

# Strontium horse, copper dog and iodine cat

Animals play a modest role in physics. Over the years, specific characteristics have been investigated in species such as bats, guinea pigs and fruit flies, and only some species have remained attached to a single physicist. Examples include the dubious cat of Schrödinger, the frogs with which Volta undertook his quest, and the glow-worms that Faraday used to find out how they could produce light. My own experience with animals in physics is limited to flesh flies (Sarcophagidae). In a biophysical laboratory, I had a practical exercise about the compound eye. An assistant had prepared a fly in a lump of adhesive and she had manoeuvred a tiny probe in the insect so that electrophysiological responses in the brain cells could be measured. I pressed a button and indeed, the fly observed the emitted photons: the attached screen lit up. Was I impressed? Not really, but as a trainee physicist, I was surprised to discover how an insect could be reduced to a measurement instrument.



Physics has benefited from the animal, but have animals had any benefit from physics? How can physics be put to good use for the animal kingdom? I give lectures to veterinary students on a fairly regular basis. Within the Faculty of Veterinary Medicine, there are three departments, namely farm animals (mainly cattle, pigs and sheep), pets (animals with a high cuddle factor that participate in the human household) and horses (with all the associated aspects of breeding, welfare, sport, legislation and pharmaceutical industry).

As a physicist, it might happen that you are asked to fulfil an advisory role with respect to a method of treatment. For example, there was a horse with an unusual swelling near the eye that was impossible to remove surgically. As a solution you might suggest a treatment with  $\beta$  radiation. But which isotope would be suitable? Preferably a high energetic  $\beta^-$  emitter, without gamma rays, as that would be undesirable for the surroundings. It should also be easy obtainable and not too expensive.

At the Faculty of Veterinary Medicine, researchers have experience with radiotracers like  $^{99m}\text{Tc}$  and  $^{166}\text{Ho}$ . Furthermore, use is made of  $^{131}\text{I}$  for cats with an overactive thyroid. The  $\beta$  emitters do their curative work to ensure that only a small quantity of the thyroid gland remains for a normal level of hormone production. During this treatment, the cat receives 100 MBq, while his owner is invoiced for 1000 euros. As a physicist, you understand: companionship comes at a price.

For the horse,  $^{131}\text{I}$  would not be suitable, as the energy of the  $\beta$  emitters is too small to reach the deeper lying tumour cells near the eye. Also it was impossible to allow the noble animal to participate in a study that had started with  $^{64}\text{Cu}$ . Copper is vital for oxygen transport in the body, but too much copper is risky. In the case of dogs, it gives rise to copper accumulation, which causes inflammations and connective tissue formation. For the treatment of the horse, the half-life of radioactive copper is too short (thirteen hours).

Eventually,  $^{90}\text{Sr}$  was chosen. This emits two hard  $\beta$  particles with a maximum energy of respectively 0.55 MeV and 2.3 MeV, due to the decay  $^{90}\text{Sr} \rightarrow ^{90}\text{Y} \rightarrow ^{90}\text{Zr}$ , during which  $n \rightarrow p + \beta$  occurs twice. This radioisotope was available at the faculty. It had once been purchased in abundance, because with a half-life of 28 years, it was considered a solid investment. However, to use ionising radiation, permission is required from the government, and in due course, a research project was started, supplemented with an action plan, justification and risk inventory.

What was the outcome of the horse's treatment? It took some time to receive permission from the government. An unexpected problem was that the Faculty had permission to use radioisotopes for pets. Now a horse can be a happy family member, but certainly is not a pet... How is a physicist supposed to know that?

The Inspectorate proved to be reasonable and finally issued the licence. On that very same day, we went to the holding rooms and arrived at an empty stall. It was quiet for a moment, then the vet asked: "Where is that horse?"

The carer did not know, but had an anxious suspicion, for some aspects of life cannot wait for a government decision nor on current progress in science. The horse had departed for the eternal meadows, where it did not need its eyes. A real pity, and at such moments it is unavoidable, then even physics falls silent.