Pathological Lesions in the European Bison
Caused by Foot-and-Mouth Disease in Polish Reservations

Bisoniana XXVI

Thirty five European bisons died during the epizootic of foot-and-mouth disease in polish reservations (1953—1954). The post mortem examinations revealed lesions characteristic for foot-and-mouth disease, namely: freshly burst secondary vesicles, surface erosions, and in case of secondary infection, extensive necrotic lesions. The above lesions were observed in the mucous membrane of the alimentary tract (oral cavity, esophagus, rumen) and on the skin of interdigital space. In 9 cases the primary process of foot-and-mouth disease was complicated by bronchial pneumonia, purulent broncho-pneumonia, fungal invasion, actinomycotic pneumonia, abscesses in different organs and tissues or bone fractures.

There is very little published data on foot-and-mouth disease in the European bison. Thoroughful work of Tomescu, Gheorghiu & Isopescu (1960) does not mention the foot-and-mouth disease in this species, while Skoromchow (1954) mentions only that similarly to many other species European bisons are susceptible to the virus of foot-and-mouth disease.

This disease was observed in the European bison (Folmer, 1939; Jaczewski, 1959; 1960) in the american bison (Urbain, 1939; Hediger, 1940; Stasikiewicz, 1946) and in hybrids of the two species. Specially valuable are detailed observations of Jaczewski (1959; 1960) on the course of the foot-and-mouth disease epizootic of the European bison in 1953 and 1954 in Polish reservations. It is interesting that in natural conditions in the Białowieża Primaeval Forest the foot-and-mouth disease was observed three times between 1906 and 1909 but the mortality of sick animals was only 5% (Wróblewski, 1927).

The above mentioned papers were concerned predominantly with the clinical and epizootic aspects of the disease.

During the epizootic of foot-and-mouth disease in the polish reservations Lö-
puszna, Pszczyna and Niepołomice (1953—1954) a total of 35 bison died. As demonstrated in later studies the foot-and-mouth disease in Pszczyna and Niepołomice was caused by the A$_5$ variant of the virus (Baranowski, 1956).

In the Łopuszna reservation the first symptoms of foot-and-mouth disease were noticed on July 6, 1953. Eight days later (July 14, 1953) the female bison »Puma« died. During the following 15 day five more bison died. About 3 months after the outbreak of the disease (December 18, 1953) female »Tatra« died and three months later »Pustak«, a male the last bison in the reservation died (Table 1). The latter two animals survived the disease but had serious complications of its primary process (Jaczewski, 1959) which were the indirect cause of death.

In the Pszczyna reservation the first symptoms of the disease (lack of appetite, slow rumination and sluggishness) were observed on December 20, 1953. Male bison »Platanek« died already on December 21, 1953. Sixteen bison died in the seven following days. On January 4, 1954 female »Plesnianka« died while the last bison from the herd, female »Plusia« died on January 19, 1954 (Table 1).

On April 19, 1954 in one of the three enclosures of the Niepołomice reservation the female bison »Puszcza« was noticed to be sad, without appetite and with slight salivation. Similar symptoms were noticed on April 21 in »Pura«, »Puzon« and »Puchawka«. During the following few days the disease attacked the remaining 2 bison in this enclosure. »Puszcza« died on April 23 and 3 more bison died during the following 8 days (»Puzon«, »Puchawka« and »Pura«). Three more animals succumbed between May 20 and May 28 (»Pustybór«, »Pułkownik« and »Pukajka«) and three months after the outbreak of the disease male »Pułan« died. The disease did not transfer to the remaining two enclosures (Table 1).

In 33 of 34 cases autopsy revealed pronounced lesions indicating infection with foot-and-mouth disease virus. The process of the disease was accompanied by more or less typically expressed lesions in the mucous membrane of the upper segment of the alimentary tract (mucous membrane of the tongue, the lips, the gums, the hard and soft palate) rarely in the mucous membrane of further parts of the alimentary tract (esophagus, rumen, abomasum) an in the skin of interdigital space.

In animals which died during the first few days of the disease, surface erosions in the mucous membrane of the dorsal and ventral surface of the tongue were found usually on the lateral edges and the tip. These erosions had uneven, shredded edge and a more or less bright red center, or else smooth edge and finely granular, brown-grey center. Appearance of the latter erosions was indicating a beginning of regenerative processes in the epithelium. In similar cases, in animals which died somewhat later, spots in which secondary vesicles burst were covered with completely regenerated epithelium (providing that there was no second-

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1) This number also includes the female bison »Puma« which was autopsied by the staff of the local veterinary service; the results of the autopsy and additional tests were not available to the author and therefore this case is omitted in the listing of lesions.
ary infection of these vesicles). Lack of pigmentation in these spots of the mucous membrane and occurrence of taste buds less developed than in the surrounding area were indicating previous damage (Fig. 1, Pl. XIX).

In case of secondary infection of surface erosions by saprophytic microorganisms necrotic lesions of various size were formed. Usually they

<table>
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<tr>
<th>No.</th>
<th>Name</th>
<th>Sex</th>
<th>Pedigree book No.</th>
<th>Date of birth</th>
<th>Date of death</th>
<th>Period of the disease</th>
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<tr>
<td>1.</td>
<td>Puma</td>
<td>☄️</td>
<td>242</td>
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<td>2.</td>
<td>Pużanka</td>
<td>☄️</td>
<td>501</td>
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<td>3.</td>
<td>Pupileczka</td>
<td>☄️</td>
<td>786</td>
<td>6.V.1950</td>
<td>17.VIII.1953</td>
<td>11 days</td>
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<td>5.</td>
<td>Tatrzanka</td>
<td>☄️</td>
<td>904</td>
<td>30.VI.1953</td>
<td>21.VII.1953</td>
<td>15 days</td>
</tr>
<tr>
<td>7.</td>
<td>Tatra</td>
<td>☄️</td>
<td>858</td>
<td>22.VII.1953</td>
<td>18.XII.1953</td>
<td>ca 5 month</td>
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<th>Pedigree book No.</th>
<th>Date of birth</th>
<th>Date of death</th>
<th>Period of the disease</th>
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<td>1.</td>
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<td>☄️</td>
<td>892</td>
<td>10.V.1953</td>
<td>21.XII.1953</td>
<td>1 day</td>
</tr>
<tr>
<td>2.</td>
<td>Pliete</td>
<td>☄️</td>
<td>255</td>
<td>1.VI.1935</td>
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<td>2 days</td>
</tr>
<tr>
<td>3.</td>
<td>Pletwa</td>
<td>☄️</td>
<td>907</td>
<td>18.VII.1933</td>
<td>23.XII.1953</td>
<td>3 days</td>
</tr>
<tr>
<td>4.</td>
<td>Pleńze</td>
<td>☄️</td>
<td>256</td>
<td>31.VIII.1935</td>
<td>24.XIII.1953</td>
<td>4 days</td>
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<td>5.</td>
<td>Pleban</td>
<td>☄️</td>
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<td>24.XIII.1953</td>
<td>4 days</td>
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<td>7.</td>
<td>Płosa</td>
<td>☄️</td>
<td>701</td>
<td>7.XII.1946</td>
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<td>4 days</td>
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<td>8.</td>
<td>Plastuś</td>
<td>☄️</td>
<td>863</td>
<td>7.VII.1952</td>
<td>25.VII.1953</td>
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<td>25.VII.1953</td>
<td>5 days</td>
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<td>17.</td>
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<th>Sex</th>
<th>Pedigree book No.</th>
<th>Date of birth</th>
<th>Date of death</th>
<th>Period of the disease</th>
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<td>4.</td>
<td>Pura</td>
<td>☄️</td>
<td>627</td>
<td>17.X.I.1943</td>
<td>2.V.1954</td>
<td>13 days</td>
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<tr>
<td>5.</td>
<td>Pustybór</td>
<td>☄️</td>
<td>905</td>
<td>3.VI.1933</td>
<td>29.V.1954</td>
<td>31 days</td>
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<tr>
<td>6.</td>
<td>Pulkownik</td>
<td>☄️</td>
<td>864</td>
<td>8.VII.1952</td>
<td>23.V.1954</td>
<td>34 days</td>
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<td>7.</td>
<td>Pukajka</td>
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<td>25.VII.1952</td>
<td>27.V.1954</td>
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<td>8.</td>
<td>Pulan</td>
<td>☄️</td>
<td>899</td>
<td>22.V.1953</td>
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were round with a diameter of 3—4 cm and reaching deep into the muscles of the tongue (Fig. 2). The most pronounced lesions were observed in a male »Pulan« which died 99 days after the outbreak of the foot-and-mouth disease in the herd. The lesion covered about 1/5 of the dorsal surface and both lateral margins as well as the underlying muscle of the tongue. On the dorsal part of the tongue there was a large (8 × 10 cm) and about 1 cm deep loss of tissue irregularly shaped with roll-like edges elevated above the surrounding undamaged surface of the mucous membrane with some scars. The center was mostly smooth, but in the middle where the erosion was H-shaped (Fig. 3) and deeper, reaching about half of the tongue’s thickness, the center was rough covered with a necrotic spongy mass.

Freshly burst secondary vesicles, surface erosions, or traces of healed erosions, or else (in case of complications) deep ulcerations were found in the mucous membrane of the lips with similar frequency. Similar changes were relatively rare in the mucous membrane of the hard and soft palate (»Plisa«, »Plew«, »Puszcz«, »Pustybor«, »Purchawka«), of the gums (»Pliete«, »Pleciuga«, »Puszcz«, »Pustybor«), or of the nares (»Puszcz«, »Plew«, »Plazma«, »Pleciuga«, »Pura«, »Pustybor«) there were numerous and relatively deep erosions on the tops of the folds in the mucous membrane of the thoracic portion of the esophagus. These erosions had roll-like and elevated edges and a grey-brown, relatively dry, scab-like mass deep at the center. One of the erosions measured 3 × 1.5 cm and was covered by dry thick scab, easy to separate from the surface (Fig. 4).

In five bison (»Plšnianka«, »Puszcz«, »Puzon«, »Pura«, »Pustybor«) lesions similar to those observed in the mouth were found in the mucous membrane of the ruminal pillars. In »Puszcz« which died on the fourth day of the disease, the ruminal pillars were covered with numerous round or irregular shallow erosions measuring from 0.3 to 2.0 cm. Their edges were uneven shredded with remnants of burst vesicles. Some of the erosions were covered with thin brown-grey or brown-red scabs tightly adhering to the membrane. In the animals which died later during the disease (»Plšnianka«, »Pura«) the process of epithelium regeneration was well pronounced. The edges of the erosions were smooth and even; the surface of the erosions usually free from scabs, smooth or finely granular ranging from pink to bluish red in colour. Lesions in the mucous membrane of the ruminal pillars were much more pronounced in »Pustybor« which died a month after the outbreak of the foot-and-mouth disease in the reservation. Besides round small erosions not exceeding 1 cm of diameter, there were vast (3 × 4 cm) deep ulcerations reaching the muscle layer (Fig. 5).
Lesions in the skin of the interdigital space were observed in 30 of 34 cases, in both front and hind limbs. There were either fresh erosions with brown scabs covering red foci without epithelium, or older erosions in the stage of regenerating the epithelium or else scars after healed erosions. Similar changes were much less common in the coronary region. In four cases (»Plusia«, »Pukajka«, »Pulan«, »Pustybor«) complications of the primary process of the disease were observed on the skin of interdigital space, namely deep ulcerations and abscesses. »Pukajka« had an abscess the size of a wallnut in connective tissue, between second digits above the interdigital space of the right hind limb. This abscess did not have a tendency to encyst itself (Fig. 6 — Plate XIX).

Edema, congestion and extravasation were relatively frequently observed in the mucous membrane of abomasum (18 mases) and small intestine (7 cases).

In the heart muscle autopsy revealed indications of cloudy swelling in the majority of the cases. In two cases (»Tatrznaka«, »Plesniak«) there was a simultaneous occurrence of cloudy swelling and fatty degeneration, the so called tigre heart. In some cases small extravasations were observed under epicard especially in the region of vascular grooves. Also an increased amount of serous fluid in the pericardial sac was observed.

Fatty degeneration of the liver was frequent and in six bisons (»Pupilczka«, »Pupilka«, »Tatra«, »Puszczka«, »Purchawka«, »Pura«) this process was so advanced that even quite large fragments of the liver did not sink when placed in water.

In the 7 months old »Platanek« which died in the Pszczyna reservation on the second day of the disease no lesions characteristic of the foot-and-mouth disease were detected. In the mucous membrane of the oral cavity and in the skin of interdigital space there were no vesicles and no resulting erosion. Post mortem examination revealed only congestion of the mucous membrane of the lips, the presence of numerous petechiae in the tracheal mucosa, under the visceral pleura, under the epicard and in the mesentery as well as catarrhal gastritis. Advanced processes of post mortem autolysis (autopsy was done 3 days after death) made any histopathologic studies impossible. The above described picture of lesions indicated an acute course of the disease without vesicle formation. This is known to occur in the course of the malignant form of foot-and-mouth disease in cattle and especially in calves.

Frequently, namely in 9 cases, the primary process of the disease was complicated by bronchial pneumonia or purulent broncho-pneumonia (»Tatra«, »Pulkownik«, »Pulan«, »Pukajka«, »Pustybor«, »Plesnianka«), purulent broncho-pneumonia caused by mycotic organisms from the gen. Aspergillus (»Plusia« — Podgurniak, 1962), by an abscess in
the subcutaneous connective tissue and in the muscles (»Pulan«) and by bone fracture (»Pustak«, »Tatra«).

Secondary vesicle formation in the epithelium of the mouth and ruminal pillars (Fig. 7) was observed in the histopathologic picture of animals which died after the first few days of the disease, similar to the situation sometimes found in cattle. The vesicles contained serous fluid with dead epithelial cells, neutrophilic polymorphonuclear granulocytes and single red blood cells. The prickle cells of the epithelium immediately adjacent to the secondary vesicle were subject to the so called »ballooning degeneration« (Fig. 8, Pl. XX).

Serous exudation appears among the cells of this layer causing their loosening and manifestation of bridges between cells. Subsequently the prickle cells swell, become more or less round, the links between them disappear and the cells are transformed into spherical bodies (ballooning degeneration). Serous exudation and neutrophilic polymorphonuclear granulocytes fill the spaces formed between degenerated cells. Accumulation of fluid increases the pressure in the vesicle; the cornified layer becomes thin and eventually breaks. An erosion partially covered by shreds of necrotic epithelium is formed in place of the burst vesicle. The surface of the erosion is later covered with a yellowish-brown scab formed from dried exudation. The epithelium starts to heal beneath the scab and after 5—8 days is completely regenerated. However, fibrinous and purulent inflammation of deeper layers of the mucous membrane occurs in case of a secondary infection. A relatively deeper erosion is formed which, under favourable conditions, can heal in some two weeks (Fig. 9); or else, the necrotic process spreads to surrounding tissue causing for example the above described lesions of the tongue (»Pusty-bór«, »Pulan«).

In animals which died during the first few days of the disease cloudy swelling of muscle fibres was the most common lesion of the heart muscle. However, it was often accompanied by leucocytic infiltration and perivascular proliferation of cells from the adventitia of vessels (Fig. 10). In animals which died in the later course of the disease degenerative changes were accompanied by exudations of variable size composed of limphoidal cells, histiocytes and plasma cells with concomitant degeneration of muscle fibers and the proliferation of connective tissue (Fig. 11). The character of these exudations indicates an advanced stage of phagocytosis and the beginning of regeneration processes. In four bisons which died 13—39 days after the outbreak of foot-and-mouth disease in the Niepołomice reservation (»Pura«, »Pusty-bór«, »Pułkownik«, »Pukajka«) small deposits of calcium salts were
Zmiany anatomopatologiczne u żubrów w przebiegu pryszczycy

found in fibers of the heart muscle showing hyaline degeneration. These foci (centers) were surrounded with either young fibers of connective tissue or with elements of non specific granulation (Fig. 12 — Plate XX).

REFERENCES


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OBRAZ ZMIAN ANATOMOPATOLOGICZNYCH U ŻUBRÓW W PRZEBIEGU PRYSZCZYCY W POLSKICH REZERWATACH

Streszczenie

W okresie (1953—1954) epizootii pryszczycy w 3 rezerwatach żubra w Polsce (Łopuszna, Pszczyna, Niepołomice) padło ogółem 35 sztuk. Wyginął cały stan pogłów żubrów w rezerwatach Łopuszna (8 sztuk) i Pszczyna (10 sztuk), zaś w jednej
z trzech zagród w Niepołomicach, w której przebywało do czasu choroby 14 żu- 
brów, zostało przy życiu zaledwie 3 sztuki.

W 32 przypadkach stwierdzono sekcjinnie charakterystyczne dla pryszczycy zmiany w górnym odcinku przewodu pokarmowego (w błonie śluzowej języka, 
warę, dziąseł, policzków), rzadko w błonie śluzowej dalszych odcinków przewodu 
pokarmowego (przełyk, zwycz) oraz w skórze szpar międzyrzutowych. W zależ- 
ności od czasu jaki upłynął od zakażenia do śmierci zwierzęcia obserwowano albo 
świeże pęknięte pęcherzyki wtórne, powierzchowne nadżerki i miejsca po ich wy- 
gojeniu, albo w przypadku wtórnego ich zakażenia mniej lub bardziej rozległe gę- 
bokie ogniśka martwicy. W mieścieniu sercowym w większości przypadków wystę- 
powało zwyrodnienie mięśniowe, w dwóch przypadkach tzw. serce tygrysie, wy- 
broczynny pod nasierdziem, w worku osierdziowym zwiększona ilość płynu surowi- 
czego. Histologicznie obserwowano w mieścieniu sercowym obok zmian wtocznych (zwyrodnienie mięśniowe, szkliste, ogniśka martwicy) procesy zapalne z występo- 
waniem nacieków drobnokomórkowych.

Stosunkowo często stwierdzano powikłania pierwotnego procesu pryszczycowego 
(nieżytowe, nieżytowo-ropne zapalenie płuc, grzybica i promienica płuc, ropne w 
różnych tkankach i narządach, złamania kości).

EXPLANATION OF PLATES

Plate XIX.
Fig. 1. »Plesnianka« — Tongue — traces of healed surface erosions.
Fig. 2. »Pustybór«. Tongue — deep round necrotic lesion on the edge.
Fig. 3. »Pulän«. Tongue — extensive erosion on the dorsal surface of the tongue 
with roll-like edges. In the middle H-shaped necrosis reaching down to half of 
the tongue’s thickness.
Fig. 4. »Pustybór«. Esophagus — deep ulceration of mucous membrane reaching 
the muscle layer.
Fig. 5. »Pustybór«. Rumen — extensive deep ulceration of mucous membrane 
reaching the muscle layer and smaller erosion, 1 cm in diameter.
Fig. 6. »Pukajka«. Hoof — interdigital space abscess in the connective tissue (size 
of a walnut).

Plate XX.
Fig. 7. »Puszcza«. Rumen — fragments of two secondary vesicular lesions in the 
mucous membrane of the ruminal pillars. Neutrophilic polymorphonuclear granulo-
cytes, single red blood cells and prickle cells of epithelium are seen; magnif. oc. — 
4 X, ob. — 40 X.
Fig. 8. »Plieties«. Tongue — so called balloning degeneration of prickle cells in the 
mucous membrane. Cells become loosened and round. Exudation of neutrophilic 
polymorphonuclear granulocytes between the cells. Magnif. oc. — 4 X, ob. — 16 X.
Fig. 9. »Puchawkas«. Tongue — healed erosion in the mucous membrane. Magnif. 
oc. — 4 X, ob. — 6.3 X.
Fig. 10. »Plazma«. Heart muscle — cloudy swelling. Leucocytic infiltration and 
perivascular proliferation of cells from the vascular adventitia. Magnif. oc. — 4 X, 
ob. — 40 X.
Fig. 11. »Tatra«. Heart muscle — extensive infiltrations of limphoidal cells, histio-
cytes and plasma cells. Atrophy of muscle fibers. Magnif. oc. 2.5 X, ob. — 40 X.
Fig. 12. »Pukajka«. Heart muscle — small deposits of calcium salts in hyaline 
degenerated muscle fibers and extensive lymphocytic infiltration. Magnif. oc. — 
2.5 X, ob. — 16 X.