

Perceptions of unconventional slow virus
diseases of animals in the USA

G A H Wells

REPORT OF A VISIT TO
THE USA
APRIL-MAY 1989

Visits to Colorado State University, College of Veterinary Medicine and the Wyoming Game and Fish Department, Sybille Wildlife Research and Conservation Education Unit.

The main objective here was to obtain some understanding of CWD. A visit was made to the University of Wyoming Game and Fish Department, Sybille Wildlife Research and Conservation Education Unit where most of the cases of CWD have occurred. The Sybille Wildlife facility is situated some 50 miles northeast of Laramie, Wyoming through the Laramie Mountains. Here most of the hoofed big game species of North America; Mule Deer (*Odocoileus hemionus*), Whitetail Deer (*Odocoileus virginianus*), Elk (*Cervis canadensis*) Mountain Goat (*Oreamnos americana*), Bighorn Sheep (*Ovis canadensis*) and Pronghorn (*Antilocapra americana*) and some other wildlife species are kept in small numbers for experimental use in the investigation of wildlife diseases.

A colony of the blackfooted ferret (*Mustela nigripes*) has been established because of its imminent extinction. At present there are only 35 but it is proposed to breed up to 200 and then, probably in 1991, re-introduce them into the wild in a nation wide operation. Blackfooted ferret diet is mainly Prairie Dog (*Cynomys spp.*) and it is thought that the elimination of this species from large areas by poisoning campaigns in the past has been responsible for the precipitous ferret decline.

The buildings and pens at the facility are entirely of wooden/log construction with heavy duty wire mesh fences. Pen floors are bare earth. A long race connecting many different areas within the facility enables movement of deer and antelope between pens when necessary. There is provision for holding deer of different sizes in a custom built crush for bleeding and treatments.

The educational role of the unit includes school visits to provide instruction in the work of the department and to promote conservation. I was accompanied on this visit by Stuart Young and Beth Williams. On arrival I was introduced to Hughie Dawson who has managed the facility for some 20 years.

CWD occurred principally in two locations, this one at Sybille and in a similar facility at Fort Collins, Colorado, some 120 miles southwest. It was estimated that in total probably 60-70 cases of CWD have occurred.

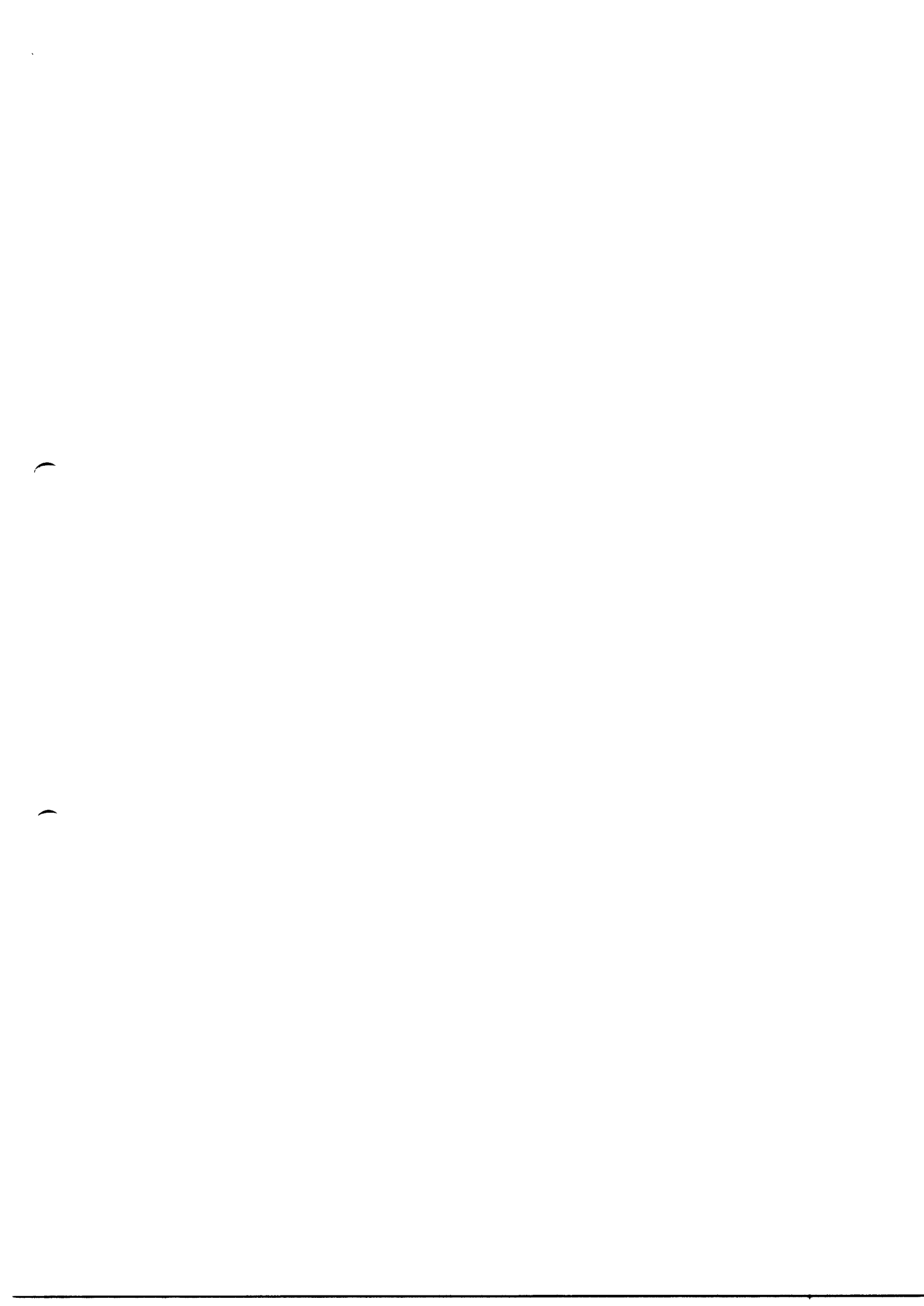
It was difficult to gain a clear account of incidence and temporal sequence of events (- this presumably is data awaiting publication - see below) but during the period 1981-84, 10-15 cases occurred at the Sybille facility. Recollections as to the relative total numbers of cases at each facility were confusing. Beth Williams recalled that more cases had occurred in the Colorado facility.

The morbidity amongst mule deer in the facilities ie. those of the natural potentially exposed group has been about 90% with 100% mortality. The age distribution of affected deer was very similar to that in BSE. The clinical duration of cases was 6-8 weeks. Mortality in CWD cases was greatest in winter months which can be very cold.

When the problem was fully appreciated both the Sybille and the Colorado facilities were depopulated. All cervids were culled but Pronghorn, Bighorn Sheep and Mountain goat, where present simultaneously in the facility, were retained. There have been no cases of CWD in these non cervid species.

A few cases continue to occur at Sybille, the last was 4 months ago.

An account of the occurrence of CWD at the Colorado facility was obtained from Terry Spraker, Diagnostic Laboratory, CSU College of Veterinary Medicine, Fort Collins. He examined tissues from cases of CWD at the Colorado facility some time prior to Beth Williams's involvement and examination of brains which resulted in the initial diagnosis. The deer holding facilities in Colorado comprise the Colorado Division of Wildlife Research Pen, established 10 years ago and some older deer pens at the Foot Hills Campus of CSU, close to Fort Collins. Originally there were just 1-2 cases CWD/year and a total of 24 over several years. In contrast to Beth Williams recollection Terry Spraker thought more cases had occurred at Sybille than in Colorado. The cull at the Colorado facility involved 20-30 clinically normal deer. Early lesions in dorsal nucleus of the vagus and olfactory cortex were found in (some) of these deer. At the time of the cull here Pronghorn was the only other hoofed species present. Bighorn Sheep and Mountain Goat were introduced only one year after the cull and occupied ground where CWD had occurred. Immediately after depopulation the ground was ploughed and disinfection was carried out using 1% NaOH. The buildings/pens were not changed. There has been no recurrence of disease at the Colorado facility since the cull.



Transmission Studies

Mule deer transmissions of CWD were by intracerebral inoculation and compared with natural cases ~~first passage (by this route)~~ resulted in a more rapidly progressive clinical disease with repeated episodes of syncope ending in coma. One control animal became affected, it is believed through contamination of inoculum (?saline). Further CWD transmissions were carried out by Dick Marsh into ferret, mink and squirrel monkey. Transmission occurred in all of these species with the shortest incubation period in the ferret.

Mouse and hamster transmissions were attempted at Wyoming State Diagnostic Laboratory, Laramie and at CSU Fort Collins but were unsuccessful.

Also at the Wyoming State Diagnostic Laboratory, Laramie, transmission to goats was attempted. In 1984 three goats were inoculated intracerebrally with a 10% CWD brain suspension. One goat, untreated, was placed in contact with the CWD inoculated goats and three controls, housed separately, received saline intracerebrally. To date these animals remain healthy.

Epidemiology of CWD

Descriptive epidemiological data has been collected from the two wildlife facilities and a publication is in preparation.

The occurrence of CWD must be viewed against the context of the locations in which it occurred. It was an incidental and unwelcome complication of the respective wildlife research programmes. Despite its subsequent recognition as a new disease of cervids, therefore justifying direct investigation, no specific research funding was forthcoming. The USDA viewed it as a wildlife problem and consequently not their province! Thus

there have been no specific epidemiological studies, other than information gained from noting the occurrence of cases. Because of the relatively short term nature of the programmed research at the facilities it has not been possible to keep Mule Deer under the appropriate experimental circumstances or for sufficient periods to establish horizontal or maternal transmission. Beth Williams is of the view that the occurrence of CWD at Sybille is entirely related to propagative spread by contagion. Investigations have failed to identify any common source of infection and the incident has presented a protracted time course with sporadic cases throughout. There is no evidence that wild born deer were responsible for introduction of the disease to the facility.

I asked Hughie Dawson about the nutritional aspects of the deer kept at Sybille. Mule Deer calves are reared on condensed milk and homogenised or pasteurised domestic cow's milk from birth to 1 month or to 6 months. some would be given "Lamb milk replacer" which has a higher butter fat content than either of the former products, but is derived also from domestic cow's milk. It was thought that at the Colorado facility calves would receive only "evaporated milk". Calves are weaned on to a pelleted feed containing corn, wheat bran and linseed meal with no crude mineral supplement. Salt licks ("sulphur blocks") which have a specific mineral composition are supplied.

CWD has occurred or is suspected to have occurred in establishments supplied with Mule Deer from the Colorado facility. In some cases evidence for this is tenuous. For example, it is understood that Denver Zoo state that "they have not had cases of CWD" and yet they have had cases of Mule Deer succumbing to a chronic wasting disorder which was not diagnosed. A case of CWD occurred in a Mule Deer in Toronto Zoo in 1976. The animal in

question came from Denver Zoo but was originally from the Colorado wildlife facility.

Pathology of CWD

A paper (Williams et al) is in preparation on the distribution of brain lesions in CWD. Vacuolar changes occur predominantly in the dorsal nucleus of the vagus nerve (this nucleus is invariably affected), the hypothalamus and the olfactory cortex with occasional vacuolation of the olfactory tract white matter.

Cerebellar lesions are sometimes present but there are very few changes in the spinal cord which probably accounts for the rarity of ataxia clinically. As in sheep scrapie the hypothalamic lesions correlate with the common clinical occurrence of polydipsia. Beth Williams is aware of occasional neuronal vacuoles occurring in the red nucleus of clinically normal deer! Spraker has added that he has experienced vacuoles in neurons of Gasserian ganglia and at the level of the obex in normal deer.

It has never been reported but Pat Merz carried out SAF detection on CWD brain material. Work may be undertaken with NIH on the immunohistological demonstration of PrP in sections but to date there has been no PrP work.

Does CWD occur in free-living cervids?

There is some, mostly circumstantial, evidence that CWD occurs in free-living cervids but to what extent, if at all, this represents an established reservoir of infection in the wild is not known.

At Sybille two Mule Deer orphans (wild caught) and a White-tail Deer (*Odocoileus virginianus*) hybrid developed clinical signs when only 2½ years of age.

An Elk (*Cervus canadensis*) wild caught as an adult, presumed 2 years old, developed signs when 3-4 years old.

Another group of elk, wild caught 400 miles from the facility, with an age range 2-8 years, old subsequently developed the disease in the facility (?period of captivity). The location of capture relative to the facility did not apparently rule out that they may have at some time had fence-line nose contact with animals in the facility!

Cases have also occurred in Mule Deer that were obtained from the wild within one hour of birth but these were never kept completely isolated through to maturity.

Also at Sybille there has been one case of CWD diagnosed in a free ranging Elk. It was killed in Sybille Canyon 3 miles from the facility. It could have had fence-line contact with captive Mule Deer in the facility.

Similar incidents had occurred in Colorado. In 1985 a free-ranging affected Elk was caught in the Rocky Mountain National Park within a 2 mile radius of the Colorado Division of Wildlife Research Pen. In 1986 and again in 1987 a single affected Mule Deer on each occasion was caught within a 5 mile radius of the Pen. These latter cases occurred within 2 years of the cervid cull at the Pen (?1985). Brain tissue from the free-ranging Elk brain was inoculated into mice but for some reason these were kept for only 6 months and then the experiment was abandoned.

A specific exercise has been carried out by Beth Williams with the Wyoming State Diagnostic Laboratory and Fish Department to sample the brains of healthy wild Mule Deer for histological examination. On two separate occasions the first in 1985 and again in 1987 a total of 150 Mule Deer

brains were collected from areas of, and adjacent to, Sybille Canyon. These deer would have been shot under a game permit by local hunters. As they were brought down from the hills to the Game station for the mandatory registration of the kill the heads were removed and ages estimated. Most were 2-5 year old with a few 6 year old. For obvious reasons hunters were reluctant to give up stag heads. Thus, but for 15-20 brains from stags, examinations were on brains from females. No evidence of CWD lesions was found in any of these brains. However, it was considered that sporadic cases of CWD, should they occur in the wild population, would soon become separated from the herd and fall prey to coyotes (*Canis latrans*).

The possibility of any reservoir of infection in wild cervids originating from scrapie in domestic sheep flocks seems remote. Scrapie has been recorded in only three flocks in Wyoming since 1947 and Beth Williams could recall only one previous occurrence in 1966. This had involved a Suffolk flock close to the border with Nebraska. However, there has been one new confirmed and a suspected affected flock this year in Wyoming. In the latter a ewe bought-in from an Illinois flock is incriminated.

Spraker suggested an interesting explanation for the occurrence of CWD. The deer pens at the Foot Hills Campus were built some 30-40 years ago by a Dr Bob Davis. At or about that time, allegedly, some scrapie work was conducted at this site. When deer were introduced to the pens they occupied ground that had previously been occupied by sheep. Whether they were scrapie infected sheep or not is unclear. There were domestic sheep and goats present in the facility also in the 1960's but there is no evidence that these animals developed scrapie. During the 60's hybridization studies between the Bighorn and domestic sheep were carried

out, again, without evidence of scrapie. Domestic goats were also kept at Sybille in the 1960's.

Spraker considers that the nasal route is responsible for transmission of CWD through nose to nose contact, which may well occur also between captive and free-living individuals.

In domestic cattle of which about 15-20 adults were necropsied per year at the Diagnostic Laboratory, CSU., Spraker had not encountered any lesions suggesting BSE. Polioencephalomalacia (PEM) and Encephalic Listeriosis were the most common morphologic neuropathological diagnoses. No bovine rabies was seen.