thankful for fools. Without them, the rest of us wouldn't look so good.

Flattery is like chewing gum. Enjoy it briefly, but don't swallow it.

Little minds are tamed and subdued by misfortune; but great minds rise above.—Washington Irving

Friendship, of itself a holy tie,
Is made more sacred by adversity.—Charles Caleb Colton

Genius does what it must, and talent does what it can.—Edward G. Bulwer-Lytton

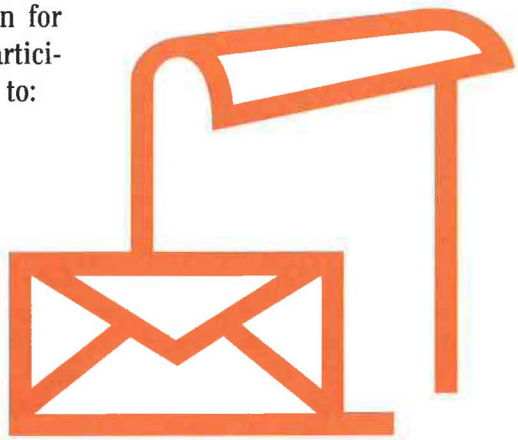
The chief danger in life is that you may take too many precautions.—Alfred Adler

Be slow of tongue and quick of eye.—Miguel de Cervantes

No great genius is without a [blend] of madness.—Aristotle

NOTICE: We welcome any materials that you submit to the Holmes Safety Association Bulletin. We DESPERATELY need color photographs suitable for use on the front cover of the ***Bulletin.*** We cannot guarantee that they will be published, but if they are, we will list the contributor(s). Please let us know what you would like to see more of, or less of, in the Bulletin.

REMINDER: The District Council Safety Competition for 1995 is underway—please remember that if you are participating this year, you need to mail your quarterly report to:



Mine Safety & Health Administration
Educational Policy and Development
Holmes Safety Association Bulletin
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Falls Church, Virginia 22044-0187

Please address all editorial comments to the editor, Fred Bigio, at the above address. Phone: (703) 235-1400

Joseph A. Holmes Safety Association
Awards Criteria

Type "A" Award – For Acts of Heroism
The award is a medal with a Medal of Honor Certificate.

Type "A" Award – For Acts of Heroic Assistance
The award is a Certificate of Honor.

Type B-l Award – For Individual Workers
(40 years continuous work experience without injury that resulted in lost workdays)
The award is a Certificate of Honor, a Gold Pin, and a Gold Decal.

Type B-2 Award – For Individual Officials
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The award is a Certificate of Honor.

Type C Award – For Safety Records
(For all segments of the mineral extractive industries meeting adopted criteria)
The award is a Certificate of Honor.

Other Awards – For Individual Workers
(For 10, 20, or 30 years without injury resulting in lost workdays)
The awards are 30 years - Silver Pin and Decal, 20 years - Bronze Pin and Decal, 10 years - Decal bearing insignia.

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(Mine operators with 25 employees or less with outstanding safety records)
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For information contact: Secretary-Treasurer, Joseph A. Holmes Safety Association (703) 235-8264

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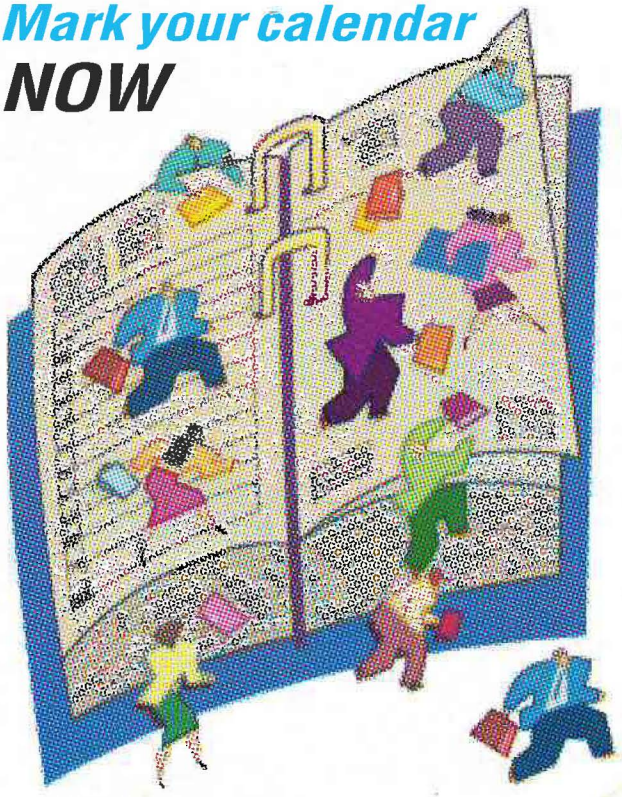

Coming events:

- *The first Health and Safety Conference of the Ontario Natural Resources Safety Association, Sept. 18-20 at the Toronto Colony Hotel, Toronto, ON*

- *Fifth Annual International Mine Safety & Health Conference & Expo, Sept. 27-29 at Francisco Grande Resort, Casa Grande, AZ*