

Research Paper

Summary report

Experiments for the objectification of pain and consciousness during conventional (captive bolt stunning) and religiously mandated (ritual cutting) slaughter procedures for sheep and calves.

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The Animal Welfare Act of 24 July 1972 (TierSchG) assumes the basic concept of an ethically orientated animal welfare legislation. It further stipulates that the standards for evaluating the obligation to protect animals should not so much be the result of human sensitivities and emotional, but to be increasingly replaced by exact and representative scientific knowledge of standards and requirements specific to animal species and correspondent to their behaviour (Ertl. 1972). The Act thus conforms to the changing attitude of man to the life circumstances and legitimate welfare entitlements of animals, a development which can also be noticed internationally.

The rules for animal welfare founded on scientific standards of evaluation mean for many of the regulated welfare concerns, e.g. the keeping and transportation of animals, a necessity to clarify individual scientific and subject-specific issues. This clarification is a precondition for a continued reform of animal welfare.

This applies in particular to the third section of the TierSchG, which deals with the killing of animals. The provisions of this section are further directly connected to the law on slaughter, which thus assumes the legal position of a special legislative part of the Animal Welfare Act. This fundamental integration of the law on slaughter within the Animal Welfare Act has been explicitly confirmed by a vote of the Council of Federal States dated 25 October 1963. At that time the Council of Federal States refused to authorise the draft of a Third Directive on the Modification of the Directive on the slaughter of animals by the Federal secretary of state for Nutrition, Agriculture and Forestry (BML) giving the following reasons:

The regulations of the Law on slaughter (Act and directions on implementation on the slaughter of animals dated 21 April 1933) are to be seen in their totality as part of the topic Animal Welfare, which is to be seen as an independent and complete legal matter in the

meaning of the decision of the Federal Constitutional Court dated 11 May 1955 (BverfGE 4, 128-184). The Law on slaughter is therefore an integrated part of the Animal Welfare Act and included in the general reform of the Animal Welfare Act demanded by parliament and the public.

According to article 4, para. 1 TierSchG a vertebrate must only be killed after being stunned or otherwise, where reasonable under the given circumstances, without afflicting pain. Where the killing of a vertebrate is permitted without stunning, e.g. due to other legislation, the killing must only be carried out with no more than the inevitable pain. This binding general provision of the TierSchG must equally be the basis of the reformed Law on slaughter.

With regard to the slaughter of hot-blooded vertebrates the task of a scientific clarification of the processes during stunning and killing becomes paramount here. In other words: a full-scope scientific investigation of existing ideas of the start, course and extent of the reduction of perceptiveness and the sensitivity to pain including its expiration. This means: clarity about the relation between stunning and killing. The term consciousness should be avoided.

From an animal welfare rights perspective stunning here means a measure which moves the animal to be slaughtered as quickly as possible and without fear into a condition of complete loss of sensitivity and perception; the time factor does play an important role here. This is followed by the killing, normally by way of bloodletting, which transforms the animal to be slaughtered into a carcass.

Investigations of the effectiveness of stunning an animal to be slaughtered must in today's understanding be based on the possibility of measuring pain reactions. There are a number of publications on the various methods of stunning animals for slaughter. However, their conclusions are so far predominantly based on subjective methods of evaluation and contain little scientific evidence.

Recently, critical essays on the effectiveness of current methods of stunning animals for slaughter are on the increase (Cantieni, 1977; Scheper, 1977). In the Netherlands a committee (De Studiecommissie Bedwelming Slachtdieren) was established for the same reason in 1975, and its most important task is to advise the government on reliable methods of stunning animals for slaughter with regard to animal welfare.

For ruminants the captive bolt stunning device is the usual stunning device. In recent decades it has been accepted for use all over the world. Whereas this device has been recognised legally for stunning animals for slaughter nationally and internationally only very few experimental works on this method have been published to date. A particular cause for a careful evaluation is not at least the information by Arlt (1971) that 3 of 9 patients (suicide attempt) remained conscious for longer periods of time in spite of severe penetrating brain injuries after a bolt shot in the frontal and temporal regions.

For animals, here specifically with regard to the slaughterhouse situation, a loss of sensitivity and perception (stunning) can only be assumed when the animal lies completely without movement after the respective measure and does not show any reaction to given

pain stimuli. On the other hand, we know from daily experience that captive bolt stunning, in its various applications, can lead to different reactions. A knowledge and observation of the necessary strength of the physical force applied in order to have the required mechanical effect on the brain seems equally important here as the point of application and direction of application of the bolt. There are hardly any experiments available for the purpose of ensuring a definite stunning of the animal to be slaughtered.

The preparatory considerations for the restructuring of the slaughter legislation for cows, calves and sheep also had to include the slaughter of these animals in accordance with religiously mandated regulations without prior stunning (so-called ritual slaughter). Since long, factual, legal, and ethical issues confront each other inextricably in this matter. The opposition to a stunning-free slaughter has a long history. For example, the executive committee of the Federation of Animal Welfare Associations petitioned the Imperial German Parliament already in 1895 to proscribe the stunning-free slaughter. In 1910, 612 German slaughterhouse veterinarians and 41 German veterinary associations described stunning-free slaughter as cruelty to animals in a declaration to the Imperial German Parliament and demanded a legal prohibition.

Even before, in 1901, 441 out of 463 experts described the stunning-free slaughter as contrary to animal welfare in a questionnaire aimed at all veterinarians as well as university lecturers at veterinary colleges and professors of physiology in the then German Empire (Spitaler, A., 1965). Representatives of animal welfare present the same opinion today not only nationally, but also internationally. For example, the representatives of the World Animal Welfare Association and the International Society for Animal Welfare participating as observers in the deliberations of the Animal Protection Committee of the Council of Europe in Strasbourg for the creation of a European Agreement on Animal Welfare during Slaughter stated the following, amongst other things, about their strict opposition of slaughter of ruminants in accordance with religious regulations (ritual cutting): Ritual slaughter as such means considerable pain for the animals.

Further: The connection between the central and the peripheral nervous systems is not severed by the ritual cut; in addition the vertebral artery remains intact, which results in bovine animals in the brain continuing to a degree to be supplied with blood. And: As brain impulses (electroencephalogram) and the capability of coordinated movement can still be observed some time after the ritual cut, it must be assumed that the sensation of pain also continues for some time. These considerations were presented by the observers mentioned as the result of a discussion with scientific experts in veterinary medicine at the university Munich in November 1996 (Council of Europe, Committee of Experts on the Protection of Animals, 1976).

Representations of this kind have long been challenged by equally thorough studies and observations of other established experts. For example, Bongart (1927) pointed out on the basis of very extensive studies on the ritual slaughter of calves carried out with his colleagues Hock, Muchlinsky and Schellner, that where ritual slaughter has been carried out properly on animals, the resistance movements observed could no longer be interpreted as signs of consciousness and sensation of pain. He reaches the conclusion with regard to calves that no cruelty to animals of whatever kind can be found in the

application of the ritual slaughter method. As an example of a similar view of more recent years the representations of Spoerri (1964) on the topic Animal welfare and ritual slaughter can be cited. He reached the conviction on the basis of observations on some 50 ritually slaughtered animals, as well as related experiments on rabbits, sheep, goat, and cows under laboratory conditions, that the ritual slaughter of animals did not cause any or at least no more pain than killing after captive bolt, electric or CO₂ stunning. The studies of Levinger (1976) are of a similar nature.

Schultze-Petzold (1973) characterises the scientific debate of these issues during a lecture on the imminent creation of a European Agreement on the Welfare of Animals in the Committee Animal Protection of the Council of Europe as follows: Those familiar with the national and international literature on this problem must note that the problem of causing and sensing pain and the elimination of consciousness and its criteria already existed before the turn of the century with regard to the slaughter methods at the centre of the evidence and counter-evidence of the cruelty of animals assumed in this case with the exception of the issue of laying down the animal to be slaughtered, which today seems resolved by using the hydraulic tilting equipment. All these considerations and attempted experiments last carried out comprehensively by veterinary medicine some 40 years ago are only more or less hypothetical in their conclusions.

For example they are not or only insufficiently able to make any statements on the kind and intensity of the brain function linked to consciousness. This is, of course, mostly due to the inadequacy of methodological possibilities at the time. Practically we are today, when tackling the reform of the Law on slaughter, still faced with a situation that with regard to the beginning and extent of the loss of perception and sensitivity and the stimulation of sensing pain and its discontinuation, whether using captive bolt stunning or ritual slaughter, there is no scientifically secure evidence available. The precondition of such generally valid evidence is comparative studies aiming at the objectification and measurability of pain and consciousness processes. This is furthermore a highly topical issue in general medicine, as it comes close to the question of where life ends and death begins. One need only refer to the discussion on the timing of the right to remove organs for human transplantation.

The research of human medicine into the physiology of the senses has in this respect turned intensively to modern methodological possibilities of discovery and has since developed these into a useful objectification of these questions. Here the electroencephalogram (EEG) most certainly plays a key role.

This poses the question for the Federal ministry of nutrition, agriculture and forestry (BML) when starting work on the reform of the Law of slaughter: Should it not be possible, after an adjustment for the various models of animals for slaughter, to find ways through this kind of method to reach within a reasonable time a scientifically sound and predominantly objective statement on the processes relevant for animal welfare during conventional as well as ritual slaughter of hot-blooded animals?

In 1971 and 1973 the BML discussed this theoretical approach for a scientific clarification of the issues at stake during talks with representatives of the Rabbinical Conference and

the Central Council of Jews in Germany, and the spiritual management of Muslim refugees in the Federal Republic of Germany, respectively. At the same time the religiously mandated factors applying to the ritual slaughter were clarified with these religious communities. It was made clear that the respective religiously mandated provisions of both religions continue to be binding for their members. As this conclusion has until recently been repeatedly questioned with regard to the members of the Islamic faith in the Federal Republic of Germany, a statement on the topic by the Turkish Government representative in the Committee Animal Protection of the Council of Europe, Strasbourg, during the creation of the above-mentioned European Agreement on Animal Welfare during slaughter is partly quoted here: Turkey investigated the possibility of the electric stunning of animals for slaughter. It must be noted that this procedure violates the expectations of the Turkish people as well as the rules of the Muslim faith (Council of Europe, Committee of Experts on the Protection of Animals, 1976).

During this preliminary work the BML asked experts of the various branches of learning mentioned in a meeting in early 1974 to present their experiences and ideas. Both the general discovery of the physiology of the senses relevant to this matter as well as all potential methodological possibilities were discussed, not least with regard to their adaptation to the models of animals for slaughter cow, calf, sheep and any necessary initial experiments. The discussion was guided by the following questions:

1. What do we know and what can be measured using instruments?
2. What do we not yet know or do not know sufficiently?
3. What can be made measurable using instruments?

This does not merely concern the ritual slaughter complex, but also the scientifically proven definition of the term stunning during captive bolt stunning. It needs to be established whether the captive bolt does with the respective animals to be slaughtered definitely cause a *Commotio cerebri* which only leads to unconsciousness after shaking the limbic system. Otherwise the captive bolt method would only cause a *Contusio* in these animals to be slaughtered, which generally would only lead to a motor paralysis.

Aim of the expert consultation was mainly an answer to the question: Does the current state of methodology permit the experimental study of the pertaining scientific questions in principle?

The minutes of this expert meeting on 7-9 February 1974 at the BML contain the following summary of results: The experts discussed the anatomical, physiological and clinical issues in depth with regard to the current methodological possibilities. Special emphasis was given to the species-specific variations and the comparability to analogous human experiences. The experts mainly agree that, especially due to the different anatomical starting conditions for the animal species under consideration, a principal comparability must not be assumed from the outset. This also applies to the respective age categories (e.g. calf/cow). Relevant research is being advocated. When investigating the methodological possibilities, the key candidates are: EEG, blood pressure and brain pressure measurements, angiography, reflex studies, and functional investigations of the

adrenocortis. During initial experiments measurements should be as extensive as possible, in order to reveal unidentifiable correlations. During questioning the experts appeared to place special emphasis on the factor time/pain, as for a future legislative regulation both terms are of equal importance. Initially investigations using EEG together with electrocardiogram (ECG) and blood pressure and reflex measurements appear promising, followed by checking the adrenocortical function (adrenalin corticosteroid discharge) with horizontal catheter (BML AZ. 321 2971.4 60/73).

Following the decision of the expert group the BML issued on 1st July 1974 a research brief on the topic Objectification of pain and consciousness in the context of conventional and ritual slaughter of ruminants (initially sheep and calves) to Prof Dr W Schulze, director of the Clinic for small clawed animals and forensic medicine and mobile clinic of the veterinary university of Hanover. Within the research work of that clinic religious, physiological, and technical issues of ritual slaughter had been dealt with in a comprehensive study since the time of Kunkel (1962).

The research brief issued by the BML demanded a gradual development of the studies. The mastery of electrode technology and electrode implantation for the animal species concerned, the mastery of external electricity by building a Faraday cage for the experiments, and the preliminary experiments on rabbits must be mentioned as the first significant steps of the study. The individual work approaches required for this have since been published (Weber, 1975; Freeseemann, 1976, and Gross, 1976).

Early June 1977 the Clinic for small clawed animals and forensic medicine and mobile clinic of the veterinary university of Hanover published a short report on this research brief (Hazem, A.S., Gross, R., Schulze, W., 1977).

These documents reveal the following: The investigations carried out aimed at providing objective data for the evaluation of ritual slaughter from an animal welfare legislation point of view. As part of the research project the effectiveness of captive bolt stunning was first analysed using EEG. Comparable data about the ritual slaughter were then gained using the same method of deduction and evaluation. The ritual cut experiments were carried out on 17 sheep of the breed black headed meat sheep and 15 calves of various breeds. To further investigate the occurrence of low frequency potentials in sheep stunned by captive bolt followed by a bloodletting cut, six sheep were stunned in a second phase of the experiment by captive bolt and then bled at various intervals.

The approach of these studies can be summarised as follows:

Experiments for measuring the heart frequency and brain activity during slaughter conditions were carried out on 23 sheep and 15 calves. After implanting permanent electrodes into the Os frontale the cerebral cortex impulses were measured for 17 sheep and 10 calves during ritual slaughter and for 6 sheep and 5 calves during captive bolt application with subsequent bloodletting. Some sheep were additionally subjected to thermal pain stimuli after the ritual cut.

The investigations had the following results:

a) For slaughter by ritual cut:

1. After the bloodletting cut the EEG initially is the same as the EEG before the cut. There is a high probability that the loss of reaction took place within 4-6 seconds for sheep and within 10 seconds for calves.

2. The zero line in the EEG was recorded no later than after 13 seconds for 17 sheep and no later than 23 seconds for 7 calves.

3. Thermal pain stimuli did not cause an increase in activity.

4. After the cut the heart frequency rose for calves within 40 seconds to 240 heart actions per minute and for sheep within 40 seconds to 280 heart actions per minute.

b) For slaughter after captive bolt application:

1. After captive bolt stunning all animals displayed most severe general disturbances (waves of 1-2 Hz) in the EEG, which almost with certainty eliminates a sense of pain.

2. The zero line in the EEG was reached for 4 calves after 28 seconds.

3. For two sheep the cerebral cortex activity only stopped in one half of the brain, whilst it continued in the other in the region (up to 3.5 Hz) until the bloodletting cut.

4. The bloodletting cut resulted for all animals in a brain activity (e and d waves).

5. Thermal pain stimuli caused an increase in activity in one sheep.

6. The heart frequency rose directly after stunning to values above 300 actions per minute.

In summary the following conclusions are possible:

1. Slaughter after captive bolt stunning

A. Calves

After captive bolt stunning most severe general disturbances (waves of 1-2 Hz) occurred in the EEG, which almost with certainty eliminates a sense of pain.

B. Sheep

Similar disturbances were also seen in sheep, but besides the somewhat higher frequency there are still clearly superimposed waves. For one animal waves could be recorded after pain stimuli until after the 200th second. Apparent cramps were registered for all sheep with the exception of one animal.

2. Slaughter in the form of ritual cut

A. Calves

After the bloodletting cut loss of reaction (loss of consciousness) occurred with high probability within 10 seconds. A clear reaction to the cut could not be detected in any animal. For 7 animals a zero EEG was recorded no later than after 23 seconds. Cramps occurred in the animals regularly only after the brain currents had stopped.

B. Sheep

After the bloodletting cut loss of reaction (loss of consciousness) occurred after 10 seconds the latest. A clear reaction to the cut could not be detected in any animal. The zero line was recorded no later than 14 seconds after the cut. Cramps only occurred after the zero line had been detected and were much shorter than after captive bolt stunning.

The slaughter in the form of ritual cut is, if carried out properly, painless in sheep and calves according to the EEG recordings and the missing defensive actions.

During the experiments with captive bolt stunning no indications could be found for proscribing this method for calves.

For sheep, however, there were in parts severe reactions both to the bloodletting cut and the pain stimuli. A proof of the reliable effectiveness of captive bolt stunning could not be provided using the methods applied.

These first experiments carried out under clinical conditions and the insights for the correlations of sensory physiology during stunning/slaughter of small ruminants initially lead to the following factual and legal considerations for the preparation of legislation:

These experiments on sheep and calves carried out within a clinic show that during a ritual slaughter, carried out according to the state of the art using hydraulically operated tilting equipment and a ritual cut, pain and suffering to the extent as has since long been generally associated in public with this kind of slaughter cannot be registered; the ritual slaughter carried out under these experimental conditions complies with the requirements of article 4 para. 1 TierSchG. The EEG zero line as a certain sign of the expiration of cerebral cortex activity and according to today's state of knowledge also of consciousness occurred generally within considerably less time than during the slaughter method after captive bolt stunning.

Nobody can dispute that any slaughter of animals is an aesthetically loaded process. Thus the wide-spread emotional resistance to kill an animal, which has not been stunned, by cutting the throat, is understandable. Certainly the psychological argument for stunning the animal to be slaughtered must be considered to some degree for the person carrying out the slaughter or consuming the meat of these animals. Whether these initial findings of objective data on the processes of consciousness/pain made possible by the research brief are sufficient to somewhat alter existing opinions in the sense of the scientific orientation of animal welfare as demanded by the TierSchG, remains to be seen. They need to be followed as a high priority by further investigations in the continuation of the scientific clarification of the issues of loss of pain and consciousness during slaughter of this kind with and without stunning using the same experimental approach with a

representative number of grown cows of various breeds. A new research brief is already due to be issued to a different scientific institute.

The objective results presented for the captive bolt application in sheep show that here a satisfactory prevention of pain could not be proven with clinical methods; rather it indicates that the captive bolt device used is suspect. Therefore, research work in this field is also urgently required. This must be concerned with achieving an appropriate standardisation of the charge size, to ensure the rapid loss of perception and sensation in animals of different kinds and sizes. Similarly, the optimal dimension of the captive bolt must be found and finally the best shooting position and direction during application of the captive bolt device for the respective type of animal for slaughter. This must be based on the experience that the results gained for one species cannot simply be transferred to another. Further a subsequent regulation of the official approval for stunning devices, the methods of application after scientific review and a regular notification of approved devices must already be considered, as must a regular official audit of approved devices used for stunning. An appropriate training of the personnel concerned is also intended.

On the whole the insights into responses of the cerebral cortex to invasion and interference with the organism of an animal for slaughter gained through the existing research brief should also give rise to placing the research of sensory physiology in animals increasingly in the centre of veterinary medicinal research. Why should the measurable brain functions not also be given particular relevance during diagnostics!

Finally a few thoughts on the relevance of new scientific findings for existing law:

New scientific findings and the results presented are only a very first contribution which show that the ritual cut causes a very rapid loss of consciousness have an immediate bearing only if the practice ritual slaughter comes under the heading of causing pain (articles 1 and 4 para. 1 TierSchG).

They do not affect the requirement for stunning contained in article 4 para 1 TierSchG and the Law on slaughter of 1933 with the exception of the religious slaughter/ritual cut protected as part of the freedom of religious practice by the higher-order constitutional law. New findings of this kind may make the original considerations on this issue for including the requirement of stunning into the above-mentioned laws appear irrelevant. As laws do, however, remain in force irrespective of the causes which lead to their enactment, such findings are to this extent without consequence.

It must, however, be considered separately to what degree and in which way such findings should be considered during the restructuring of the Law on slaughter.

The same applies with regard to the stunning requirement demanded in the directive of the Council of European Communities dated 18 November 1974 on the stunning of animals prior to slaughter (1974). Here too, new scientific findings can only give rise to deliberations, whether such an instruction is or maybe continues to be factually justified, but they cannot question the validity of this instruction. New findings must, therefore, be left out of the consideration to what extent the national Law of Slaughter meets the demands of the above-mentioned directive. They can only be relevant when determining

the special cases in article 3 of the above-mentioned EC directive, as the religiously mandated ritual slaughter/ritual cut included as an exemption should be re-evaluated against the background of legal reasoning.

Summary

The deliberations on the restructuring of the Law of slaughter must with respect to the area stunning/killing mainly follow the guidelines of article 4 TierSchG. The Law of slaughter is seen as an integral part of the Animal Welfare Legislation. This stipulates generally that the standards of evaluation for the protection of animals should increasingly be oriented on exact and reproducible scientific findings. The approach, preparation, and implementation as well as the results of a research project of the BML at the Clinic for small clawed animals and forensic medicine and mobile clinic of the veterinary university of Hanover in the context of conventional (captive bolt stunning) and ritual (ritual cut) slaughter of small ruminants are being reported.

The insights gained through comparative investigation into the sensory physiological processes during the slaughter of these animals differ in parts greatly from existing conceptions. The necessary conclusions are being discussed and finally the effects on the legal situation are being commented on.

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