1981

Euthanasia of Day-Old Male Chicks in the Poultry Industry

Walter Jaksch
University of Vienna

Recommended Citation

Jaksch, W. (1981). Euthanasia of day-old male chicks in the poultry industry. International Journal for the Study of Animal Problems, 2(4), 203-213.

Euthanasia of Day-Old Male Chicks in the Poultry Industry

Walter Jaksch

Humane killing of animals implies a painless death (euthanasia). This depends on the rapidity with which unconsciousness is achieved and the maintenance of this state until death occurs. Euthanasia methods for day-old chicks must also be economical and should not interfere with the use of the carcasses for animal food or fertilizer. Manual decapitation or dislocation of the neck are the best available manual methods of euthanasia. For larger numbers of birds, the literature recommends homogenization in a crusher. In the author's own experiments, the destruction of day-old chicks was most effectively carried out by poisoning with carbon dioxide (CO_2). A simple gas chamber was constructed, which is now commercially available, into which boxes of chicks were placed. The chamber has the capability to euthanize approximately 8,000 chicks within 2-3 hours at minimal cost.

Introduction

With the development of modern hybrid breeds, the poultry industry has produced flocks with distinctive genetic performances. The laying flocks, bred for maximum productivity, utilize all their energy for producing eggs, with a minimal amount of weight gain. The males of the laying flocks, with the exception of those few used to fertilize the hen, are of little use. Because of their genetic make-up, it is economically unfeasible to fatten them up for meat production. As a result, millions of newly hatched male chicks are destroyed each year.

Although most industrialized countries have regulations for the slaughter of livestock, these concern mainly food animals, and as such govern the techniques of stunning and bleeding, and ensure hygenic preparation of the meat. Since there is no consumption of the day-old chickens and thus no public health consideration, little attention has been given to this procedure. In fact, there are no known regulations which exist specifically for the euthanasia of these birds.

The first scientific report in the German literature on the methods of euthanizing male chicks did not appear until 1969, when Gerriets (1969) investigated euthanasia by gas poisoning and manual techniques. Poisoning with carbon dioxide and nitrogen, homogenization in a crusher, and manual blows are at present considered the most effective and efficient methods.

All other publications on the euthanasia of poultry up to 1973 dealt only with the adult fowl or single birds. In 1973, Mitterlehner and Jaksch presented a preliminary report of their research on the euthanasia of day-old male chicks. This was followed by their publication of reports on the development of mass euthanasia of chicks by carbon dioxide poisoning (Jaksch and Mitterlehner, 1979). Hilbrich (1976, 1977) also published the results of experiments using crushers, and in 1976, mention of the problem was first made in a textbook (Siegmann, 1976).

This paper will discuss and evaluate the various methods used for mass euthanasia of male chicks with regard to the existing literature and the author's own research.

Dr. Jaksch is Professor of veterinary medicine at the University of Vienna, Medical Clinic for Hooved Animals, Small Animals and Poultry, Linke Bahngasse 11, A-1030 Vienna, Austria.

Killing Methods for Chicks

Methods currently in use may be divided into four groups:
1) Mechanical—manual dislocation of the neck or decapitation; large scale homogenization.
2) Oxygen withdrawal—suffocation or drowning.
3) Carbon dioxide or nitrogen gassing.
4) Electrocution.

Mechanical methods
(i) Manual

Decapitation is effected by using sharp scissors or for large animals, a sharp, heavy chopper. An assistant should hold the bird by its legs, wings, and breast, placing the head and neck sideways on a block with the bird facing away from the operator. After decapitation, one can observe movements of the body for 44-75 seconds after unconciousness and death (Jaksch, 1980).

Decapitation, while esthetically unpleasant, is not objectionable from the medical and humane points of view, as death is virtually instantaneous.

The spinal cord of small birds and chicks can also be cut without using an instrument (*cervical dislocation*). The bird is held with the left hand and the neck taken between the thumb and forefinger knuckle of that hand. The thumb and the forefinger knuckle of the right hand are applied to the neck, close to those of the left hand. Using a hard grip with both hands and a sharp twist (UFAW, 1967) the joint between the head and neck areas is dislocated, and death occurs immediately as a result of destruction of the medulla. This method is used in some small hatcheries in continental Europe, and if performed correctly, is rapid and humane.

Stunning may be performed by striking the head smartly against a hard object. To ensure death, a second blow should follow. This method is only reliable when perfectly performed; otherwise birds may regain consciousness some time later with severe brain injury. This is more of a problem when large numbers of birds are being killed. After stunning, the throat should be cut on a diagonal, as near to the head as possible.

Decapitation, which usually results in a spray of blood, seems to be the preferred mechanical method of euthanasia for chicks. German animal protective legislation also recognizes the head-strike (stunning) and cervical dislocation as acceptable methods if correctly performed.

Manual methods are not widely used in hatcheries, probably for several reasons. They are labor-intensive and may therefore prove uneconomical (although the author has witnessed one operator killing approximately 1,000 chicks per hour). They are esthetically displeasing to the layman and emotionally stressful for the operator. Furthermore, it is likely that a social stigma attaches to personnel who euthanize animals in such a manner (Owens *et al.*, 1981). These factors, combined with the possibility of slovenly and consequently inhumane handling and execution, seem to outweigh the advantages of these methods.

(ii) Homogenization

Homogenization of chicks in a crusher has the advantage of being able to kill large numbers of birds in a short time without any handling by individuals. Several authors have recommended this technique with the proviso that the equipment be properly designed to ensure rapid and humane death (Gerriets, 1969; Fiedler, 1976; Gylstorff, 1976; Siegmann, Woernle, personal communications).

Hilbrich and von Mickwitz (1977) used a special-feed homogenizing mill running at 5,000 or more revolutions per minute which could handle over 1,000 chicks every two minutes. The author found that at lower revolutions per minute (1,420 or 2,810), the results were not satisfactory. Even after twenty seconds, there were only partly damaged animals with whole skulls. Therefore, these speeds should be used for anesthetized chicks only. In all cases, it is essential that the crusher be equipped with a funnel through which chicks are dropped one at a time (Fiedler, 1976; Hilbrich, 1976). The produced mash can then be used as animal feed or manure, or it can be deep-frozen. Death occurs virtually within one second. The method is safe for personnel. It is quick and costs are minimal, disregarding the initial cost of purchasing the equipment. Only esthetic considerations remain to bar the use of this method; although the sensibilities of personnel should be taken into account, they should not override considerations of humaneness and efficiency.

Oxygen withdrawal

Decompression is a highly controversial killing method. It is argued that decompression due to low ambient air pressure leads to a painless, rapid descent into unconsciousness and death. Decompression has been used on a wide scale in the U.S. for killing dogs and cats, but the known resistance to the effects of hypoxia in young animals (and many of the animals killed are puppies and kittens) has thrown the method into serious question. However, without further research, the physiological responses of dogs and cats cannot be reliably extrapolated to chicks.

Decompression is practiced widely in the poultry industry of the German Democratic Republic, and is recommended as a rapid and safe method (Heider, 1972). In the author's research, it was found that the reduction of air pressure within ten seconds to 8.0 kPA (60mm Hg) induced dyspnea (labored breathing) in the chicks. After twenty seconds, the birds fell over onto their sides and later onto their backs. Just before death, which occured within 40-80 seconds, a foamy discharge appeared on the beak, indicating lung edema. Time of onset of unconsciousness was uncertain.

Decompression equipment is very expensive, but the operating costs are minimal. The equipment is complex and requires careful attention by properly trained and skilled operators.

Suffocation of chicks in sacks or firm containers is also practiced in hatcheries. Although hatcheries have claimed that densely packed chicks die within two to three minutes, the author has found chicks at the top of a sack still breathing after 1½ hours, which suggests that death is caused not only by oxygen starvation, but also by mechanical hindrance to breathing caused by the birds being squeezed so tightly together.

Large numbers of chicks are killed in hatcheries by drowning in special cages or nets. This is a highly unsatisfactory method due to the prolonged killing time (90-120 seconds in our experiments) and the high probability that some of the chicks will die by suffocation as a result of being crowded together. Boiling water reduces the killing time but does not alleviate the crowding problem.

In summary, all currently available methods involving oxygen withdrawal are unacceptable in varying degrees. Drowning is probably the most objectionable, and has been categorically rejected by UFAW (1968) as a method of euthanasia.

Gassing

(i) Chloroform, nitrogen and carbon monoxide

Euthanasia with ether or preferably, *chloroform*, can be performed on chicks in

the same manner as for dogs and cats, *i.e.*, by introduction of the gas into a closed chamber (UFAW, 1968; Carding and Fox, 1978). However, in practice, this method is often misused because of the large numbers of animals involved. Chicks are collected in sacks, sprayed with chloroform, and placed in closed chambers. Depriving the birds of air makes it difficult for the volatile chloroform to produce a vapor. The high concentration of liquid chloroform irritates skin and mucus membranes, and most of the birds suffocate before the chloroform can take effect.

For dogs and cats a concentration of 1.5-2.0% of chloroform vapor in air is sufficient to produce anesthesia and death. For large numbers of chicks, exposure must last longer; the birds should remain in the gas chamber for at least 15 minutes, as shorter exposure may result in deep anesthesia only (UFAW, 1968; Eckloff, 1963; Fiedler, 1976).

Unfortunately, the proper use of chloroform is time-consuming and expensive. Additional disadvantages include the volatility of the gaseous substances, the danger to the operators from chronic inhalation of chloroform fumes, and the unsuitability of the killed chicks for use as feed.

Nitrogen was first used to kill mink (Vinter, 1957) and later to kill other animals, including ducks (Fitch *et al.*, 1974). In high concentrations, nitrogen produces unconsciousness through hypoxia by displacing oxygen in the air. UFAW has not yet approved this method, as hypoxia and respiratory paralysis may be distressing and often unavoidable prior to unconsciousness. Gerriets (1969) has had disappointing results with a mixture of nitrogen and carbon dioxide: The chicks took up to 3 minutes to die and demonstrated intense excitation during that period.

Exhaust fumes from car engines are the most usual source of *carbon monoxide* as a killing agent. In 2% concentration, this gas causes rapid death through anemic anoxia leading to respiratory paralysis and unconsciousness. Death occurs painlessly and without apparent discomfort at 70-80% concentration in the blood (Lumb and Jones, 1973). Although carbon monoxide is nonflammable, nonexplosive and odorless, the gasoline engine generator produces impurities (carbon particles, oxides and oxygenates) which may be irritating to the chicks. Furthermore, failure to cool the gas sufficiently may result in the chicks suffering pain from the hot air. This can be avoided by passing the gas through a large water chamber which cools it and removes some of the impurities. Pure carbon monoxide is available in cylinders, but can be prohibitively expensive. According to Gylstorff (1976) both carbon monoxide and chloroform are more dangerous than carbon dioxide, as repeated prolonged exposure to these substances can have toxic effects on humans.

(ii) Carbon dioxide

Nonflammable, nonexplosive, odorless, colorless carbon dioxide (CO_2) is a preferred agent for euthanasia of chicks in poultry-producing countries. Recommended by UFAW for euthanasia of small animals, CO_2 inhalation causes little or no distress to the birds, works reasonably fast, and suppresses nervous activity (UFAW, 1978).

Experiments on the effects of CO_2 as a killing agent have been confined mainly to dogs, cats and small laboratory animals (American Veterinary Medical Association, 1972). Inhalation of low concentrations of CO_2 increases the threshold of pain, while higher concentrations (30% +) depress the central nervous system, leading to unconsciousness followed by respiratory arrest and death. In dogs, 70% is the approximate optimum concentration at which the animals collapse after 20 seconds and die after 5 minutes with almost no hyperpnea (rapid breathing). It is generally believed that because the gas is odorless and colorless, the animal cannot detect it

and therefore the depressive effect occurs without preliminary fear or excitement, as long as enough oxygen is provided until onset of unconsciousness. However, Carding and Fox (1978) state that the use of CO_2 has not been satisfactorily adapted for euthanasia of dogs and cats and recommend its use only as an alternative to intravenous injection of barbiturates in wild or fearful cats.

Poultry must be evaluated separately due to their special air-sac respiratory system, which influences gas concentration and duration of fumigation. Experiments with CO_2 to produce anesthesia prior to slaughter have been performed on chickens by Kotula *et al.* (1957, 1961) and Scott (1967), and on turkeys by Drewniak *et al.* (1955).

CO_2 anesthetization of slaughter poultry requires 33-36% concentration for chickens and 70% for turkeys; fumigation times are 75 and 15 seconds, respectively. Day-old chicks, however, are relatively resistant to carbon dioxide since respiration begins during embryonic development, resulting in CO_2 concentrations of up to 14% in the egg before hatching. Thus CO_2 concentrations must be especially high for this age group.

Kaltofen and Houben (1973) reported that chicks become unconscious within 10-15 seconds after being submerged in carbon dioxide; they appeared to have no fear, jumped once or twice, and then collapsed, opening their beaks. In contrast, Hilbrich and von Mickwitz (1977) observed considerable movement until death occurred. Dyspnea and jumping lasted up to 45 seconds, and movements were observed even after 90 seconds. In an open system, chicks remained alive after 45 minutes and then recovered after 4 minutes. In a closed system (a bag filled with CO_2), the chicks died after two minutes. In the author's experiments using a closed system, chicks showed dyspnea after 10 seconds and grew quiet after 20-30 seconds, resting on their sides and showing occasional eye movement. Only one bird continued to move (for 20 seconds) 40 seconds after the experiment commenced. These results corroborate the findings of Cooper (1967) and Kaltofen and Houben (1973), but the author agrees with Hilbrich and von Mickwitz that gassing should last at least 5 minutes to ensure the chicks' death.

It cannot be concluded on the basis of the observed excitation that the chicks experience pain or distress. The same movements often occur after decapitation. Fiedler (1976) attributes most of these movements to hypoxemia in the breathing center which occurs after the onset of unconsciousness.

Because carbon dioxide has a high density, it can be administered either in an open or closed system.

Open system: CO_2 gassing in an open system involves placing the animals in an open container or chamber with a gas lake on the floor. UFAW (1967) recommends a lidless chamber of 100x1.33cm (3x4 ft) square dimension and 150cm (4 ft, 6 in) in height. The birds are placed in a polypropylene crate with a grid floor, and lowered into the gas-filled chamber. To displace any air pockets present between the body and the feathers, the crate should be moved up and down a distance of 15-30cm.

Anesthesia is produced within 30-45 seconds, accompanied by a small amount of wing-flapping. After two minutes, more carbon dioxide should be introduced to replace the gas already inhaled. To ensure that all birds are killed before the crate is removed, it is necessary to allow 5 minutes to elapse from the time the crate enters the chamber.

In the author's experiments (Mitterlehner and Jaksch, 1973; Jaksch and Mitterlehner, 1979), there was a distinct difference between the times required for

euthanasia of the birds in the first crate and the second and subsequent crates. Birds in the first crate required 25 seconds for euthanasia compared to 3 minutes for the second. After nine introductions, the concentration of the carbon dioxide had been reduced to only 50%. With each subsequent gassing, it is therefore recommended that the open containers be refilled. Further, the period of exposure should be less than 5 minutes. After gassing the crates should be carefully checked to ensure that all birds have been killed.

A modification of this technique is the use of polythene bags in which small numbers of chicks are placed and CO_2 then introduced. A rubber band placed at the neck of the bag prevents the gas from escaping. Because carbon dioxide euthanasia in an open system is not always reliable and requires constant refilling (more expense), carbon dioxide euthanasia in a closed system is preferred.

Closed system: The method most used is similar to the modified technique described above. The chicks are placed in air-tight sacks or containers and the gas is introduced afterward. While UFAW recommends only a small number of chicks for the modified technique, this method allows for more chicks, filling the sack to the neck. As has been noted, the chicks require enough air to become unconscious without distress. After the onset of unconsciousness, the gas concentration can be increased to ensure that the birds are killed.

In the first group of experiments, sacks of 1m height and 35cm diameter were filled (within 4-10 minutes) with 650-1,560 chicks. Without introduction of the gas, one third of the chicks at the lower end of the sack were killed after 15 minutes. Of the remaining chicks, some were damaged in various ways, while those in the uppermost layers were still alive and had sustained no damage. When this experiment was repeated with introduction of the gas *after* filling, those chicks in the upper layers were immobilized by the gas, but not all were killed. Those in the lower layers were killed and/or damaged. In the last of these experiments, the sack was filled with 1,560 chicks within 10 minutes and no additional gas was introduced. Upon filling the sack, the chicks in the lower half of the sack showed no movement; 15-25 minutes later the chicks in the upper layers were still alive. Upon introduction of carbon dioxide, it was again found that the gas did not reach the bottom of the sack.

In other trials using smaller numbers of chicks, as some hatcheries do, similar results were obtained.

As a result of these experiments, the author concludes that because a large number of birds die by suffocation before the carbon dioxide is introduced, this method is unsatisfactory for proper euthanasia in modern poultry production. Experiments have been conducted, however, with the aim of modifying this technique to accommodate large numbers of birds. Kaltofen and Houben (1973) devised an air-tight sack containing a funnel and a valve which closed the opening after each bird was passed through the funnel. The sack has a capacity of 1,200 chicks, and the carbon dioxide is introduced through a tube which extends from a cylinder to the bottom of the sack. Initially a large amount of CO_2 is introduced with smaller amounts added later. When the sack is filled with gas, CO_2 is supplied for two more minutes, then the sack is closed. Generally, the chicks are unconscious within 10-15 seconds after entering the sack. Death occurs within five minutes. The sack must be adjusted to a sloping position to prevent the chicks from falling to the bottom (Fiedler, 1976). If too large a number of chicks is used, death occurs too quickly (by suffocation). If too small a number is used (50), the time required to render them unconscious is increased.

Gas chambers: The author has constructed simple gas chambers in which the chicks are placed in small boxes such as those used in transport (Figs. 1 and 2). The boxes are placed on different floors with ample air space to avoid compression, hindrance of movement, and suffocation. After filling the chambers and closing the air-tight doors, the gas is introduced.

On the basis of the author's work, an Austrian manufacturer (R. Schropper, A-2641 Schottwien, Austria) has constructed a modified chamber. Built from rust-free sheet-steel, the chamber is constructed to accommodate the transport boxes. Each box has four compartments which are normally filled with 25 chickens each. For euthanasia purposes, twice this number is used, *i.e.,* about 200 chickens per box. The chamber can hold 8 boxes, or 1,600 chickens. The gas tube is so constructed that there is a pipe over each compartment of a given box, allowing for direct introduction of the gas. On the top of the chamber there is an opening to allow air to escape while the CO_2 is being supplied. The pipes are designed to introduce a small amount of CO_2 into the compartment to mix with air so that the chick may breathe without distress while becoming unconscious. After rendering the chick unconscious, a high concentration of the gas is added which kills the chick. The introduction of the gas requires 3 minutes, after which the chamber is closed for 15-30

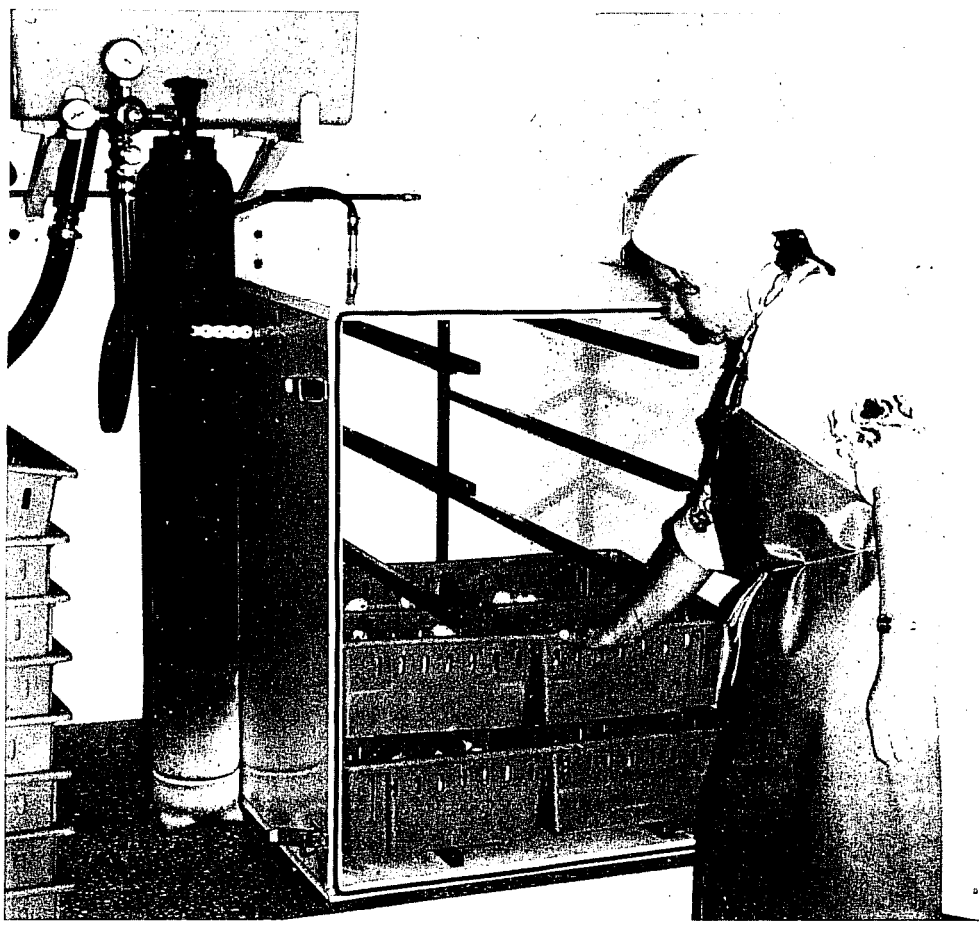

Figure 1 Chamber and apparatus for carbon monoxide euthanasia.

minutes. Since the gas is concentrated primarily in each compartment, only a small amount is required for euthanasia.

Electrocution

Electrocution has been used widely since 1920 but most methods are considered unsatisfactory and cause pain to the animal.

The procedure involves inducing unconsciousness in the animal by passing a current directly through the brain. Following the animals' display of the classic electroplectic fit, a second and lethal current is passed through the body to produce death from ventricular fibrillation and circulatory failure. Electrocution can be an efficient method of euthanasia for dogs if the sophisticated apparatus is used correctly and the operator recognizes the electroplectic fit (Carding and Fox, 1978).

Experiments with the electrocution of poultry have been performed by Richards and Sykes (1964, 1967), who used stunning electrodes to produce unconsciousness. Immediately following, an automatic knife opened the veins and arteries of the neck to complete the slaughter process. This particular method was found to be time-consuming and sometimes ineffective.

Most processing equipment has apparatus that passes the current through the head via a waterbath. Scott (personal communication) claims that with this method the typical electroplectic fit is produced, thereby rendering the animal unconscious. However, Müller (personal communication) and Fricker (1974) have found that such currents may produce only a painful fibrillation or muscle spasm and leave the animal fully conscious for some time before death. This has been observed in dogs. In euthanasia, as opposed to slaughter, it is unnecessary to bleed the animal. Therefore, *simultaneous* initiation of unconsciousness and death would be acceptable.

Figure 2 Chicks in transport boxes inside chamber.

Experiments involving electrocution of poultry have only been conducted on slaughter birds and not on day-old chicks. In actual practice, electrocution is not used on poultry for technical reasons (Fiedler, 1976; Heider, 1972).

Evaluation of Different Methods

A method for euthanasia of day-old chickens which could be recommended by the veterinary medical profession and welfare organizations should satisfy the following criteria:

- Speed
- Reliability of inducing unconsciousness and death
- Painlessness (or to satisfy European legislation, as painless as possible).
- Ease of application
- Economy, *i.e.,* cost of equipment, installation and labor
- Safety (for the personnel and environment)
- Preservation of the dead chicks for further use (as animal food or manure)
- Esthetics (no disturbing effect on personnel or observers).

None of the methods reviewed fulfill all these criteria perfectly. Many methods, when practiced on a large scale, can cause pain to the animal. While euthanasia by decapitation is the preferred method, it is not cost-effective, as an operator can kill no more than 1,000 birds per hour. Further, it may be esthetically disturbing to personnel and laymen.

Other mechanical methods such as damaging the medulla or skull by head-striking are equally unpleasant, with the added danger of negligence. Thus, the author does not recommend these methods.

The use of crushers seems to be acceptable if certain technical criteria are fulfilled (number and position of knives, speed of revolution, etc.) and the chicks are placed one by one into the machine. Homogenization is, however, esthetically unpleasant to personnel and laymen.

Euthanasia by carbon dioxide gassing is advantageous in that it produces rapid anesthesia which leads to death. This can be effected, however, only if certain technical requirements are satisfied, such as a minimal time of exposure. The UFAW modified technique described earlier would not be suitable for practice, as only small numbers of chicks can be used. The technique of Kaltofen and Houben (1973) is also suitable only for small groups of chicks.

Fumigation in closed systems where the transport crates are simply put into a gas chamber is recommended by the author as an economical, quick, and "fail-safe" method for large-scale euthanasia of chicks.

References

American Veterinary Medical Association (1972) Report of the AVMA Panel on Euthanasia, *J Amer Vet Med Assoc 160*:761-772.

Carding, T. and M.W. Fox (1978) *Euthanasia of Dogs and Cats.* Institute for the Study of Animal Problems, Washington, DC.

Cooper, D.M. (1967) Destruction of birds with carbon dioxide, *Vet Rec 81*:444-445.

Drewniak, E.E., E.R. Bausch and L.L. Davies (1955) *USDA Circular No. 958.* U.S. Department of Agriculture, Washington, DC.

Eckloff, F. (1963) Humane killing, *The ATA Manual of Laboratory Animal Practice and Techniques.* D.J. Short and D.P. Woodnott, London, UK.

Fiedler, H.H. (1976) Die Tötung aussortierter Eintagshähnchen — eine Literaturstudie unter tierschützerischem Aspekt, *Arch Geflugelk 40*:56-60.

Fitch, J., P. Hall and R. Herin (1974) *Report to the American Humane Association on the High Altitude (Low Pressure) Method of Euthanasia.* American Humane Association, Denver, CO.

Fricker, Ch. (1974) *Die elektrische Betaubung von Huhnern vor dem Schlachten mit Wechselstrom von 50 Hz.* Dissertation, Veterinary Medical Faculty of the University of Zurich.

Gerriets, E. (1969) Schlachten und Töten von Hühnern, *Berl Munch tierarztl Wschr 82*:63-65.

Gylstorff, I. (1976) Tierschutzgerechte Tötung von Wirbeltieren, *Arch tierarztl Fortbldg 3*:52.

Heider, G. (1972) *Vorbeugender Gesundheitsschutz in der industriellen Geflugelproduktion.* VEB Gustav Fischer Verlag, Jena, DDR, pp. 103-104.

Hilbrich, P. (1976) Tierschutzgerechte Tötung von Wirbeltieren, *Arch tierarztl Fortbldg 3*:25

Hilbrich, P. and G. von Mickwitz (1977) Tierschutzgerechte Töten aussortierter Eintagschähnchen und nicht schlupffähiger Küken im Brutei, *Berl Munch Tierarztl Wschr 90*:355-358.

Jaksch, W. and A. Mitterlehner (1979) Euthanasie von Eintagsküken in der Massentierhaltung, *Wien tierarztl Mschr* 66:37-46, 145-149.

Jaksch, W. (1980) Betrachtungen zur elektrischen Betäubung des Geflügels bei der Schlachtung, *Wien tierarztl Mschr 67*:77-86, 321-337.

Kaltofen, G.S. and G.J.T. Houben (1973) Het doden van eendagskuikens, *De Pluimveehouderij 3*: Spelderholt Mededeling 198.

Kotula, A.W., E.E. Drewniak and L.L. Davies (1957) Effect of carbon dioxide immobilization on the bleeding of chickens, *Poult Sci 36*:585-589.

Kotula, A.W., E.E. Drewniak and L.L. Davies (1961) Experimentation with in-line carbon dioxide immobilization of chickens prior to slaughter, *Poult Sci 40*:213-216.

Lumb, W.V. and E.W. Jones (1973) *Veterinary Anesthesia.* Lea and Febiger, Philadelphia, PA.

Mitterlehner, A. and W. Jaksch (1973) *Proc 5th Internat Cong World Veterinary Poultry Assoc,* Munich, BRD, p. 639.

Müller, A. (1970) Grundlegendes zur Elektroanästhesie, *Schweiz Arch Tierhk 112*: 215-226.

Owens, C.E., R. Davis and B. Smith (1981) The psychology of euthanizing animals — the emotional components, *Int J Stud Anim Prob 2*(1):19-26.

Richards, S.A. and A.H. Sykes (1964) Observation on the electrical stunning and slaughter of poultry, *Vet Rec 76*:835-840.

Richards, S.A. and A.H. Sykes (1967) Physiological effects of electrical stunning and venesection in the fowl, *Res Vet Sci 8*:361-368.

Scott, W.N. (1967) Cited from Glen, J.B. (1971) The use of carbon dioxide for preslaughter anesthesia, *Humane Killing and Slaughterhouse Technique.* Universities Federation for Animal Welfare, Potters Bar, Herts., UK.

Scott, W.N. (1971) The use of electrical stunning devices in poultry slaughter, *Humane Killing and Slaughterhouse Technique.* Universities Federation for Animal Welfare, Potters Bar, Herts., UK.

Siegmann, O. (1976) *Kompendium der Geflugelkrankheiten.* M. & H. Schaper, Hanno-

ver, BRD, p. 30.
Universities Federation for Animal Welfare (1967, 1968) *Humane Killing of Animals.* Universities Federation for Animal Welfare, Potters Bar, Herts., UK.
Universities Federation for Animal Welfare (1976) *Humane Destruction of Unwanted Animals.* Universities Federation for Animal Welfare, Potters Bar, Herts., UK.
Universities Federation for Animal Welfare (1978) *Humane Killing of Animals* (3rd ed). Universities Federation for Animal Welfare, Potters Bar, Herts., UK.
Vintner, F.J. (1957) Humane killing of mink, *Brit Fur Farm's Gazette,* August 1957.

Animal Welfare Science Essay Competition

Deadline: December 31, 1981 Two $500 Prizes

Competition Rules:

- All enrolled veterinary students in the U.S. (including those who have graduated within six months of the deadline) are eligible to compete.
- The two best essays, selected by a panel of judges comprised of veterinarians, philosophers, ethologists and other relevant scientists, will be awarded a cash prize of $500 and a Certificate of Appreciation. Judging criteria will include quality of writing, the accuracy of the supporting data and the extent to which opposing viewpoints have been taken into consideration and/or refuted.
- Essays should be between 4,000-5,000 words in length and may be based on literature and analyses, data gathering projects or personal viewpoints. All essays should be thoroughly documented with appropriate citations and references using the JAVMA format.
- The winners will be welcome to submit their essays to the International Journal for the Study of Animal Problems for consideration of publication.
- Copyright of the winning entries will be transferred to the Institute for the Study of Animal Problems as a condition of receiving the award. The author's rights will be reserved.
- Candidates who are in doubt about the suitability of proposed topics are invited to contact Dr. Michael W. Fox for advice. Examples of subjects from which essay topics (either broader or more specific) may be selected include:

Trapping
Predator Control
Farm Animal Husbandry and Welfare
Use of Animals in Teaching
Humaneness and Veterinary Ethics
Ethical and Legal Aspects of Animal "Rights"
Euthanasia Techniques
Laboratory Animal Welfare
Zoo Animal Behavior Problems
Welfare of Circus Animals
Rodeo Animals/Race Horses
"Pet" Welfare and Owner/Breeder Responsibilities

Sponsored by: The Institute for the Study of Animal Problems
2100 L Street, N.W., Washington, D.C. 20037

Send Essays or Enquiries to the Attention of: Dr. Michael W. Fox