Activation Analysis of Ungulate Hair

Abstract. *Hair samples from the horse, elk, deer, moose, and antelope; subcutaneous tissue from the moose and antelope; and cast and living skin of the rattlesnake were activated by exposure to a neutron flux. The resulting products were studied by pulse-height analysis. Differences in type and proportion of trace elements appear to be consistent within the species studied.*

Human hair contains more than 20 elements in trace amounts. Whether these elements participate in a crucial way in the structure or function of the hair is not known. It is convenient to activate hair by neutron irradiation, however, and a number of studies have been made of the trace elements found in human hair (*1*). Much of the interest in activation analysis of human hair has revolved around problems of a forensic nature, of which the study of Napoleon's hair by Smith (*2*) is an example. We have now employed neutron activation of hair of several large mammals, and of the cast and intact skin of a rattlesnake to outline certain species differences; a more penetrating look into the physiological role of hair might yield useful information.

In order to keep the experiment within manageable limits, an arbitrary selection of hair types was made. In making the selection, two objects were kept in mind: (i) to allow differences in habitat within species to appear if present; and (ii) to demonstrate, if present, differences between species and within ranges of habitat. Accordingly, four large native mammals and the domestic horse were chosen as subjects (Table 1). Also included are samples of rattlesnake skin which were brought into the analysis to help elucidate a role of hair which seems to be related to the cast reptile skin.

Hairs from different parts of the body of the same animal show some variation in physical and chemical features (*3*). It is also believed that hairs vary in character throughout their length, presumably because of physiological changes within the animal which occur from time to time (*4*). In order to minimize these sources of within-species variation, samples were taken, where possible, from the poll region of the head; several hairs (usually 5 to 10) were used so that various proportions of proximal and distal areas tended to

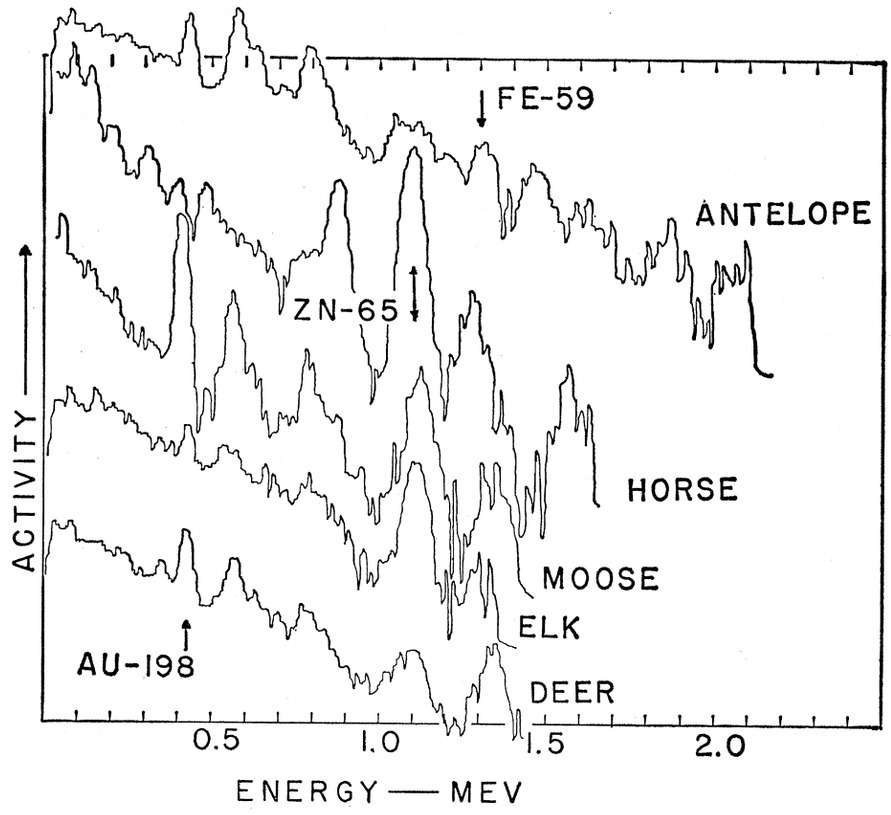

Fig. 1. Gamma-ray spectra of hair from five mammals.

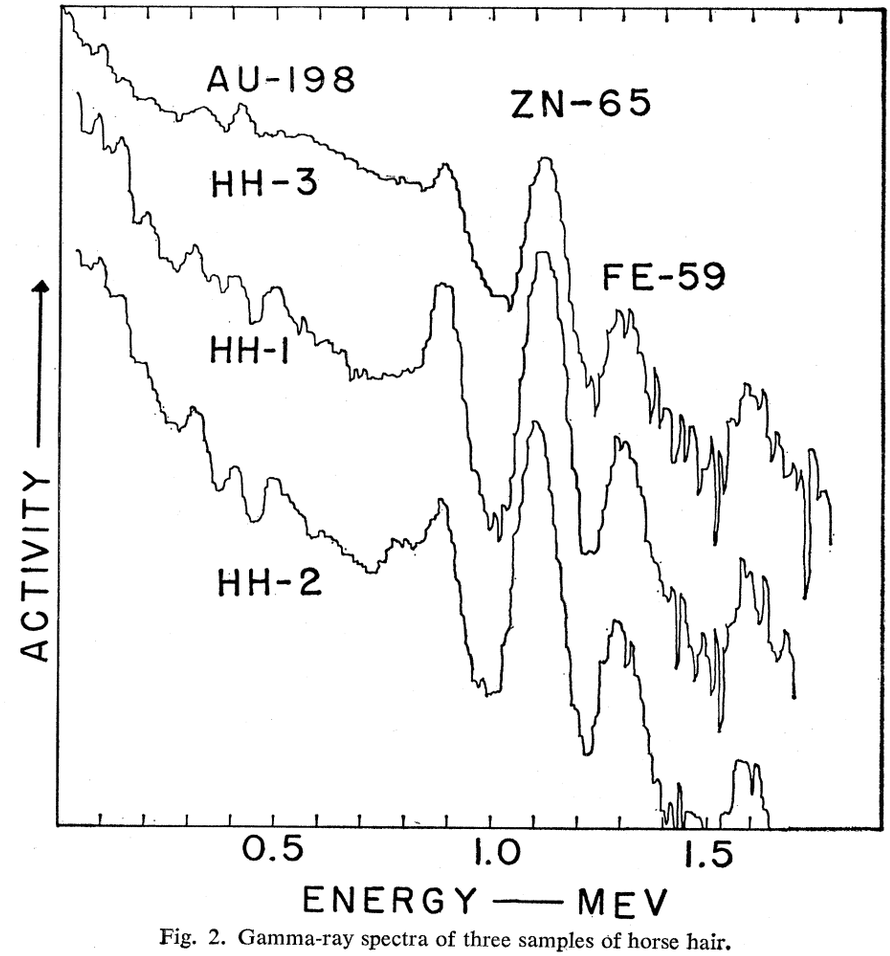

Fig. 2. Gamma-ray spectra of three samples of horse hair.

Table 1. Source of hair or skin tested.

Code label	Source
	Horse *Equus caballus*
HH–1	Idaho Falls, Idaho (black hair)
HH–2	Salt River Narrows, western Wyoming (bay or red hair)
HH–3	Bedford, Wyo. (white hair)
	Moose *Alces alces*
M–1	Northwest Wyoming
	Elk *Cervus canadensis*
E–1	Northwest Wyoming
	Mule deer *Odocoileus hemionus*
D–5	Greys River area, Wyo.
D–6	Sybille area, Wyo.
D–7	Fontanelle area, Wyo.
	Antelope *Antilocapra americana*
A–1	Shirley Basin, Wyo.
A–2	Laramie Plains, Wyo.
A–3	Laramie Plains, Wyo.
A–4	Daniel area, Wyo.
	Rattlesnake *Crotalus viridis*
SL–1	Intact skin Arco, Idaho
SC–1	Cast skin Arco, Idaho (both from the same snake)

compensate for lengthwise variations along the shaft.

The hairs were then bundled into groups, with a hair of the same type being used to code and hold the bundle together. All the samples of a given run were washed in a refluxing ether bath for a minimum of 1 hour to remove surface oils and oil-held contamination. The samples were then weighed, and sealed with heat in individual polyethylene packets, all of which were then enclosed in a polyethylene "rabbit" for activation in the Materials Testing Reactor (MTR) at the National Reactor Testing Station. Our first runs indicated that an exposure time of approximately 8 hours was required for adequate analysis of longer-lived activities. Accordingly, samples were exposed to a neutron flux of 1.3 $\times 10^{13}$ neutrons cm^{-2} sec^{-1} for 8 hours and then allowed to cool for 8 hours before pulse-height analysis was started. After removal from the "rabbit" and the polyethylene packet in which they were irradiated, the samples were again sealed in a small package of "cool" polyethylene and taped to a small card which was placed on the scintillation crystal. Activities were recorded and analyzed by means of a 400-channel pulse-height analyzer (Technical Measurements Corp., model 401C) coupled to a NaI(Tl) scintillation crystal (7.5 by 7.5 cm) and photomultiplier. The crystal and photomultiplier were mounted in a steel cave, the walls of which were 27.5 cm thick.

Spectra were resolved at intervals starting immediately after cooling. The most distinctive spectra appeared after a period of approximately 250 hours. Not shown in most of these spectra are a number of shorter-lived isotopes, the most prominent being Mn^{56} and Na^{24}.

The spectra from the five different genera of ungulates were resolved 230 to 260 hours after activation (Fig. 1). For approximately the first 200 hours, most of the nuclide peaks shown here were obscured by Na^{24} peaks, and it was necessary to wait until Na^{24} had decayed enough to reveal other nuclides.

There is dissimilarity among the spectra in respect to the species of nuclide present or the proportionate amount of the nuclide or both. The scales of each spectrum are the same, but the actual position on the y-axis has been ignored to allow the comparison. Figure 2 shows within-species consistencies and variation; differences in hair color and grazing range do not affect the gamma-ray spectrum of horse hair significantly. The Wyoming horses fed predominantly on plants growing in alluvial soils derived from Paleozoic sediments, whereas the Idaho area is composed of characteristically volcanic soil of relatively recent (Cenozoic) origin. Similarly consistent patterns were found in the wild ungulates. It would appear that although differences in habitat, range, and physiological condition may produce certain differences in the amount and composition of trace elements found in the hair, these differences are superimposed on a general species or perhaps generic pattern.

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5. Supported by grant from the Associated Rocky Mountain Universities, Inc., and the cooperation of the National Reactor Testing Station, Idaho Falls, Idaho. I thank the Analytical Chemistry Branch, particularly D. G. Olson, for their cooperation and encouragement, and F. Kennington and the Wyoming Game and Fish Commission Laboratory for hair samples.

6 December 1965

Complement-Fixing Antigens in Hamster Tumors Induced by the Bryan Strain of Rous Sarcoma Virus

Abstract. *Hamster tumors transplanted subcutaneously from primary intracranial tumors which developed after inoculation of the Bryan strain of Rous sarcoma virus, contained virus-specific tumor antigens indistinguishable from those induced by the Schmidt-Ruppin strain.*

The Rous sarcoma virus (RSV) was first shown to be oncogenic in mammals by Svet-Moldavsky who induced sarcomas in rats with the Carr strain of this virus (*1*). Ahlstrom and Forsby (*2*) reported the induction of tumors with the Schmidt-Ruppin (S-R) strain (*3*) of RSV in hamsters, mice, rats, guinea pigs, and rabbits. Huebner *et al.* (*4*) showed the presence of specific avian leukosis complement-fixing (CF) antigens in hamster and guinea pig tumors induced by the S-R strain. These tumors elicited CF antibodies which were specifically reactive with antigens found in the homologous virus-free hamster tumors, with antigens in virus-containing chicken tumors induced by both the S-R and the Bryan strains of RSV, and also with tissue cultures of chicken-embryo fibroblasts (CEF) infected with various strains of avian leukosis viruses (*4, 5, 6*). The group-specific antigens in infected tissue cultures were smaller than complete avian-tumor virus particles (*4, 5*), and hamster tumor antibodies directed against them did not neutralize infectious S-R strain RSV (*4*). Vogt *et al.* (*7*) have presented evidence that the avian leukosis antigens in RSV-transformed CEF tissue cultures free of infectious virus ("nonproducer cells") were induced by the integration of genetic material from the "defective" (*8*) Bryan strain of RSV, which is incapable of replicating complete infectious particles in the absence of a helper virus. These authors concluded that the group-specific antigens are not part of the virus envelope but may be internal viral components common to all avian tumor viruses (*7*).

Rabotti *et al.* recently succeeded in producing gliomas, leptomeningeal sarcomas, and choroid plexus papillomas by intracranial inoculation of the Bryan strain of RSV into young hamsters, mice, rabbits, guinea pigs, and dogs (*9, 10*). We now report the presence of specific avian leukosis complement-fixing antigens in subcutaneous tumors