

catering industry and the full extent of accidents is therefore not known. However, through the questionnaire it was hoped that many more accidents would be "unveiled".

The large majority of accidents reported were accidents of a small scale which would not have been revealed if the manager had to follow the legal channels of accident reporting. The Machinery and Occupational Safety Act (MOSA) requires that any accident must be reported to the Department of Manpower Inspector where the accident caused the death of the worker, could have caused the death of the worker, resulted in a worker losing consciousness, injury or the loss of a limb, or resulted in the worker becoming ill and remaining off work for at least fourteen days. It is clear from these provisions that accidents recorded in the present study would not have been reported to the Department of Manpower Inspector. The only possible reports may have been in those cases where amputation occurred.

Unfortunately occupational accidents are often considered to be caused solely by human error. This can be seen by the recommendations forwarded by the Department of Manpower where accidents, such as persons falling, are seen to a large extent to be prevented by "working more carefully and by better supervision" (Report of the Director General, 1987; p108).

As discussed in Chapter 2, early research focused largely on the notion of "accident proneness". This concept rested upon the idea that a person with certain personality characteristics was very likely to have accidents. When a person was said to be accident prone it was generally meant that he/she had some psychological characteristics which predisposed him/her toward having accidents (Ramdial, 1981). However, these early

studies ignore the fact that factors such as individual background and emotional disposition cannot provide an adequate and sole explanation of all accidents in every situation.

Kirchner (1961) suggests that the concept of accident proneness has received far more attention than it deserves. As indeed in Chapter 2 it was shown that accidents can be due to factors which are not the individuals fault such as lack of training or no training at all, poor supervision, unfavorable attitudes towards accident prevention and tolerance of poor work conditions. Thus, without carefully investigating the circumstances surrounding an accident which a person has, it would be unwise to label a person accident prone, as what at first may appear to be accident proneness, could upon further inspection reveal other factors or conditions which are causes of accidents. A worker may be a victim of poor environmental conditions such as having to work with faulty or poorly designed machinery, or in a hot surrounding, or under stress conditions. In addition the individual could have had little or no adequate training (Ramdial, 1981).

Thus, although the theory of accident proneness seemed for many years to be a possible solution to the problem of work-related injuries, when put in proper perspective, it contributed little to the overall problem (Beach, 1980). One cannot explain accidents by looking for personal or other factors, as these factors do not recognise the complexity of the behavioural environment. It is for these reasons that accident prevention is particularly dependent on ergonomists who are aiming at improvements in the working environment, instead of unsuccessful attempts to reduce natural variation of human behaviour.

From the tables and statistical analysis presented in the previous chapter, three major areas of accidents can be observed. There is a clear relationship between accidents in commercial kitchens and:

1. slips, trips and falls,
2. burns,
3. cuts

These expected relationships are now discussed in sections 1, 2 and 3 of this chapter.

1. Slips, trips and falls

It is universally recognised that slippery surfaces are dangerous (James, 1983). Hunter (1930) recognised the influence of contaminating substances such as dirt, water and oil. Sigler, Geib and Boone (1948) emphasised the importance of wear and contaminants. Attention has also been drawn to the influence of floor polishes and treatments on the safety of floors (Jablonsky, 1978).

The frequency of slips, trips or falls was thirty seven (20%). This was the second highest item chosen in the category of immediate causes of injury. Slips, trips and falls are a direct function of floor surface and it is therefore necessary to identify the relationship between slips, trips and falls and floor surfaces as well as other items related to slips, trips and falls.

There was a significant correlation between slips, trips and falls by a worker and slippery and greasy surfaces. Thirty six of the 135 reported incidents were accounted for by slippery or greasy surface or material. Greasy and wet floors present a major hazard in commercial kitchens. Accidents as a result of such conditions led to injuries in the form of strain or sprains and injuries to the back. The frequency of these injuries were ten for strain or sprain (5.1%) and seven for back (3.6%). These accounted for almost 9% of the injuries in the study.

In trying to extract information which would define areas of ergonomic concern, a number of relationships were observed. Significant relationships were found between "walking without carrying anything on a level surface" and "slippery surface or material" (see Table 10). "Carrying or wheeling material on a level surface" correlated significantly with "slip, trip or fall by worker" (see Table 11).

Thus, there is a clear relationship between a greasy or slippery material and a slip, trip or fall by a worker. In addition, movements such as "walking without carrying anything on a level surface" and "carrying or wheeling material on a level surface or material", when slippery, may result in injury.

Slippery and greasy surfaces, in kitchens are caused by such things as spilt ice being left on the floor, as well as oil and water on the floor. In addition bits of peel or dropped food remaining on the floor becomes a potential hazard. In one of the restaurants, the manager pointed out that there was always water on the floor from an ice machine which was placed in the kitchen area. Once again perhaps a relief surface could be incorporated in which to collect the spilt water. Alternatively the

ice machine could be placed in a position which is easily accessible, yet will not cause workers to come into contact with the water on the floor.

When looking at slippery and greasy surfaces, a number of restaurants showed concern regarding this issue. One restaurant was contemplating placing a rubber mat in the kitchen area to avoid slips. Another was in the process of placing a metal grid in the cooking area which was filled with a substance called cerza zorb, aimed at preventing slips. None of the restaurant managers had considered supplying the workers with non-slip rubber boots or shoes. On phoning a number of suppliers of safety equipment, it was revealed that such boots and shoes are in fact manufactured.

"Slip, trip or fall by worker" correlated with "uneven surface or material" as well as with "jumping or stepping down from an elevated surface or material" (see Table 12). "Jumping or stepping down from an elevated surface or material" also showed a relationship with injury to the back and "uneven surface or material" resulted in injury to the legs (see Table 13).

Uneven surfaces could include steps as well as a mat which is not placed smoothly on the ground. In one particular restaurant, when the author of this research was going through the questionnaire with the manager, it was observed that a worker tripped, on two successive occasions, on a plastic mat which was not placed smoothly on the carpet in the dining area. The manager's comment on this incident was that the worker was always doing such clumsy things. This indicates that the manager was accepting such dangerous circumstances, and was passing the blame to the

worker, as opposed to isolating the actual cause of the accident which was in this case the mat which was not placed smoothly on the carpet.

Tuckett (1987) stresses that steps should be avoided in kitchens. In the open ended section of the questionnaire it was commented that a worker missed a step and therefore fell. In another restaurant participating in the study it was noted that meat was kept in an area which was only accessible by climbing down a number of steps. The manager himself commented that workers may trip or fall while fetching meat or bringing it back to the kitchen area. In "A Guide to Hotel and Catering Services" (Lian, 1981), it is stated that workers should "try to walk, not run" in order to promote safety in the kitchen (p 120). However, the "service" period is the time when most workers are likely to be under pressure and therefore the situation is "frenzied" and it is this time when most accidents are likely to occur (Telephonic interview with Richfield, L.; 4 August 1988). From the researcher's observation of kitchen workers during the "service period" it was impossible for workers to "try to walk, not run". It is not possible to operate in a busy restaurant by simply "walking". The nature of the work during such a period necessitates working at high speed under extremely pressurised conditions. These conditions include manager/esses, waiters and waitresses running into the kitchen and demanding food for their customers. Workers are thus faced with a situation of having to produce the food as quickly as possible. It is for this reason that flooring and equipment should be designed in such a way so as to minimise accidents.

Due to the high frequency of slips, trips and falls in this study as well as the high frequency of such accidents overseas (Andersson and Lagerlof, 1983; Grieve, 1983) this issue has to be addressed.

Successful prevention of slips, trips and falls in practice requires measurement techniques and criteria for the objective selection of satisfactory slip-resistant shoes and walking surfaces. Unfortunately, this problem has been underestimated by many investigators of slipping accidents, who did not consider slips and falls to be complicated phenomena. This is due to three reasons which have been expanded upon in Chapter 4. Firstly, there is inadequate accident classification. Secondly, such incidents usually result in bystanders laughing about them resulting in the general public not regarding such incidents seriously. Thirdly, there is no national system for collecting and analysing information about the causes of all injuries. Thus, accidents with tripping and slipping which are very frequent, will often be neglected compared to other accidents which are more rare and dramatic.

Harrison and Malkin (1983) forwarded certain recommendations with regard to safety in the area of slips, trips and falls. Wherever there is a risk of water lying or of water spillages, relief surfaces should be used to reduce the chance of slipping. Design of the floor texture has to be modified according to foot comfort and ease of cleaning. Grip soles and heels are also effective. Where high relief on the floor and/or shoes is not feasible an improvement can be made by inclusions on the floor surface. These are usually particles of silicon carbide in the case of ceramics. Some improvement can be obtained by choosing suitable shoe materials. The most effective system demands that a combination of the floor and shoe materials and surfaces should be decided upon (Harrison and Malkin, 1983). However, no sole or floor combination is safe if they are not cleaned regularly with proper materials.

The second area of accidents to be identified is the area of burns.

2. Burns

Clearly due to the kind of work performed in a kitchen, and because of the nature of the equipment used in preparation of meals, there is high potential for heat related accidents to occur. Equipment which could be potentially hazardous includes steamers, boiling pans, pressure cookers, fish fryers, pots, pans, microwaves and ovens. Such equipment can be damaging to the worker as hot equipment can result in burns to the worker. Oil which is hot may splash onto the worker causing burns. Pressure cookers may explode and injure the worker. Microwaves are potentially hazardous as many workers are unaware that food such as egg and potatoes may burst, causing grave harm to the worker when the microwave door is opened. Training in the use of microwaves could avoid such a risk. In addition, workers should be enlightened as to the workings of a microwave so that under no circumstances should a part of the body be placed in the microwave while it is in operation. Although microwaves have a safety device which stops the microwave from functioning when the door is open, it was related by one of the restaurant managers that in order to speed up the cooking process, workers had jammed the safety device with an ice-cream stick so that the microwave was operational with an open door. Such a risk can only be overcome through training. Ovens present a hazard as workers may trip over an open door, and may burn themselves on hot equipment in the oven.

In the context of the design of domestic cookers for the South African consumer population, Fisher, Levin, Abrams and Gordon (1986) report a survey of currently marketed cookers within six randomly selected retailers in central Johannesburg. The survey yielded nineteen different models of domestic cookers. Each of these models revealed little fundamental ergonomics in the wide range of interface arrangements. An example

of this is that 21% of the sample used an anticlockwise-for-increase control stereotype despite the deeply ingrained human expectation for a clockwise-for-increase relationship (Pheasant, 1985), whilst 58% included a mixture of both anticlockwise and clockwise controls for performing the same increase value function with different features of the apparatus (Fisher and Levin, 1989).

Clearly such a lack of fundamental ergonomics creates unnecessary problems for the user. The devices are not straightforward to use and incorrect selections and control actions pose a potential hazard (Wilson and Kirk, 1980).

One of the most significant findings of Fisher, Levin, Abrams and Gordon's (1986) report was that all but one of the models displayed a South African Bureau of Standards (SABS) mark. It may be then that there is considerable scope for the development of ergonomic guidelines within standards for design of electrical appliances in general and the domestic cooker in particular (Fisher and Levin, 1989).

In the commercial kitchen where the work is far more pressurised than in the domestic kitchen, the problems highlighted above become far more dangerous with greater implications for the user who under stress resorts to stereotypes.

Because kitchen equipment may be of such potential hazard, care must be taken in the design and subsequent use of the equipment.

Burns and scalds are caused through factors such as faulty electrical equipment, gas equipment, fire, hot water, gas or electric grillers and

spilt boiling liquids. The results from the present study indicate that burns and scalds contribute significantly to accidents which occur in the commercial kitchen. The frequency of burns was thirty eight (20%). This injury represented the second highest injury and it is therefore imperative to identify significant relationships in this area.

Relationships were found between burns and injuries to the hand/s and eye/s (see Table 14). The frequency of injury to the hand/s was thirty one (16%) and to the eye/s was 4 (2.1%). Thus, burns are a definite hazard in the catering industry.

In order to isolate which are the sources or agents of injury, on correlation, a relationship was found between burns and "material being moved manually by the worker" and "hot surface or materia" (see Table 15). Thus, it can be seen that information regarding the state of the equipment, which in this case is hot, is not being adequately transmitted to the worker. This is further emphasised when one observes that burns correlate with "lifting material or equipment", "pulling material towards him/herself" and "taking hold of material, equipment or tool" (see Table 16). These were three movements which preceded the injury. From the nature of the movement preceding the injury it becomes apparent that the worker is operating in an environment which could be improved upon from an ergonomic point of view. From looking at the immediate causes of injury, a relationship was found between "worker failing to allow for physical properties of material:" (see Table 17). This immediate cause of injury (freq=20) accounted for 10.8% of this category (see Table 6).

The question arises as to whether the physical properties of the equipment are adequately displayed to the worker who is interacting with the equipment. This will be discussed further on.

When looking at the individuals who had sustained burns (i.e. sorting the data in terms of those who had, and those who hadn't sustained burns) a number of relationships were found. "Tools or equipment being used or moved by the worker" correlated with "handling a tool or equipment" (see Table 18). In addition there was a relationship between "workers failure to use protective equipment" and injury to the finger/s (see Table 19). Lastly "material being moved manually by worker" correlated with "lifting material or equipment". These results as well as the high frequency of burns (20%) in this study indicate that there is a mis-match in work design. As Edwards (1981) suggests, accidents are symptomatic of a failure in the system and as such provide clues as to the location of the source of failure, indicating where the mismatches occur and what kind of action is likely to be effective in reducing these mismatches. The questionnaire, through its design, has highlighted areas of direct ergonomic significance and concern, indicating where mismatches have occurred.

Thus, there is a need in the design of kitchen equipment to transmit information (such as heat), from the equipment to the worker in a manner appropriate to the system and task requirement. There needs to thus be information flow from the equipment (which is hot) to the worker. The purpose of a display is to transmit information from the equipment to the worker in a manner appropriate to the system and task requirements. Functionally a good display is one which allows the optimum combination of speed, accuracy and sensitivity when transferring the necessary information from the equipment to the worker.

Because qualitative displays are suitable where the user needs to distinguish between a small number of different conditions such as temperature, this would be the appropriate display. As Tuckett (1987) recommended (see Chapter 4), workers should be advised when a pot or equipment is hot through the incorporation in the design of the equipment of a thermostat which would glow red to indicate that the pot is hot. The need for such an indicator is demonstrated by looking at the traditional way in which chefs indicate hot equipment - flour is sprinkled over the handle. Visual indicators can be made distinctive through differences in position, colour, shape and size. Heglin (1973) recommends that a warning light should be at least twice as bright as the immediate background. Warning lights are normally red as this colour is associated with danger for most people.

By making use of a thermostat, burns and scalds could be reduced and considerably avoided. This is a recommendation which can only be incorporated at the design stage of the equipment, but it would have a definite effect with regards to the number of burn accidents.

From the open ended responses it becomes apparent that many of the injuries were caused by oil splashes. However, in one restaurant where the frequency of burns from oil splashes was particularly high, the manager did not perceive such an injury as being worthy of recording. His reaction to the researchers probe as regarding burns of this nature was "Oh, burns, they happen everyday, that's not an accident!." This comment serves to substantiate the problem inherent to accident investigation which is that when determining which events truly constitute an "accident" and which do not, still remains open to complex attribution processes

which will vary according to the decision makers involvement in the event (Kelly, 1979).

However, oil splashes do occur in restaurant kitchens and the problem has to be addressed. Once again, as in the case of hot equipment, the fact that oil is hot should be passed on to the worker. A thermostat could be incorporated in the design of equipment in order to control oil temperature. An overriding thermostat could also be included to control the thermostat should it wear or break, thus cutting off the power. According to Tuckett (1987) liquid oil or fat equipment should always have this feature.

The question to now be addressed is whether safety equipment would reduce injury. Insufficient information was yielded from the present statistical analysis from which to draw any positive conclusions. However, it is hypothesised that the use of aprons, boots, gloves and a hat would reduce the possibility and frequency of burns. This would be of special importance to those directly involved with frying and grilling tasks. In one restaurant burns were caused by workers removing hot plates with their bare hands from an oven. In such a case heat pads should be used and they should be placed in a position which is easily and quickly accessible.

Workers should be trained with regards to the use of safety equipment. In addition recommendations such as when lifting lids of kettles or boiling pots, they should be tilted away from the body rather than towards it, should be made to the workers. However, the ultimate goal of the ergonomist should be to include as many safety mechanisms in the design

of the equipment so as to reduce, as far as possible, the risk of accidents.

An area where burns also occurred was in the use of gas grillers. Gas is widely used in commercial kitchens. From the open ended responses there were reports of a gas explosion. Once again this is an area where the worker is not at fault. Managers commented that very often workers would first turn on the gas on the griller and then light a match. In many instances it would take a number of strikes before the match would ignite and by this time gas would have escaped from the griller. Once the flame came into contact with the escaped gas, the worker would get burnt. Managers suggested that workers were "untrainable" in this area. They were adamant that although they had demonstrated that this process should be reversed i.e. first light the match and then switch on the gas, workers were still getting burnt, especially during rush periods.

This situation is one in which ergonomics could greatly improve the operational usage of the equipment and minimise the error which is often (as in the above case) attributed to operator error or ignorance. Here design recommendations could include the incorporation of a flame switch in the griller which would only ignite when the gas flow was very low. By introducing such a mechanism, excessive gas would not be allowed to escape and the worker would not have to perform a task using two separate sources of equipment (i.e. the gas and the match). In this way the likelihood of such an accident occurring would be greatly reduced.

Burns as a result of electrical fault were also reported in the open ended section. In one restaurant an electrical wire had been exposed in a wire box during repair. A worker had touched the wire and had, as a result,

burn himself. Once again, an ergonomic consideration such as the wire box being unoperational while exposed, would have avoided such an accident. In addition workers should be trained to deal with fire in the event of a fire breaking out (e.g., know how to operate a fire extinguisher). However, wherever possible ergonomic design should reduce the risk of such an event.

This above area of burns and scalds indicates that by improving the design of equipment and by considering ergonomics, the frequency of accidents could be greatly reduced.

By considering ergonomics, the individual is no longer the focal point for all events which occur. Accidents are thus explained by badly designed interfaces and as such are symptomatic of a failure in the system (interaction of "hardware", "liveware", "environment" and "software" see chapter 3) and as such provide clues about the location of the source of failure, indicating where the mismatches occur and what kind of action is likely to be effective in reducing these mismatches (Edwards, 1981).

3. Cuts

The third area of accidents to be discussed is that of cuts.

When looking at cuts, the nature of the cut ranged from a slight nick to the extreme of amputation. In attempting to isolate items of significance when looking for causes of cuts, the item of "handling a tool or equipment" was looked at as the movement preceding injury.

"Handling a tool or equipment" was the most frequent movement preceding injury. The frequency was fifty eight which was 29.4%. This item cor-

related with injury to the finger/s (see Table 22). The frequency of injuries to the finger/s was the most frequent injury reported (30%). As suspected at the outset, cuts are prevalent in the catering industry. It was expected that through the design of this questionnaire, information regarding the incidence of such events would be exposed. This type of accident is in the majority of cases small scale, therefore not requiring reporting. Thus, from the results, it can be observed that when handling tools or equipment, injuries do frequently occur. An immediate cause of injury which correlated with "handling a tool or equipment" was "worker placing part of body in position of risk" (see Table 21).

Ergonomic design should reduce the occurrence of a worker placing a part of his/her body in a position of risk. "Worker placing part of body in position of risk" was the highest frequency in the category of immediate cause of injury (freq=51, 27.6%; see Table 6). This is of great concern to the ergonomist as ergonomics is aimed at reducing the risk of accidents. This will be further expanded upon at a later stage.

Relationships were then looked at within the category of "handling a tool or equipment". To achieve this the data was sorted into two groups with the one group consisting of the reports where "handling a tool or equipment" was chosen as the movement preceding injury, and the second group where this item was not ticked. Within the group where this item was ticked, a number of relationships were found.

A correlation was found between "placing part of body in position of risk" and injury to the finger/s. "Material being moved manually by worker" correlated with "lifting material or equipment", "pulling material towards him/herself", and "taking hold of material equipment or tool".

These movements are manual movements performed by the worker him/herself. Such movements could include for example cutting with a knife ("material being moved manually by worker").

When looking at "mechanically moving tools or equipment" a relationship was found between this item and "pushing material away from him/herself" (see Table 24). This could be conceptualised by thinking of a worker cutting meat on an electric meat cutter and cutting the meat in a motion whereby the meat is pushed away from the body.

From these results it becomes apparent that the issue of cuts cannot be ignored. When one looks at the open ended section of the questionnaire, the qualitative data indicates even more forcefully how hazardous some kitchen equipment actually is.

Accidents reported in the open ended questions included a worker placing a finger in a baking machine, not putting the cover over a cabbage slicing machine and thus cutting a finger, placing a finger in a dicing machine while slicing tomatoes requiring stitches in the finger and having a finger amputated while cutting meat on a meat machine. Although these accidents are rare when compared with accidents such as cuts, they are of extreme importance when one looks at the severity of the injury. Ergonomic considerations are crucial in the design of this kind of equipment which could cause severe injury.

There are many situations and equipments in industry where ergonomics could greatly improve the operational usage and minimise the waste which is often attributed to operator error or ignorance. The appropriate de-

sign of safe equipment to prevent injuries is possibly one of the most important prevention strategies available.

It is clear from the fact that cuts do happen in restaurant kitchens, even leading to amputation, that this problem has to be addressed. Equipment, specifically mechanical equipment such as baking machines, slicing machines etc, should not be operational unless all the safety mechanisms are operational and/or in place. Furthermore grids should be placed over areas where workers may inadvertently place a part of their body. Workers should not perform dangerous tasks unless they are suitably trained or supervised. This is clear from the example of a worker having a finger severed while cutting meat on a meat machine.

Ergonomic data relevant to the design of displays and controls should be closely followed when designing kitchen equipment. Displays should allow for the optimum combination of speed, accuracy and sensitivity when transferring the necessary information from the equipment to the worker. Controls such as knobs, switches, pushbuttons, levers or cranks must be designed to match the capabilities and limitations of the worker. The positioning of the machine control should depend on factors such as the sex and age of the operators who are going to use it. It must be born in mind that many women work in commercial kitchens and as a result differences in size and strength must be considered.

The design recommendations for hand tools must also be considered as many of the items used in kitchens are hand tools (e.g., knives). Because human factors, until recently, had largely ignored the design of hand tools, many tools and devices are not designed for efficient safe operations by humans, especially for repetitive operation (McCormick and

Sanders, 1983). The proper design of hand tools requires an understanding of technical, anatomical, physiological, anthropometric and hygienic considerations.

Where possible, handles should be designed to have large contact surfaces to distribute the force over a larger area and to direct it to less sensitive areas of the hand such as the rough tissue between the thumb and index finger. Many hand tools and devices are not designed to accommodate women who have on average only about two thirds the grip strength of that of men. In addition most women have smaller hands than men. Left-handers who constitute approximately 8-10% of the world population are also not always taken into account. These differences have obvious implications for tool and device design (McCormick and Sanders, 1983). The design of hand tools and devices must take into consideration the anthropometric and ergonomic differences that exist between men and women. Tools should also be designed in order to facilitate use in the operators preferred hand.

Another area to be considered when reducing injury from "handling a tool or equipment" is the use of protective equipment.

4. Protective equipment

The focus now turns to the use of protective equipment. Failure to use protective equipment, although yielding a low frequency of seven (3.8%), resulted in injuries to the finger/s as well as amputation (see Table 27). The failure to use protective equipment also correlated with "mechanically moving tools or equipment being used or moved by workers" and "chemicals other than gas" (see Table 28). This immediate cause of injury correlated with the movements preceding injury of "pushing material away

from him/herself", and "taking hold of equipment, material or tool" (see Table 29).

These above correlations could indicate that protective equipment could be perceived as leading to a reduction in accidents. The use of gloves could decrease the risk of injury, however in performing many tasks (such as chopping vegetables) protective gloves could serve as a hindrance to the worker. In such cases a preventative measure could be taken by the worker by cutting away from the body when cutting with a knife. In addition sharp edges should always be carried facing downwards. Knives should be stacked either horizontally (with no edges sticking out) or in a vertical position with the edge facing downwards. However, these measures require training.

The present researcher, however, contends that the encouragement of the use of gloves would greatly reduce the risk of injuries. This, in conjunction with increased safety mechanisms on mechanically operated equipment, would reduce the incidents of cuts in restaurant kitchens.

However, no safety equipment would be functional in the long term unless there is support by management. Workers should be continually encouraged to wear protective equipment and training programmes should be instituted stressing the importance of safety equipment. Of equal importance however is that workers be trained in the workings, functioning and safe operation of kitchen equipment before they use it.

5. General Recommendations

Richfield, (telephonic interview, 1988) a food and restaurant critic, made a number of recommendations regarding restaurant kitchen size. He

noted that a prominent hotel chain had built kitchens which were too small for their output needs. He attributes this to the fact that many restaurant and hotel kitchens are designed by architects who have no experience with cooking and who are ignorant of the needs of the workers. In many cases the size of the kitchen is not commensurate with the size of the serving area.

Other recommendations which the present researcher feels could be made to the general safety of kitchen workers is that handles of cooking utensils should not jut out awkwardly from the edge of the range, but should rather be turned inwards. Perhaps the cooker design needs to be reconsidered to take account of handles which are also part of the pot. Alternatively, handles should perhaps be shorter so as to reduce the possibility of them protruding from the cooker range. Overstacking should be avoided as this could lead to the overstacked equipment toppling over and injuring a worker. Such an event occurred in one of the restaurants participating in the study.

Most of the restaurants participating in the study had two doors leading in and out of the kitchen. Workers were generally aware as to which door was the "in" door and which was the "out" door. However, in one of the restaurants there was only one door leading from the serving area into the kitchen. In this restaurant the frequency of accidents in the form of workers bumping into one another or banging part of their body on the swinging door, was far higher than the other restaurants which had two doors. In another restaurant, which had two doors, the doors were placed in such a way that workers wanting to enter the kitchen had to pass the door of workers exiting from the kitchen. As a result, workers were constantly bumping into one another. Thus, it is not sufficient to simply

incorporate two doors in the design of the kitchen. The doors must be positioned in such a way so as to be accessible by being directly in front of the approaching worker. In all of the restaurants, the type of door used was a swinging door so that workers could enter or exit from the kitchen even if their hands were full.

Temperature, ventilation and lighting are all part of the physical environment in which kitchen work is performed. There may be a general nonrealisation of such hazards, however they cannot be ignored.

Excessively high or excessively low temperature and inadequate ventilation reduce productivity through sickness, discomfort and lowered vitality of workers. Heat may effect, amongst other things, mental activities and performance in industrial settings (McCormick and Sanders, 1983).

Grillers, and all those working with hot equipment, in commercial kitchens are exposed to intense heat for extended periods of time. A cooling system or ventilation system should be functioning at all times in such situations. The kitchen itself is hot and here too ventilation should be considered.

As regards lighting, lighting levels must be sufficiently high to enable workers to clearly see their tasks but not too high as to cause glare or dazzle. Poor workplace lighting not only creates eye strain, but can cause fatigue leading to errors in the work and an increase in accident risk.

CONCLUDING COMMENTS

Accidents do happen in restaurant kitchens. Workers experience the issue of health and safety every day of their working lives. They are faced with hazards such as poor ventilation, unsafe machinery and other hazards which have been identified in this research.

This is an attempt to overcome the major shortcomings of past safety research which included the absence of a theoretical framework necessary for predicting accidents before they happen and the lack of a cohesive force for drawing together the vast amount of information available. One of the major drawbacks of early research has been the omission of any attempt to analyse a whole sequence of events that lead up to the occurrence of an accident.

The definition of the term "accident" was decided upon in such a way so as to allow for purposeful investigation. In terms of this definition it was established as to what constitutes deliberate, calculated and avoidable events in order to overcome the central problems associated with the definition of "accident" such as an accident only being labelled an accident after the event. Because the focus of this research was not primarily on accidents which cause injury, emphasis is placed on the incorporation of safety and health considerations at the design stage of new equipment and technology. These considerations depend on the engineers', designers', and technicians' knowledge of ergonomics and occupational safety and health. These aspects were considered at all stages of the research, both theoretical and practical, as it is essential to broaden the definition of "accident" to include contributing factors such

as health and safety and to demonstrate how they interact with other factors.

As such, a more sophisticated approach to maintaining safety, other than mere intuitive intervention, was required. This was achieved through the careful design considerations of interacting elements by following ergonomic principles.

Ergonomic principles were dealt with in detail and it was demonstrated how accidents are symptomatic of a failure in the system which is the dynamic relationship between interacting components of the human-machine system. By observing failures in the system, the location of the source of failure was identified indicating where the mismatches occurred and what kind of action was likely to be effective in reducing these mismatches.

Results in the present study yielded information regarding the importance of a safe kitchen design. In addition poor procedures and poorly prepared individuals were identified. Through the combination of safety and ergonomic data recommendations were made in order to prevent, as far as possible, accidents from occurring. Suggestions were made regarding training and supervision.

In conclusion, the incorporation of safety and health considerations at the design stage of new equipment and technology requires the improvement of existing education and training systems in this field. In addition, training programmes on ergonomics, safety engineering and occupational health should be developed (Kundiev, 1962). It is encouraging to note

that in the Report of the Director General of the Department of Manpower in the year ended 31 December 1987, it was stated that

"manufacturing processes are becoming increasingly complex and in view of the high cost of the machinery involved and the relatively large losses that may result from any breakdown in the manufacturing process, increasing attention is being given to safety and reliability in the design of equipment. Section 14 of the (MOSA) Act provides that no one may impart, display or offer for sale machinery or safety equipment that does not comply with the prescribed standards. In this manner everybody, including private individuals, is protected against machinery and safety equipment that is not safe and that does not comply with the prescribed safety standards". (p 103)

However, it must be noted that the general requirements of the SABS specific appliance standards is that such appliances "shall be free from electrical and mechanical hazards, including sharp edges, burns and similar defects that might cause injury to a user... shall be so designed and constructed that the risk of fire, or of mechanical damage, or of both, that impairs safety as a result of abnormal or careless operation is so reduced... shall be so constructed that accidental changing of the settings of a... control device is not possible if this can result in a hazard" (Government Gazette, No.7464, 1981).

It may be then, from the above, that there is considerable scope for the development of ergonomic guidelines within standards for design of electrical appliances in general and specifically for kitchen equipment.

IMPLICATIONS FOR FUTURE RESEARCH

1. In carrying out any research into accidents, it would be beneficial for workers to fill in the checklist. Through this, the complex attribution processes which come into play when deciding what factors constitute an accident would be overcome.
2. Emphasis should be placed, in future research, on the use of protective equipment as a factor in reducing the risk of injury.
3. Data should be gathered regarding the possible effects of shifts in restaurant kitchens. It may then be identified as to whether rotation of workers would reduce the risk of accidents.
4. A study of a larger scope including an intervention programme, would indicate whether the recommendations made do in fact reduce the rate of accidents. Unfortunately the scope of this study did not allow for an intervention programme to be instituted.

Appendix 1

Johannesburg City Health Department Regulations regarding Kitchen layout
and design of equipment for cafes, restaurants, and eating houses.

Johannesburg City Health Department regulations regarding kitchen
layout and design of equipment.

- (a) The minimum floor area of a food preparation room or area is 25 metre squared for a dining area not exceeding 40 metre squared.
- (b) Where the dining area exceeds 40 metre squared but does not exceed 200 metre squared, 0.4 metre squared for every 1 metre squared that the dining room area exceeds 40 metre squared must be added to the 25 metre squared.
- (c) Where the dining area exceeds 200 metre squared, a further 0.3 metre squared for every 1 metre squared that the dining room area exceeds 200 metre squared must be added.

In addition a minimum of 7 metre squared must be added for scullery purposes.

<u>Dining area in m</u>	<u>Preparation area in m</u>
(a) up to 40	25
(b) 41 to 200	$(\text{Area up to } 200 - 40) \times 0.4 + 25 = Y$
(c) in excess of 200	$(\text{Total area} - 200) \times 0.3 + Y$

In addition to determining the size of the kitchen, there are certain health requirements for the preparation of food in terms of the standard food handling by laws 1972.

1. Before any work is commenced a lay-out plan of the premises drawn on a scale of 1:50 indicating the position of all equipment in the preparation area, scullery, storerooms, changerooms and seating accommodation in the dining area must be submitted to the Health department for approval.

2. The following structural requirements must be provided:

- (i) A food preparation area with a minimum floor area of 25 metre square, width not less than 3m. Where fresh fish is sold a separate area of 10m, and in the case of a fish frier, not less than 20m must be provided. The part of the premises used for the preparation and sale of fish must be sufficiently separated from the remainder of the business.
- (ii) The area set aside for the consumption of food or drink by patrons on the premises shall allow for a minimum of 1.2m for every intended patron.
- (iii) Sanitary facilities shall be provided for the use of all patrons of such cafe, restaurant or eating-house consuming food or drink on the premises.
- (iv) Approved laundry facilities must be provided where the laundering of articles other than drying clothes is undertaken on the premises of any cafe, restaurant or eating-house, and where such laundering is not undertaken, such articles shall only be laundered at a licensed laundry.
- (v) A scullery minimum floor area of 7 metre squared, minimum width 2.5m.
- (vi) A storeroom, adequately lit and ventilated, having a minimum floor area of 16 metre squared, height not less than 2.4m, minimum width 3m. The storeroom must be equipped with adequate and approved metal dunnage boards or storage racks at

least 250mm above floor level. Goods such as potatoes, onions and empty cooking oil containers must be stored separately.

(vii) Should such a storeroom not be conveniently accessible from the food preparation room then a daily supply storeroom, at least 7m in extend must be provided.

(viii) The walls of every room shall be constructed of brick, cement, concrete or other approved substantial impervious material.

(ix) Separate facilities may also be required if deemed necessary for the storage of raw vegetables and fruit.

(x) Where more than two employees of the same sex are employed, a changeroom 6.5m in extend, minimum width of 2m, must be provided for each category. Enclosed pedestal type metal lockers must be provided for each employee.

(xi) Where five or more male persons are employed, at least one urinal stall, 700mm wide, must be provided.

(xii) Each room must be provided with natural light by means of windows equal to at least 10% of the floor area, 50% of which must be openable and positioned in such a way to afford cross ventilation. At least 250 lux must be maintained at areas where food is prepared or stored.

(xiii) All window sills and tops of walls not extending to the ceiling

must be constructed at a 45 degree angle.

- (xiv) All walls to be constructed of brick, smoothly plastered, and covered with glazed wall tiles up to a height of 2m above floor level. The remaining wall surfaces and ceilings are to be painted with light coloured oil or enamel paint.
- (xv) Every floor must be cement-concrete with a smooth finish and covered with heavy guage marley tiles, except the scullery and food preparation area which must be covered with non-slip ceramic tiles laid with an epoxy grouting in close joints, (5mm), graded and drained to a gully.
- (xvi) The junctions between the walls and floor of the preparation room, scullery and toilets must be provided with a covered ceramic tile which must be flush with the wall and floor tiles.
- (xvii) An adequate supply of hot and cold running water must be laid on to all taps. The minimum capacity of the hot water supply tank is to be at least 135 litres.
- (xviii) Wash-hand basins must be installed in approved positions for employees. Approved transparent soap dispensers and disposable paper towelling must be provided at all wash-hand basins.
- (xix) All water piping and electrical ducting must be embedded in the wall plaster and smoothly finished off.
- (xx) The wall surfaces above and adjacent wash-hand basins not in the

preparation and scullery areas must be covered with glazed tiles to a minimum height of 500mm above the upper edge and extend 200mm on either sides and below such basins.

(xxi) All projective tiled wall corners to be protected with a metal lining (37mm x 37mm).

(xxii) At least one water closet plus one wash-hand basin must be provided for each sex working on the premises. Such a water closet must be separated from any room in which food is handled by means of a ventilated lobby or 3m which opens on to the external air. All doors communicating with such a lobby must be fitted with self-closing devices.

(xxiii) The closets or urinals must have separate approaches which are to be screened and clearly designated.

(xxiv) Approved appliances and/or display cabinets must be provided for the display and/or storage of food at correct temperatures.

(xxv) Where walk-in fridges are constructed provisions must be made for a graded and drained floor in such fridges as well as for the disposal of waste water from the cooling unit.

3. The food preparation and scullery areas must be equipped as follows:

(a) All tables or other working surfaces must be constructed of stainless steel and provided with an upright 100mm high.

- (b) All the equipment must be of the pedestal type, mounted on legs at least 150mm above floor level to facilitate cleaning.
- (c) An approved hood or canopy of adequate size, having a flue of at least 300mm in diameter must be provided immediately over every cooking stove, oven or similar apparatus. The flue must exhaust to the atmosphere at such a height and in such a position as is necessary to prevent the discharge therefrom from constituting a nuisance to the neighbourhood. The hood must overlap the cooking appliance by 225mm. A total height of 2.1m above the floor is considered satisfactory. V-type removable gauze filters, sufficient in numbers and space and 500mm apart must be installed at the mouth of the flue which must also be fitted with an approved extractor fan. The extractor fan must be of maintaining an air speed of at least 30m per minute over the face of the canopy. The air velocity in the duct must be at least 457m per minute or not more than 670m per minute in order to prevent drumming or excessive noise.

It is now necessary to digress from the by laws in order to expand upon the specifications regarding canopies.

Specifications Regarding Canopies in Food Handling Premises

Public Health Laws state that a canopy must be installed over all cooking appliances in food handling premises, where any form of cooking is undertaken. The canopy must have an extract which will remove all fumes in such a manner that they will not cause any unpleasantness in the vicinity.

The canopy must achieve three things:

It must remove steam and fat from the cooking area so that it does not spread and condense on the walls and ceilings,

It must eliminate the spread of cooking odours through the rest of the premises,

It must ventilate the room and remove excess heat.

In other words, the canopy must be properly designed, installed and must be maintained at all times.

It must be deemed that canopies which meet the following specifications are in compliance with the regulations-

1. The inside perimeter of the canopy must overhang all the cooking appliances on all sides by a minimum of 230mm.
2. The lower edge of the canopy must be a minimum of 200mm and a maximum of 2134mm above the floor.
3. The depth of the canopy from the bottom edge to the top ridge must be a minimum of 610mm.
4. There must be an extract fan which will ensure that-
 - (a) There is air movement of at least 30m per minute over the face of the canopy or
 - (b) The total volume of air in the room is changed at least twenty times per hour.

NOTE:

- (a) is suitable for smaller canopies in large rooms and

(b) Is suitable for larger canopies in small rooms.

5. The canopy must be designed in such a manner that it is easily cleaned and must have a channel all round for run-off.

6. Where filters are installed, they must be easily removable for cleaning, and a removable drip tray must be fitted at the lower edge of the filters to collect any fat which may run off.

7. If filters are fitted the following must be taken into account-

(a) The fan must be capable of overcoming the resistance of the filters.

(b) The total area of the filters must be sufficient to allow the required volume of air to pass through them. (A standard 500x500x500mm filter will allow approximately 2.5 metres per second of air through).

(c) The filters must be easily removable.

(d) Drip trays must be fitted below the filters to catch any excess fat.

(e) All parts of the filter must be non-flammable.

(f) The minimum distance from the underside of the filter to the top of the cooking unit must be as follows to minimise the dangers of fire-

- | | |
|---------------------------------|--------|
| i. No open flame | 760mm |
| ii. Open flame (charcoal grill) | 1371mm |
| iii. Other open flames | 1070mm |

8. The extract duct must have an area capable of handling the volume

of air from the fan, but must be of such a size as to allow an air speed of 460 metres per minute minimum, and 670 metres per minute maximum, and must be designed in such a way that it does not vibrate or cause any other irritating noise.

9. The duct must remove odours and gasses to a position of height where it will not cause a disturbance to the surrounding area.
10. It must be ensured that enough air is brought into the room to cope with the volume being extracted.
11. Drawings and specifications should be submitted to the local council for approval before manufacture or installation.
12. Other methods of extraction are permitted provided they meet with the approval of the local council.

These specifications are a guide only and may vary with different councils.

Returning to the health requirements for the preparation of food in terms of the standard food handling by laws:

- (d) Separate sinks and working surfaces must be provided for the preparation of vegetables, meat, fish, etc., - the various areas must be designated according to use with approved impervious signs.
- (e) The scullery must be provided with an approved pedestal type double bowl stainless steel sink, each bowl having a capacity of

at least 55 litre, fitted on the side nearest the wall with a splash screen rising to a height of 150mm above the top of the sink and located at a distance of at least 100mm from any wall.

- (f) An approved mobile drying rack for crockery and pots must be provided.
- (g) An approved table solely for the reception of soiled crockery and cutlery and the removal from such crockery and cutlery of unconsumed food.
- (h) Approved working surfaces must be provided next to the preparation sinks and cooking appliances.
- (i) An approved potsink must be installed if deemed necessary.
- (j) At least 50% of the floor area required for the preparation room must be unobstructed floor space.
- (k) No fixtures, shelving and fittings shall be installed against walls - shelving to be free standing, constructed of metal and raised 150mm above floor level onto metal legs.
- (l) The potato peeler must be a separate unit mounted on legs.
- (m) All tables and sinks to be fitted with metal stoppers with rubber ends to maintain a distance of at least 100mm between such equipment and any wall.

(ii) Wastepipes to be at least 50mm from any wall or floor.

4. A yard area suitably graded and paved to an extent of 9m outside each door must be provided.

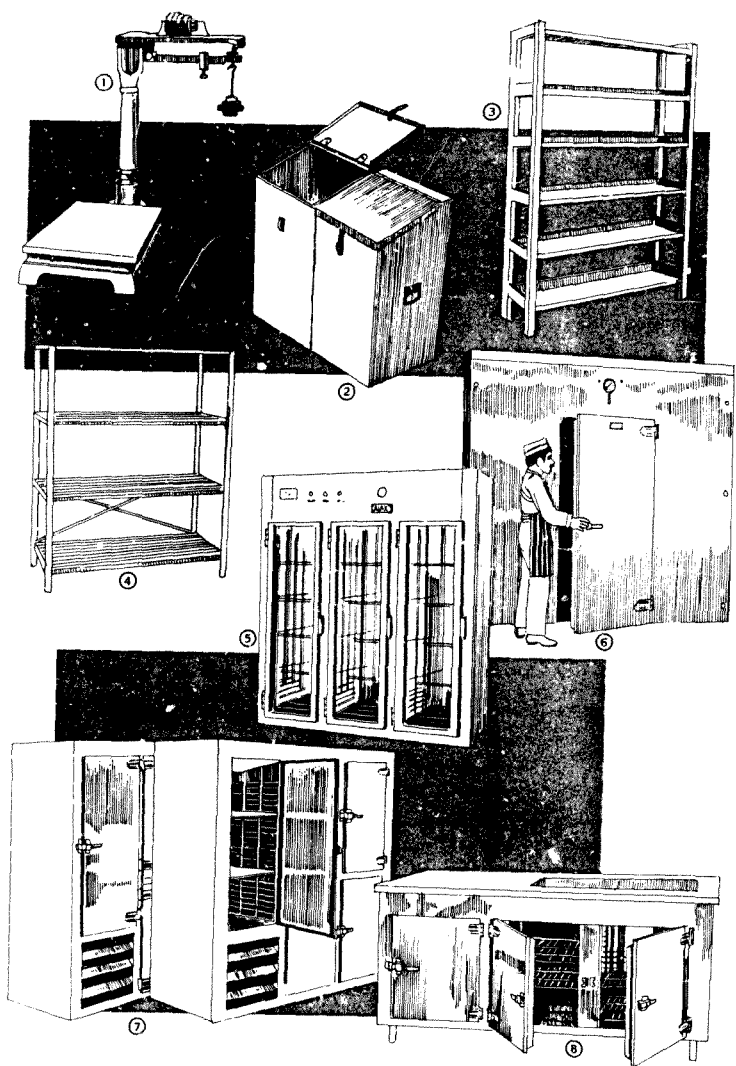
5. An approved storage area for refuse receptacles must be provided in a position easily accessible. Such area must be enclosed and provided with an impervious graded and drained floor - the gully must be connected to the Municipal Sewer. A waterpoint must be provided within the said area.

6. All work must be done in a workmanlike manner and to the satisfaction of the Health Department.

Appendix 2

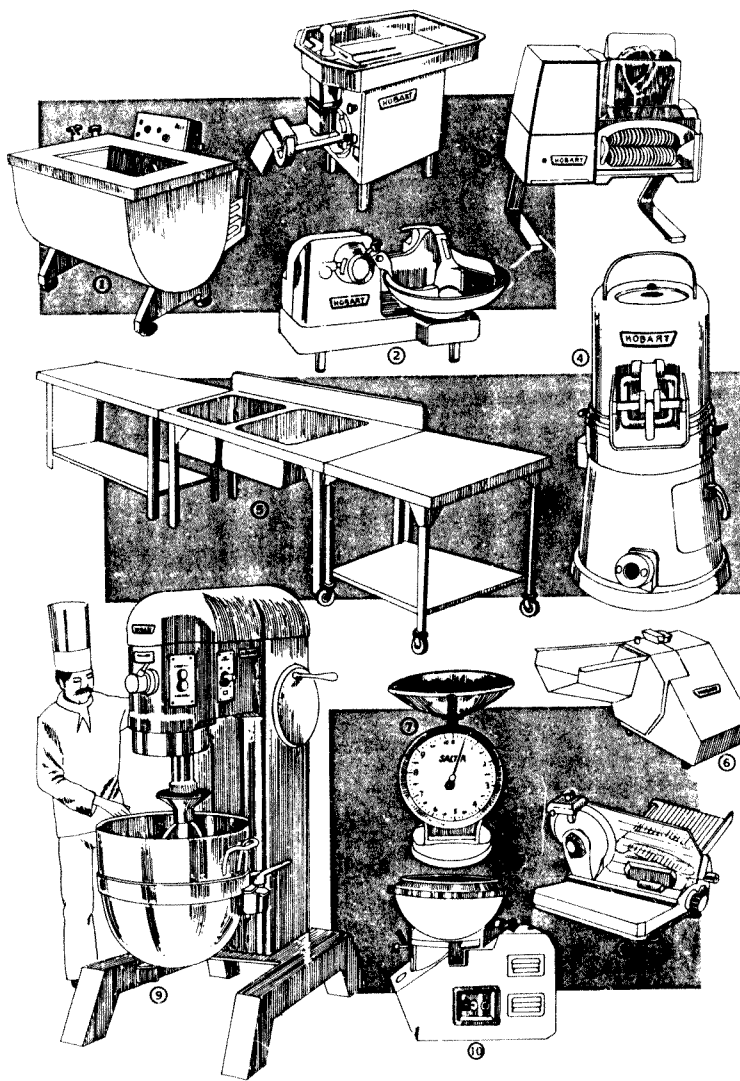
Examples of Kitchen Equipment

("Presiden: Catering Supplies" pamphlet)



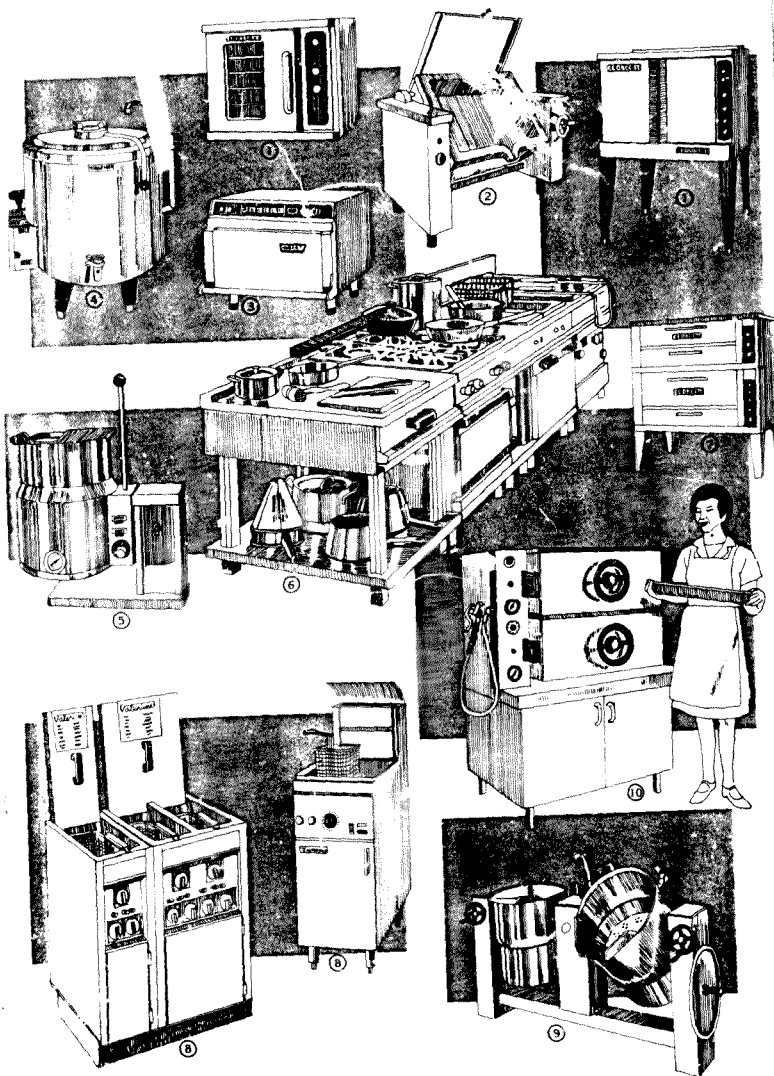
Receiving, Storage and refrigeration

1. Receiving Scales
2. Storage Bins
3. Racking and Shelving
4. Cold Store Racking
5. Display Reach-in Refrigerators
6. Coldrooms
7. Reach-in Refrigerators and Freezers
8. Underbar Refrigerators



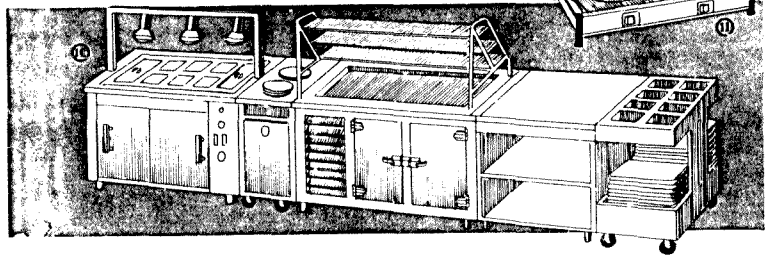
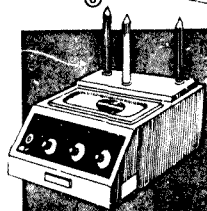
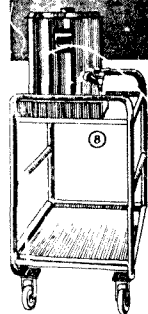
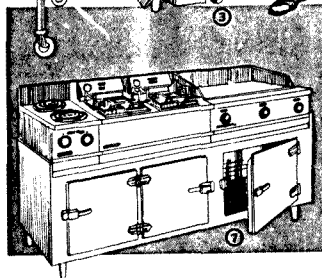
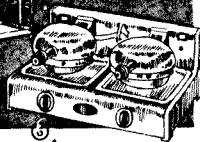
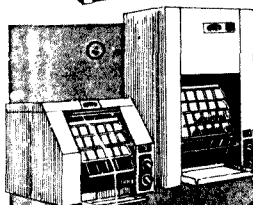
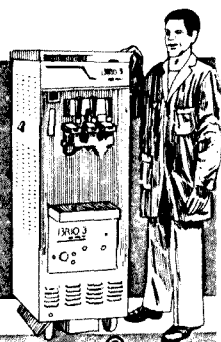
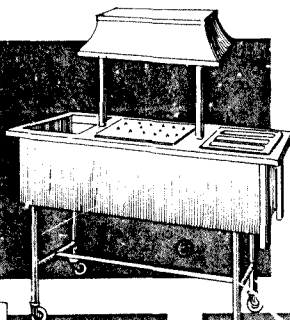
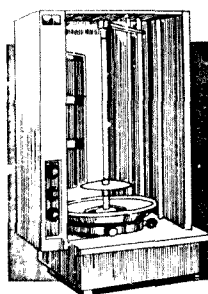
Preparation

1. Vegetable Washing Machinery
2. Food Cutters
3. Meat Preparation
4. Vegetable Peelers
5. Stainless Steel Tables and Sinks
6. Portioning Scales
8. Slicing Machines
9. Mixers
10. Vegetable and Fruit Processors



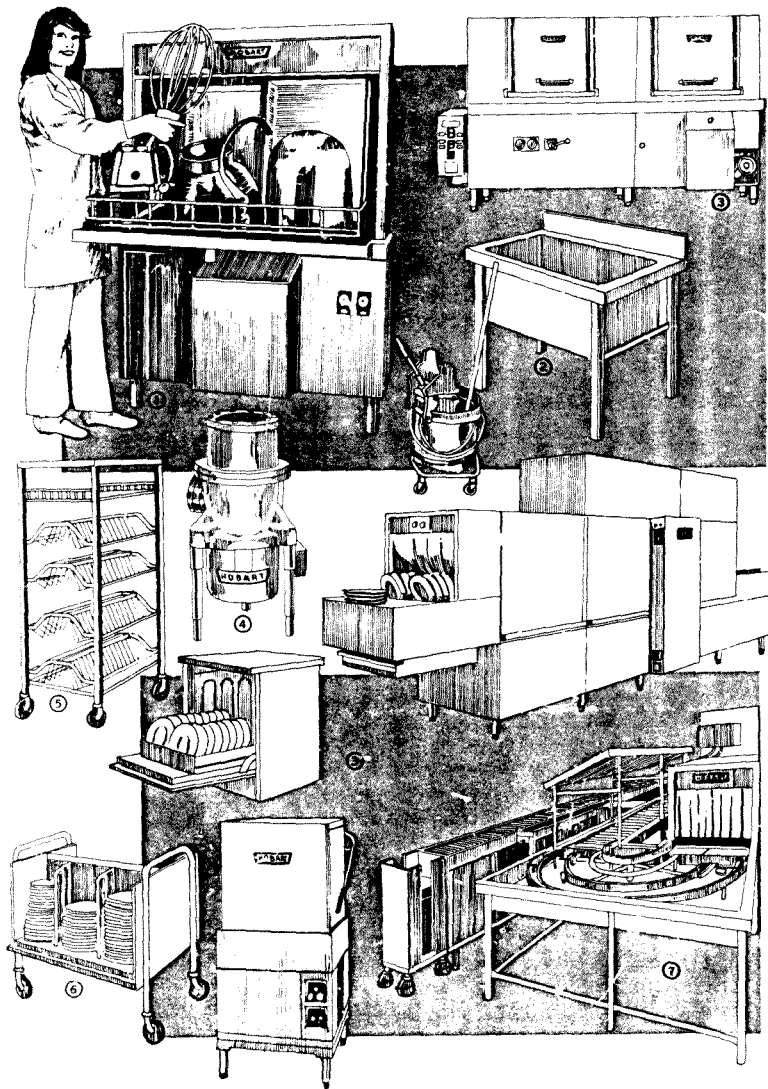
Cooking

1. Convection Ovens
2. Tilt pans
3. Microwave Ovens
4. Boiling Pans
5. Diet Kettles
6. Cooking Suites
7. Pizza or Baking Ovens
8. Fryers
9. Tilting Kettles
10. Steamers



Food Service

1. Shawarma Units
2. Carvery and Buffet Equipment
3. Ice-Cream Machines
4. Toasters
5. Salamander Grills
6. Fast Food Specialities
7. Backbar Counter Equipment
8. Multipots and Water Boilers
9. Milk Shake Mixers
10. Food Service Counter Areas
11. Coffee Brewers



Clean-Up

1. Utensil Washers
2. Sink Units
3. Dishwashing Machinery
4. Food Waste Disposal Units
5. Crockery Racks
6. Crockery Handling Trolleys
7. Mechanised Tray Removal and Warewashing Systems



Utensils and Accessories

3. Woodware
4. Saucepans, Stock Pots and Fryers
5. Professional Utensils and Cutlery
6. Wirework
7. Baking and Roasting Trays
8. Food Service Pans

Appendix 3

Checklist administered to the restaurants

ACCIDENT REPORT AND INVESTIGATION.

DATE: _____ TIME: _____.

Complete the following table by placing a tick (✓) in each box
where a "yes" answer applies to the safety equipment worn.

EQUIPMENT	Necessary for job	Was being worn	Was shown how to use it
Apron	☐	☐	☐
boots or shoes	☐	☐	☐
hat	☐	☐	☐
gloves	☐	☐	☐

PLACE A TICK (✓) IN EACH BOX WHERE A " YES " ANSWER APPLIES.

SECTION A. Primary cause of accident.

1. Action of injured worker. ☐
2. Action of fellow worker. ☐
3. Unforeseeable mechanical failure. ☐
4. Any other cause - please describe here: _____

SECTION B. Body Injuries.

Head	☐	finger/s	☐	burn	☐
neck	☐	leg/s	☐	poisoning	☐
eye/s	☐	foot/feet	☐	fracture	☐
chest	☐	confusion	☐	suffocation	☐
arm/s	☐	internal wound	☐	amputation	☐
hand/s	☐	strain or sprain	☐	back	☐

SECTION C. Source or Agent of Injury.

1. Material moving mechanically and handled by worker ☐
2. Material being moved manually by worker ☐
3. Stationary equipment or tools in correct place not being used by worker ☐
4. Stationary equipment or tools in incorrect place not being used by worker ☐
5. Mechanically moving tools or equipment being moved or used by worker ☐
6. Tools or equipment being moved or used by worker ☐
7. Sharp objects such as nails not being used by worker ☐
8. Falling object ☐
9. Slippery surface or material ☐
10. Greasy surface or material ☐
11. Uneven surface or material ☐
12. Flying object ☐
13. Hot surface or material ☐
14. Mechanically moving tools or equipment not being used by worker ☐

15. Chemicals other than gas ☐
16. New task eg causing blisters ☐
17. Aggravation of a disability already present ☐
18. Gas ☐
19. Any other: please describe: _____ ☐

SECTION D. Movement preceding injury.

The injured person was:

1. Lifting material or equipment ☐
2. Handling a tool or equipment ☐
3. Standing still and upright ☐
4. Standing still, leaning over material or equipment ☐
5. Pulling material towards himself ☐
6. Pushing material away from himself ☐
7. Walking without carrying anything upstairs ☐
8. Walking without carrying anything downstairs ☐
9. Walking without carrying anything on a level surface ☐
10. Reaching for material, equipment or a tool ☐
11. Taking hold of material, equipment or a tool ☐
12. Carrying material upstairs ☐
13. Carrying material downstairs ☐
14. Carrying or wheeling material on a level surface ☐
15. Jumping or stepping on to an elevated surface ☐
or position
16. Jumping or stepping down from an elevated surface ☐
or position

15. Chemicals other than gas ☐
16. New task eg causing blisters ☐
17. Aggravation of a disability already present ☐
18. Gas ☐
19. Any other: please describe: _____ ☐

SECTION D. Movement preceding injury.

The injured person was:

1. Lifting material or equipment ☐
2. Handling a tool or equipment ☐
3. Standing still and upright ☐
4. Standing still, leaning over material or equipment ☐
5. Pulling material towards himself ☐
6. Pushing material away from himself ☐
7. Walking without carrying anything upstairs ☐
8. Walking without carrying anything downstairs ☐
9. Walking without carrying anything on a level surface ☐
10. Reaching for material, equipment or a tool ☐
11. Taking hold of material, equipment or a tool ☐
12. Carrying material upstairs ☐
13. Carrying material downstairs ☐
14. Carrying or wheeling material on a level surface ☐
15. Jumping or stepping on to an elevated surface ☐
or position
16. Jumping or stepping down from an elevated surface ☐
or position

17. Engaged in more complex movement. Please describe _____

SECTION E. Immediate cause of injury.

- | | |
|--|--------------------------|
| 1. Worker misjudging position of material | ☐ |
| 2. Worker placing part of body in position of risk | ☐ |
| 3. Worker's grip on tool or material too loose, allowing it to slip or drop | ☐ |
| 4. Worker failing to allow for physical properties of material | ☐ |
| 5. Worker's failure to use protective equipment | ☐ |
| 6. Worker's over-estimating movement space in a confined area | ☐ |
| 7. Slip, trip or fall by worker | ☐ |
| 8. Worker misjudging own strength or physical ability | ☐ |
| 9. Over reliance on protective equipment by worker | ☐ |
| 10. Movement of poorly stocked or placed material | ☐ |
| 11. Worker over-reaching with tool, material or part of body | ☐ |
| 12. Worker misjudging speed of moving material | ☐ |
| 13. Worker's bodily reaction to new task or equipment (eg blisters from new boots) | ☐ |
| 14. Any other cause. Please describe _____ | |

REFERENCES

- Adams, N.L. Personnel Practice Bulletin, 1974, 30, 3, 244-256. Using Injury Statistics to Set Safety Goals.
- Adams, N.L.; Barlow, A.; and Hiddlestone, J. Obtaining Ergonomics Information About Industrial Injuries: A Five-Year Analysis. Applied Ergonomics, 1981, 12, 2, 71-81.
- Anderson, J.R. Cognitive Psychology and its Implications. San Francisco: Freeman, 1980.
- Anderson, J.R. (Ed) Cognitive Skills and their Acquisition Hillsdale, N. J. Lawrence Earlbaum and associates, 1981.
- Andersson, R. and Lagerlof, E. Accident Data in the new Swedish Information System on Occupational Injuries. Ergonomics, 1983, Vol. 26, No.1, 33-42.
- Arbus, A.G. and Kerrick, J.E. Accident Statistics and the Concept of Accident Proneness. Journal of the Biometric Society, 1951, 7, 340-432.
- Ashford, N.A. Crisis in the Workplace: Occupational Disease and Injury. Cambridge, Mass, The MIT Press, 1976.
- Baker, S.P., Samkoff, J.S., Fisher, R.S. and Van Buren, C.B. Fatal Occupational Injuries. Journal of the American Medical Association 1982, 248, 692-97.
- Barret, G.A., Ambrot, F.H. and Smith, G.R. Relationship Between Individual Attributes and Job Design 1975 in Rahimi, M. and Malzahn, D.E. Task Design and Modification Based on Physical Ability Measurement. Human Factors, 1984, 26(6), 715-726.
- Barry, R.P. The Real Problem of Safety at Work. Iron and Steel, Nov 1981, 403-404.
- Barsley, M. Left-Handed Man in a Right-Handed World. London,

- Pitman, 1970.
- Beach, D.S. Personnel. The Management of People at Work.
4ed. Macmillan Publishing Co., Inc. New York, 1980.
 - Broadbent, D.E. Language and Ergonomics. Ergonomics, 1977, 8(1),
15-18.
 - Brough, R., Malkin, F. and Harrison, R. Measurement of the
Coefficient of Friction of Floor. Journal of Physics, 1979,
D.12, 517-528.
 - Burns, W. Physiological Effects of Noise. In C. Harris (Ed),
Handbook of Noise Control. New York: McGraw-Hill, 1979.
 - Burrows, A.A. Acoustic Noise, an International Definition. Human
Factors, 1960, 2(3), 163-168.
 - Chapanis, A. and Lindenbaum, L. A Reaction Time Study of Four Control-
Display Linkages. Human Factors, November 1959, 1(4), 1-7.
 - Christensen, L.B. Experimental Methodology. 2nd ed. Allyn
and Bacon. USA 1980.
 - Cliff, K.S. Accidents. Causes, Prevention and Services.
Croome Helm, Ltd. Kent 1984.
 - Cuff, R.N. On Casual Users. International Journal for Man-Machine
Studies, 1980, 12, 163-187.
 - Davis, P.R. Slipping, Tripping and Falling Accidents: an Introduction.
Ergonomics, 1983, Vol. 26, No.1, 1-2.
 - Dugoff, H.; Segel, L. and Ervin, R.D. Measurement of Vehicle
Response in Severe Braking and Steering Manoeuvres. SAE
paper 710080, 1971.
 - Dunn, J.A. Safety Psychology: A Review of the Literature.
Applied Psychology Unit: University of Aston. 1971 publication
no. AP35
 - Dunnette, M. Critical Concepts in the Assessment of Human Capabilities

in Dunnette, M. and Fleishman, E.A. (eds). Human Performance and Productivity Vol. 1. Human Capability Assessment. Hillsdale, N.J. Erlbaum, 1982.

- Edwards, A.L. Statistical Methods for the Behavioural Sciences. Rinehart and Company, INC. New York, 1960.
- Edwards, F.C. Prevention of Musculoskeletal Injuries in the Workplace. National Approaches to Safety Standards: Great Britain. Ergonomics 1987, Vol. 30, no.2, 411-417.
- Edwards, M. The Design of an Accident Investigation Procedure. Applied Ergonomics 1981, 12.2, 111-115.
- Eschenbrenner, A.J., Jr. Effects of Intermittent Noise on the Performance of a Complex Psychomotor Task. Human Factors, 1971, 13(1), 59-63.
- Eysenck, M.J. A Handbook of Cognitive Psychology. London: Lawrence Earlbaum and Associates, 1984.
- Farmer, E. and Chambers, E.G. A Psychological Study of Individual Differences in Accident Rates. British Industrial Fatigue Research Board, 1926, Report no 38.
- Fedics Corporate Report - Catering Through the Ages. Supplement to the Financial Mail, October 18, 1985.
- Fire Protection Association of South Africa (FPASA). Causes of Fire, 1985, Fire Protection, June 1986, 8-9.
- Fisher, J. Industrial Safety. In Behaviour in Organisations. 1986 J. Barling, C. Fullagar and S. Bluen (eds). Mc.Graw-Hill, Johannesburg, 1986.
- Fisher, J. and Levin, N. Display-Control Compatibility in the Design of Domestic Cookers for the South African User Population. Ergonomics, S.A. 1989, Vol. 1, No.1, 29-41.
- Fisher, J., Levin, N., Abrams, N. and Gordon, G. Ergonomics and the

Design of Domestic Cookers for the South African Consumer.

Proceedings for the second Annual Conference of the Ergonomics Society of South Africa. 1986. (Pretoria: Design Institute, SABS)

- Fisher, J. and Parry, R. Effective Safety Propaganda: a Study in South African Industry. South African Journal of Business Management 1985, 16 (2) 92-97.
- Fleishman, E.A. Toward a Taxonomy of Human Performance. American Psychologist December, 1975, 1127-1149.
- Flippo, E.B. Personnel Management. 6ed. McGraw Hill, 1984.
- Forester, N.K. Mental attitudes - Their relationship to industrial accidents. Industrial Medicine Vol. 6, 1937, 193-195.
- Froggat, D. and Smiley, J.A. The Concept of Accident Proneness. British Journal of Industrial Medicine, 1964, 21, 1-12.
- Gill, F.S. and Aston, I. Monitoring for Health Hazards at Work. London. Grant McIntyre, 1982.
- Government Gazette, No. 7464, Compulsory Standard Specification for the Safety of Electrical Appliances (Cape Town: Government Printer), 1981.
- Gray, M. Questionnaire Typography and Production. Applied Ergonomics, 1975, 6, 2, 81-89.
- Greenwood, M. and Woods, H.M. A Report on the Incidence of Industrial Accidents Upon Individuals with Special Reference to Multiple Accidents. Report No. 4, British Industrial Fatigue Research Board, 1919, London.
- Greenwood, M. and Yule, C.V. An Enquiry Into the Nature of Frequency Distributions.....of Repeated Accidents. Journal of the Royal Statistical Society, 1920, 83, 225.
- Grieve, D.W. Slipping Due to Manual Exertion. Ergonomics, 1983, Vol. 26, No.1, 61-72.

- Grieve, D. and Pheasant, S. Biomechanics. in W.T. Singleton (Ed)
The Body at Work: Biological Ergonomics. Cambridge
University Press, 1982.
- Guillemin, M.P. Why is Industrial Hygiene Lagging Behind in Education
and Training Policies? Report Given at the International Symposium on
Occupational Safety and Health and Ergonomics. International
Labour Office, Geneva, 1982.
- Gulian, E. Noise as an Occupational Hazard: A Survey of the
European Literature. Cincinnati, Ohio: National Institute
for Occupational Safety and Health, 1974.
- Haddon, W., Suchman, E.A., and Klein, D.A. Accident Research:
Its Methods and Approaches. London: Harper and Row, 1964.
- Harrison, R. and Malkin, F. On-Site Testing of Shoe and Floor
Combinations. Ergonomics, 1983, Vol 26, No.1, 101-108.
- Hartwell, N.M. Prevention of Accidents by the Consideration of
Job Design in the Development of a New Plant. Research Report No
6245, 12/8/043, 1977, British Steel Corporation.
- Hartwell, N.M. and Adams, N.L. Accident Reporting Systems: A
basic Problem Area in Industrial Society. Journal of Occupational
Psychology, 1973, 50.4, 285-298.
- Health Requirements for the Preparation of Food in Terms of the
Standard Food Handling by laws 1317 of 16/8/1972.
- Heglin, R.J. NAVSHIPS Display Illumination Design Guide:
II. Human Factors (NELC/TD223) San Diego, California Naval Electronics
Laboratory Centre, July 1973.
- Hobbs, B.C. and Gilbert, R.J. Food Poisoning and Food
Hygiene 4ed. Edward Arnold publishers, London, 1982.
- Hockey, G. Effects of Noise on human Work Efficiency. In D. May (Ed)
Handbook of Noise Assessment. New York: Van Nostrand

- Reinhold, 1978.
- Hunter, R.B. A Method of Measuring Frictional Coefficients of Walk-Way Materials. Journal of Research, National Bureau of Standards, 1930, 5, 329-347.
 - Industrial Aid Society - National Union of Mineworkers: Conference on Health and Safety and Increased Compensation: Problems and Suggestions. Unpublished Article, 1986.
 - I.L.O., First International Conference of Labour Statisticians. Statistics of Industrial Injuries. D17 (Geneva: International Labour Office), 1970.
 - International Labour Office: Introduction to Work Study. Impression Couleurs, Geneva, 1971.
 - Jablonsky, R.D. Standardisation of Test Methods for Measurement of Floor Slipperiness. American Society for Testing and Materials. Special Technical Publication 649, 1978.
 - James, D.I. Rubbers and Plastics in Shoes and Flooring: the Importance of Kinetic Friction. Ergonomics, 1983, Vol. 26, No.1, 87-99.
 - Jansen, G. Effects of Noise on Physiological State. In W.D. Ward and J.E. Frick (Eds) Noise as a Public Health Hazard. (ASHA Reports 4.) Washington, D.C; The American Speech and Hearing Association, February, 1969.
 - Jenkins, W.H. and Connor, M.B. Some Design Factors in Making Settings on a Linear Scale. Journal of Applied Psychology, 1949, 47(3), 161.
 - Kantowitz, J.H. and Sorkin, R.D. Human Factors: Understanding People - Systems Relationships. New York: Wiley, 1983.
 - Kelley, H.H. Personal Relationships: Their Structures and Processes. Hillsdale, New Jersey: Earlbaum, 1979.
 - Kerr, W.A. Accident Proneness of Factory Departments.

- Journal of Applied Psychology, 1950, 34, 167-170.
- Kerr, W. Complementary Theories of Safety Psychology. Journal of Social Psychology, Vol. 45, 1957, 3-9.
 - Kinton, R. and Ceserani, V. The Theory of Catering. 4ed Edward Arnold publishers, London, 1978.
 - Kirchener, W. K. The Fallacy of Accident Proneness. Personnel, Vol 38, 1961, 34-36.
 - Konz, S. Work Design. Columbus, Ohio: Grid Inc., 1979.
 - Kundiev, Y.I. Action at the National Level for Improving the Education and Training of Occupational Health Specialists. Report given at the International Symposium on Education and Training policies in Occupational Safety and Health and Ergonomics. International Labour Office, Geneva, 1982.
 - Lian, M. Guide to Hotel and Catering Services. Kyodo-Shing Loong printing industries, Singapore, 1981.
 - Lindsay, P.H. and Norman, D.A. Human Information Processing. (2nd ed) New York Academic Press, 1977.
 - Nalenticchi, M. The Trade Union Movement and Health and Safety at work. Report Given at the International Symposium on Education and Training Policies in Occupational Safety and Health and Ergonomics International Labour Office, Geneva, 1982.
 - Manning, D.P. Deaths and Injuries Caused by Slipping, Tripping and Falling. Ergonomics, 1983, Vol. 26, No.1, 3-9.
 - McCormick, E.J. and Sanders, M.S. Human Factors in Engineering and Design. 5ed. Japan. McGraw-Hill, 1983.
 - Meister, D. Human Factors in Reliability. in W.G. Ireson Reliability Handbook. (section. 12). New York: McGraw Hill, 1966.
 - Michaelis, P.R.; Miller, M.L. and Hendler, J.A. Artificial

Intelligence and Human Factors Engineering: A Necessary Synergism
in Interface of the Future in Badre, A and Schneiderman, B (eds).
Directions in Human/Computer Interaction. Ablex Publishing
Corporation: New Jersey, 1982.

- Mitchell, T.R. Evaluation of the Validity of Correlational research
Conducted in Organisations. Academy of Management Review, 1985.
Vol. 10, No. 2, 192-205.
- Murrell, H. Men and Machines. London: Methuen, 1976.
- Myers, J. and Steinberg, M. Health and Safety: An Emerging
Issue on the Shop Floor. South African Labour Bulletin, 1986,
145-155.
- National Safety Council: Accident Prevention Manual for Industrial
Operations. National Safety Council. Chicago, 1974.
- Newbold, E.M. A Contribution to the Study of the Human Factor in
Causation of Accidents. British Industrial Health Research Board,
Report No. 34, 1926.
- Noguera, D.P. Action at the Level of Teaching Establishments: Training
in Elements of Occupational Safety and Health for Other Professionals.
Report given at the International Symposium on Education and
Training Policies in Occupational Safety and Health and
Ergonomics. International Labour Office, Geneva, 1982.
- Norman, D.A. Categorisation of Action Slips. Psychological
Review, 1981, 88, 1-5.
- NIOSA Year Book. Twenty Five Years of Progress in Industrial
Safety. Mastward Promotions, Fontainebleau, 1976, 1-14.
- NIOSA - Pamphlet number 350.
- NIOSA Incident (accident) Report and Investigation.
NIOSA form 4.12.06.02 (Revised November 1984).
- Oberne, D. and Clarke, M.J. Questionnaire Surveys of Passenger

- Comfort. Applied Ergonomics, 1973, 5, 2, 97-103.
- O'Brien, C. Man, Machine and Robot Ergonomics, 1983, Vol. 26, No. 10, 937-938.
 - Perkins, P.J. and Wilson, M.P. Slip Resistance Testing of Shoes - New Developments. Ergonomics, 1983, Vol. 26, No.1, 73-82.
 - Pheasant, S.J., Clockwise for What? - Stereotypes Reconsidered. Ergonomist, No. 160, April 1983, 3-4.
 - Pimble, J. and O'Toole, S. Analysis of Accident Reports. Ergonomics 1982, 25, 11, 967-979.
 - Piron, J. Labour Law in the Context of the Industrial Relations System. Barling, J.; Fullagar, C. and Bluen, S. (eds) Behaviour in Organisations - South African Perspectives 2nd ed. McGraw-Hill Book Company Johannesburg, 1986.
 - Powell, P.L., Hale, M., Martin, J. and Simon, M. Two-Thousand Accidents. Report No 21, NIIP. 1971.
 - President Catering Supplies. Catering Equipment Pamphlet Johannesburg. 1988
 - Rahimi, M. and Malzahn, D.E. Task Design and Modification Based on Physical Ability Measurement. Human Factors. 1984, 26(6), 715-726.
 - Ramdial, S. An Investigation Into the Influence of Certain Variables Affecting the Accident Rate Among Sugar-Mill Workers on the Natal North Coast. Unpublished Master of Administration dissertation. University of Durban. Westville, 1981.
 - Reason, J. How Did I Come to Do That? New Behaviour, 24 April 1975, 10-13.
 - Reason, J. Absent Minds. New Society 4 Nov 1976, 244-245.
 - Reason, J. Actions Not as Planned: The Price of Automatisation. In G. Underwood and J. Steven, Aspects of Consciousness: Vol 1

- New York: Academic press, 1979.
- Reason, J. and Mycielska, K. Absent Minded? The Psychology of Mental Lapses and Everyday Errors. Englewood Cliffs, New Jersey Spectrum, 1982.
 - Report of the Director General of the Department of Manpower for the year ended 31 December 1986.
 - Report of the Director General of the Department of Manpower for the year ended 31 December 1987.
 - Rich, E. Users and Individuals: Individualising User Models. International Journal of Man - Machine studies, 1983, 18, 199-214.
 - Richfield, L. Food and Restaurant Critic Telephonic Conversation, 4 August 1988.
 - Rolfe, J.M. Whither Workload. Applied Ergonomics, 1973, 4, 8-10.
 - Rumer, G.J. The Importance of Accident and injury Prevention. Ergonomics, 1987, Vol. 30, No. 2, 173-179.
 - Rook, L.W. Reduction of Human Error in Industrial Production (SCTM 93-62(14) Albuquerque, N Mex. Sandia Corporation, 1962.
 - Runyon, R.P. and Haber, A. Fundamentals of Behavioural Statistics. 5ed. Addison-Wesley Publishing Company, Inc. Philippines, 1985.
 - Russel-Davis, D. Railway Signals Passed at Danger: The Driver, Circumstances and Psychological Processes. Ergonomics, 1966, 9, 211-223.
 - SABS, Standardisation and the SABS Marks. (Pretoria: South African Bureau of Standards), 1985.
 - SAS Users Guide: Statistics 5ed. SAS Institute Inc., Cary, NC, USA, 1985.

- Schulzinger, M. S. The Accident Syndrome - The Genesis of Accidental Injury. Charles C. Thomas publisher, Springfield, United States of America, 1956.
- Senneck, C.R. Over-3-Day Absences and Safety. Applied Ergonomics, 1975, 6, 3, 147-153.
- Shackel, B. Ergonomics and Design in the Design Method. S.A. Gregory, 1966.
- Shackel, B. The Applied Ergonomics Handbook. Guildford: IPC Science and technology press, England, 1974.
- Shackel, B. and Whitefield, D. Instruments and People. Applied Ergonomics Handbook. Guildford: IPC Science and technology press, England, 1974.
- Shaw, L. and Sichel, H.S. Accident Proneness. London: Pergamon Press, 1971.
- Siegel, S. Nonparametric Statistics for the Behavioural Sciences. McGraw-Hill. Kogakusha, 1956.
- Sigler, P.A., Geib, M.N. and Boone, T.H. Measurement of Slipperiness of Walkway Surfaces. National Bureau of Standards Research Paper 1897. Journal of Research, 1948, 40, 339-346.
- Singleton, W.T. Man-Machine Systems Designing in Current Trends Towards System Design. Ergonomics for Industry. 1966 no 12 London, HMSO 2-10.
- Singleton, W.T. General Framework and Workstation Analysis. Applied Ergonomics Handbook, 1974. IPC Science and Technology. England.
- Smith, G.S. Injuries as a preventable disease: the control of occupational injuries from the medical and public health perspective. Ergonomics, 1987, Vol. 30, No.2, 213-220.
- Strandberg, L. On Accident Analysis and Slip-Resistance Measurements. Ergonomics, 1983, Vol. 26, No 1, 11-32.

- Strobl, W.M. The Investigators Handbook, Butterworth publishers, 1984.
- Stutterheim, N. Horrifying Facts About Safety at Work, Sunday Tribune, 30 April, 1978.
- Suchman, E.A. A Conceptual Analysis of the Accident Phenomenon in Association of the Aid For Crippled Children, Approaches to accidents. 1961.
- Sunday Star. Fiddles Make South African Work-Injury Statistics Look Good, Say Safety Officers. 3 May 1987.
- Sunday Star. NOSA Faces More Rumbles From the Safety Fiddle Thunderclouds. 17 May 1987.
- Surry, J. Industrial Accident Research: A Human Engineering Approach. Ontario Government publications services, 1971.
- Swain, A.D. Design Techniques for Improving Human Performance in Production. Industrial and Commercial Techniques Ltd, 7 High St. Camberley, Surrey GU15 3QU England, Jan 1972 (revised July 1977).
- Terrel, R. and Purswell, J. The Influence of Forearm and Wrist Orientation on Static Grip Strength as a Design Criterion for Hand-Tools. Proceedings of the 20th Annual Meeting of the human factors Society. Santa Monica, California, Human Factors Society, 1976.
- Tichauer, E.K. The Biomechanical Basis of Ergonomics. New York. Wiley, 1978.
- Tuckett, G. Director of Foodservice Design. Personal Interview conducted on the 20 October 1987.
- Vernon, H.H. Prevention of Accidents. British Journal of Industrial Medicine Vol. 2, 1945, 2-6.
- Viteles, M.S. Industrial Psychology. Jonathan Cape, London, 1962.

- Westgard, R.H. and Aaras, A. Interdepartmental Education and Co-Operation may Enable Medium-Sized Companies to Solve their Own Ergonomic Problems. Report Given at the International Symposium on Education and Training Policies in Occupational Safety and Health and Ergonomics. International Labour Office, Geneva, 1982.
- Williamson, J.B.; Karp, D.A.; Dalphin, J.R. and Gray, P.S. The Research Craft. An Introduction to Social Research Methods. 2nd Little, Brown and Company Boston/Toronto, 1982.
- Wilson, J.R. and Kirk, N.S., Ergonomics and Product Liability. Applied Ergonomics, 1980, 11, 130-136.
- Wygant, R.M. Job Analysis: a Review of Concepts and Methods. Proceedings of the Annual Conference of the Institute of Industrial Engineers. Norcross, G.A: Institute of Industrial Engineers, 1983.
- Wyndham, C.R., Strydom, N.B., Cook, H.N. and Mauetz, T.S. Studies on the Effects of Heat on Performance of Work. Applied Physiology Laboratory Reports, 1-3/59, 1959 Transvaal and Orange Free State, Chamber of Mines, Johannesburg, South Africa.

- Westgard, R.H. and Aaras, A. Interdepartmental Education and Co-Operation may Enable Medium-Size Companies to Solve their Own Ergonomic Problems. Report Given at the International Symposium on Education and Training Policies in Occupational Safety and Health and Ergonomics. International Labour Office, Geneva, 1982.
- Williamson, J.B.; Karp, D.L.; Dalphin, J.R. and Gray, P.S. The Research Craft. An Introduction to Social Research Methods. 2nd Little, Brown and Company Boston/Toronto, 1982.
- Wilson, J.R. and Kirk, N.S., Ergonomics and Product Liability. Applied Ergonomics, 1980, 11, 130-136.
- Wygant, R.M. Job Analysis: a Review of Concepts and Methods. Proceedings of the Annual Conference of the Institute of Industrial Engineers, Norcross, G.A: Institute of Industrial Engineers, 1983.
- Wyndham, C.E., Strydom, N.B., Cook, H.M. and Mauetz, T.S. Studies on the Effects of Heat on Performance of Work. Applied Physiology Laboratory Reports, 1-3/59, 1959 Transvaal and Orange Free State, Chamber of Mines, Johannesburg, South Africa.

Author Amiel Talia

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