

Commission of the European Communities

INFORMATION ON AGRICULTURE

**Review of pre-slaughter Stunning
in the E.C.**

No. 30
March 1977

REVIEW OF PRE-SLAUGHTER STUNNING IN THE E.C.

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This study gives first an analysis of legislation on pre-slaughter stunning in force in each of the member states. Legal requirements concerning equipment, techniques and persons are examined. Furthermore, a practical survey was carried out in an important number of slaughter houses in the Community, and a comparative analysis made of stunning methods and equipment used in practice. A scientific and practical assessment is made in relation to methods applied for stunning cattle, calves, pigs, sheep, goats, poultry and horses. Special attention is given to the effectiveness of the stunning process depending on species of animals and the type of appliance used. Reduced effectiveness of stunning as a result of incorrect treatment of the animals prior to slaughter and of inadequate maintenance of equipment are also referred to.

Recommendations are made in the field of provisions for legislation and stunning practices as well as for fundamental studies necessary to develop reliable tests for the assessment of objective signs of pain reaction during and after pre-slaughter stunning.

This study is published in English and in German.

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COMMISSION OF THE EUROPEAN COMMUNITIES
DIRECTORATE-GENERAL FOR AGRICULTURE
Directorate: Agricultural Economics – Division: “Balance-sheets, Studies, Statistical Information”

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Foreword

The present study has been carried out within the framework of the study-programme of the Directorate General for Agriculture by

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The division "Balance-sheets, Studies, Statistical Information" and "Harmonization of Laws, regulations and administrative provisions relating to veterinary matters and zootechnics" of the Directorate General for Agriculture have cooperated in this project.

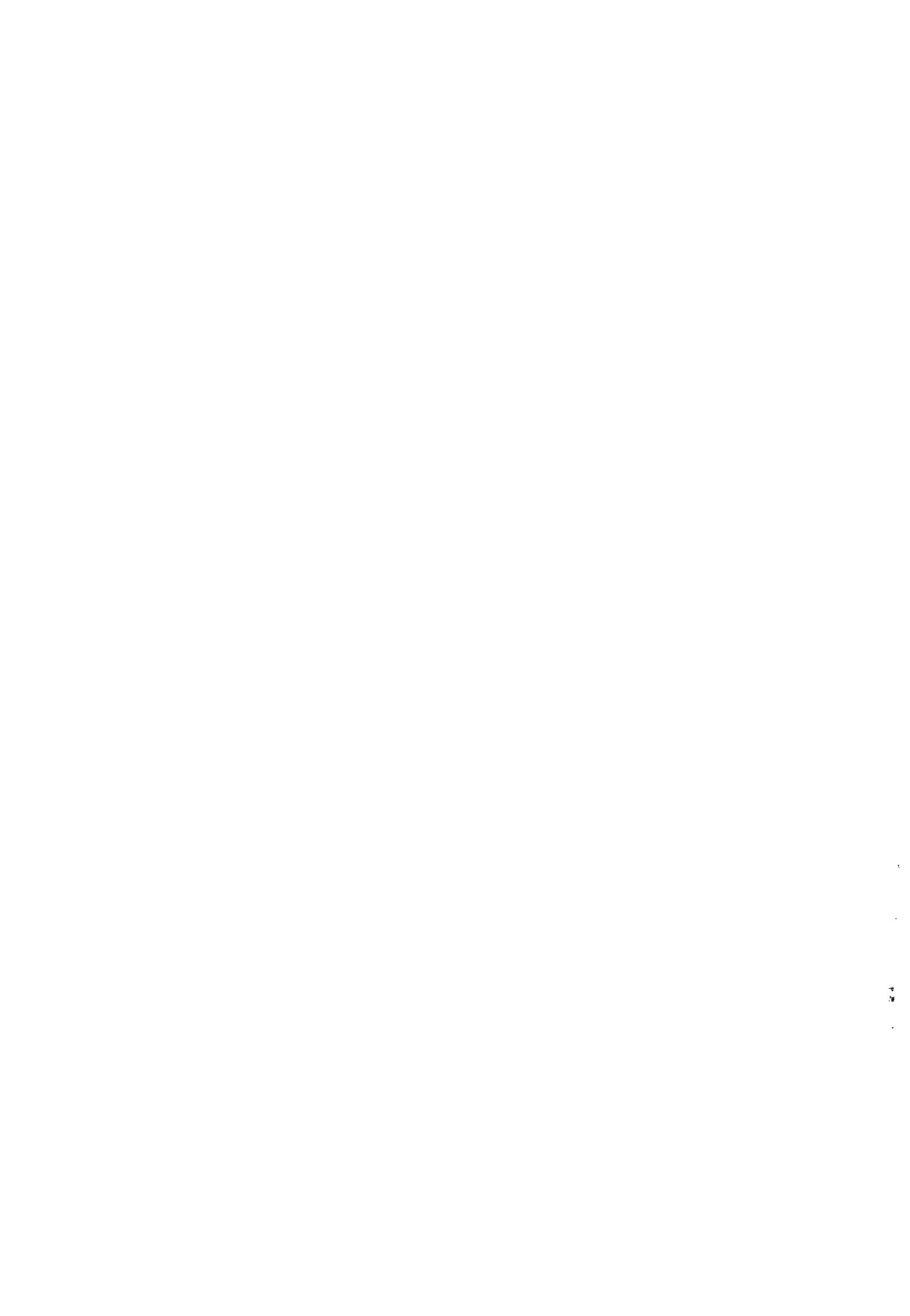
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This study only reflects the opinions of the authors which are not necessarily those of the Commission of the European Communities and does not prejudice its future position on this subject.



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Part 1: Summary and Conclusions

1.1 Introduction

The commission asked us to examine and report on the following aspects of pre-slaughter stunning in the European Economic Community:

- the existing legislation in the Member States and its practical application in each country
- the efficiency of methods currently in use, or under investigation, to stun animals with a view to producing unconsciousness
- research in progress relating to the differentiation of "consciousness" and "unconsciousness".

Part 1 of this report summarises our conclusions, Part 2 contains an analysis of domestic legislation in force in the Member States during 1975/76, with a comparison of the various requirements while Part 3 contains an account of our observations on stunning methods in use in each Member State.

The way in which animals are handled influences their reaction to the process of slaughter and we have considered our remit to include the period from the animal's arrival at the slaughterhouse to its death. Because of differences in national usage, we have not attempted to define all the various terms used, but we regard slaughtering as embracing stunning, to render the animal completely insensible immediately and painlessly, and killing, to transform it into a carcass for human consumption, usually by bleeding out. We have not given detailed consideration to the subject of ritual slaughter, which is permitted in all the Member States, as it does not involve stunning. Nor have we examined the slaughtering of animals other than in a slaughterhouse.

1.2 Legislation

Part 2 analyses the domestic legislation in force in the Member States during 1975/76. Stunning before killing was a legal requirement in all States before the introduction of Directive 74/577 on the pre-slaughter stunning of animals. It is presumed that the primary objective of the requirements on pre-slaughter stunning is to protect the welfare of food animals by making the process of slaughter as humane as possible.

The legislation is broadly similar, particularly in relation to the types of equipment approved. The laws of some states specify stunning techniques in detail, while in others they may be defined in official circulars. Similarly, animal welfare requirements, e.g. the prohibition of hoisting before stunning, except in the case of poultry, may be included in the legislation. Alternatively, national cruelty to animals laws may prohibit such practices.

There is a lack of uniformity in the case of the central authority responsible for stunning and, in general, the precise authority responsible for enforcement of the legislation is not very clearly defined. The same comment can be made on requirements as to the frequency and thoroughness of supervision of stunning practice, nor is stunning defined in certain cases.

1.3 Stunning methods in use or under investigation

1.3.1 COLLECTING INFORMATION

We visited 69 slaughterhouses, approximately equally distributed between all the Member States, and observed 68 series of stunning slaughter animals. Part 3 summarises this information, 3.1.1 - 3.2.4 giving an assessment of each method of stunning seen in operation.

1.3.2 ASSESSMENT OF EFFECTIVENESS

Part 3 also considers the means used in practical conditions to assess the effectiveness of pre-slaughter stunning, 3.3 - 3.3.3. The difficulty of controlling such assessments in slaughterhouses is commented on briefly in 1.5.1.2, and the need for research on this subject is emphasised in 1.5.4.1 of this report. Nevertheless, we conclude that neither enervation nor shooting large animals in the poll with a captive bolt pistol was a satisfactory method of pre-slaughter stunning. Methods of assessing effectiveness under laboratory conditions are considered in 1.3.3.

The concern felt in scientific circles at the present situation in the industry has been exemplified by the establishment in the Netherlands during 1975 of a committee (De Studiecommissie Bedwelming Slachtdieren) with the primary task of advising the Government on reliable pre-slaughter stunning methods from the animal welfare point of view. A recent publication by four of the leading Dutch workers in this field (van de Wal et al., 1975), enumerated the following problems in the electrical stunning of pigs: the need to provide good transport conditions, adequate rest at the abattoir before slaughter and quiet handling; economic pressure to increase throughput, thus reducing the time available for stunning; proper restraint at stunning, to facilitate correct positioning of electrodes; provision for the maintenance of stunning equipment; keeping the time between stunning and sticking to a minimum, to reduce the possibility of losing the effect of stunning before death supervenes.

Some of these points may appear to have little direct connection with pre-slaughter stunning, but they can, in fact, exert an important influence on the process. All were evident in the course of the present review and have been commented on in Part 3.

1.3.3 CURRENT SCIENTIFIC KNOWLEDGE AND RESEARCH IN PROGRESS

1.3.3.1 Studies on the differentiation between the conditions of "consciousness" and "unconsciousness"

Laboratory observations are almost exclusively based on the type of wave form, or appearance of the zero line, in electroencephalograph (EEG) tracings. In a study of brain injuries, based on 880 human cases, Karimi-Nejad and Tritz (1974) concluded that consciousness was present if the patient's eyes opened in response to a painful stimulus. In the slaughterhouse, unconsciousness can only be presumed with confidence when the stunned animal remains motionless and gives no response to a painful stimulus.

1.3.3.2 Studies on measurement of the effectiveness of the methods of stunning in use in relation to the practical application of the scientific definition of unconsciousness

Studies on the effectiveness of pre-slaughter stunning must be based on the ability to measure the reaction to pain. Some work has been done in this field in connection with electrical anaesthesia, but it has

not been effectively linked with pre-slaughter stunning methods. There are many publications relating to all types of pre-slaughter stunning which base their findings on subjective judgements made without a foundation of scientifically established facts. There is also a need to relate clinical research findings to practical tests.

1.3.3.2.1 Captive bolt stunning

Stunning of cattle with a poleaxe developed into the use of a mask with a bolt attached and then into the captive bolt pistol, use of which was first reported by Breidert (1902). von Conrad (1909) summarised current knowledge on this method, concluding that it was unsuitable for general adoption because of mechanical unreliability. During the next twenty-five years improved technical knowledge resulted in increased reliability and widespread adoption of the captive bolt. While this equipment is commonly approved in the legislation for use in pre-slaughter stunning, very little scientific work has been published on the method. A literature survey on this subject was undertaken for the Federal German Ministry of Nutrition, Agriculture and Forests by the Institute for Veterinary Medicine, Berlin, in 1973 (Grossklaus, 1973). Subsequently, research at the Veterinary High School, Hannover, was undertaken, using the EEG to compare captive bolt stunning of sheep (Freeseemann, 1975) and calves (Gross, 1976) with ritual slaughter. When the apparatus was correctly placed, the method was shown to be suitable in sheep, which were not only stunned but killed, and also for calves. Guidance on the effects of captive bolt stunning may be derived from the clinical signs and feelings of human patients with severe brain injuries. Thus, while Arct (1971) reported twelve human fatalities from accidents involving penetration of the brain by captive bolts, Arlt *et al.* (1971) gave details of three patients out of nine who remained conscious despite severe penetrating injuries caused by captive bolts in the frontal or temporal regions. There are two main effects from captive bolt stunning, varying degrees of unconsciousness and violent muscular activity. Delank (1970) stated that the depth of unconsciousness increased with the force of the blow. He also reported that it was possible for open brain lesions to occur, for example from shooting accidents, without loss of consciousness. It is presumed that the type and severity of muscular activity depends on the region of the brain damaged by the captive bolt.

Although experiments with laboratory animals on the effects of captive bolt and concussion stunning can be carried out by variation of the physical trauma to produce different degrees of brain disturbance (Unterharnscheidt, 1971), we are not aware of scientific publications establishing that similar conditions apply in slaughter stock. We observed that captive bolt stunning carried out in different ways produced different reactions, Part 3, 3.4.1.

Recommendations for further research on captive bolt stunning are included in 1.5.3.1.

1.3.3.2.2 Concussion stunning

Blackmore (1975) reported that he had obtained satisfactory results in preliminary experiments on concussion stunning of sheep. However, as reported in Part 3, 3.4.4.1, we have seen unsatisfactory results with this technique in sheep. The important factor appears to be the strength of the blow and its site of application. Observations

at the Veterinary High School, Hannover, have shown that concussion stunning is effective in adult cattle if the apparatus is correctly placed and the weight of charge is sufficient. Results with pigs of c.80 kg were less satisfactory. It was found that, when the blow from the stunner fractured the cranial bones, violent struggling followed. Good results were achieved when no fracture occurred. On the other hand, excessive power may give less satisfactory results.

1.3.3.2.3 Electrical stunning

Electrical stunning became general in those countries where pre-slaughter stunning was a legal requirement in the 1930s. It has received the greatest amount of attention from research workers, but there is a dearth of information on the efficiency of electrical stunning in causing unconsciousness. The findings show considerable variation between different investigators and subjective opinions predominate in the interpretation of results.

The early history of research on electrical anaesthesia and the subsequent development of electrical stunning up to 1973 have been reviewed by Warrington (1974). There are numerous publications describing experiments on electrical pre-slaughter stunning, using a wide variety of voltages, frequencies, wave forms and durations of current flow. Most of these papers are concerned with objective data on the effects of particular systems on meat quality, especially pH values and also the occurrence of blood splash (petechial haemorrhages), but are not concerned with the efficiency of pre-slaughter stunning in causing unconsciousness. This is possibly mainly due to the difficulty of making an objective assessment in slaughterhouse conditions. Experience with electro-convulsive therapy in man and experiments with electrical anaesthesia in animals have shown that the subjects are unable to recall painful procedures applied while the current flowed (von Mickwitz and Reinhard, 1966). Observations such as these need to be repeated with pre-slaughter stunning methods. Experiments are in progress at the Schoonoord Institute, Zeist, using the EEG to study electrical stunning of pigs (Hoenderken, 1976).

Poultry can be stunned effectively by electricity. Difficulties arise from the innate high resistance of the feathers, the high line speed and the path taken by the current in poultry slaughtering plants, and the results are often defective, Part 3, 3.4.6. Only one example was seen of a machine which fixed the heads of poultry during stunning, facilitating the correct flow of current.

1.3.3.2.4 Carbon dioxide anaesthesia

Carbon dioxide anaesthesia was introduced as a commercial pre-slaughter stunning method in 1952 (Swem), without preliminary publication of experimental results. It has since only received a limited amount of attention from research workers. One of our colleagues, Mr. L. J. Wilkins*, is at present preparing a review of the literature on the application of carbon dioxide anaesthesia to pre-slaughter stunning and we are indebted to him for the opportunity to refer to his draft paper. Our own observations on this technique appear in 3.4.3.2 of Part 3.

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If publications on the application of carbon dioxide to induce surgical anaesthesia are disregarded, and these involve much lower concentrations of the gas than are general for pre-slaughter stunning, there are about thirty reports on its use for the latter purpose, but many of these are descriptive rather than experimental. Most of them are concerned with the effect of the technique on meat quality, sometimes in comparison with various types of electrical stunning and, in these cases, results obtained by different workers may conflict. A paper by Sybesma and Groen (1970) suggested that the deleterious effect they observed on meat quality after carbon dioxide stunning was attributable to the stress involved in entering the apparatus, rather than to the gas itself.

Although pigs emerging from the commercial plants we observed were in a deep coma, experiments on pigs exposed to the gas in a transparent chamber at the United Kingdom Meat Research Institute showed that they often struggled violently during induction of anaesthesia. Professor A. Müller of the Zurich Veterinary School told us he had noted the same response. This observation was apparently confirmed by the fact that at the commercial plants we visited some pigs emerged with their heads wedged against the vertical dividing bars on the conveyor which separated individuals and a few had turned round completely. At two of these plants we were told that the dividing bars were often in need of repair, possibly suggesting that they were damaged by violent struggling. In the absence of relevant research, it remains an open question whether carbon dioxide anaesthesia complies with the definition of pre-slaughter stunning.

1.3.3.2.5 Centres carrying out research on pre-slaughter stunning

General investigations are currently in progress at the following centres :

- Abattoir Section, Agricultural Research Council Meat Research Institute,
Lower Langford, BRISTOL, BS18, 7DY, United Kingdom.

Electrical and carbon dioxide stunning of pigs and sheep.
Captive bolt stunning of cattle.
- Bioscience Division, Meat Industry Research Institute of New Zealand,
P.O.Box 617, HAMILTON, New Zealand.

Electrical stunning of sheep.
- Faculty of Veterinary Science, Massey University, PALMERSTON NORTH,
New Zealand.

Concussion stunning of sheep.
- Instituut voor Veeteeltkundig Onderzoek "Schoonoord",
Driebergsweg 10d, ZEIST, Netherlands.

Stunning of pigs.
- Klinik für kleine Klautiere und Forensische Medizin, Tierärztliche
Hochschule, Hannover, 3000 HANNOVER, Bischofsholer Damm 15, Western
Germany.

Captive bolt and concussion stunning of cattle, sheep and pigs.

- Slageteriersnes Forskningsinstitut, Maglegaardsveg 2, ROSKILDE 4000, Postbox 57, Denmark.

Electrical stunning of pigs.

- Veterinär-Chirurgischen Klinik der Universitat, ZURICH, Switzerland.

Carbon dioxide stunning of pigs. Electrical stunning of poultry.

1.4 Comparative study of the legal requirements for pre-slaughter stunning and the methods currently in use in relation to existing scientific knowledge

The legislation of the Member States is summarised and compared in Part 2, as well as the consequences of the differences between the various laws. Reference to Part 3 will show that standards of pre-slaughter stunning do not vary greatly between Member States, although there is a wide range in the level of performance in each country.

We have indicated on p.2 above that there is a need for research into various aspects of all the methods of pre-slaughter stunning at present in common use. Nevertheless, many of the deficiencies observed in stunning practice are attributable either to lack of well designed handling facilities or to inadequacies in the training and supervision of slaughtermen, or both. The former is exemplified by the poor design of many cattle stunning pens, which make it difficult for even the most competent slaughterman to position the captive bolt pistol correctly, see Part 3, 3.4.1 and p. 74. The latter is illustrated by the incorrect positioning of the electrodes and by the inadequate time of exposure to the current flow, both faults noted quite often in observing electrical stunning, see Part 3, 3.4.3.1 and 3.4.4.2.

The general adoption of a formal system of examining stunning equipment before approval and publication of officially approved methods of operation, in conjunction with the points made in the preceding paragraph on handling facilities and the training and supervision of slaughtermen, are necessary if the pre-slaughter stunning methods at present in use are to be applied in accordance with existing scientific knowledge, see Part 3, 3.5.

1.5 Conclusions

We were required to summarise the conclusions of the study under the following heads :

- stunning practices which are considered to be operating satisfactorily within the Community, judged by current scientific knowledge
- stunning practices which scientific knowledge indicates could be brought to a satisfactory standard by action within the Community without the necessity for further research, e.g. by legislative changes
- fields where progress is limited by the need for additional research on a national or Community level, including an indication of possible future co-ordinated research programmes, with corresponding priorities.

1.5.1 STUNNING PRACTICES CONSIDERED SATISFACTORY

1.5.1.1 Captive bolt and concussion stunning

When the animal is correctly positioned, the instrument is properly applied, has a bolt of correct size and an adequate charge is used, captive bolt stunning was seen to stun cattle of all sizes effectively. This is also true of concussion stunning.

1.5.1.2 Electrical stunning

Because of the convulsions inseparable from electrical stunning, objective judgement of the efficiency of the method was difficult. Nevertheless, when less than 100 V was used, the electrodes correctly positioned and the current flowed for an adequate time, pigs and poultry were satisfactorily stunned.

1.5.2 STUNNING PRACTICES WHICH COULD BE BROUGHT TO A SATISFACTORY STANDARD

1.5.2.1 Captive bolt and concussion stunning

As indicated above, we consider this method to be satisfactory when accurately applied and an adequate charge is used. The need for proper restraining facilities, to enable slaughtermen consistently to aim accurately, has already been stressed. In many cases this would enable stunning by captive bolt or concussion, where it is at present applied unsatisfactorily, to be brought to a satisfactory standard, see below.

1.5.2.2 Electrical stunning

Changing the habits of slaughtermen to achieve proper positioning of the electrodes and to ensure that the current flows for an adequate time through the brain would improve the efficiency of electrical stunning in many cases, although the need for research would remain, see 1.5.3.2.

1.5.3 FIELDS WHERE THERE IS NEED FOR ADDITIONAL RESEARCH

1.5.3.1 Captive bolt and concussion stunning

Research is needed to achieve standardisation of the weight of charge required to ensure efficient stunning of animals of different sizes and also on the optimum dimensions for the captive bolt, or of the head of the concussion stunner, and their best point and direction of application for different species. It is important to avoid extrapolating results from one class of animal to another, e.g. from sheep or calves to large cattle.

1.5.3.2 Electrical stunning

The diversity of techniques being applied in practice has been referred to in 1.3.3.2.3. Their efficiency is considerably affected by the facilities for restraint of the animal and the method of application of the current. Nevertheless, there is a clear need for critical studies on the effects of the various electrical parameters in use, to determine which are most satisfactory for animals of different species and various sizes, e.g. the validity of increasing voltages and reducing stunning times in response to economic pressures. When the electrodes are so placed, after initial stunning across the brain, that the current runs through the heart, fibrillation occurs and death follows rapidly. It is at present an open question how often electrical stunning results in insensibility and how often in death.

1.5.3.3 Carbon dioxide anaesthesia

The pigs emerging from the plants visited were in a deep coma. However, for the reasons stated in 1.3.3.2.4 above, there is evidence that the pre-anaesthetic stage in the gas is stressful and possibly painful. Critical studies of brain activity are needed to assess the acceptability of this technique from the animal welfare point of view, including the effect of increasing the concentration of oxygen in the gas mixture.

1.5.3.4 Animal behaviour and work study

Studies are needed on animal handling facilities; these should include investigations on animal behaviour, to ensure that the designs minimise stress during movement to and subsequent immobilization at the point of stunning, to enable the process to be carried out correctly. Application of the principles of ergonomics to stunning facilities should not be neglected.

1.5.4 RESEARCH PRIORITIES

It is recommended that the following priorities should be allocated in research on pre-slaughter stunning.

1.5.4.1 Objective methods for identifying pain reactions

Fundamental studies are necessary to develop reliable tests for the assessment of objective signs of pain reaction during and after pre-slaughter stunning. Judgement of the effects of stunning in slaughterhouse conditions is difficult and there is evidence that the abolition of the corneal reflex, often taken as a sign of insensibility, is not a reliable guide. We consider the terms "consciousness" and "unconsciousness" should not be used in the context of pre-slaughter stunning because of their inappropriate and emotive connotation; the term "insensibility" is to be preferred.

1.5.4.2 Equipment testing

Development of methods for testing the efficient functioning of different stunning apparatus under slaughterhouse conditions.

1.5.4.3 Electrical stunning

A comparison of the effects of stunning pigs, sheep and poultry by the various methods at present used (current form, amperage, voltage, wave form, frequency, design and position of electrodes), including attention to particular problems of electrically stunning sheep and poultry, as well as into the use of the technique for cattle.

1.5.4.4 Restraining equipment

Design of facilities to reduce stress from handling to a minimum and to ensure correct positioning of the animal for stunning.

1.5.4.5 Captive bolt and concussion stunning

Optimum design of equipment, strength of charge and site of application, including use in sheep and pigs, as well as modification to permit the simultaneous injection of air under high pressure through the captive bolt, with the objective of reducing convulsions.

1.5.4.6 Carbon dioxide anaesthesia

Studies on induction stress, effects of increased oxygen concentration and application of the technique to poultry.

1.5.4.7 Other methods

Consideration of new approaches to humane pre-slaughter stunning.

Co-ordinated research programmes would be most appropriate in the case of 1.5.4.1 above. Secondly, items 1.5.4.3 and 1.5.4.5 should receive consideration.

1.6 Recommendations

1.6.1 LEGISLATION

It is recommended that the legislation of the Member States should include the following provisions: (The relevant Section of Directive 74/577 is shown in parenthesis).

1. a definition of pre-slaughter stunning and of the species to which it must be applied. (Art. 1, 1 and 2)
2. a system for the official approval of stunning equipment and its method of application, after scientific appraisal, periodical publication of lists of approved instruments and regular official testing of all types of equipment. (Art 2, 1; partially)
3. a system for the training and licensing of persons undertaking pre-slaughter stunning. The licence should state the type of instrument and class of animal authorised. (Art 2, 1; partially)
4. a definition of the officials responsible for supervision of stunning in all slaughterhouses, with a statement of the frequency and degree of thoroughness of supervision of stunning. (Not covered)
5. requirements specifying the design of facilities for the handling of animals to the point of slaughter and for their effective restraint and accessibility during stunning. (Art 2, 2; partially)
6. a requirement for animals to be stunned and killed one at a time, by bleeding out immediately after stunning. They must be insensible before they are shackled, hoisted and bled. (Not covered)
7. requirements to protect workers from the hazards connected with stunning. (Not covered)
8. provision for the introduction of new methods of pre-slaughter stunning. (Not covered)

1.6.2 PRACTICE

1. stunning by enervation and shooting large animals at the poll by captive bolt should be prohibited
2. provision should be made for the training of instructors in pre-slaughter stunning methods.

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Part 2: An analysis of the legislation on pre-slaughter stunning
in force in each of the Member States

2.1 Introduction

The commission required an analysis of the legislation on pre-slaughter stunning in force in each of the Member States, including any amendments which may be under consideration. This analysis will include a comparative study of the various legal requirements, in order to identify similarities and differences in their objectives and consequences.

The Member States were requested to supply a copy of their legislation on pre-slaughter stunning and also to indicate whether any alterations were proposed. The legislation received is listed in Appendix I and has provided the basis for this analysis and comparison. The Danish Government was introducing an amendment at the time of the initial enquiry; it is now in force and has been listed with the other enactments. A complete revision of the Luxemburg legislation is proposed and a copy of the new draft text has been received. It has not been included in Appendix I, but is commented on at appropriate points in this report. No other governments notified an impending revision of their legislation on this subject.

Humane slaughtering of animals for meat production involves stunning, with the purpose of immediately rendering the animal insensible, and subsequent killing, by bleeding it to death before dressing of the carcass begins. All the Member States have regulations requiring pre-slaughter stunning, often of several decades standing. However, this legislation seldom includes definitions of the procedures involved.

To facilitate consideration of the various legislative provisions, they have been collated into the following appendices:

Appendix IIa Equipment (Approving Authority, Types, Requirements)

IIb Techniques (Species, Handling, Exemptions)

IIc Persons (Prohibitions, Licensing, Supervision)

Similarities and differences in the legislation of the Member States are commented on in the following sections.

2.2 Notes on legal requirements

2.2.1 EQUIPMENT

2.2.1.1 Authority

Approval of equipment to be used for pre-slaughter stunning is generally exercised by Central Governments, although Italy and Western Germany delegate authority in certain circumstances. The Republic of Ireland and French Governments have systems for examining new stunning equipment before authorising its use and they publish lists of approved instruments. The Government of Ireland can specify for which types of animals particular equipment may be used. The Netherlands Government can require a report on new electrical stunning equipment before approving it and has detailed routine inspection requirements, including a register of authorized inspectors. In Western Germany fire-arms must be sent for overhaul at least every second year.

2.2.1.2 Methods

Captive bolt instruments and electrical stunners are in general use. Gas narcosis is employed in some pig slaughterhouses; although this method is not authorized in Luxembourg at present, it is included in the new draft regulations, which would also approve use of a captive bolt or percussion stunner, in place of a free bullet for large animals. Percussion stunners do not appear to be widely used in the Community at present.

2.2.1.3 Worker Safety

The Belgian and French legislation contain stipulations on worker safety. This point is in all probability covered by separate labour regulations in the other Member States.

2.2.1.4 Special requirements

Cattle must be restrained in a stunning box in the Republic of Ireland, France and the United Kingdom, although a wall-ring is an acceptable alternative in the French legislation, which also specifies that equipment must be provided to protect animals from injuring themselves while falling before exsanguination begins. Denmark, the United Kingdom and some Lander of Western Germany require the provision of a special pen for slaughter of cattle by the Jewish ritual.

2.2.2 TECHNIQUES

2.2.2.1 Species

Western Germany requires the pre-slaughter stunning of all warm blooded animals, although there are exceptions in the case of calves when the pituitary is collected, of lambs, nannies and piglets, which may be clubbed, and of rabbits and poultry, which may be stunned with a heavy piece of wood. Stunning by sticking in the nape of the neck is specifically prohibited in the Netherlands and Western Germany. The legislation of the other States generally requires the common species of meat animals to be stunned. It is proposed that the authorization of the use of a fire-arm for large animals in the Luxembourg legislation should be replaced by a requirement to use a captive bolt or a percussion stunner.

2.2.2.2 Pre-slaughter

The French, Netherlands, and West German legislations prohibit hoisting before stunning. United Kingdom regulations define the maximum times poultry may be suspended before stunning. The Irish Republic and United Kingdom legislations prohibit slaughter of an animal within sight of another. These points may be covered by separate cruelty regulations in the other Member States.

2.2.2.3 Captive bolt

The Belgian decree defines the site of stunning at the poll and Irish regulations detail the technique for frontal stunning.

2.2.2.4 Electricity

The Irish and Netherlands legislations specify the site of application of the electrodes and the latter gives the electrical parameters for the three approved types of stunning.

2.2.2.5 Gas narcosis

Provisions relating to the construction of carbon dioxide stunning plants, including monitoring of gas concentration and for stunning pigs in an emergency, are included in the United Kingdom regulations. The Irish Republic legislation requires that pigs must be unconscious before being shackled, hoisted and bled.

2.2.2.6 Other methods

The Belgian legislation defines the procedure for breaking rabbits' necks. Calves may be stunned with a hammer in Luxembourg, where this method may also be used for piglets, and sheep, goats and kids may be slaughtered by "compression of the bulb". Poultry may be beheaded in Denmark, Western Germany and the United Kingdom, where dislocation of the neck is also an authorised slaughter method. In Italy severing the medulla oblongata (enervation) is a method of slaughter authorized by the Central Government. It does not appear to be usual for sheep and goats to be stunned before slaughter in Italy.

2.2.2.7 Post stunning

Exsanguination must be carried out immediately after stunning in all the Member States, except Luxembourg. The West German law also requires that dressing may start only when death has occurred and in the Netherlands animals must be bled to death within one minute of stunning and no other acts may be performed until permanent immobility occurs.

2.2.2.8 Ritual slaughter

This is permitted in all the Member States, with stipulations in some cases on the location, and Denmark, the United Kingdom and some Lander of Western Germany require cattle to be confined in a specially designed box.

2.2.2.9 Emergency slaughter

This may be carried out without stunning in Belgium, Denmark, France and the United Kingdom. It will be permitted in the revised Luxembourg regulations.

2.2.3 PERSONS

2.2.3.1 Prohibitions

Children under 14 years of age may not carry out slaughtering or be present in Denmark. They may not be present in Western Germany. Slaughtering must be carried on out of public sight in Belgium and West Germany.

2.2.3.2 Licensing

Slaughtermen are licensed in Ireland and the United Kingdom. Operators of electrical stunners have to have a certificate of competence in the Netherlands. Those carrying out ritual slaughter in France and the Netherlands have to be licensed and in Western Germany it is necessary to have a licence to stun calves with a hammer to permit collection of the pituitary gland.

2.2.3.3 General

In Italy severing the medulla oblongata is only to be done by a fully skilled person, authorized by the slaughterhouse manager. It is specifically prohibited in the Netherlands and Western Germany.

2.3 Summary

To summarise, examination of Appendices IIa, b and c shows that the legislation of the Member States on pre-slaughter stunning is broadly similar, particularly in relation to the types of equipment approved, and all permit exemptions for ritual slaughter. This practice is not referred to in our contract and, as it does not involve pre-slaughter stunning, is not commented on.

We wish to draw attention to the following points, which we regard as of particular importance. Lack of uniformity is noticeable in the case of the central authority responsible for pre-slaughter stunning, no doubt due to national differences in the assignment of fields of interest between government departments. In general, the precise authority responsible for enforcement at slaughterhouse level is not very clearly defined in the legislation received and the same may be said of requirements relating to the frequency and thoroughness of supervision.

The adoption of specific provisions in some States for examining new types of equipment, publishing lists of approved instruments and carrying out a system of routine inspection should all tend to improve the standard of pre-slaughter stunning. Enforcement of an effective system of licensing slaughtermen should facilitate training and, consequently, the maintenance of a better standard of pre-slaughter stunning. Some States specify stunning techniques in detail, while others make no provision on this point in their law, although procedures may sometimes be defined in official circulars. Stunning is not defined in some national legislation and it is considered that this omission should be repaired.

Animal welfare requirements, e.g. the prohibition of hoisting before stunning, are included in some legislation. Where this is not the case, prosecution for such malpractices might be possible under national cruelty to animals laws, copies of which have not been supplied by all States. However, it is desirable that animal welfare provisions relating to slaughtering should be incorporated in the pre-slaughter stunning legislation, so that they are familiar to operators and inspectors. Similarly, there are specific provisions on worker safety in the case of a few States, particularly in relation to electrical stunning, but this aspect is known to be dealt with in separate labour or factory legislation in some other States, although copies of these enactments were not received. Nevertheless, it is desirable that provisions on worker safety should be included in the pre-slaughter stunning legislation, particularly in view of the tendency to use more powerful current in electrical stunning, as this should help to draw the attention of those immediately concerned to these hazards.

Certain species or age groups of animals are excepted from the pre-slaughter stunning requirements of some States, no doubt on economic grounds. It is not possible to justify their exclusion from the humanitarian point of view. In the same way, certain alternative methods of stunning, e.g. severing the spinal cord behind the medulla oblongata (enervation) cannot be approved in this context. The requirement to use a stunning box for cattle presents an obstacle to humane stunning (Part 3, 3.4.1) in the case of most stunning boxes at present in use. The major points requiring revision in the legislation have been listed in the Recommendations, Part 1, 1.6.1.

This legislation has been enacted in the Member States within the last fifty years, with the principle objective of achieving humane pre-slaughter stunning. There is a general uniformity in the methods approved and, consequently, the results achieved throughout the Community are broadly similar. Variations result more from differences in application than from differences in legal requirements.

APPENDIX I

PARTICULARS OF LEGISLATION ON PRE-SLAUGHTER STUNNING PROVIDED BY THE
GOVERNMENTS OF THE MEMBER STATES

Royaume de Belgique

Royal Decree of 28th June, 1929
Introduced under Section 5 of an Act, dated 22nd March, 1929, (not
supplied) and subsequently amended by Royal Decrees of 5th October,
1930; 17th October, 1966; and 16th June, 1967

Kongeriget Danmark

Law 256 of 27th May, 1950
Decree 233 of 15th August, 1953; introduced under Section 16 of
Law 256
Decree 234 of 24th June, 1954
Decree 51 of 20th February, 1976

Instructions from Veterinary Directorate on enforcement of pre-slaughter
stunning legislation, 2nd March, 1976

Bundesrepublik Deutschland

Law Pertaining to the Slaughtering of Animals, 21st April, 1933
(Imperial German Law Gazette I, p. 203)

Decree Pertaining to the Slaughtering of Animals, 21st April, 1933
Decree Pertaining to the Slaughtering of Live Fish and Other Cold-
blooded Creatures, 14th January, 1936
(Imperial German Law Gazette I, p. 13)

Law Pertaining to the Slaughtering of Animals, 20th June, 1947
(Gazette of Laws and Ordinances p. 37, 15.7.47)

Amendment to the Decree Pertaining to the Slaughtering of Animals,
7th March, 1946 (Hamburg)
(Gazette of Ordinances, p. 25, 12.3.46)
Decree Pertaining to the Slaughtering of Animals in Accordance with
Jewish Rites, 7th March, 1946 (North Rhine)
Decree Pertaining to the Slaughtering of Animals in the Jewish
Fashion, 23rd March, 1946 (Westphalia)
Decree no.49 Pertaining to the Slaughtering of Animals, 14th January
1946 (Bavaria)

Republique Française

A summary of the provisions of Sections 276, 278, 283.1 and 283.3 of the Country Law, relating to cruelty to animals and their slaughter.

Decree 64-334 of 16th April, 1964

Decree 70-886 of 23rd September, 1970

Departmental Orders 16th April, 1964; 5th April, 1971

Departmental Circular 8099, 28th December, 1970

Ireland

Agricultural Produce (Fresh Meat) Act, 1930

Agricultural Produce (Fresh Meat) (Beef, Pork and Mutton) Regulations, 1930

Slaughter of Animals Act, 1935

Slaughter of Animals (Approved Instruments) Order, 1936

Slaughter of Animals (Approved Instruments (Pigs) Order, 1973

Repubblica Italiana

Regulation for Hygienic Supervision of Meat, 20th December, 1928
(Official Gazette 36, 12th February, 1929)

Photocopy of Section 9 only

Grand-Duché de Luxembourg

Ministerial Regulation of 11th November, 1961, promulgating Grand Ducal Decree of 3rd November, 1960 (Official Gazette A-No.61 30th December, 1961)

Prevention of Cruelty to Animals Law, 26th February, 1965
(Parliamentary Record 13, 22nd March, 1965)

Commentary on Council Directive 74/577/CEE, pertaining to pre-slaughter stunning, in relation to the national law by the Veterinary Director-General

Koninkrijk der Nederlanden

Decree on Meat Inspection. Photocopy of Chapter III, Articles 8-13
Decree 18860 of 23rd December, 1957, as amended by Decree 126 of 30th June, 1959, and Decree 152 of 1st August, 1969. Photocopy

United Kingdom

General (excluding Northern Ireland)

Protection of Animals Act, 1911 (excluding Scotland)

Slaughter of Animals (Pigs) Act, 1953

Slaughter of Animals (Amendment) Act, 1954

Slaughter of Pigs (Anaesthesia) Regulations, 1958 (excluding Scotland)

Slaughter of Animals (Prevention of Cruelty) Regulations, 1958 (excluding Scotland)

Slaughter of Poultry Act, 1967

Slaughter of Poultry (Humane Conditions) Regulations, 1971

Agriculture (Miscellaneous Provisions) Act, 1972

Slaughterhouses Act, 1974 (excluding Scotland)

Scotland

Protection of Animals (Scotland) Act, 1912

Slaughter of Animals (Scotland) Act, 1928

Slaughter of Animals (Prevention of Cruelty)(Scotland) Regulation, 1955

Slaughter of Animals (Stunning Pens)(Scotland) Regulations, 1963

Northern Ireland

Slaughter of Animals Act (Northern Ireland), 1932

Slaughter of Animals (Amendment) Act (Northern Ireland), 1956

Commentary on Council Directive 74/577, pertaining to pre-slaughter stunning, in relation to the national law

APPENDIX IIa EQUIPMENT (Approving Authority, Type, Requirements)

Subject	ROYAUME DE BELGIQUE	KONGERIGET DANMARK	BUNDESREPUBLIK DEUTSCHLAND
Approving Authority	Minister of Public Health and the Family	Minister of Justice	Minister of Nutrition, Agriculture and Forestry Ministers of Interior and Economics and Finance in respect of fire-arms (captive bolts and concussion stunners)
Captive bolt Percussion stunner Free bullet	Captive bolt	A mechanical device	Bolt-type device
Type of equipment approved	Approved	Approved	Approved if instrument reliable and well tested
Gas Narcosis	Approved if does not endanger wholesomeness of the meat	Approved if does not adversely affect the meat or offal	See "Other methods"
Other methods	Not mentioned	Not mentioned	Other stunning methods can be prohibited, approved or made mandatory
Requirements for Approval (General)	Apparatus must comply with general regulations on safety precautions in industry and function to ensure safety of personnel. Must permit easy, rapid manipulation, steady slaughter cycle and be as noiseless as possible. Captive bolt pistols must be easily cleaned and have a returnable bolt	Not mentioned	Equipment must ensure stunning is carried out in an impeccable fashion. Instruments must be in proper repair. Fire-arms must be approved by the Federal Physical and Technical Institute. Each must carry model number

APPENDIX IIa EQUIPMENT (Approving Authority, Types, Requirements) Continued:

Subject	REPUBLIQUE FRANCAISE	IRELAND	REPUBBLICA ITALIANA
Approving Authority	<p>Minister of Agriculture. Submits all applications to a defined group for advice. Can specify procedure for installation. Publishes list of approved instruments.</p> <p>Director-General of Production and Marketing, Ministry of Agriculture, is responsible for enforcement</p>	<p>Minister of Agriculture. Can have an enquiry before approved. Can specify kinds of animals and methods of use. Publishes list of approved instruments</p>	<p>Provincial Health Council</p>
Type of equipment approved	<p>Captive bolt Percussion stunner Free bullet</p> <p>Electricity</p> <p>Gas Narcosis</p> <p>Other Methods</p>	<p>An approved instrument. Captive bolt</p> <p>An approved instrument</p> <p>Approved for pigs only</p> <p>Not mentioned</p> <p>Not mentioned</p>	<p>Captive bolt</p> <p>See "Other methods"</p> <p>See "Other methods"</p> <p>Other suitable systems approved by local authority (see also II b & c)</p> <p>Not mentioned</p>
Requirements for Approval (General)	<p>Must comply with labour code for protection of workers, ensure safety of the operator, be effective, permit complete bleeding, not cause any noticeable damage to the brain, muscles or cervical vertebrae, be quick and avoid excessive noise</p>	<p>Not mentioned</p>	<p>Not mentioned</p>

APPENDIX IIa EQUIPMENT (Approving Authority, Types, Requirements) Continued:

Subject	GRAND-DUCHE DE LUXEMBOURG	KONINKRIJK DER NEDERLANDEN	UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND
Approving Authority	Minister of Public Health	Director-General of Ministry of Social Affairs approves electrical equipment. Can call for a report on details of the apparatus and its performance. Detailed routine inspection requirements and list published of authorised inspectors approved by the Director-General, Ministry of Social Affairs	Minister of Agriculture, Fisheries and Food or Secretary of State for Scotland approve instruments for stunning poultry
Type of equipment approved	Fire-arms for large animals	Captive bolt (free bullet not permitted)	A mechanically operated instrument
Electricity	Approved	Approved	Approved
Gas Narcosis	Approved	Approved	Approved. Design of equipment regulated
Other methods	Not mentioned	Not mentioned	Such other means as may be prescribed by regulation
Requirements for Approval (General)	Not mentioned	Electrical stunning and gas narcosis may be used only with the approval of the Minister	Instrument must be in proper repair

APPENDIX IIa EQUIPMENT (Approving Authority, Types, Requirements) Continued:

Subject	ROYAUME DE BELGIQUE	KONGERIGET DANMARK	BUNDESREPUBLIK DEUTSCHLAND
Requirements for Approval (Special)	Not mentioned	A special pen must be provided for the slaughter of cattle by the Jewish ritual	Cattle slaughtered by the Jewish method must be in a box of specified type in some Lander. Owners of firearms are responsible for sending them for overhaul at least every two years or sooner if necessary

APPENDIX IIa EQUIPMENT (Approving Authority, Types, Requirements) Continued:

Subject	REPUBLIQUE FRANCAISE	IRELAND	REPUBBLICA ITALIANA
Requirements for Approval (Special)	Cattle slaughtering premises must have a means of controlling the animal, i.e. a stunning box or wall-ring. Equipment must be provided to protect animals from falling or contusion immediately before the throat is cut	Cattle must be restrained in a stunning box. Minister stipulates for which type of animal approved electrical stunning equipment can be used	Not mentioned

APPENDIX IIa EQUIPMENT (Approving Authority, Types, Requirements) Continued:

Subject	GRAND-DUCHE DE LUXEMBOURG	KONINKRIJK DER NEDERLANDEN	UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND
Requirements for Approval (Special)	A ring must be provided in the floor to which large animals are secured before stunning	Electrical stunners must have a good contact, raised edges with sharp points	A stunning box must be used for the slaughter of cattle. A pen of specified design must be used for the slaughter of cattle by the Jewish method

APPENDIX IIb TECHNIQUES (Species, Handling, Exemptions)

Subject	ROYAUME DE BELGIQUE	KONGERIGET DANMARK	BUNDESREPUBLIK DEUTSCHLAND
Species to be pre-slaughter stunned	Slaughter animals, poultry and rabbits	Horned cattle, sheep, pigs, goats, hoofed animals	All vertebrates
Handling immediately before stunning	Not mentioned	Not mentioned	Animal only to be brought to point of stunning when every-thing is ready. If necessary, it must be tied immediately before slaughter. Hoisting before stunning is prohibited
Captive bolt Percussion stunning Free bullet	Frontal penetration or nape of neck (site defined). Must avoid excessive damage in brain or nape of neck	Not mentioned	Not mentioned
Electricity	Not mentioned	Not mentioned	Not mentioned
Gas Narcosis	Not mentioned	Not mentioned	Not mentioned
Other approved slaughter techniques	Procedure for breaking rabbits' necks defined	Poultry must have their heads severed with a quick, sharp blow	Calves can be clubbed when the pituitary is collected. Lambs, nannies and piglets may receive a blow on the skull or be clubbed. Rabbits to have a blow behind the neck with a special hammer or wooden club

APPENDIX I Ib TECHNIQUES (Species, Handling, Exemptions) Continued:

Subject	REPUBLIQUE FRANCAISE	IRELAND	REPUBBLICA ITALIANA
Species to be pre-slaughter stunned	Horses, asses, mules, cattle, sheep, goats, pigs	Cattle, sheep, goats, horses, asses, mules, pigs	Animals slaughtered for meat
Handling immediately before stunning	Hanging before stunning is prohibited	No animal is to be slaughtered within sight of another animal	Not mentioned
Captive bolt Percussion stunning Free bullet	Trepanning or at nape of neck. Percussion, providing there is complete bleeding and no damage to brain	Techniques for frontal penetration defined	Not mentioned
Electricity	Not mentioned	Technique of application of electrodes defined. Pigs must not be exposed to electric current until the instrument is applied in the manner specified	Not mentioned
Gas Narcosis	Not mentioned	Pigs must be unconscious before being shackled, hoisted and bled	Not mentioned
Other approved slaughter techniques	Poultry and domestic rodents must be stunned when slaughtered in an abattoir		Severing medulla oblongata (see IIC). Other suitable pre-stunning methods officially recognized by the local authority

APPENDIX IIB TECHNIQUES (Species, Handling, Exemptions) Continued:

Subject	GRAND-DUCHE DE LUXEMBOURG	KONINKRIJK DER NEDERLANDEN	UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND
Species to be pre-slaughter stunned	Not mentioned	Horses, cattle, calves, pigs, sheep and goats	Horses, cattle, sheep, swine and goats. Turkeys and domestic fowls.
Handling immediately before stunning	Not mentioned	Pigs only to be stunned in a restraining conveyor, box or pen. Suspension before stunning is prohibited	No animal is to be slaughtered within sight of another animal. No pigs over 12 weeks to be slaughtered unless stunned. Maximum periods of suspension of domestic fowls and turkeys before stunning are defined
Captive bolt Percussion stunning Free bullet	Stunning procedure laid down in municipal by-laws. Large animals to be stunned by fire-arms, pigs by electricity	Function of brain must be interrupted. Use of a free bullet is not approved	Not mentioned
Electricity	Not mentioned	Three specified stunning systems approved. Technique for application of electrodes defined. Only the electrodes used for the low voltage stunning of pigs may be moistened. Cattle and pigs must be standing when electrically stunned, calves, sheep and goats must be on their backs or sides	Not mentioned
Gas Narcosis	Not mentioned	Not mentioned	Gas concentrations and monitoring equipment specified, as well as emergency procedure
Other approved slaughter techniques	Calves and piglets may be stunned by blow of a club; sheep, goats and kids by "compression of the bulb"	Killing by poleaxe, stabbing in the neck or breaking the neck are prohibited	Poultry may be decapitated, the neck may be dislocated or they may be stunned electrically or by an instrument approved by the Minister (see IIA). Pre-slaughter stunning by such other means as may be prescribed by regulation

APPENDIX IIb TECHNIQUES (Species, Handling, Exemptions) Continued:

Subject	ROYAUME DE BELGIQUE	KONGERIGET DANMARK	BUNDESREPUBLIK DEUTSCHLAND
Other approved slaughter techniques	Not mentioned	Not mentioned	Poultry, pigeons or rabbits can be stunned with a heavy piece of wood. Poultry can be swiftly beheaded. Stab blow behind the neck is forbidden, except for rabbits. Other stunning methods can be approved.
Post-stunning requirements	Stunning must ensure a period of unconsciousness to permit painless, rapid, complete exsanguination	Animals must be fully stunned immediately before shedding of blood starts	Blood letting to start only after complete stunning. Dressing may begin only after death and when no movement is observed
EXEMPTIONS Religious	Slaughter according to religions rites excepted	Jewish rite excepted, must be performed in a public or export slaughterhouse in a box of special design. Animal to be held and felled as gently as possible by machine. Slaughtered by cutting throat with sharp instrument immediately felled	Ritual slaughter excepted
Other	Emergency slaughter excepted. Injured animals unable to stand may be slaughtered in the lairage	Emergency slaughter excepted. Slaughter of poultry excepted	Not mentioned

APPENDIX IIb TECHNIQUES (Species, Handling, Exemptions) Continued :

Subject	REPUBLIQUE FRANCAISE	IRELAND	REPUBBLICA ITALIANA
Other approval slaughter techniques	Not mentioned	Not mentioned	Not mentioned
Post-stunning requirements	Stunning must be carried out immediately before blood letting	Animals must be unconscious before they are shackled and bled. No slaughtering to involve unnecessary, avoidable or excessive pain or suffering	Stunning must be followed immediately by cutting the vessels of the neck
EXEMPTIONS Religious	Ritual slaughter excepted	Jewish and Muslim rites excepted	Ritual slaughter excepted. Must be done in strict accord with established standards
Other	Emergency slaughter excepted	Slaughter by order of the Minister of Agriculture	Not mentioned

APPENDIX IIb TECHNIQUES (Species, Handling, Exemptions) Continued:

Subject	GRAND-DUCHE DE LUXEMBOURG	KONINKRIJK DER NEDERLANDEN	UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND
Other approved slaughter techniques	Not mentioned	Not mentioned	Not mentioned
Post-stunning requirements	Not mentioned	When killing cattle, calves, sheep and goats, the neck must be cut immediately the electric current ceases to pass. Pigs may be bled by stabbing. Animals must be bled to death within one minute of stunning. Animal must not regain consciousness during bleeding out. No other acts to be performed during bleeding until permanent immobility occurs	Animals are to be killed immediately after they are stunned (Scotland). Minimum times of suspension of poultry between sticking and scalding are specified
EXEMPTIONS Religious	Slaughter according to Jewish rite permitted in Luxembourg City municipal abattoir only	Jewish rite exempt only in public abattoirs approved by the Minister	Jewish and Muslim rites excepted. Cattle slaughtered in the former must be in a special box
Other	Not mentioned	Not mentioned	Emergency slaughter excepted

APPENDIX Iic PERSONS (Prohibitions, Licensing, Supervision)

Subject	ROYAUME DE BELGIQUE	KONIGERIGET DANMARK	BUNDESREPUBLIK DEUTSCHLAND
Prohibitions	Slaughtering must be carried out away from sight of the public	Children under 14 years old may not carry out or be present at slaughtering	Children under 14 years old may not be present in slaughterhouse. The public may not witness slaughtering in a slaughterhouse.
Licensing of slaughtermen	Not mentioned	Not mentioned	Local authorities can licence slaughtermen to stun calves with a hammer when pituitary glands are being collected. Electrical stunning may only be carried out by trained employees
General conditions	Not mentioned	Slaughtermen must have the necessary skill and knowledge	Slaughtering must be done only by experts. They must be strong enough to deliver effective blow on the head. Trainees must be under supervision
Supervision	Supervised by officials of the Ministry of Public Health and Family	Supervising Veterinarian, Ministry of Agriculture, approves stunning instrument, method and ensures functions properly	In some Lander Government veterinary officers responsible for the supervision of pre-slaughter stunning

APPENDIX IIC PERSONS (Prohibitions, Licensing, Supervision) Continued:

Subject	REPUBLIQUE FRANCAISE	IRELAND	REPUBBLICA ITALIANA
Prohibitions	Not mentioned	Not mentioned	Not mentioned
Licensing of slaughtermen	Slaughtermen carrying out ritual slaughter must be properly trained and are subject to the Minister's approval. They are issued with a license	Slaughtermen must be over 18 years of age. They are licensed by the local sanitary authority. Licenses last for one year and can be revoked	Not mentioned
General conditions	Not mentioned	Slaughtering in a slaughterhouse can only be carried out by a licensed slaughterman or a veterinary surgeon	Severing of the medulla oblongata is only to be done by a fully skilled person authorised by the manager of the slaughterhouse
Supervision	Supervised by officials of the Veterinary Service, Ministry of Agriculture. Préfets can make by-laws on slaughtering	Local sanitary authority is responsible for enforcement	Not mentioned

APPENDIX IIc PERSONS (Prohibitions, Licensing, Supervision) Continued:

Subject	GRAND-DUCHE DE LUXEMBOURG	KONINKRIJK DER NEDERLANDEN	UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND
Prohibitions	Not mentioned	Not mentioned	Not mentioned
Licensing of slaughtermen	Not mentioned	Operators of electrical stunners must have a certificate of competence from the Food Inspection Department. Jewish slaughtermen must have a certificate of competence	Slaughtermen must be over 18 years of age and physically fit. The initial licence requires them to work for a probationary period under supervision of an experienced slaughterman. Licences are issued by local authorities and last for one year; they specify the kind of animal and type of instrument approved
General conditions	Not mentioned	Slaughtering must be carried out by qualified persons with reliable apparatus.	Not mentioned
Supervision	Slaughtering is only to be carried out in the presence of the municipal veterinarian or a slaughterhouse inspector	Veterinarian in charge of the area is responsible for supervision	Local authority is responsible for enforcement

Part 3 : Review of current pre-slaughter stunning
methods and an assessment of their effectiveness

3.1 Introduction

Between 11th August, 1975, and 17th March, 1976, we visited a total of 69 slaughterhouses in all the Member States. Their representatives had been informed that we wished to gather information on current methods of stunning slaughter animals in their countries. They were asked to give us as complete a picture as possible of the methods used for stunning animals during ordinary slaughtering sessions.

Since these visits were intended for the collection of information and a general exchange of opinions and experience, and were in no way meant to be formal inspections, no slaughterhouses are referred to by name in this report. Each slaughterhouse has been allotted a number used in the reports on our visits.

Wherever possible, we visited the slaughterhouses for the first time on the day preceding slaughtering, when no work was going on, so that we could examine the layout and equipment at leisure. When slaughtering was in progress, some forty-five minutes were required per species and/or particular class of animal to collect all the available data. This amount of time was necessary because the stunning of several animals of the same group with the same equipment was assessed in each case.

It was not always possible to witness the stunning of all species of animals normally slaughtered in each slaughterhouse, because certain species are sometimes only slaughtered on specific days. We were, however, able - albeit by devoting a relatively long period of time to it - to witness 68 series of stunning slaughter animals, each country being represented in almost equal proportions.

Our request to see not only large slaughterhouses or "model plants", but also medium-sized and small ones, was met in most cases; this report may therefore be regarded as a broadly based investigation of the current situation regarding the stunning of slaughter animals in the Member States.

As mentioned above, there was no opportunity in some slaughterhouses to see all the available equipment in use. The operation of this equipment was demonstrated and it was taken into account in the compilation of the general statistics pertaining to the appliances used for the stunning of slaughter animals. However, this equipment was not considered when opinions were being formed as to the effectiveness of various methods.

Polaroid photographs were taken for documentation purposes of the appliances used for stunning and of typical procedures in each slaughterhouse and in respect of each species of animal. A selection of these photographs is reproduced on pp. 72-89 at the end of this review.

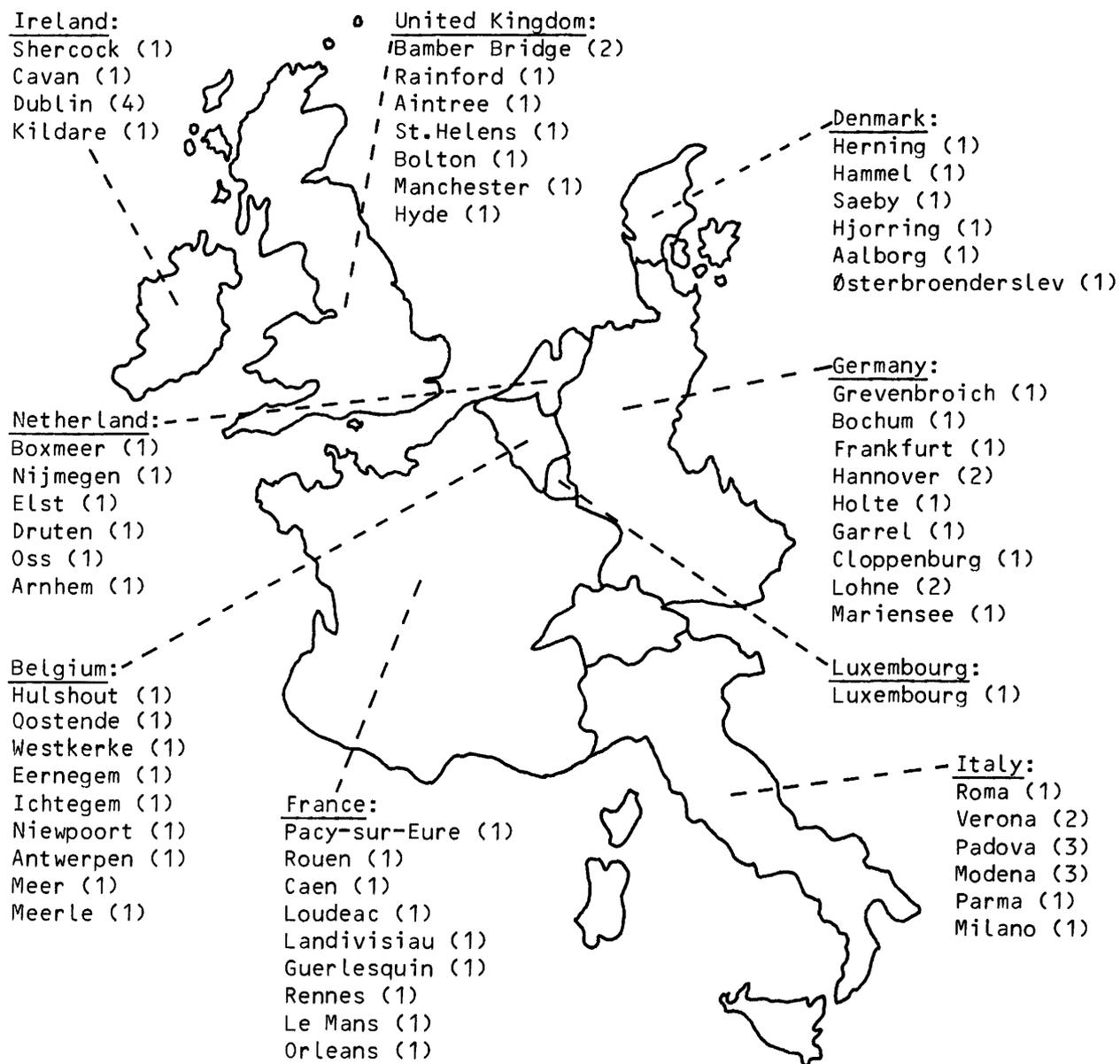
3.1.1 LIST OF PLACES WHERE SLAUGHTERHOUSES WERE VISITED

The following map (Table 1) shows the places in the Member States where slaughterhouses were visited and where the information on stunning of slaughter animals contained in the report was obtained.

The figures in brackets represent the number of slaughterhouses visited at each place.

On average, 7 slaughterhouses were visited per Member State ($X = 7.5$; $s.d. = 3$), each visit being made, as a rule, during a normal slaughtering day.

Table 1



3.1.2 SURVEY OF THE NUMBER OF STUNNINGS OBSERVED, SUBDIVIDED ACCORDING TO SPECIES OF ANIMALS

A total of 1,240 individual stunnings was analysed in detail in 68 series.

These referred to the following individual types of animals:

Cattle and calves	212
Pigs	660
Poultry, including turkeys	249
Sheep	116
Goats	1
Horses	2

3.1.3 SURVEY OF THE NUMBER OF STUNNING APPLIANCES EXAMINED

Table 2 contains a list of the stunning appliances examined, subdivided according to countries and species of animals.

The columns headed "seen working" list the number of appliances which it was possible to see and assess in operation.

The figures do not indicate the number of animals stunned with each appliance.

The columns headed "examined, but not seen working" list those appliances which were demonstrated, but which it was not possible to see in operation.

3.2 Methods and equipment used for stunning in the Member States

3.2.1 SUMMARY OF METHODS USED

Six methods of stunning are in general use in the Member States, these are:

- A. Captive bolt
- B. Concussion stunner
- C. Free bullet
- D. Enervation (neck sticking)
- E. Electrical stunning
- F. CO₂ anaesthesia

3.2.2 SUMMARY OF THE EQUIPMENT USED

Many different models are used in applying the methods of pre-slaughter stunning listed above. The various types of equipment seen are listed in Table 3, while Table 4 gives details of the species and classes of animal for which each model was used at the time of the visits to the various slaughterhouses.

3.2.3 ASSESSMENT OF THE FREQUENCY WITH WHICH VARIOUS METHODS ARE USED FOR INDIVIDUAL TYPES OF ANIMALS

3.2.3.1 Stunning of cattle

Comparison of the normal procedures employed in the various Member States in Table 4 shows that the method of stunning predominantly used in the case of cattle is the penetrating captive bolt. Of the various models, three or more different types are used as a rule in each Member State.

3.2.3.2 Stunning of calves

Again, it is predominantly penetrating captive bolt appliances that are used for stunning calves. In three countries, however, (Belgium, France and Luxembourg) concussion stunning is also commonly used for calves.

Stunning of calves by means of electrical power is apparently only practised in France.

TABLE 2

STUNNING APPLIANCES EXAMINED

(w = seen working: n.w. = examined, but not seen working)

	Cattle		Calves		Pigs		Sheep		Goats		Poultry				Horses		
	W.	n.w.	W.	n.w.	W.	n.w.	W.	n.w.	W.	n.w.	W.	n.w.	W.	n.w.	W.	n.w.	
																	Broilers
<u>Member State:</u>																	
Belgium	2	4	-	2	2	7	1	1	-	-	1	-	-	-	-	-	1
Denmark	1	2	-	-	5	2	-	1	-	-	-	-	-	-	-	-	-
Ireland	4	-	-	-	2	2	-	-	-	-	1	-	-	-	-	-	-
France	2	3	2	5	2	5	-	7	-	-	1	-	-	-	-	-	-
Germany	4	-	-	1	3	-	5	1	-	-	2	-	-	1	-	-	-
Italy	6	3	1	4	-	4	-	-	1	-	1	-	-	-	1	-	1
Luxembourg	-	1	-	1	1	-	-	1	-	-	-	-	-	-	-	-	-
Netherlands	1	2	1	2	4	1	-	-	-	-	1	-	-	-	-	-	2
United Kingdom	3	-	-	-	2	2	1	2	-	-	2	-	-	-	-	-	-
<u>Total:</u>	23	15	4	15	21	23	7	13	1	-	9	-	1	2	-	1	4

TABLE 3

LIST OF STUNNING EQUIPMENT SEEN

Captive bolt

1. Schermer ME 9 (6.4 cm/11 mm) - German
2. Schermer ME 9 (8.0 cm/12 mm) - German
3. NN (unidentified make)
4. Cox Universal/Temple Cox - British
5. Supercash/Mark 2 - British
6. Dick - German
7. Humanitas - French
8. Kerner - German
9. Infallibile Brevettato - Italian
10. Matador (6 cm/12 mm) - French
11. K.O. 9 mm - French
12. Bebe-Matador 6 mm - French
13. Cash-X 11 mm - British

(length of bolt in cm, diameter in mm)

Concussion stunner

14. K.O. - French
15. Bebe-Matador - French
16. Schermer "Mushroom" ME 9 - German
17. Matador - French

Free bullet

18. Free bullet (unidentified make)

Enervation

19. "Puntilla" (neck sticking)

Equipment for electrical stunning

20. NN (unidentified make)
21. Schermer 180 V - German
22. Schermer 70 V 80 mA - German
23. Maen - Dutch
24. Lindholst & Co. 100 V
25. Stork 70 - 100 V (dry) - Dutch
26. Stork 110 - 120 V (water bath) - Dutch
27. SFK 60 V - Danish

TABLE 3 (cont'd)

28. NN 82 V 80 mA (unidentified make)
29. Schermer 235 V 75 mA/210 V 60 mA/140 V 40 mA - German
30. Morphee 170 V 150 mA (primary current at 24 V) - French
31. Jemau 100 V 80 mA - French
32. ETIM-Narkose 222 V 300 mA/250 V 220 mA/300 V 280 mA/300 V 300 mA - French
33. IWEL 75 V 75 mA/80 V 80 mA/100 V 100 mA - British
34. Stoffelberg 70 V 56 mA (two separate electrodes) - Dutch
35. Ashton Sheffield - British
36. Schermer 80 V 3 point electrodes - German
37. Stoffelberg 180 V 200 mA, Time Switch giving 10 sec. current flow - Dutch
38. Schermer 190 V 170 mA, Time Switch giving 2 sec. current flow - German

Equipment for CO₂ stunning

39. Oval Tunnel - Danish
40. Compact - Danish

3.2.3.3 Stunning of pigs

Electrical stunning is mainly used for pigs. Twelve types of electric stunning are listed (Table 3), varying according to voltage, current strength, duration of current flow and electrode design.

As Table 4 shows, three different models were used in four Member States, two in each of two countries, while three countries each had only one model for the electric stunning of pigs.

As far as the models were concerned, of the twelve examined eight were only seen once, two types appeared in each of two countries, whereas three countries each used only one model. In each of four Member States types of appliances were seen of which the manufacturers could not be identified.

CO₂ stunning of pigs was demonstrated in four Member States, in two different models of plant (Oval Tunnel and Compact).

Captive bolt stunning of pigs must seldom be practised; it was only mentioned in two countries.

Taking all the observed examples of pig stunning together (appliances seen 21 times in use, 23 times as demonstrations at 44 slaughterhouses), the captive bolt was used in 2 (4.45 %), stunning by CO₂ gas was practised in 5 (11.36 %) and electrical stunning in 37 cases (84.1 %).

3.2.3.4 Stunning of sheep

Appliances for stunning sheep were examined 19 times; of these, six were seen in use. Of the 19 slaughterhouses, 10 (52.6 %) stunned sheep electrically, 7 (36.8 %) with a captive bolt and 2 (10.5 %) by means of concussion stunning; there is thus a tendency towards electrical stunning.

3.2.3.5 Stunning of goats

Goats were killed at only one of the 69 slaughterhouses visited. The single slaughtering witnessed was carried out by cutting the animal's throat without prior stunning. After the throat was cut, the spinal cord was separated by a thrust with a sharp knife into an intervertebral cavity from the ventral aspect of the neck (p. 73 a and b).

3.2.3.6 Stunning of poultry

The stunning of poultry is carried out in large slaughtering plants solely by electrical current. The method predominantly used is a procedure which involves the head and neck of the birds being immersed in a 'live' water bath (p. 84 a and b, P. 85 a and b).

Of ten poultry slaughterhouses visited, nine were seen in operation. Seven used a stunning bath. In three slaughterhouses the birds were stunned by touching 'live' dry metal wires (p. 84 c-f) or metal plates (p. 85 d).

Five different makes of appliance were encountered. The predominant one was type no. 26 (see Table 3), which was used in six out of 12 cases. Type no. 23 was found in two Member States, types 24 and 25 in one each. In two cases it was impossible to identify the manufacturers of an appliance.

3.2.3.7 Stunning of horses

The stunning of horses is carried out solely by means of a captive bolt appliance (page 85e). On the five occasions when it was possible to report on the stunning of horses, four different captive bolt models were demonstrated (Table 4).

3.2.4 SURVEY OF EQUIPMENT AND APPLIANCES, SUB-DIVIDED ACCORDING TO MEMBER STATE, SPECIES OF ANIMAL AND TYPE OF APPLIANCE.

The stunning appliances used in the Member States are summarised in Table 4, subdivided according to country, species of animal and type of appliance (see pp. 42 and 43).

The code number for the appliances is in each case their serial number from Table 3 (see pp. 38 and 39).

Key:

If the code number is ringed:

- Example: ① Appliance No. 1 was examined, but was not seen in operation.

If the code number is inside a square :

- Example: 15 Key number of apparatus seen at a slaughterhouse where it had already been seen in use, or ready for use, with another species of animal (when an apparatus was seen in use for stunning different species, it is listed as in example "20" below under each of these species).

A number without any marking:

- Example: 20 Appliance no. 20 was seen in operation.

This code thus shows whether it was possible to see an appliance in operation or whether it was merely displayed as being the normal one used for a certain species of animal in that specific slaughterhouse in the country in question.

3.3 The assessment of stunning procedures

3.3.1 TYPE OF QUESTIONNAIRE USED

The same questionnaire was used at each slaughterhouse. It covered the species of animals normally slaughtered on the premises, sub-divided according to classes and carcass weight, together with the average throughput per hour of each species of animal, the procedures usually employed for stunning and the types and manufacturers of the appliances.

A specimen is enclosed as Table 5 (see p. 46)

TABLE 4
 TYPES OF STUNNING EQUIPMENT SEEN IN THE MEMBER STATES
 Numbers = Stunning Model used (Key: see Table 3)

Member States	Cattle				Calves			Pigs				Sheep			Goats	Poultry			Horses
	Captive bolt	Puntilla (neck sticking)	Free bullet	Concussion stunner	Captive bolt	Concussion stunner	Electrical equipment	> 100 kg	100 kg	Large pigs	Captive bolt	Concussion stunner	Electrical equipment	-	Broilers	Hens	Turkeys	Captive bolt	
Belgium	2 5 (5) (13) (3)	-	(13)	-	(5)	(15)	-	-	-	-	-	15	(20)	23	-	-	-	(10)	
Denmark	4 (5) (6)	-	-	-	(6)	-	27 27	39 40	27 20	-	(6)	-	-	-	-	-	-	-	
Germany	2 2 2	-	-	16	(1)	-	21 22 36	-	-	-	2 1 1	20 21	-	23 26	(20)	-	24 25	-	
Ireland	4 4 4 13	-	-	-	-	-	27 (21) (35)	39	-	-	-	-	-	26	-	-	-	-	
France	10 10 (10) (10) (10)	-	-	-	11 11 (11) (11)	14	30 (30) (30) 31 (31) (31) (31)	-	-	-	-	(31) (32) (32) (32)	-	26	-	-	-	-	
Luxembourg	(5)	-	-	-	-	(16)	21	-	-	-	(13)	-	-	-	-	-	-	-	

TABLE 4 (cont'd)

Member States	Cattle				Calves			Pigs			Sheep			Goats	Poultry			Horses
	Captive bolt	Puntilla (neck sticking)	Free bullet	Concussion stunner	Captive bolt	Concussion stunner	Electrical equipment	> 100 kg	100-200 kg	Large pigs	Captive bolt	Concussion stunner	Electrical equipment	Knife	Broilers	Hens	Turkeys	Captive bolt
Italy	9 5 7 7 7 7 8	19	-	-	7 7 5 0	-	-	20 20 20 20	-	-	-	-	41	26	-	-	-	7 7
Netherlands	5 2 8	-	-	-	5 2 3	-	-	20 37 37	-	-	15	-	-	-	26	-	-	2 8
United Kingdom	4 5 13	-	-	-	-	-	20 33 63	69	-	-	-	33 60 69	-	-	20 26	-	-	-

3.3.2 METHOD OF COLLATING INFORMATION ON STUNNING APPLIANCES AND ACCESSORIES

The following information was noted in respect of each type of appliance used for stunning:

- length and diameter of bolt;
- calibre of cartridge;
- voltage;
- strength of current, using a prescribed test resistance of 1,000 ohms.

Photographs are enclosed of all the stunning appliances seen, together with all relevant auxiliary devices and equipment (pp. 72-89).

3.3.3 METHOD OF ASSESSING THE STUNNING PROCEDURE AND THE ANIMALS' REACTIONS DURING AND AFTER STUNNING

In order to enable the methods to be assessed, records were kept of the stunning and slaughtering processes. The following details were recorded (see Table 5):

- time taken to transfer animal from lairage to stunning box;
- an assessment of the period during which animal was stressed;
- duration of stunning process;
- period of time elapsing between the end of the stunning and sticking;
- duration of convulsions;
- duration of exsanguination;
- occurrence of convulsions after exsanguination;
- corneal reflex: present/absent;
- pain reaction during sticking: yes/no.

In the case of electrical stunning (pigs and poultry), random checks were also made to ascertain if the animals were merely stunned by the electric current or if they were already killed (cardiac arrest due to ventricular fibrillation).

Each observed slaughtering was subsequently evaluated; the highest mark awarded was 1, the lowest 6.

All equipment used in the preparatory stages of stunning (approach passageways, design of stunning boxes and pens) was similarly assessed as regards its suitability for ensuring that the stunning process was properly carried out.

The opinions of both investigators were combined at the end of the visit to achieve a joint evaluation.

This attempt to provide a comparative assessment of the methods of stunning used in practice was based on the premise that perfect stunning (awarded grade 1) must produce an instant state of complete unconsciousness, with the animal's musculature losing all tension immediately following stunning. Physiological reflexes and all reactions to external stimuli must be non-existent in this state. Consequently the animals must show no reaction whatsoever when one or both hind legs are being shackled, when they are suspended and when the cut is made for exsanguination. Similarly, animals subjected to a stunning process graded as "good" will not produce any serious convulsive movements either during or after exsanguination. On completion of stunning there must be no corneal reflex and it must remain in abeyance until the animal dies.

The more unsettled a group of animals' behaviour was during and after stunning, the less favourable was the grading awarded to the process. In other words, the more frequently convulsions were noted after stunning, while the animals were being hoisted for exsanguination or during bleeding out and the more often a corneal reflex was seen after stunning, then the lower was the grading allotted to that process.

Gradings: 1 - very good	4 - adequate
2 - good	5 - unsatisfactory
3 - satisfactory	6 - poor

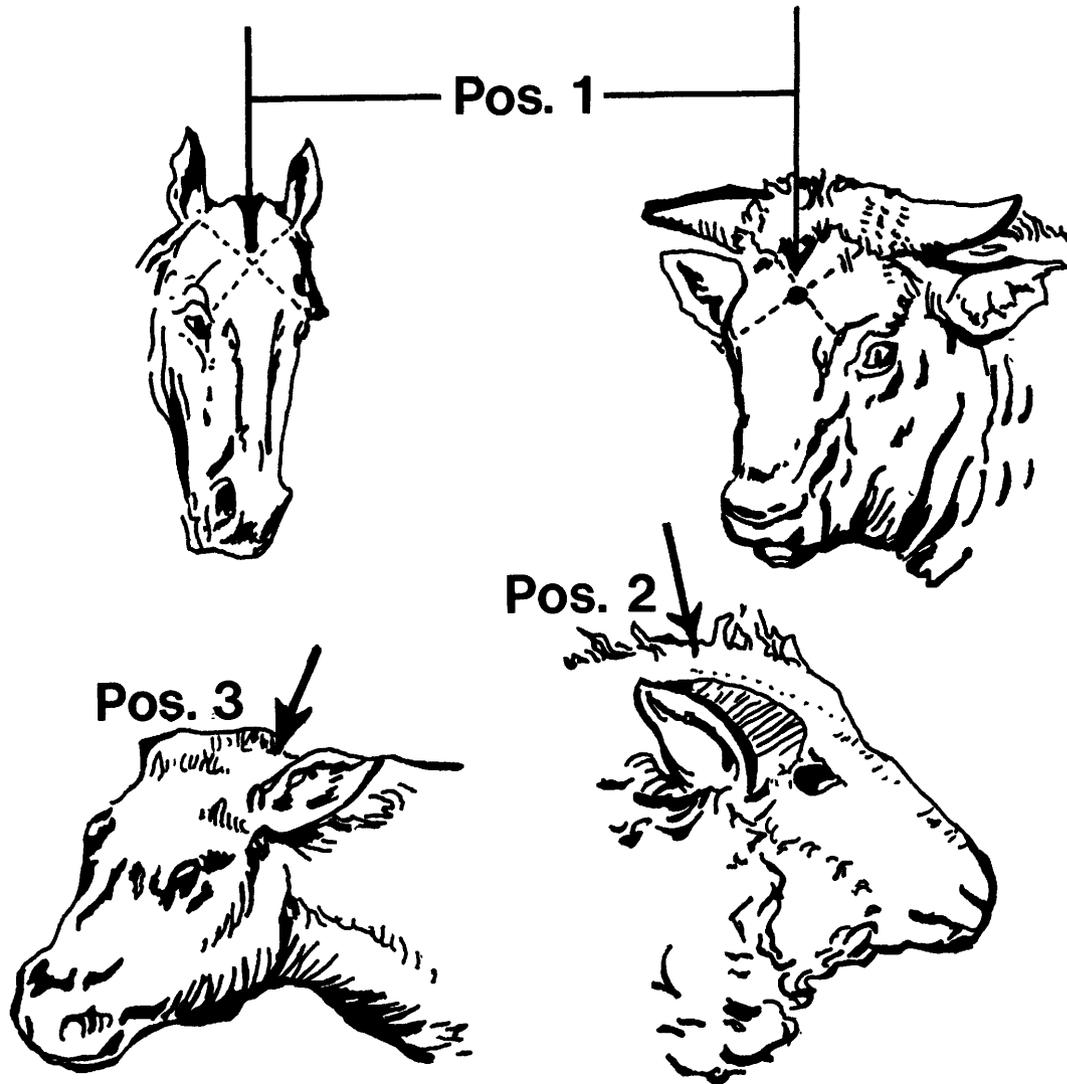
With this attempt to assess the effectiveness of all observed stunnings of slaughter animals, we have tried to meet the requirement in our contract to describe the means used in practical conditions for assessing the effectiveness of pre-slaughter stunning and the methods available to control the efficiency of such assessments. All measurement procedures and all the clinical investigations made can be carried out under normal conditions obtaining in actual practice, i.e. under standard slaughter-house conditions.

3.3.4 ELECTRODE POSITIONS COMMONLY USED IN THE STUNNING OF PIGS

Code no. of item	Circuit 1st point of application	Circuit 2nd point of application
1.	ear - ear	-
2.	nape of neck-underside of neck	-
3.	nape of neck-bridge of nose (three-point electrode)	-
4.	ear - ear	ear - eye
5.	eye - body	eye - heart
6.	ear - ear	nape of neck-underside of neck

3.3.5 DESCRIPTION OF THE SHOOTING POSITIONS WITH CAPTIVE BOLT STUNNERS

Key No.	Position of Apparatus
1.	Forehead
2.	Neck, in middle of line joining the ears
3.	Neck region, between 1st and 2nd vertebra



3.4 Assessment of the effectiveness of a stunning process depending on the species of animal and the type of appliance used

Details of all the stunning methods in use, as obtained from our own observations of stunning procedures applied in practice to slaughter animals, are given in Tables 6-17 (see pp. 59-69).

3.4.1 ASSESSMENT OF THE STUNNING OF CATTLE

Table 6 shows our assessment of the stunning of cattle with captive bolt appliances and concussion stunners, and "stunning" by means of sticking in the nape of the neck ("enervation").

Stunning by means of captive bolt appliances was demonstrated 21 times in 19 slaughterhouses. In 11 of these cases stunning was carried out in a special "stunning box"; in over half these cases (6 out of 11) the design of the boxes was considered to be unsuitable (graded "5" as regards box design), because the stunner had to stand in an awkward position which made it difficult for him to place the captive bolt appliance in the correct firing position (see in this connection p. 74, c, e, f).

Securing the animal's head and obtaining a suitable firing position for the stunner both appear to be essential pre-conditions for carrying out proper stunning p. 75 c and d, p. 76 b, c, d).

In most cases (95 %), the firing position selected was no. 1 (forehead). In one slaughterhouse (= 4,5 %) only position 3 (nape) was used. In five slaughterhouses (= 23 %) positions 1 and 3 were used indiscriminately. The stunner decided to use one or other of the positions depending on the way the animal's head was held.

In 11 out of 19 cases a pithing rod was applied after the bolt had been fired. The reason given for doing this was that the animal's severe contractions after being stunned can, in certain circumstances, endanger the slaughtermen.

Convulsions following stunning were noted in 10 out of 21 cases.

The last vertical column in Table 6 shows the final grading (ranging from 1 to 6) for each series of stunnings. If slaughterhouse no. 23 - where "stunning" was effected by sticking in the nape of the neck ("enervation") - is included, then the grading "5" or even "6" had to be awarded seven times in the 23 series. The majority of cases (10) could be graded as just adequate, and only in 6 out of the 23 cases was it possible to award a grading of "very good" or "good".

The reasons for these widely differing results are of a highly complex nature.

Beyond any doubt, in the case of stunning by means of a captive bolt appliance, the securing of the animals, and in particular the placing and holding of the head, plays an important part. Also important are the design of the captive bolt appliances as regards bolt length and thickness and weight of charge (energy) of the cartridge and, finally, the firing position.

An attempt is made in Table 7 to show the relationship between the success of a stunning process on the one hand and, on the other, the type of appliance and the way in which the animals were secured prior to stunning. Thus in the case of captive bolt model No. 4, "good" stunning was only achieved where the design of the stunning boxes was "very good". If the stunning boxes were only graded "5", then the stunning achieved with this type of appliance was only "adequate" or even "poor".

If, on the other hand, the animals were well secured for stunning, then the grading "poor" or "unsatisfactory" was awarded in only 2 out of 12 cases; in the remaining instances stunning was "adequate" (four times) or even "good" to "very good" (six times).

A striking feature was the very good result with model no. 16 (Table 6; slaughterhouse no. 69). This was a concussion stunner, which did not penetrate the skull. The weight of charge of the cartridge was the same as that used in slaughterhouses nos. 2 and 3 (Table 6). Since it is not common practice to stun cattle in this weight group with a concussion stunner (which nevertheless deserves special mention because of the surprisingly good results achieved with it), detailed photographs of the appliance (before and after use) have been specially included (p. 77), together with a photograph of one of the animals stunned by it.

A particularly unsatisfactory feature of captive bolt stunning was the fact that in some cases there was still a corneal reflex after the captive bolt had been fired. Equally unsatisfactory was the fact that in 11 out of 23 cases there were convulsions of varying intensity after stunning had been carried out with the captive bolt appliance.

3.4.2 ASSESSMENT OF THE STUNNING OF CALVES

The assessment of the stunning of calves by means of a captive bolt appliance was even more unsatisfactory than in the case of cattle. We were shown the stunning of calves in four slaughterhouses. In two cases it was possible to award the grading "adequate", but the remaining two had to be assessed at 6 ("poor") (see Table 8).

Often, several calves were running loose in the stunning box at the same time, and their quick movements, particularly in the case of firing position 3, lead to shots missing the target (p. 74 b).

In firing position 3, the one mainly used, the animals, it is true, fall to the ground immediately the shot is fired. The depth of unconsciousness, however, seems less than in the case of position 1. In some cases we had the impression that the animals were in a relatively wakeful state after the shot, and that they had been merely suddenly rendered inactive by the blow in the base of the skull rather than stunned by it. Thus this method of stunning would occasionally become very similar to "enervation", and would therefore be a very questionable method for calves and cattle.

3.4.3 ASSESSMENT OF THE STUNNING OF PIGS

3.4.3.1 Electrical stunning

The electrical stunning of pigs, demonstrated in 17 slaughterhouses (see Table 9), was in five cases graded "unsatisfactory". Three were assessed as "adequate" and the remaining nine "satisfactory" to "good".

As will be seen from Table 9, 11 different types of appliance and six different electrode positions are used (see p. 45). The various appliances were characterised by different voltages (60 to 280 volts); the average time used for stunning fluctuated between 2.5 and 26.5 seconds.

The general tendency of reducing the stunning time by means of a higher voltage and/or greater current flow in the animal's body, in order to increase the throughput of slaughtered animals per hour, was also evident in our random samples. Table 10 shows that increased voltage does not necessarily produce better stunning results. In this table we have extracted the figures pertaining to voltage, electrode position and stunning time from Table 9 and listed them in accordance with the grading. Two aspects become very clear from this:

1. Higher voltages seem clearly to increase the occurrence of convulsions after stunning.

4 out of 5 groups of slaughter animals, which had to be graded "unsatisfactory" because of strong muscular convulsions, had been stunned with voltages between 180 and 200 volts, whereas in the case of the remaining 12 groups, which were graded "adequate" to "good", nearly all (10) were stunned with voltages below 100 volts.

2. The position of the electrodes also seems to be important as regards the result in the case of electrical stunning. In all cases where the electrodes were placed in position 2 (nape of neck - underside of neck) there were vigorous convulsions after stunning and, to a certain extent, after exsanguination as well. In no case was a "good" or "satisfactory" grading awarded with the electrodes in this position.

If, on the other hand, the electrodes were in the ear - ear position when stunning began and were changed to the ear - eye position (position 4) immediately electrical stunning started, then, in 5 out of 6 cases, it was possible to award a "good" to "satisfactory" grading.

Mention should also be made of electrode position 5, in which stunning was carried out by means of electrodes on two handed tongs (see p. 78 f). Stunning began with the electrodes in the eye - body position. After the animal collapsed, the stunner changed the points of application to the eye - heart position (p. 80 e and f).

This positioning of the electrodes, whereby the heart lies directly in the path of the current, produces such an intense electrical field that the heart ceases to function automatically (irreversible ventricular fibrillation) and stops beating. The phenomenon was seen at slaughterhouses nos. 48 and 65, Table 9. No heartbeats could be heard in any of these animals once stunning was completed.

Once ventricular fibrillation starts, the supply of blood to the brain is cut off, thus producing hypoxia; this must also be borne in mind as an additional "stunning effect".

3.4.3.2 Stunning by means of CO₂

It was possible to observe the process and effectiveness of carbon dioxide stunning in four slaughterhouses. The gas concentrations encountered were estimated to be about 80 %, but as a rule concentrations of 65 to 70 % (Table 11) were aimed at. The period of immersion in the gas (stunning time) varied between 35 and 65 seconds.

The animals we observed left the plant in a deep coma; in some cases animals were gasping (see p. 82 d), but, generally, breathing had stopped. It was noticeable that some animals lay with their heads and necks wedged against the vertical iron bars dividing sections of the conveyor-belt. This suggested that there were vigorous bodily movements while the animals were being subjected to the gas. The engineers at two slaughterhouses told us that the vertical dividing bars were frequently in need of repair. In two establishments there were severe muscular contractions 26 seconds after exsanguination.

Gradings ranged from 2 to 5, with the reservation, however, that no opinion can be expressed as regards the actual stunning procedure in these establishments, since the animals cannot be observed at all during this vital period.

To supplement this report, we carried out some observations at an Institute with a dip-life CO₂ stunning appliance which enabled the animals to be watched during gas narcosis. During four separate experiments carried out on pigs (80-100 kg body weight), using a 70 % concentration of CO₂, considerable agitation was noted among the animals in all cases after a stunning period of 13 seconds. Convulsions of the extensor muscles (opisthotonus) and rowing-like movements of the front legs set in. After an immersion period of 25-35 seconds, three of the four animals kept squealing loudly; after about 35 seconds breathing stopped. After 35-40 seconds the animals lay quiet, with their breathing in most cases completely stopped. Similar results, using a transparent chamber to facilitate observation of the animals in the gas, are reported in 1.3.3.2.4.

If it is assumed that similar situations occurred in the gas chambers in the conventional CO₂ stunning plants we assessed, then the gradings, which included a 2 as well as a 5, must be treated with some reserve.

3.4.4 ASSESSMENT OF THE STUNNING OF SHEEP

3.4.4.1 Captive bolt stunning and concussion stunning

We were able to observe the stunning of sheep in a total of 7 slaughterhouses. Whereas the captive bolt stunning of sheep received a "satisfactory" grading in all cases, the concussion stunning method had to be graded "poor" (Table 13).

In contrast to its effectiveness with cattle, the concussion stunning method was less successful, because the model used was smaller and the weight of charge of the cartridge obviously less. Also, a different firing position was selected, namely position 2, at the top of the head, in the centre of the line running from ear to ear; see p. 83 b. Position 1, forehead, is used for concussion stunning of cattle.

3.4.4.2 Electrical stunning

The results of the electrical stunning of sheep are shown in Table 13. In 2 out of the 3 cases it was possible to award a grading of 4, in the third case 6 only. A striking feature of this series (slaughterhouse no. 62) was the extremely short stunning period (on average only 2.2 seconds); a result of this was that, on average, only 12.1 seconds after the removal of the electrolethaler, the corneal reflex returned. Since a total of 24 seconds elapsed between the removal of the electrolethaler and sticking, the animals regained full consciousness for 12 seconds prior to sticking. Thus, at this slaughterhouse, despite prior "stunning", the sheep are slaughtered without being stunned.

A general cause of difficulty is the unsatisfactory way in which the animals reach the stunning area (see also Section 3.5 of the report). Inadequate electrode contact often occurs in heavily woolled sheep and occasionally an animal's horns prevent the electrodes being applied correctly.

An attempt had been made to solve the problem of thick wool in slaughterhouse no. 3 by fitting steel pins, about 2.5 cm long and 4 mm thick at the base, to the centre of the two tongs of the electrolethaler (p. 83 d).

3.4.5 ASSESSMENT OF THE STUNNING OF GOATS

The slaughter of goats, from the numerical point of view, is of minor importance in all the slaughterhouses visited in the Member States. In 8 out of 9 countries we had no opportunity of seeing goats slaughtered. Thus no opinion can be expressed in this report regarding the methods employed for stunning goats.

All that can be said is that in one country (example: slaughterhouse no. 23) goats (and sheep) are slaughtered without prior stunning.

In the case of the slaughtering of a goat which we witnessed (Table 12, bottom), the animal was suspended by the hindlegs without prior stunning; the large cervical vessels were all cut through by an incision across the throat, and the same knife was used to cut the spinal cord, not, however, by a stab at the nape of the neck, but from the ventral side of the throat (page 73 a and b). The slaughtering of this one animal was graded 6.

3.4.6 ASSESSMENT OF THE STUNNING OF POULTRY

The results of the electrical stunning of poultry, including turkeys, are summarised in Table 14.

Special attention is drawn in this table to the column recording our observations on the depth of unconsciousness obtained by checking the corneal reflex. Of the total number of birds random-tested in these 11 establishments - namely 176 - the corneal reflex was still present in 67. Thus 38 % had left the stunning appliance without being stunned.

The extent to which birds were not only stunned, but killed by the electric current is shown in the column headed "recovery/total number". Of 32 birds taken from the conveyor immediately after passing through the stunning appliance, 23 (= 72 %) recovered, whereas almost one-third (= 28 %) were already dead.

The fact that such a large proportion of birds was either not stunned by the appliance or was killed is bound up, in our opinion, with the circumstance that the birds, while negotiating the appliance, either twist their bodies (head and neck) to such an extent that they do not touch the water-bath - and are therefore not stunned - or else they are plunged in too far, so that the whole chest area lies directly in the path of the current - in which case they die of ventricular fibrillation.

As regards design for introducing the birds to the stunning appliance, the equipment we saw in slaughterhouse no. 61 (appliance no. 20) deserves special mention. This equipment of unidentified manufacture worked at 60-80 volts. The special feature was that the birds' heads and necks were secured in position before stunning. Page 84 c, d, e & f show the most important parts of the appliance. The birds were suspended by the feet on the conveyor in normal fashion, but then, in addition, the head was also fixed in position by being placed between the prongs of a tubular fork. The head and neck then slid along between these parallel tubes, carried

by a link chain synchronised with the conveyor (p. 84 f) to the stunner. A 15.5 cm long section of the lower tube was 'live' and it was only there, as the bird slid past, that current flowed through the upper third of the neck area and the head.

With this appliance the stunning process lasted 3.5 seconds. In only one out of 23 birds tested was the corneal reflex present after stunning. The remaining birds were completely stunned. In the case of all birds removed from the conveyor belt to undergo the "recovery test", corneal reflexes reappeared within 15 seconds. Within 50 seconds all the birds were able to stand up again without support. Grading: "good".

The majority of poultry slaughterhouses we visited, however, did not yield such good results as regards stunning. Over 54 % (6 out of 11 establishments) had to be graded 6, and only 36 % obtained gradings of 4, 3 or 2.

The whole field of pre-slaughter stunning of poultry is so complex that it is impossible, on the basis of the present investigation, to provide reasons for the widely differing results. Beyond any doubt the throughput per hour plays a large part, as does the positioning and conveyance of the birds inside the appliance. The voltage and the type of current supply also affect the result of the stunning process.

There is no doubt that, in the field of poultry stunning, various problems remain to be solved before optimal pre-slaughter stunning can be achieved.

3.4.7 ASSESSMENT OF THE STUNNING OF HORSES

It was only possible to witness the stunning of two horses, in one slaughterhouse (no. 23). It was carried out by means of a captive bolt appliance (Table 11) and was given the grading 3.

We were, however, informed at five slaughterhouses that stunning by means of a captive bolt appliance is the favoured method, and its effectiveness is regarded as good. The animals, which are used to a halter, are led by one person to the place where exsanguination also takes place. A second person then fires the shot (position 1) (p. 85 e).

3.5 Reduction of the effectiveness of stunning as a result of incorrect treatment of the animals prior to slaughter

One aspect which should never be omitted in any discussion on the success or otherwise of stunning methods, concerns all the measures taken to ensure that the animals are properly handled before stunning. These measures start with transport of the animals, including loading and unloading procedures, and also the treatment of the animals in the lairage, in particular, immediately prior to stunning.

Particularly important are all questions concerning the maximum size of the group of animals, their passage to the stunning appliance and, last, but not least, all measures which help to prevent the animals becoming excited before being stunned. Any severe form of stress not only adversely affects the quality of the meat; it also definitely makes the stunner's work more difficult.

It is, for example, difficult for the stunner to place the electrodes on the correct spot immediately in the case of pigs which are excited - and the result of the stunning is less successful.

It is equally difficult to position the captive bolt appliance accurately with cattle which are leaping wildly around. The choice of firing position is then frequently left to chance and, depending on the direction in which the animal turns its head in its efforts to escape, the shot is either too high, too low or too much to one side, so that the effectiveness of the stunning process is clearly jeopardized through incorrect treatment of the animal (p. 74 e and f).

Pages 86 - 89 are intended to illustrate some of these aspects. If, for example, the interior of a stunning box is sharp-edged, as shown in p. 86, then the animal suffers pain as soon as it enters; this excites it, and in turn, as we observed, clearly makes it more difficult to handle the animal for stunning purposes; it also, as we were able to ascertain, adversely affects the result. A similar projection to the one in p. 86 a can be seen in p. 86 b, but without a sharp edge. In both cases the reason for the projection is the same; after being stunned the animal falls on to it and is thrown out of the box. In the box depicted in p. 86 b, however, the projection is designed in such a way that the animals cannot injure themselves.

Outside the stunning box cattle should stand in a narrow passageway in a "waiting position" one behind the other. If this is done, then the final phase prior to stunning passes off distinctly more quietly (p. 86c).

The design of the stunning boxes illustrated in p. 86 c - f incorporate important ethological aspects which play a large part in ensuring quiet and efficient stunning of cattle. The step which runs lengthways along the floor on one side of the box ensures that the animal, once it has entered, stands with its legs on one side placed higher than those on the other. P. 86 d shows a view into the box taken from above; the continuous step can be clearly seen. The slanting position encourages the animal to attempt to escape straight ahead through the oblique aperture in the front wall of the box (p. 86 e). The dimensions of this aperture are such that the animal can only get its head and neck through. A yoke with a ratchet, on the inside of the aperture enables the animal's head to be secured in position. The stunner can then stand directly in front of the animal and place the captive bolt appliance in the correct position without difficulty.

A stunning box designed in this way for cattle is, however, one of the few exceptions.

In the case of pigs, too, as already mentioned, there is an inter-relationship between the effectiveness of stunning and the pre-stunning treatment of the animals. Good preparation at the slaughterhouse starts with the unloading of the animals from the vehicles in which they were transported. If the vehicles are not fitted with appropriate unloading equipment, elevating platforms as depicted, for example, in p. 87, provide an easy method of adjusting the height of the unloading ramp to that of the vehicle.

Horizontal conveyors running the length of the approach passageways ensure that groups of animals go along quietly (p. 87 b). Spraying with water (p. 87 c & d) has a calming action and consequently a good effect on the subsequent stunning process.

Of particular importance, finally, is the handling of the pigs immediately before the stunning process. The more quietly each individual animal can be placed in the required position for stunning, the more sure the stunner can be of positioning the electrodes correctly in the case of electrical stunning. Page 87 e shows a successful solution to the problem, whereby the animals stand in parallel "waiting rows" and can be funnelled as required, from one or other of them into the stunning box (p. 87 f). This avoids having to 'drive' the animals immediately prior to stunning. Page 87 f shows an animal entering the stunning box quietly and unhurriedly.

Page 88, b and c show that pigs can be easily directed along narrow, slightly rising, lit passageways.

Plates b and c illustrate hinged gates which open in one direction only; these prevent the animals moving backwards into the crowding pen.

At the end of the passageway is a restraining conveyor which transports the pig by mechanical means along the last section of its way and automatically places the animal in the best position for the stunner, who is in front of the conveyor (p. 88 f).

Thus, important ethological considerations are already being taken into account in certain large slaughterhouses; these are very useful in ensuring that the animals are conveyed quietly to the stunning appliance.

In the case of poultry, too, suitable measures can ensure that things go smoothly prior to the stunning process. By routeing the conveyor belt along a wall which is sprayed with water it seems that the birds' behaviour becomes quieter - which in turn facilitates electrical stunning in the water bath (p. 89 b); an appliance which enables the birds' heads to be secured in position would appear to be even better (such as p. 84 c - f).

In the case of sheep it is important to sub-divide the animals into small groups in good time prior to stunning and also to ensure that each individual animal is carefully guided to the stunner. If this is not done, the stunner spends most of his time catching and securing the animal. Only a short space of time is left for the stunning. In the case of electrical stunning, this can lead, under certain circumstances, to a brief electrical inactivation of the animal (Table 13, slaughterhouse no. 62). In this case the "stunning" merely represents a means of securing the animal quickly in order to suspend it for sticking and exsanguination takes place with the animal fully conscious.

Thus, when considering the effectiveness of a stunning method, it is never enough just to assess the functioning of the appliance. Other aspects, such as:

- the avoidance of unnecessary stress;
- proper loading, transport and unloading;
- treatment in the lairage;
- the design of passageways to the stunning box;
- proper design of stunning pens, boxes and restraining conveyors;
- the securing of the head in position;

must also be borne in mind, if there is not to be any lessening of the effectiveness of the stunning process, quite apart from the equipment used and its method of application.

3.6 Reduction of the effectiveness of stunning due to inadequate maintenance of equipment

In reporting on the effectiveness of stunning methods under practical conditions, that is to say, during routine use in slaughterhouses, the above aspects must not be omitted, especially as the same types of appliances are often given different gradings. This is due, as already mentioned, partly to the method of use to which the appliances are put, but also partly to their widely-differing states of maintenance. Both the state of maintenance of an appliance for stunning slaughter animals and the wear and tear on it affect the success of the stunning process.

Captive bolt appliances are precision instruments, which require careful daily cleaning, even if only one shot has been fired. A bolt jammed in the guide tube can mean that an animal does not collapse immediately following the first shot, or else that it may in fact collapse, but without being properly stunned. In such cases, additional shots are necessary. The reason for a bolt jamming may be an accumulation of hard "powder slime" on the cartridge case or on the bolt itself. Outwardly there is nothing visibly wrong with the appliance; only the results are poor.

Because of repeated faulty positioning of the appliance (tilting), the bolt may remain embedded in the skull after the shot has been fired - the result being that the appliance falls to the ground together with the animal. There is a danger here that it may become distorted and will not produce sufficient power when subsequent shots are fired. This can occur particularly in the case of poorly designed stunning boxes; the result is that these slaughterhouses' appliances misfire, whereas elsewhere the same appliances achieve good stunning effects; in the former establishments up to 20 % of shots have regularly to be repeated.

The tip of the bolt too can become blunt. A contributory cause of this is if the stunners have the habit of knocking the appliance against a concrete wall after a shot has been fired in order to return the bolt.

The appliances also suffer considerably as a result of repeated misses. Misses can occur when, for example, large numbers of animals have to be dealt with and shots are fired at a crowd of calves leaping about with their heads not secured (p. 74 b). The results of a stunning process using a captive bolt appliance in this way are appropriately poor.

In the course of our travels we encountered some very well maintained captive bolt appliances, but also others which were extremely poorly maintained, with blunt tips to the bolts and also full of caked dried blood.

What has just been said regarding the inadequate maintenance of captive bolt appliances applies likewise to the care of electrical stunning equipment. Every factor which interrupts or impairs the flow of current, as, for example, strongly oxidised electrodes, lessens the stunning effect.

These brief remarks are intended to draw attention to the necessity for regular checking, care and supervision of appliances intended for the stunning of slaughter animals.

In Germany, the local accident insurance association and/or the meat trade co-operative association recommend that captive bolt appliances be completely checked by the manufacturers once a year at least.

Together, therefore, with the choice of method and the type of usage, the operational state of the appliances is of prime importance.

3.7 Training of staff to carry out stunning

Although Ireland and the United Kingdom have licensing of all slaughtermen, in none of the slaughterhouses we visited were there any special regulations regarding the training of staff for carrying out stunning.

As a rule, the responsibility for instructing the staff dealing with the stunning of animals devolves upon senior personnel, such as foremen, who have been employed at the slaughterhouse in question for a long time, or individuals who are familiar with the technical equipment on the premises. In other cases experienced slaughtermen instruct the younger ones.

Apart from the operating instructions issued by the firms who manufacture stunning appliances, there is scarcely any information available as to how the stunning of slaughter animals should be carried out. The information contained in the operating instructions, too, is less concerned with the actual stunning process than with the care and maintenance of the appliance and how to avoid damage to it.

3.8 Available methods of checking the assessment of the effectiveness of a stunning process

There can scarcely be any question of a control procedure in the slaughterhouse in the sense of a check as to whether an animal has been rendered unconscious or not. The decisive factor as regards carrying out the stunning process a second time has presumably always been the reaction of the animal, i.e. whether it can be suspended for exsanguination or, in the case of exsanguination on the floor, whether sticking can be carried out without danger to the staff. Animals which still give an impression of being "awake" or, most frequently of all, those which make defensive movements when being secured in position for exsanguination are the reason for a "second shot" or for a repetition of electrical stunning.

This subjective decision on the part of the stunner to repeat the stunning process is based solely on his professional experience. He will justify the necessity for a repetition by statements such as: "This one's not far enough gone" or "This one's not dead yet".

He is not acquainted with criteria for checking unconsciousness such as an assessment of the muscular tension or the absence of reflexes.

In the case of poultry-slaughtering, a repetition of the electrical stunning process is impossible from the purely technical point of view.

The part of the slaughterhouse premises where stunning is carried out is among those with which the establishments' management, who are otherwise professionally highly competent, tend to be least familiar.

Technical discussions on the problem of stunning slaughter animals revolve as a rule more around questions of meat hygiene. Thus, for example, the use of a pithing rod is prohibited basically for hygienic reasons. Even in the case of discussions regarding the most suitable duration of electrical stunning, the main considerations are how greater throughput, improved exsanguination, the prevention of fractures (muscular bleeding) and a reduction in petechial bleeding (blood splash) can be achieved. Similarly, the reasons for a change from one method of stunning to another are chiefly economic, and mostly concerned with meat quality.

It is interesting that all the establishments or associations we visited which, in addition to slaughtering, subsequently processed the meat themselves, also excelled by virtue of optimal planning and the way in which they carried out the stunning procedure. But even in these cases there is no check on the effectiveness of the stunning process in the sense of a clinical investigation.

Thus we cannot report on any customary methods - either applied generally or in individual cases - for checking the assessment of the effectiveness of the processes for stunning slaughter animals.

TABLES:

DETAILS OF ALL STUNNING METHODS IN USE

TABLE 6
 DETAILS OF ALL STUNNING METHODS SEEN IN USE
 Cattle

Method of Stunning: Captive bolt When a stunning box was used, the figure in parenthesis shows the assessment of the design of the box.	Slaughterhouse No.	Type of equipment (see Table 3)	Length of bolt (mm)	Diameter of bolt (mm)	Position of stunning (see 3.3.5)	Pithed	Number of animals	Time: Stunning/sticking in sec. (\bar{X} & S.D.)		Struggle after stunning	Struggle after sticking	Kill per hour	Assessment (1-6)
								\bar{X}	S.D.				
1.	2	2	80	12	1	+	13	84	25	+	-	30	4
2.	3	2			1	+	20	67	16	+	+	55	2
3. Box (4)	4	2			1	+	10	61	17	+		50	4
4.	14 a)	4		11	1	+	10	89	14	+		50	5
5. Box (5)	22	7		11	1 +3	-						24	4
	22	8		12	1 +3	-							4
	22	5			1 +3	-							4
6.	23	7	73	11	1	+							4
7.	27	7			3	+						14	6
8. Box (5)	33	10	58	13	1	-		43		+		60	4
9. Box (2)	35	10			1	-				-			2
10.	39	5			1	-				+		10	4
11.	44	2			1 +3	-				-		23	2
12. Box (2)	48	5			1	-	4	62	10	-		20	2
13. Box (5)	56 b)	4			1	-	6	65	34	+		100	5
14. Box (5)	58 b)	4			1 +3	-	6	34	5	+		56	5
Strangulation	59	13			1	+						7	6
16. Box (1)	60	4			1	+						10	2
17. Box (3)	63	4			1	+						5	4
18. Box (5)	65	13			1	+				+		5	6
19. Box (3)	67	5			1	+	3	284	43	+	+	50	4
20.	69	16			1	-	3	34		-	-	3	1 c)
21. Enevation	23	19								+			6 d)

a) = Corneal reflex present in 1 out of 4 animals

b) = Opisthotonus; corneal reflex present in 4 out of 7 animals

c) = Concussion stunner

d) = Corneal reflex present

TABLE 7

Relationship between type of captive bolt used, the method of restraint and the efficiency of stunning. An analysis of cattle stunning in 22 slaughterhouses using 8 different types of captive bolts, various stunning boxes and different methods of restraint (Key: see Table 3).

(Stunning boxes were graded 1 - 6, according to the ease and security with which animals' heads were placed in a good position for shooting. Animals which were secured with a halter, without the use of a stunning box, have been given the grading 2(H) Method of restraint)

Assessment of effectiveness of stunning	very good (1)		good (2)		adequate (4)		unsatisfactory (5)		poor (6)	
	Type of Captive Bolt	Method of Restraint	Type of Captive Bolt	Method of Restraint	Type of Captive Bolt	Method of Restraint	Type of Captive Bolt	Method of Restraint	Type of Captive Bolt	Method of Restraint
	Type 16	2 (H)	Type 2	2 (H)	Type 2	2 (H)	Type 4	2 (H)	Type 7	2 (H)
			" 10	2	" 2	4	" 4	5	" 13	6 (H) a)
			" 2	2 (H)	" 7	5	" 4	5	" 13	5
			" 5	2	" 8	5				
			" 4	1	" 5	5				
					" 7	2 (H)				
					" 10	5				
					" 5	2 (H)				
					" 4	5				
					" 5	3				

a) Secured by a noose round neck

TABLE 8

Calves

<p><u>Captive Bolt:</u> When a stunning box was used, the figure in parenthesis shows the assessment of the design of the box</p>	Slaughterhouse No.	Type of equipment (see Table 3)	Length of Bolt (mm)	Diameter of Bolt (mm)	Position of stunning(see 3.3.5)	Pithed	Time: Stunning/Sticking in sec.		Struggling after stunning	Struggling after sticking	Kill per Hour	Assessment (1-6)
							XI					
<p><u>Calves</u> Box (6)</p>	27 a)	7			3	-					10	6
	33	11			1+3	-	96				60	4
	35	11			3	-			+	+		6
	50	5			1				+		17	4

a) Hoisted before shooting

TABLE 9
Pigs - electrical stunning

Slaughterhouse no.	Type of equipment (see Table 3)	Voltage	mAmp (mA)	Placing of electrodes (see 3.3.4)	Stunning time in sec.			Stunning to sticking time in sec.			Struggling after stunning	Struggling after sticking	Kill per hour	Assessment
					No.	X	(S.D.)	No.	X	(S.D.)				
					2	21	180		2	20				
3	36	80		3	8	19.3 (8)	6	33.5 (7)	-		100	3		
4	22	80		2	31	14.6 (2.3)	14	7.2 (1.9)	+	+	100	4		
10	27	60 b)		4	20	7.2 (0.4)	11	3.6 (0.4)	+	+	300)	3		
11 +)	27	65		4	25	10.1 (1.2)	10	5.4 (0.9)	+	+	-400)	4		
12	27	90		4	4	26.5 (5.8)	4	16.2 (1.7)	+		17	2		
31	31	100	80	4	11	16.3 (3.5)	9	19.5 (4.6)	-	(+)	37	2		
32	30	180	160	2	14	11.3 (2.1)	5	47.6 (6.1)	+c)		200	5 c)		
45	20	80	70	2	10	18.3 (1.6)	10	7.3 (1.8)	+	+ !	70	5		
46 d)	20	80	70	4	10	19.1 (1.9)	10	11.9 (4.5)	-	(+)	130	2		
48	34	70	65	5	10	17.3 (2.2)	10	22.5 (3)	-	-	200	2		
50	20	280	300	6	10	3.5 (0.5)	1	14	+	+	230	5		
52	37	200	180	2	10	9.6 (0.8)	10	19.6 (5.1)	+	+ !	50	5		
53	38	190	170	1	10	13.0 (4)	10	29.2 (1.8)	-	-	27	2		
57	27	190	180	1	6	6.8 (0.4)	6	3.2 (0.4)	+	+	180	5		
65	20	130	110	5	5	18.0 (2.9)	2	121 (72)	-	-	33	2		
68	33	75-90	65-80	4	10	6.4 (0.9)	4	17 (1.4)	(+)	(+)	200	3		

a) = 10 sec.

b) = reduced from 80 V to 60 V

c) = Corneal reflex present in 3 out of 6

d) = both legs shackled after stunning

+) = Hoisted before stunning

TABLE 10

ELECTRICAL STUNNING OF PIGS

Assessment of the efficiency of stunning in relation to the position of the electrodes and the voltage used

Grading good			Grading satisfactory			Grading adequate			Grading unsatisfactory		
V	t	EL	V	t	EL	V	t	EL	V	t	EL
90	26	4	80	19	3	180	9	2	180	11	2
100	16	4	60	7	4	80	14	2	80	18	2
80	19	4	75	6.4	4	65	10	4	280	3.5	6
70	17	5							200	9.6	2
190	13	1							190	6.8	1
130	18	5									

V = Volt

EL = Position of electrodes (see 3.3.4)

t = duration of stunning

TABLE 11
CARBON DIOXIDE ANAESTHESIA OF PIGS

Slaughterhouse No.	Type of equipment (see Table 3)	Gas concentration in %	Optimal concentration	Time in gas (sec.)	Stunning to sticking time in sec.			Struggling after stunning	Struggling after sticking	Kill per hour	Assessment
					N	\bar{X}	(s.d.)				
12	39	80	(65-68 best)	65-60 sec.	11	36	(5.5)	-	-	200	4
13	40	80	(72 best)	50 sec.	10	23.9	(4.1)	-	+	200	5 a)
51	39	80		40 sec.	5	21.6	(2)	-	-	240	2 ?
55	39	?	(65-70 intended)	35 sec.	10	15.3		-	+	200	5

a) 26.3 (9.9) sec. after sticking there was severe convulsions for 10.7 (3.2) sec.

TABLE 12

CAPTIVE BOLT AND CONCUSSION STUNNING OF SHEEP AND THROAT CUTTING OF A GOAT

Slaughterhouse no.	Type of equipment (see Table 3)	Length of bolt (mm)	Diameter of bolt (mm)	Position of shooting (see 3.3.5)	Stunning to sticking time in sec.			Struggling after stunning	Struggling after sticking	Kill per hour	Assessment	
					N	\bar{X}	(s.d.)					
1	1	64	11	1	20	33.4	(6.8)	+	+a)	60	3	a) = \bar{X} 66.6 (S.D. = 38) sec. in 16 out of 20
3	2				3	78.6	(23)				3	
4	1				8	14.5	(2.4)			36	3	
Concussion stunning of Sheep												
44	15			3				+ b)		4	6	b) = Corneal reflex still present
Throat cutting of a Goat												
23	After sticking, enervation from the ventral aspect of the spinal column										6	

TABLE 13

ELECTRICAL STUNNING OF SHEEP

Slaughterhouse No .	Type of equipment (see Table 3)	Voltage	mAmp	Placing of electrodes (see 3.3.4)	Average stunning time N = number of animals X = average (s.d.) = standard deviation			Average stunning to sticking time			Struggling after stunning	Struggling after sticking	Kill per hour	Assessment
					N	X̄	(s.d.)	N	X̄	(s.d.)				
					1	20			1					
3	21	180		1	7	15.7	(3.4)	7	40.2	(23.1)	(+)		50	4 a)
62	33	90	80	1	10	2.2	(0.2)	10	24.2	(1.9)	+ b)	+ c)	70	6!!b)

a) Spiked electrode

b) Return of corneal reflex after stunning 12.1 (3.1) sec. afterwards in 13 sheep

c) Corneal reflex present

TABLE 14
ELECTRICAL STUNNING OF BROILERS

Slaughterhouse No.	Line Speed (m/sec.)	Longest time to stunner (sec.)	Shortest time to stunner (sec.)		Type of equipment (see Table 3)	Voltage	mAmp.	Stunning time in sec.	Stunning to sticking time in sec.	Corneal reflex present after stunning/Total	Recovered after removal from line/Total	Kill per hour (in 1000)	Body weight of birds in g.	Assessment
5	0.28	39	21	23				4	5		1/3	6.3	1250	6+
8	0.40	32	8	26	110	200 ?		2	10	25/47	1/3	9.0	1300	6
19		36		26	60/90			4.5		-		3.3	1800	3
34				26	75			3	9	1/10	6/6	9.5	950	2
38	0.045			23	90	500				14/21	1/3	2.4		6
47		35	21	26	50/70			3.5	21	11/28	3/3	8.9	1300	4
54	0.023	95		26	120			3	3-7	0/25	2/3	4.0	1400	2
61	0.044			20	60-80			3.5	7	1/23	4/4	0.5	425	2
64		99	90	26	40			3.5	145	15/22	3/3	5.0	1500	6 ++

ELECTRICAL STUNNING OF TURKEYS

6	0.1	168	43	24	100			15	19		1/2	0.5	7500-14000	6
7		35	13	25	70			13	33	+++	1/2	0.45	6500	6

+ Corneal reflex returned in 23 sec.

++ Immediately after stunning 8 out of 23 birds showed a corneal reflex. Out of 22 birds, 15 (68 %) were not stunned at the time of sticking

+++ Corneal reflex always present

TABLE 15

STUNNING OF HORSES

Stunning Model :	Slaughterhouse No.	Type of equipment (see Table 3)	Length of Bolt (mm)	Diameter of Bolt (mm)	Position of stunning (see 3.3.4)	Pithed	Number of Animals	Stunning to Sticking time in sec. (X & s.d.)		Struggling after stunning	Struggling after sticking	Kill per hour	Assessment (1-6)
								X	s.d.				
Captive bolt	23	7			1	-	2						3

TABLE 16

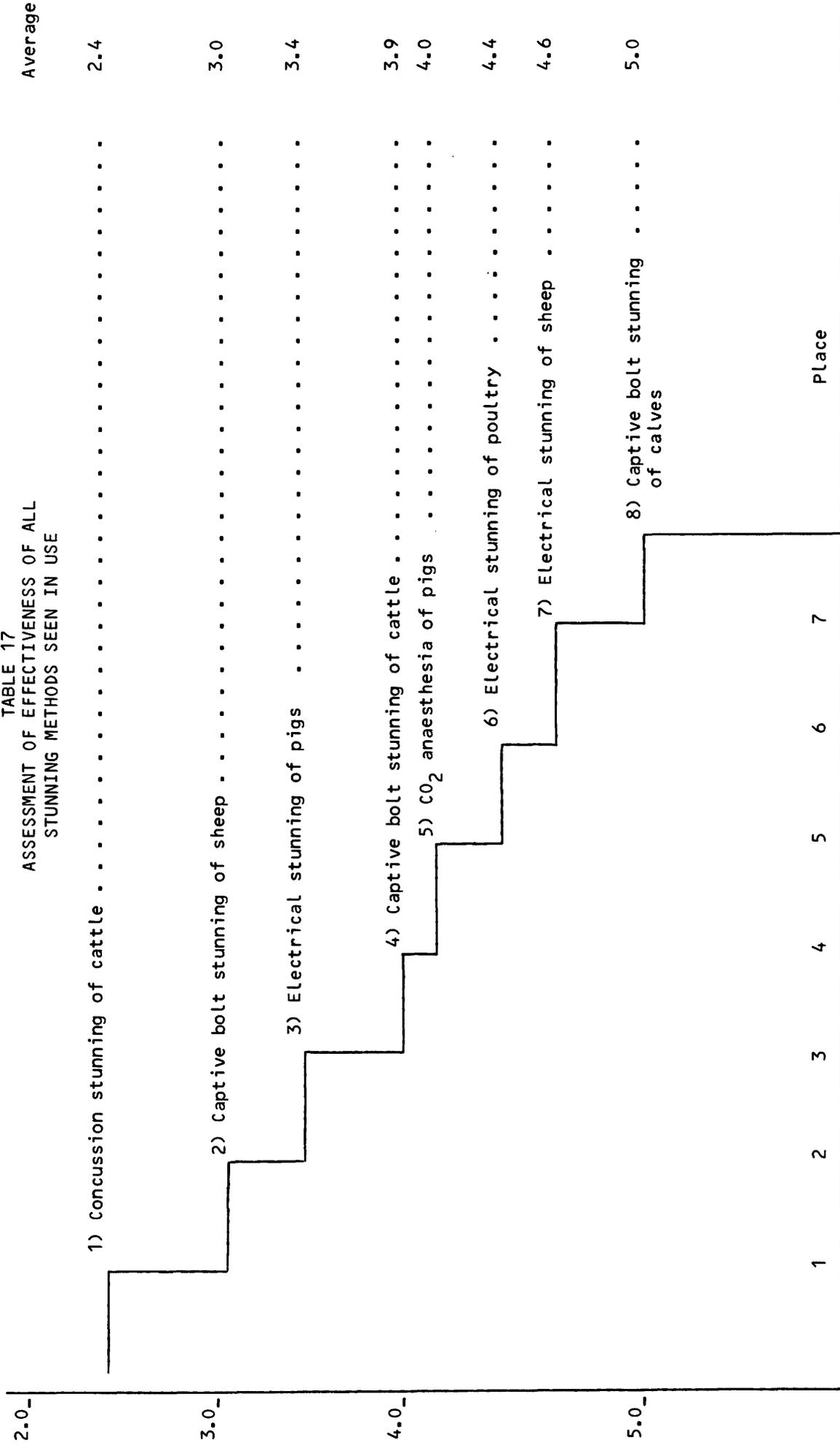
SUMMARY OF EFFECTIVENESS OF THE
VARIOUS TYPES OF STUNNING

Type of Animal	Number of Animals	Method	Number of groups investigated	Assessment	
				\bar{x}	(s.d.)
Cattle	212	Captive bolt	19	3.9	(1.3)
		Enervation	1+	6.0	-
		Concussion stunning	3	2.4	(1.3)
Calves		Captive bolt	4	5.0	(1.1)
Pigs	660	Electrical	17	3.4	(1.2)
		CO ₂	4	4.0	(1.4)
Sheep	116	Captive bolt	3	3.0	(0)
		Concussion stunning	1	6.0	-
		Electrical	3	4.6	(1.1)
Goat	1	Throat cut	1+	6.0	-
Horse	1	Captive bolt	1	3.0	-
Poultry	249	Electrical	11	4.4	(1.8)
Totals and average of assessments	1239		68	4.3	(1.2)

+ Single example

Assessment

TABLE 17
ASSESSMENT OF EFFECTIVENESS OF ALL
STUNNING METHODS SEEN IN USE



3.9

Summary and Conclusions

Basically, three different methods are used in the Member States:

1. Appliances for stunning by means of shooting (with or without penetration of the skull);
2. Appliances which produce a state of unconsciousness by means of electric current;
3. Appliances for stunning by means of CO₂ gas.

Including all methods, there are at least 40 different models and/or appliances in use; these vary, too, as regards stunning effects. These differences are due to variations of design, bolt thickness and length, cartridge energy, the size of the impact area (concussion stunning) and, in the case of electrical stunning, unsuitable positioning of the electrodes, poor electrode contact, unsuitable voltage or stunning time; also - and this applies to all methods - the unsatisfactory operational state of the appliances.

There is also a close interrelationship between the effectiveness of stunning and the method of use (treatment of the animals prior to stunning and the way in which the method is applied).

Ignorance of the most suitable type of circuit (positioning of the electrodes) often leads to poor stunning results. Pigs and poultry are not infrequently killed by electrical stunning (ventricular fibrillation).

From Table 17, which lists the various methods in staggered form and in order of merit, it will be seen that three of the eight had to be graded as "inadequate"; electrical stunning of poultry, electrical stunning of sheep and the captive bolt stunning of calves.

In all three cases this assessment may possibly be due not only to the method but to its incorrect application.

The captive bolt stunning of cattle appears in the middle of the table. The assessment average, however, has a scatter of 1.3, implying that a considerable proportion of the 19 series investigated had to be graded below "adequate". The reason for this, apart from the varying characteristics of the different appliances, was mainly incorrect application, due to faulty preparation of the animals prior to stunning.

Assessment of the CO₂ stunning process was made with some reserve. Based on the state of the animals after stunning, the requirements demanded of a good method of stunning slaughter animals seem, it is true, to have been met. But what happens to the animals during the actual stunning phase - which cannot be observed - is not, of course, allowed for in the assessment. There is, however, a suspicion that the phase preceding unconsciousness, during which the animals have difficulty in breathing, and the phase characterized by screaming and convulsions are both unjustifiably long (13-35 seconds). There is no doubt that research is required in this field before satisfactory results may be expected.

The captive bolt stunning of sheep and the electrical stunning of pigs produced relatively good results. The wide scatter in the assessment, however ($X = 3.4$; $s = 1.2$), makes it clear that in this area of the stunning of slaughter animals, too, many questions remain unresolved.

The requirements of slaughtering technology frequently conflict with those which have to be demanded of a good electrical stunning appliance from the animal welfare point of view. We are, however, of the opinion that it should be possible to achieve a better integration of the stunning procedure into the slaughtering process as a whole and thus reconcile the differing points of view.

The large number of different models of stunning equipment for which no precise physio-technical data were available has made the compilation of this report difficult, particularly as regards a comparison of the methods used.

Standardized information regarding the various features of the appliances, which would enable a comparison to be made, is not supplied by any of the manufacturers; this should include the various weights of charge of the cartridges and, in the case of electrical appliances, of information regarding amperage and voltage, operating times, duration of current flow. Only with this kind of data would it be possible to make an objective comparison of the various stunning appliances and thereby form a basis for the standardization of stunning methods in the Member States.

The necessity for regular checking of the operational state of stunning appliances must also be borne in mind.

Finally, any regulations regarding the standardization of stunning methods should also take into account considerations affecting the pre-slaughter treatment of the animals as an integral part of the stunning procedure.

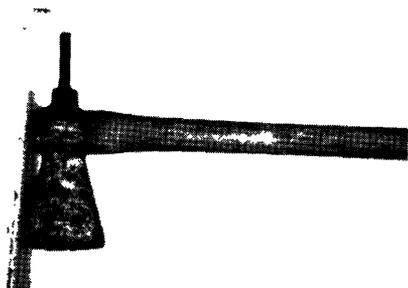
The stunning and killing of animals is an unpopular and unpleasant business, not only in the minds of outsiders, but also as far as many slaughterhouse employees are concerned. Consequently there is a tendency for the general public to prefer not to have any problems in connection with slaughtering practice brought to its notice.

There have been no investigations on which guiding principles, instructions and even training for personnel could be based. Guiding principles of this kind, concerned with carrying out the stunning of slaughter animals, would, of course, have to take into account the question of "how" it should be done; otherwise no more would be achieved than at present, namely that, in order to comply with the law, a "stunning appliance" must be used, whereas success - in the sense of actual stunning - often remains doubtful.

The possibility of diagnosing a state of complete unconsciousness under slaughterhouse conditions is confined to the following criteria:

A state of complete unconsciousness can only be assumed as certain if, immediately after stunning, the muscles largely lose their tone; the physiological reflexes and all reactions to external stimuli cease; no reactions occur when one or both hindlegs are secured and the animal is hoisted and stuck for exsanguination; and when there is no corneal reflex from the time stunning is completed until the animal's death.

Poleaxe



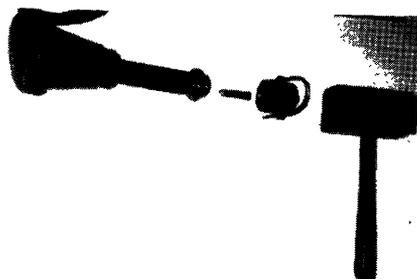
Pithing rod



Puntilla
(for enervation)

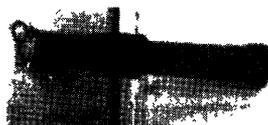


Free bullet stunner



Captive bolt Stunners

10: Matador



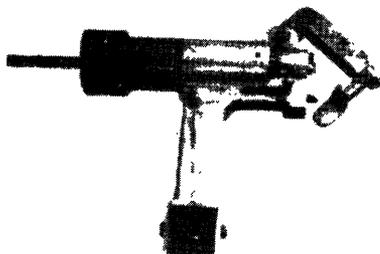
2: Schermer ME 9



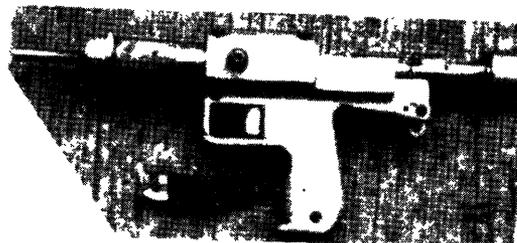
9: Infallible Brevittato



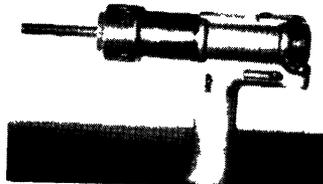
7: Humanitas



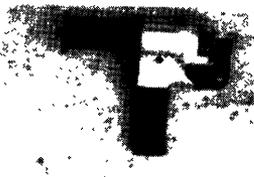
11: K.O.



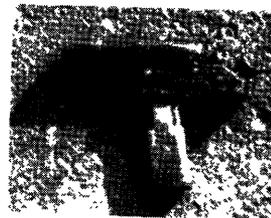
4: Cox Universal



5: Supercash Mk 2



13: Cash X



14: K.O.



Concussion Stunners

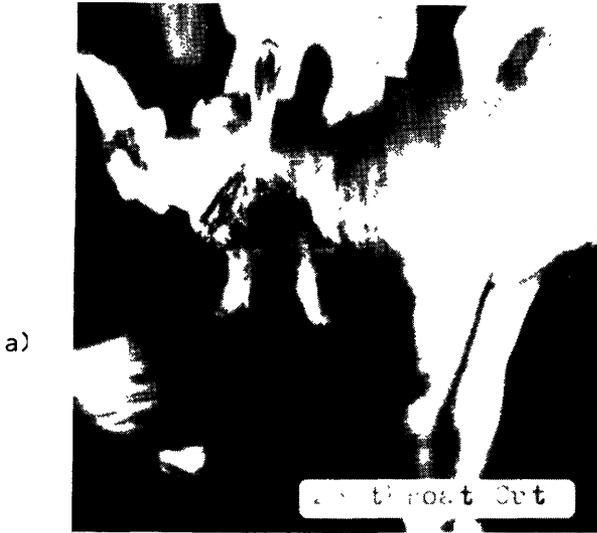
16: Schermer



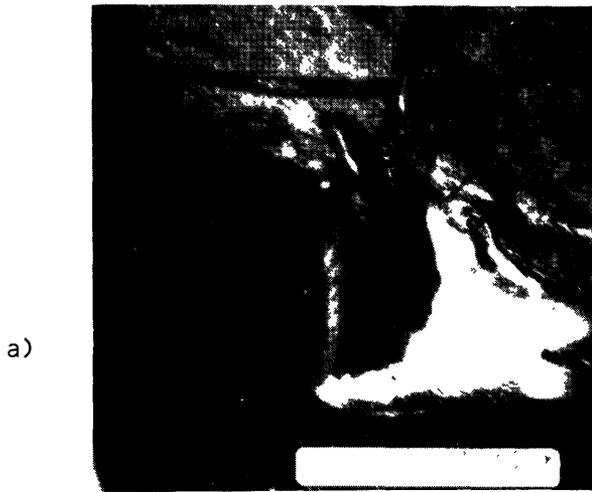
15: Bebe-Matador



- a) Cutting the throat of a kid
- b) Severing the spinal column from the ventral aspect
- c) Enevation
- d) and e) Shooting position 3 (see 3.3.5)
- f) Shooting position 1 (see 3.3.5)

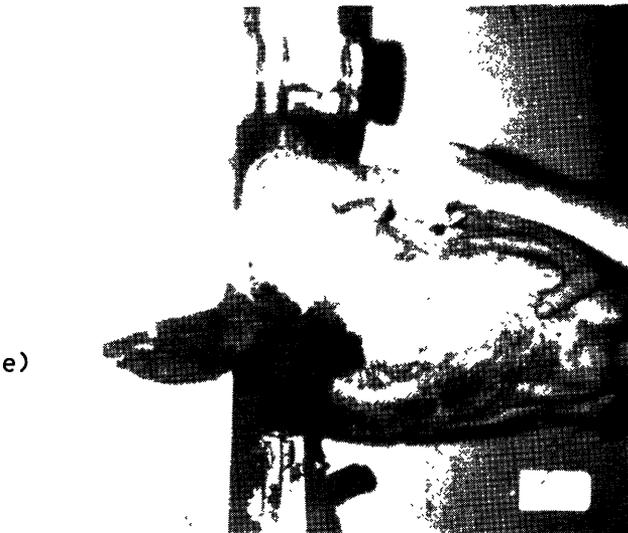
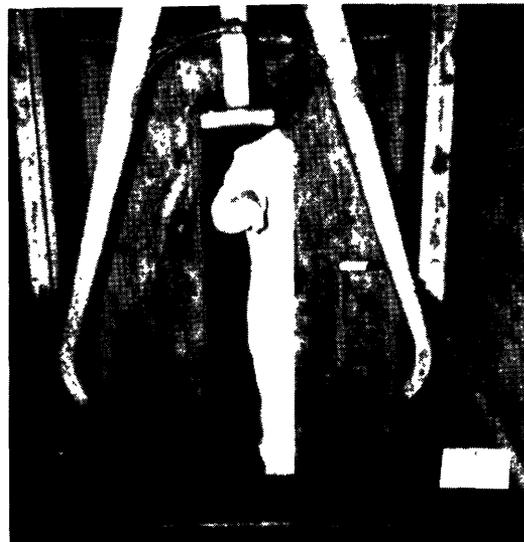
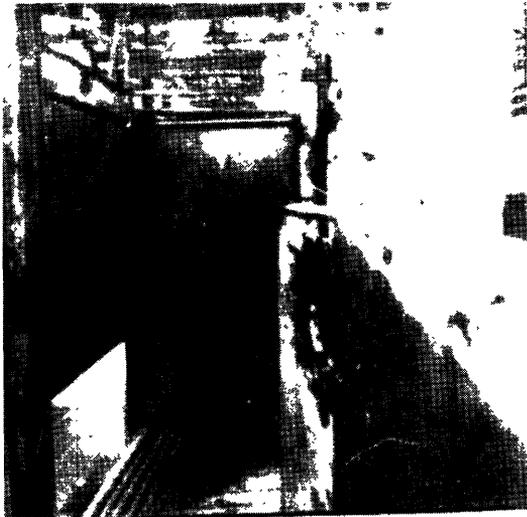
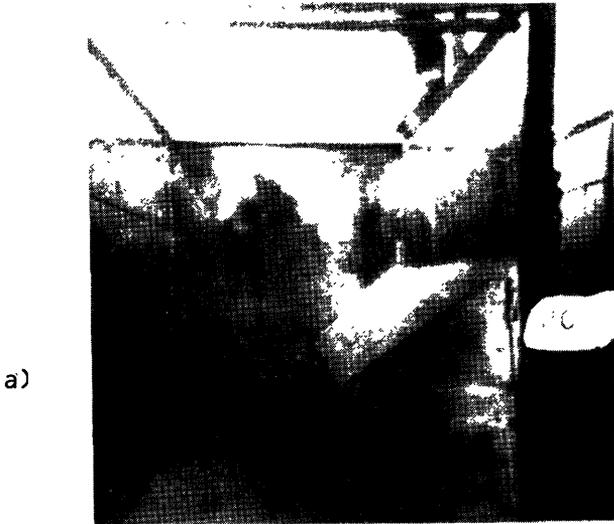


- a) Strangulation before stunning leads to bad results
- b) Shot missed, due to lack of adequate fixation of animal
- c) - f) Examples of poor stunning box design which make it very difficult for the slaughterman to shoot accurately



In more than 54 % a bad construction of the stunning box makes it impossible for the stunner to get the captive bolt in a safe shooting position.

- a) and b) Examples of bad internal design of stunning boxes; sharp edges and slippery floors stress animals and can cause injury
- c) and d) Examples of stunning boxes giving the slaughterman a good shooting position
- e) and f) Pithing after captive bolt stunning



a) - e) A well designed stunning box, enabling animal's head to be firmly secured and giving the slaughterman a comfortable shooting position



- a) Schermer MK concussion stunner ready for use
- b) After use, before mushroom head is snapped back into place
- c) Bull 610 kg stunned with this model, using red (No. 1) cartridge. Bull fell immediately, showed very little general muscle rigor and no kicking. No corneal reflex. Hoisted and bled without reaction



a)



b)

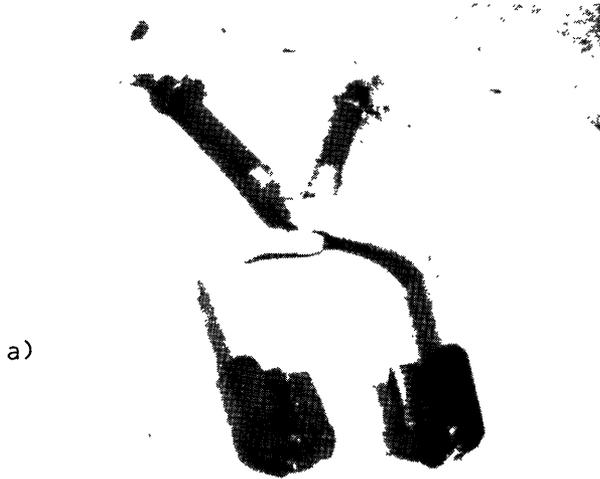


c)

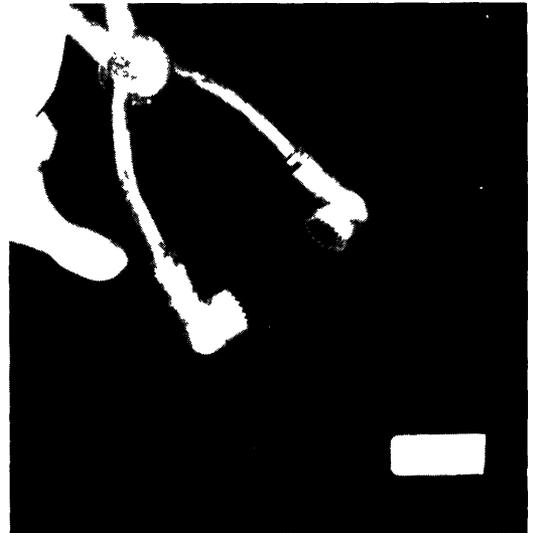
a) - f) Types of electrical stunning equipment used for pigs (Table 3)

a) Schermer, b) unknown make, c) Jemau, d) SKF, e) Schermer, 3 electrodes

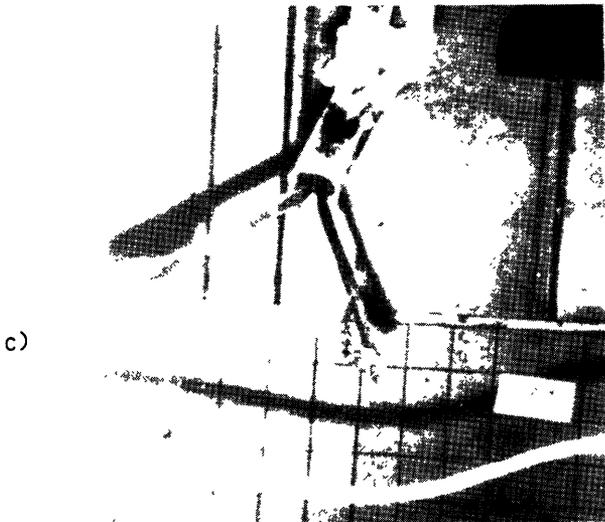
f) unknown make



a)



b)



c)



d)



e)



f)

a) - f) Different electrode positions in electrical stunning of pigs. There is a close correlation between the position of the electrodes and the effectiveness of stunning

d) and f) are good positions



a)



b)



c)



d)

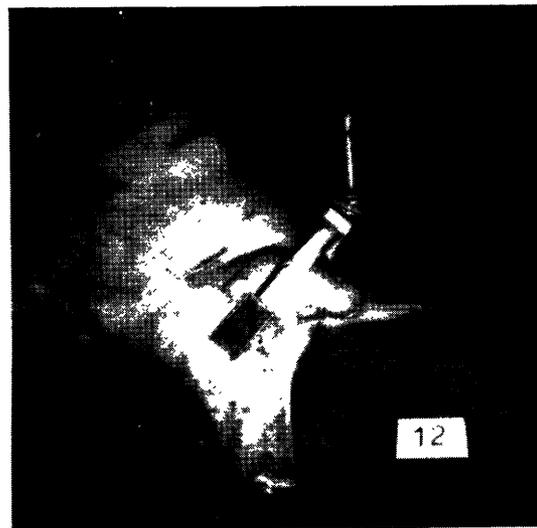
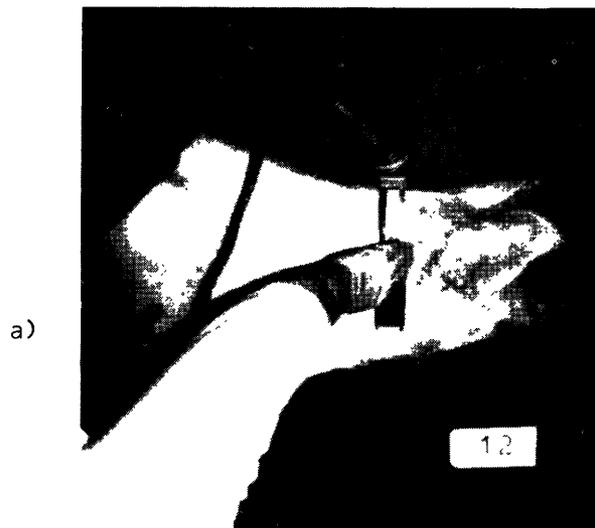


e)

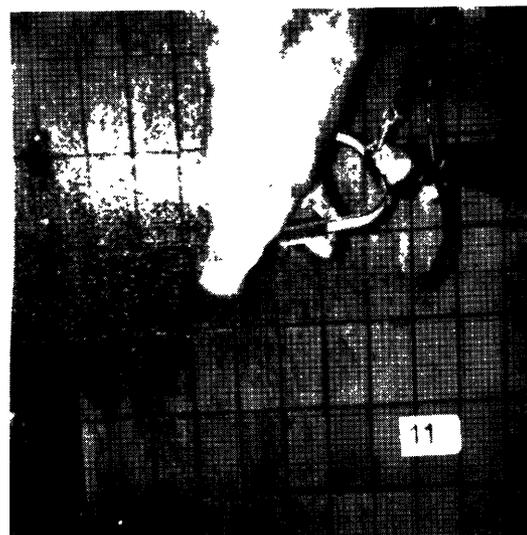


f)

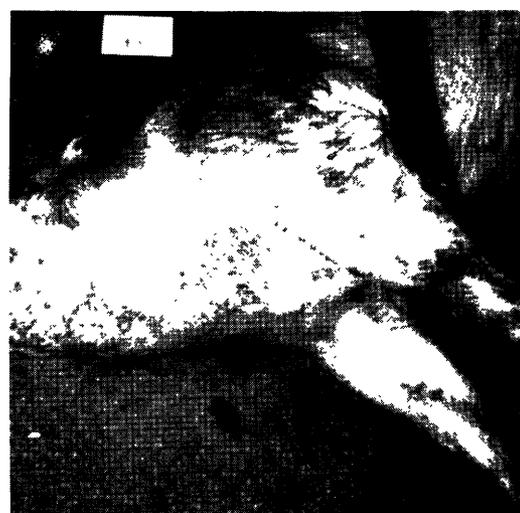
a) - f) Different electrode positions in electrical stunning of pigs
b) - d) are good positions; using e) and f) the pigs were killed by heart fibrillation



b)



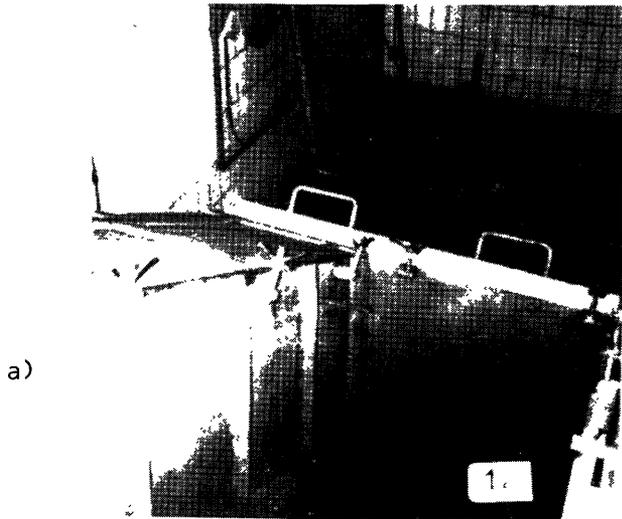
d)



f)

a) - e) Oval Tunnel plant for CO₂ anaesthetisation. It is impossible to observe the pigs while they are in the gas.

a) and b) The tunnels leading to and from c) the gas reservoir



b)

c)



d)



e)

- a) - d) Compact plant for CO₂ anaesthetisation
- a) Race and entrance door
 - b) Inside one of the containers which carry individual pigs down into the gas
 - c) Anaesthetised pig about to be ejected
 - d) Pig ejected onto shackling table

a)



b)



c)



d)



a) - f) Stunning of sheep

a) Position 2 (see 3.3.5) for captive bolt stunning

b) Position for concussion stunning

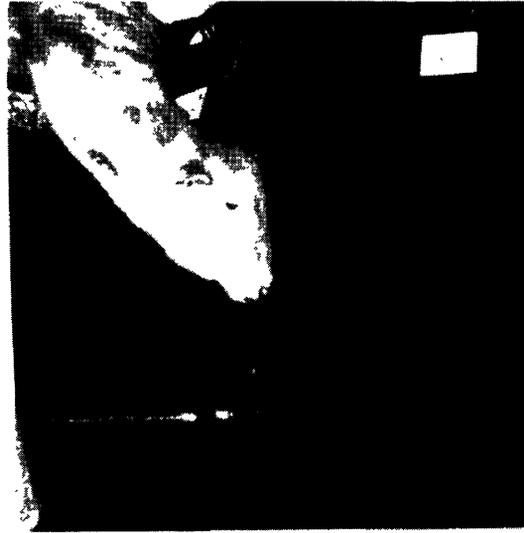
c) IWEL electrical stunning tongs

d) Schermer electrical stunning tongs, note central spikes to improve contact through wool

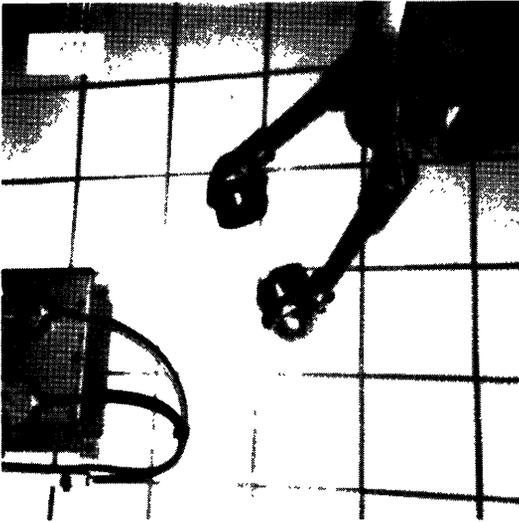
e) and f) Commonly used electrode positions for stunning sheep



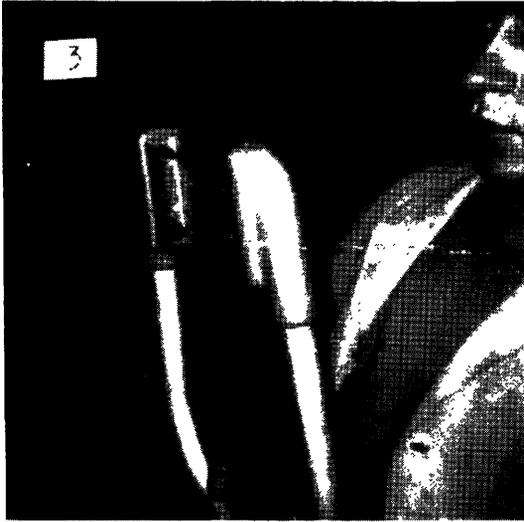
a)



b)



c)



d)



e)

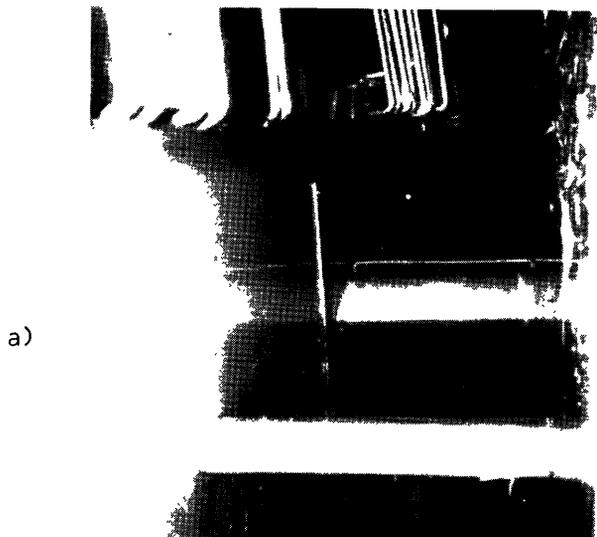


f)

a) - f) Electrical stunning of poultry

a) & b) Water bath pattern

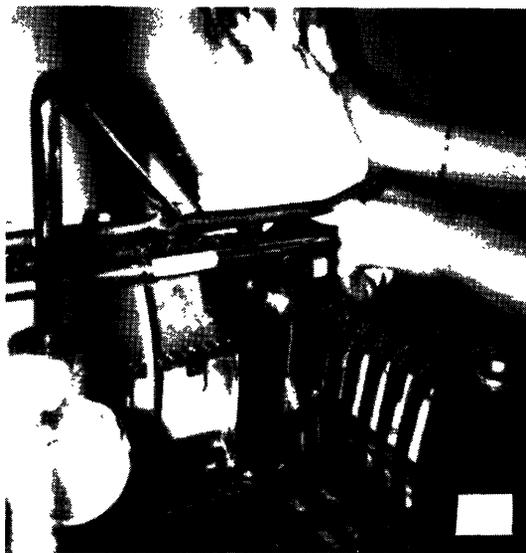
c) - f) An apparatus in which the head is fixed, thus facilitating proper flow of the stunning current - light coloured section in the rail below the bird's head is the electrified portion



a)



b)



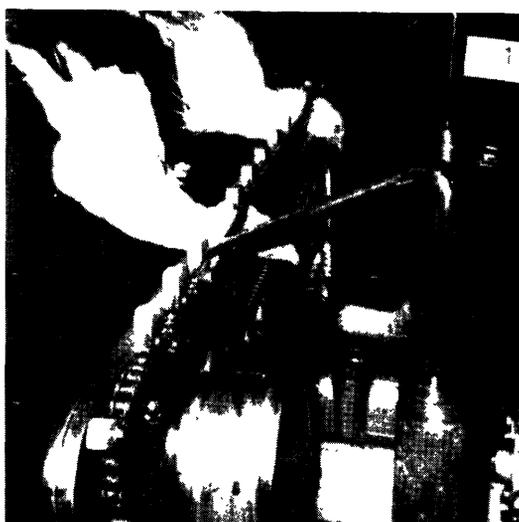
c)



d)



e)



f)

a) - d) Electrical stunning of turkeys

a) , b) & c) Water bath pattern

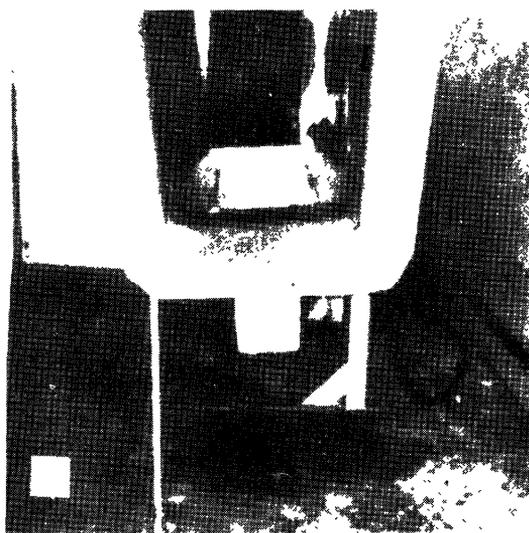
d) Dry stunner with electrified metal plate

e) Captive bolt stunning of horses

f) Apparatus used for measuring the amperage and voltage of electrical stunning equipment



a)



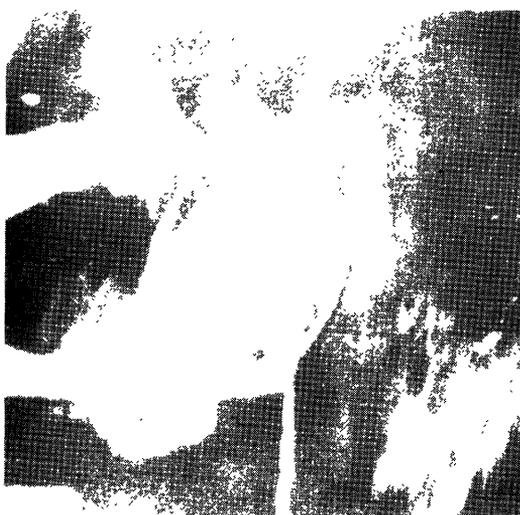
b)



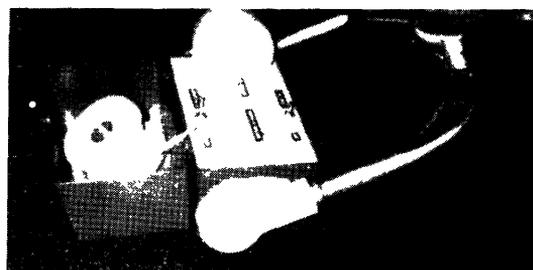
c)



d)



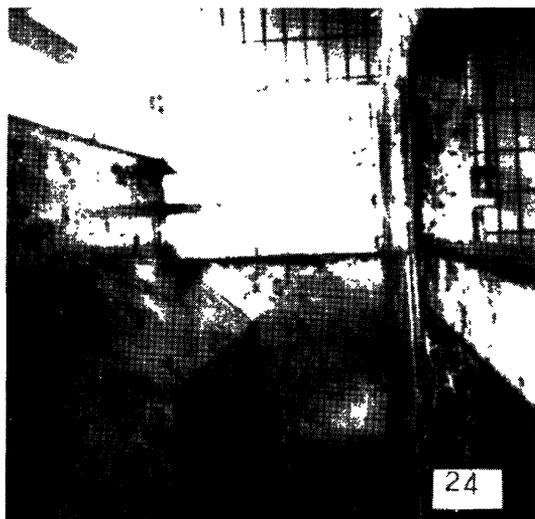
e)



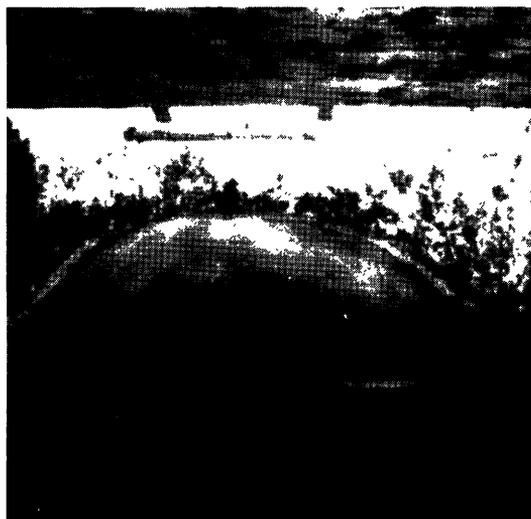
f)

- a) Bad internal design of cattle stunning box
- b) and d) Good internal design, smooth pillar and floor step (see p. 54)
- c) Cattle in a race leading to the stunning box
- e) and f) Well designed box, showing yoke for securing animal's head and animal ready for stunning

a)



b)



c)



d)



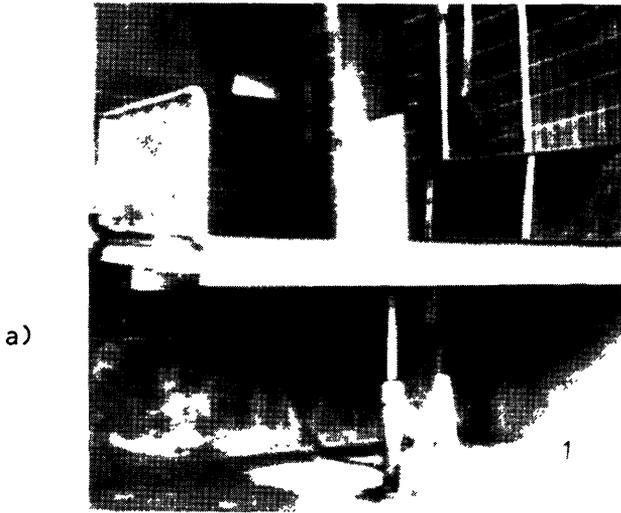
e)



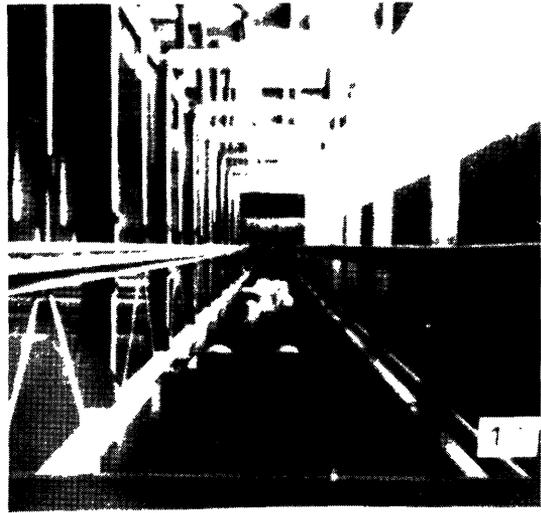
f)



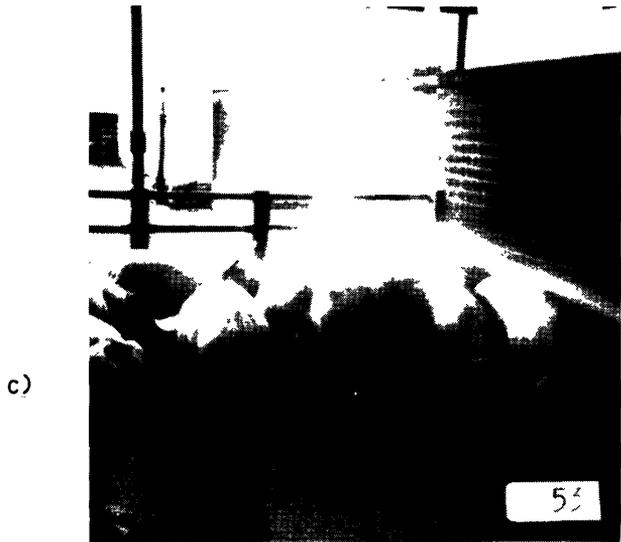
- a) Hydraulically operated ramp for unloading pigs
- b) Mechanical driving system to move groups of pigs towards the race to the stunner
- c) - d) Spraying pigs in lairage
- e) System of parallel races feeding one stunning box
- f) Pig entering box from e)



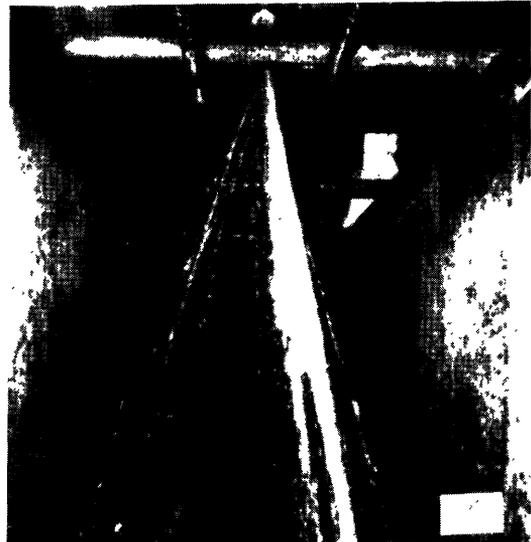
a)



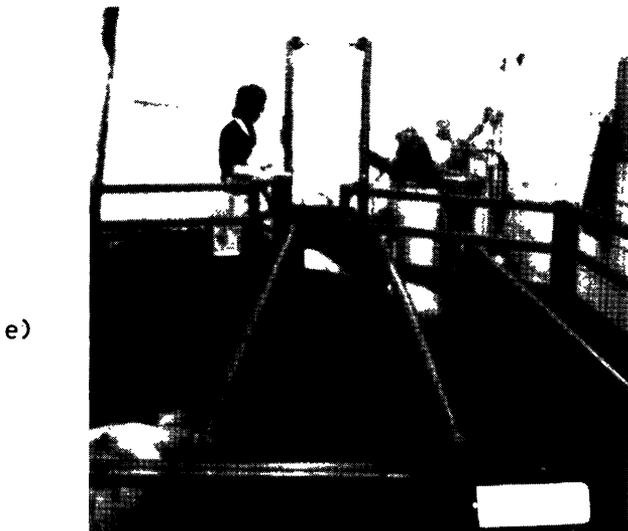
b)



c)



d)

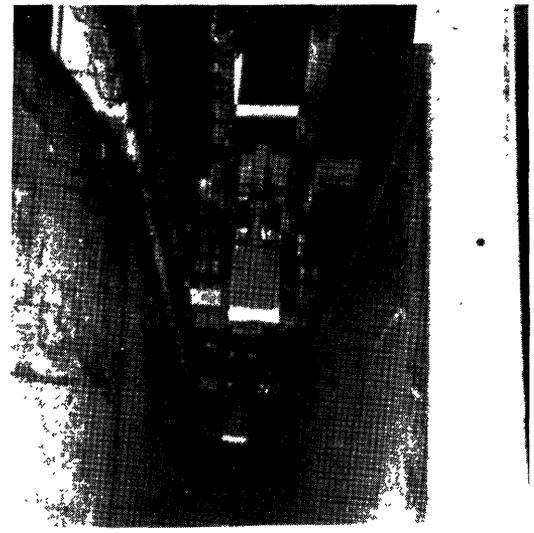


e)

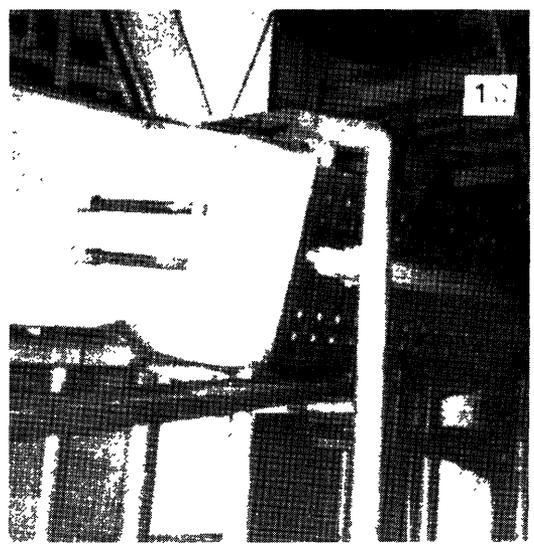
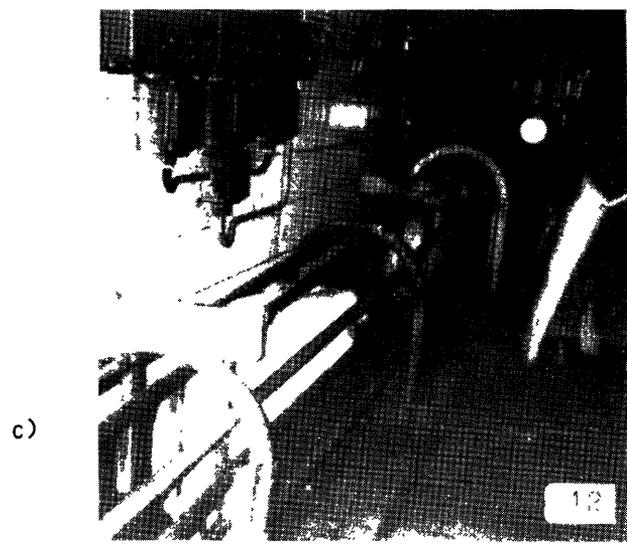


f)

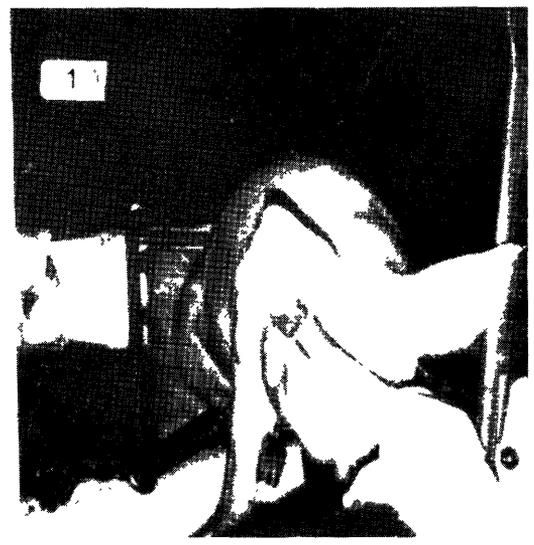
- a) & c) Races leading pigs to the stunner
- b) Lever system preventing pigs backing in the race
- d) & e) External and internal views of a restraining conveyor
- f) Stunning a pig electrically as it leaves the restraining conveyor



b)



d)



f)

- a) Fans for cooling crates of poultry awaiting unloading in hot weather
- b) Poultry loaded onto the conveyor to the stunner
- c) & d) Illustrate difficulty of correct stunning of sheep in a stunning pen

a)



b)



c)



d)



Acknowledgements

It is a pleasure to acknowledge the considerable assistance we received from both official and unofficial sources in the planning and execution of the work connected with this contract. In particular, we wish to thank the numerous officers of the national Veterinary Departments who helped us in many ways. We are also indebted to a great variety of individuals, particularly employees of slaughterhouses and research workers, for their patient and helpful responses to our many questions.

Information on Agriculture

		Date	Languages
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