

## Letters

### Humane Killing of Crustaceans

Gunter pleads for humane killing of crabs in the home and on a commercial scale [*Science* **133**, 327 (1961)]. The technique he describes, while yet to be adopted in the United States, is in full use in the United Kingdom and on the Continent. Commercially, the edible European crab (*Cancer pagurus*, Linn., 1785) is generally placed in tanks containing sea water. Sufficient heat is applied to warm the water to a point where the crabs become lethargic, then die. Additional heat is then applied to bring the water to a racing boil.

Another method practiced by fish-mongers is the "sticking" of crabs before boiling. For this, a wooden-handled awl is used. The crab is placed on its back, and the point of the awl is pushed through the exoskeleton in two places. The anterior "stick" is made in the depression in the midline at the posterior end of the first antennal segment of the sternum, just in front of the epistoma. The posterior "stick" is made in the large depression in the midline, at the posterior end of the sternum of the chelae segment. Thus, it is evident that the two main nerve centers of the body, the brain (fused cerebral ganglia) and the ventral nerve mass, are disrupted.

Historically, Sinel in England (1914), under the auspices of the Trondhjem Society for the Protection of Animals, published a method for home killing of crabs and lobsters that utilized gradual increase in water temperature. Aaser in Norway (1947) placed lobsters in a weak salt solution and gradually raised the temperature of the water to the lethal point; he found this to be between 38° and 45°C.

Baker, at Oxford University (1955), studied both the "sticking" and the "warming" methods and found the piercing of the brain and ventral nerve mass to be best for rendering crabs insensible before boiling.

Commercially, in the United States,

where both boiling and steaming of crabs is practiced, the casting of appendages (autotomy) is the rule. This does not occur where "sticking" or "warming" is practiced. As Gunter notes, crabs undergo violent reactions as they are scalded to death. The appendages are raised and pressed against the edges of the carapace. If powerful enough, the appendage breaks off at the fracture plane in the basi-ischium. This is a source of loss of fluid (with resultant loss of taste) and of edible muscle tissue, which is forced out during the steaming under pressure at 5 to 20 pounds per square inch.

As to the actual feeling of pain, however, we will have to await future experiments by competent psychiatrists for "proof" of that point.

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In his report Gunter did not mention the fairly extensive literature on the painless killing of crabs and other large Crustacea. Quite a lot of work has been done on this subject in Europe. The chief references are given in a readily available paper (1). The methods mentioned by Gunter (placing the crustacean in fresh water and gradually raising the temperature of the water) have been studied rather fully.

My own investigations on crabs (*Cancer pagurus* L.) were carried out at the Marine Biological Laboratory, Plymouth, under the auspices of the Universities Federation for Animal Welfare (UFAW). I tried every known method and reported the results in detail (1) in such a way that every experiment could be exactly repeated. I reached the conclusion that the most humane way to kill crabs was to pierce the two chief nerve ganglia with an awl. I gave precise instructions for carrying out this process, which can be quickly learned by anyone of average intelli-

gence who will make a brief study of the external anatomy of a dead crab before he practices on a living one.

I have demonstrated my method at Billingsgate (the chief fish market in London) and on television. A pamphlet on the method has been published by UFAW (2).

The killing of lobsters presents problems different from those involved in the killing of crabs, because lobsters have many nerve ganglia instead of only two main ones, and because the gills are freely exposed to the surrounding water instead of being enclosed in a branchial chamber. The killing of lobsters is now being investigated under the auspices of UFAW.

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### References

1. J. R. Baker, *J. Marine Biol. Assoc. United Kingdom* **34**, 15 (1955).
2. Anon., *The Humane Killing of Crabs and Lobsters* (Universities Federation for Animal Welfare, ed. 2, London, 1960).

The report by Gunter brought to mind a similar suggestion that caused a great deal of commotion in Norway some 25 years ago. The idea was the same; slow heating of a lobster was supposed to be painless, and thus more humane than the rapid but more violent killing in boiling water. As far as I can recall, well-meaning animal protectionists wanted the procedure prescribed by law, but the objections raised got it stopped.

I believe that we are all in favor of humane treatment of animals, and scientists in particular are well aware of the desirability of avoiding unnecessary "suffering" in experimental animals. It is unfortunate, however, that a seemingly "scientific" argument is used to advocate a procedure that may increase the sufferings of our beautiful and tasty friend the lobster.

In Norway, when newspaper readers sent letters to the editor about the best way to kill lobsters, a distressed lady wrote about her experiences. She put her lobsters in the pot and put the pot on the stove. The lobsters seemed to dislike the situation and started to climb out, so the lady had to keep the lid on. The lobsters were strong, and for some 20 minutes she fought and suffered mental anguish while the lobsters struggled to get out; luckily, they gradually succumbed and gave up the fight. In her letter the lady vowed never to be so

cruel to animals again. This little account has another point as well; it brings out a distinction between suffering and pain. Obviously the lady suffered, although presumably she felt no physical pain; what the lobsters felt is, unfortunately, beyond the realm of human knowledge.

I am therefore not much concerned about Gunter's anthropomorphic statement, "anyone who watches the violent actions of crabs being scalded to death can see that they suffer extreme pain." Of course, we know nothing about the

extent of suffering in a lobster or crab. The violent movements last for a few seconds, but who will tell us whether the lobster stops suffering when he cannot flip his tail any more? Or whether he felt any pain at all? We do know that sometimes little or no pain is felt by human beings in a serious accident until well after the event.

More seriously, I am concerned about some of Gunter's other suggestions. He wants to place the animals in cool fresh water and raise the temperature steadily to about 40°C. How can we

find out whether the lobster suffers from being placed in fresh water? Of course, we have no possible way to define suffering in a nonhuman species, but I would suggest that a lobster may not like to be in fresh water. The lobster lives in ocean water and does not have physiological mechanisms of osmoregulation to counteract the effects of fresh water. The fact that his nervous system deteriorates and his reactions get slower in fresh water proves nothing about whether or not there is anesthesia, such as Gunter claims, or about when the hypothetical anesthesia sets in. How much "discomfort" does the lobster experience up to the point when the breakdown of nerve conduction is sufficient for "anesthesia"? If he could feel and speak like a human being, the lobster would probably tell us that he is extremely uncomfortable in a pot of fresh water.

The next step is to heat him slowly. The lobster prefers cool water, and as Gunter says, his tolerance for temperature increase is limited. Gunter certainly knows how uncomfortable he can be on a hot summer day in Texas. I myself shudder at the thought of a hypothetical Texas day with the temperature continuing to rise and rise, and I find no comfort in Gunter's statement that "death from heat occurs long before coagulation of the protein." It seems logical that the more slowly we heat the lobster, the more time we give him in which to suffer, but since we have such inadequate means for communicating with lobsters about suffering and pain, I propose that we use some common sense in deciding whether to kill him slowly or quickly.

KNUT SCHMIDT-NIELSEN  
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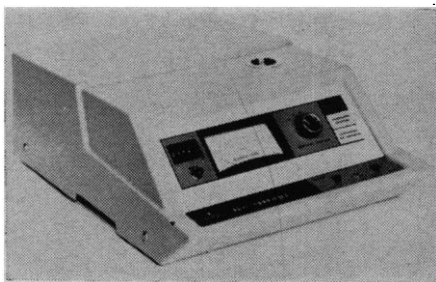
Criticisms pro and con of my idea on how to kill crustaceans have come by letter and from the newspapers at a surprising rate. Adverse criticisms state that the whole affair is a tempest in a crab pot, scalded crabs die instantaneously without suffering and are of better flavor, slow heating of crabs causes slow, torturous death, and the assumption that crabs suffer pain is based on specious reasoning and cannot be proved. One gentleman says the low-heat method gives more relief to the cook than to the crab.

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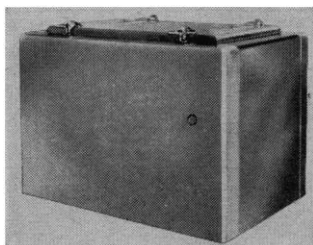
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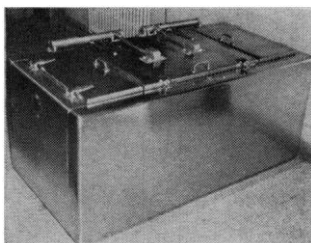
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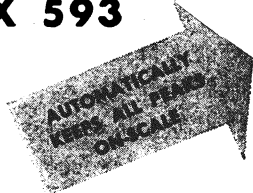
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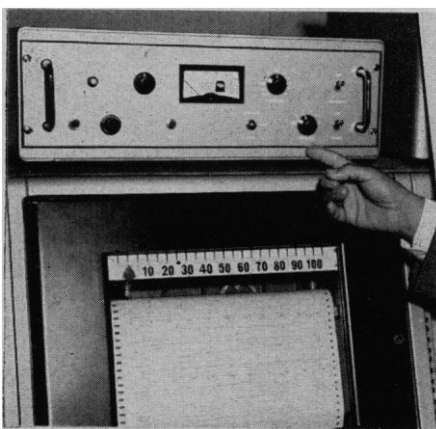
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Simon, president of the Wine and Food Society (British), in his *A Concise Encyclopaedia of Gastronomy* (1940). Bertrand Couch has stated that several older American cookbooks recommend placing live crabs in cold water and slowly raising the temperature, but that recent recipes generally recommend killing by boiling water. The latter is the common American practice, but I am glad to learn from the notes of Benarde and Baker that methods are different in northern Europe. Humane ways of killing crustaceans are certainly not well known in this country, as is shown by the widespread comment my brief note created in the newspapers and by the request received from a government official for a popular article for the benefit of the "thousands" of American housewives who will not now purchase live crustaceans for home cooking.

In reply to the criticisms which have come to me, I should like to add the following statements to my previous remarks.

Physiological and ecological studies on the effects of high temperature are scientific matters, and they also have something to do with cookery and the technology of seafood preparation, with which numbers of people are seriously concerned. Restaurateurs complain that some people force them to cut up live crabs and lobsters before cooking. This results in the loss of juice, and it may be no less painful than scalding. Destroying the crab's nervous center by stabbing also results in the loss of juices, and it cannot be done with facility by the ordinary cook. The low-heat method seems to be easier and surer.

With regard to sudden death, not everybody drops live crabs into boiling water. Instead, boiling water is sometimes poured on the crabs, and this prolongs the killing process by several seconds. Furthermore, larger animals such as lobsters do not die immediately in boiling water.

Critics who are concerned about the "slow, torturous death" of crustaceans in slowly heated water are not properly impressed with the relatively low temperatures required, which are of the order of temperatures that sometimes occur in natural waters in cool temperate climates. There is an extensive literature on heat death of aquatic organisms under natural conditions, which I cannot document here, and I call attention only to the following: "Heat stroke in Canadian Maritime stream fishes" (1) and "Differential mortality from high temperature in a mixed

population of fishes in southern Michigan" (2).

All physiological processes of aquatic invertebrates which have been studied increase in rate with temperature right up to the point of heat death at around 40° to 44°C. Presumably the reaction rate of the enzyme system increases with temperature, but as the temperature rises, the enzymes are destroyed faster than they are produced and the system breaks down. In any case, death ensues with no overt signs of distress.

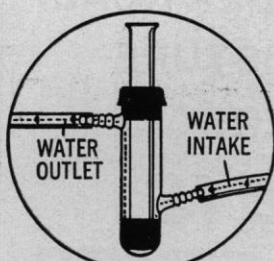
Crustaceans subjected to the low heat are certainly not paralyzed. They stir about vigorously if touched, and their gills work increasingly fast up to the moment of death. There is no sign of pain or distress, and it is reasonable to assume that an organism showing such reactions is much less likely to be distressed than one which goes into a violent spasm and throws off or cracks its own claws. There is no physiological basis for assuming that boiling water is not painful to various invertebrates, and there is ancillary and indirect evidence that it is painful. The question as to whether or not crabs suffer pain cannot be rigorously proved one way or the other, but there is no known reason why the pain sense should be correlated with intelligence, and all animals show some degree of sensitivity. Crabs certainly show a violent reaction to hot water, comparable to what would be considered evidence of extreme distress if exhibited by human beings or other mammals, and it has every appearance of a reaction to pain. I believe that the sensation we call pain is of enormous survival value, that it is unrealistic to hold the view that a similar situation does not exist in lower animals, and that it is proper to conduct ourselves, in the manner of Brooks, whom I cited in my report, as if all living things have a sensitivity somewhat akin to our own.

In connection with these matters, I should like to quote parts of a letter from William R. Catlow, Jr., in which he said he had been using the low-heat method for 30 years but was influenced by motives different from those I mentioned: "These are: *a.* With a full kettle of crabs there is likely to be a distressing amount of slopping about as the last of the lot go into the boiling pot. *b.* I am convinced that the northern lobster and the southern spring lobster (crawfish or langusta) when plunged into boiling water die under tension which promotes toughness. In your method, they appear to go to sleep, relax, and die quietly."

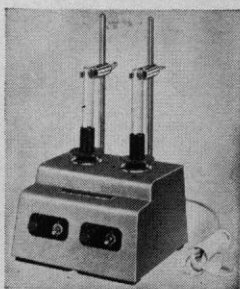
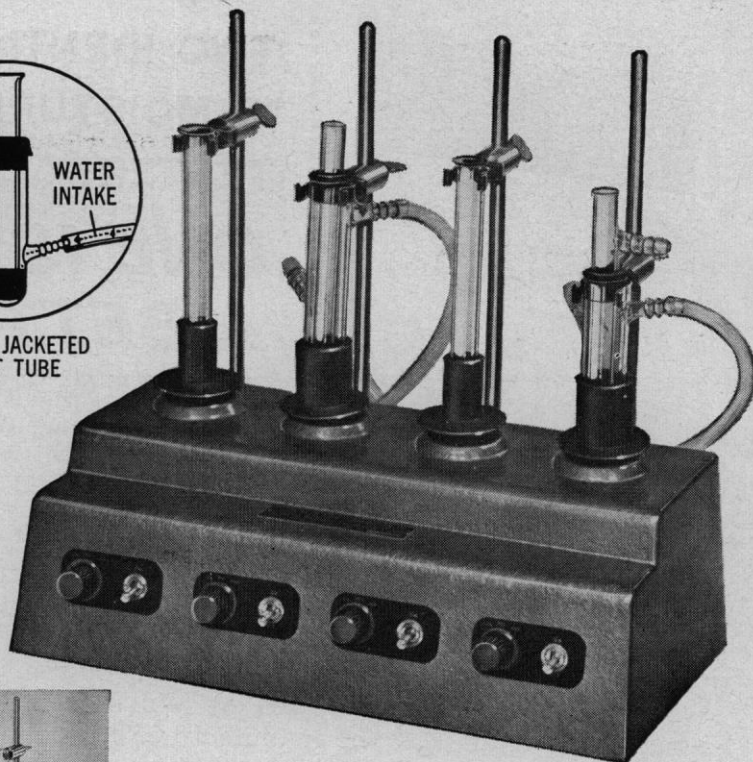
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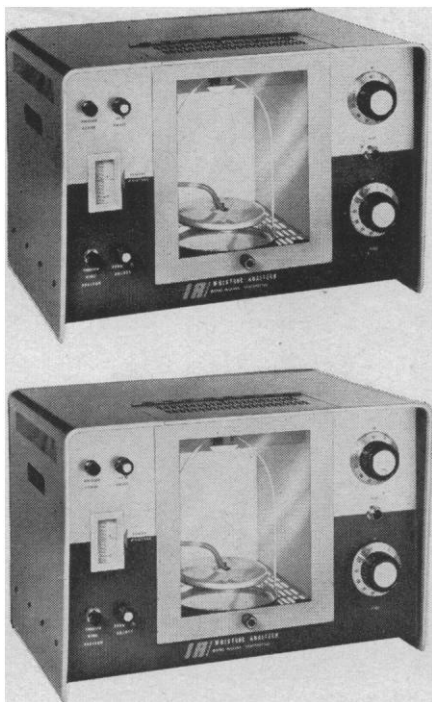
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Regarding Schmidt-Nielsen's remarks, one misconception needs correcting. I never intended to recommend or advocate the placing of marine crustaceans in fresh water as a method of killing. In this part of his argument, Schmidt-Nielsen is charging a windmill. I merely mentioned the matter as an example of what some people do in an attempt to minimize the distress of the animals they kill, and I stated further that "only one more thing is needed"—namely, the application of low heat.

The largest American lobster ever reported weighed 36 pounds. Such animals are not cooked in private homes, but even much smaller ones, weighing only a few pounds, are relatively formidable creatures in the kitchen. The application of Schmidt-Nielsen's "common-sense" method for killing these crustaceans has often resulted in a half-scalded animal flopping vigorously around the kitchen floor, to the dismay of the cook. Such episodes have disturbed the peace of some fairly large neighborhoods. Actually, the housewife usually has no adequate facilities for handling large lobsters.

I assume that the lower animals suffer pain for the same reason that some of the physicians who have written me assume that human beings suffer pain—that is to say, I have set up an arbitrary criterion as proof of pain. These criteria are assumptions and inferences only, because there is no known way that we can measure pain in terms of physics or chemistry. We cannot prove basically that several states of feeling exist in another human being. We assume that they do, but these assumptions remain inferences, and this is the reason for the old medical aphorism, "The physician is at the mercy of the man who says he suffers pain." For these gentlemen to hold me to account for not being able to prove pain finally and absolutely in an invertebrate animal, while they cannot prove or even define pain in human beings except in terms of itself, is, in their terms, anthropocentric.

In summary, crabs and the larger crustaceans are of various sizes and species, and of different shapes, and they have different locations of the brain, all of which factors virtually preclude the use of the stabbing method of killing except at the hands of an expert. In addition, most housewives will not handle individual live crustaceans. People who cannot use the stabbing method would do better to heat water containing the animals very slow-



ly to temperatures near 100°F. If this process is properly carried out, the animals die with no signs of distress, but the process carries no automatic safeguard against misapplication and ranks as another cooking art which must be executed with finesse. No valid physiological objections have been raised to this method of killing crustaceans, and it should be employed by those people who assume that lower animals feel pain and who are revolted by their violent reactions to boiling water.

GORDON GUNTER

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#### References

1. A. G. Huntsman, *J. Fisheries Research Board Can.* **6**, 476 (1946).
2. R. M. Bailey, *Ecology* **36**, 526 (1955).

### Studies of the Cuna Religion

Those who witnessed the "burning" of myself and my book *Apples of Immortality from the Cuna Tree of Life* [*Science* **134**, 278 (1961)] will wonder why Stout wasted 73 lines of type rather than tell the editor that my little 68-page essay was so bad that it did not merit review. Possibly Stout was defending his 5 months' San Blas study (1940-41) against my eight trips to the Cuna tribe from 1950 to 1959.

Stout failed to mention that *Apples of Immortality* was merely a postscript to a 352-page study of the Cuna religion as compared with other primitive religions of the world, called *Secrets of the Cuna Earthmother*, in which striking parallels of sacred symbol, belief, and ritual are discussed.

There are those who do not take Stout's dim view of these studies.

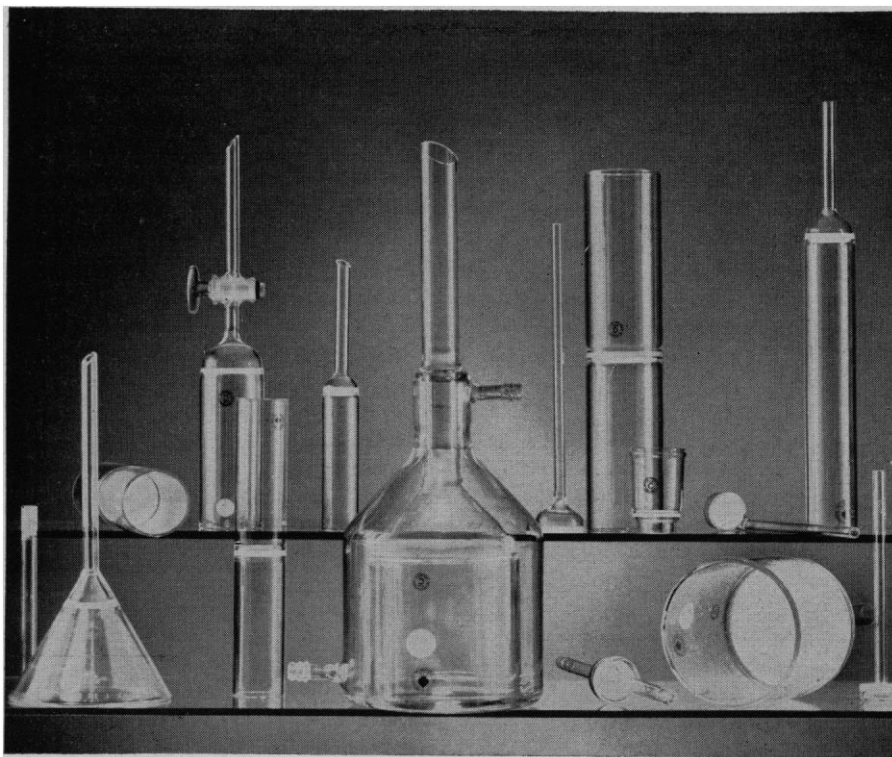
CLYDE KEELER

*Milledgeville, Georgia*

### Support for Medical Research

While I appreciated the lively journalistic style of Robert Toth in "Science and the news" [*Science* **134**, 822 (22 Sept. 1961)], the news item relative to the appropriations for the National Institutes of Health is so obviously slanted that I cannot help but feel it will give a false impression of the attitude of scientists in general toward the attempted solution of problems of illness.

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