

1 **The problems of resolving historical specimen data, focusing on a specimen of *Myotis***

2 ***austroriparius* (Mammalia; Chiroptera; Vespertilionidae) collected by Thomas Drummond.**

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9

10 **Abstract**

11 The geographical itineraries of Thomas Drummond's two separate expeditions to Canada (1825–
12 1827) and the United States of America (1831–1835) are used to provide historical context for the
13 specimens collected and their localities. The coordinates for these locations are estimated and their
14 geographical positions mapped. The difficulties of resolving various problems with historical
15 specimens are explored and several examples are provided, including the contentious origin and
16 identification of a bat *Myotis austroriparius* (NHMUK 1837.4.8.127). Information about type
17 specimens is discussed and the geographical position of several type localities of rodents and a
18 mustelid in the Rocky Mountains and a lagomorph in the USA are refined.

19 **Key words:** mammals, historical type specimens, Canada, USA, Drummond, morphology.

20 **Introduction**

21 Thomas Drummond (1793–1835), renowned for his botanical collections, is less well known for his
22 zoological exploits. He is significant for his early travels across pre-confederation Canada, traversing
23 the country and collecting on route from Saskatchewan in the east to the Columbia River in the west
24 across 12 degrees of longitude, and was one of the first explorers to collect specimens from the
25 Rocky Mountains. His subsequent journey to the United States of America proceeded from the east
26 across the Alleghenies and then used the major waterways to travel westwards and then
27 southwards before travelling across to Texas, where many of his collections were made. His
28 zoological collections, principally from Canada, contributed importantly to the *Fauna Boreali-*
29 *Americana* (Richardson 1829; 1836; Swainson and Richardson 1831) and to subsequent publications,
30 while his botanical collections, from Canada and the USA, were noteworthy inclusions in the *Flora*
31 *Boreali-Americana* (Hooker 1840).

32 Many of Drummond's mammal specimens were acquired by the Department of Natural History of
33 the British Museum (now the Natural History Museum, London). The Mammal Collection was in its

34 infancy at that time and under the custodianship of John Edward Gray, who was Assistant Keeper of
35 the Department from 1824 – 1840 and instrumental in the growth and organisation of the Mammal
36 Collection (Thomas 1906). He compiled separate catalogues for each of the major groups of
37 mammals that were recognised at that time, in which individual specimens belonging to the same
38 species were codified by a species number plus an individual alphabetical letter. This system worked
39 well while the collection remained relatively small but in 1837, Gray initiated a distinct registration
40 system in which each specimen was assigned an individual acquisition number. The two systems
41 continued in tandem for several years and in many but not all cases, individual specimens were
42 given both catalogue and registration numbers.

43 This project stemmed from an enquiry over the veracity of a putative record of a specimen of *Myotis*
44 *austroriparius* (Rhoads, 1897) in the British Museum, which was initially reported by Miller and Allen
45 (1928) from the interior of Canada or ‘?Saskatchewan’ and collected by Drummond, but which Rand
46 (1943) and Anderson (1946) subsequently dismissed as old and doubtful. In addition to the
47 investigation of this record, it is Drummond’s little known but far from insignificant collections of
48 mammal specimens from Canada and the USA that forms the subject of this study. Gippoliti and
49 Aloise (2016), Gippoliti (2020) and Moncton et al. (2020) advocate the importance of archival and
50 historical research, with type and other voucher specimens forming the basis of replicability. We
51 aimed further to retrieve and collate information about this historical collection and to assess its
52 potential value and relevance to current studies and future research.

53 **Material and Methods**

54 Locality information on the labels of historical specimens collected during the 19th century was often
55 poor or lacking and original field notes were rarely maintained or, if so, even less frequently
56 archived. While those specimens collected by Drummond are no exception, information on place
57 names may be gleaned from contemporary sources (Richardson 1829; Drummond 1830; Hooker
58 1840). Unusually for that time, Drummond (1830) included limited coordinates provided by a Royal

59 Naval surveyor for a few place names recorded in his detailed itinerary. Coordinates for geographical
60 locations were obtained from the Canadian Board on Geographic Names (CBGN 1958). Various
61 online resources were consulted to establish principal historical locations, including the Canadian
62 Register of Historic Places (CRHP):
63 https://en.wikipedia.org/wiki/Canadian_Register_of_Historic_Places; the National Historic Sites of
64 Canada (NHSC): https://en.wikipedia.org/wiki/National_Historic_Sites_of_Canada; and the Hudson's
65 Bay Company trading posts (HBCTP):
66 https://en.wikipedia.org/wiki/List_of_Hudson%27s_Bay_Company_trading_posts. To counter the
67 variation between the coordinates provided by these websites, the locations were verified where
68 possible using Google Earth Pro. Locations were mapped using the distribution mapping software
69 DMap version 7.6.

70 A database of specimen records was compiled, drawing on the registers, manuscript catalogues
71 compiled by J. E. Gray and [M. R.] Oldfield Thomas, annotated printed catalogues in the NHM
72 Mammal Section, sectional and departmental archives and references from the literature. All label
73 information on the specimens was correlated with these records. It is unclear who wrote the original
74 specimen labels, although these occasionally include comments on habitat or breeding data
75 evidently derived from field notes. Thomas' handwritten annotations are sometimes included on the
76 original labels, and it was often he who wrote additional labels for type specimens.

77 Computed tomography (CT) is a scanning technique that uses X-rays to create high-resolution
78 images and three-dimensional (3D) models that reveal detailed morphological features and allow
79 measurements to be taken (Shi et al. 2018). The very fragile specimen of *Myotis* (NHMUK
80 1837.4.8.127) was mounted inside a plastic container tightly packed with plastazote foam to cushion
81 and hold it in a firm position to prevent movement during the scanning process. The scanning and
82 reconstruction process (R. Portela Miguez, V. Fernandez, *pers. comm.*) was performed using a Nikon
83 Metrology HMX ST 225. The specimen was scanned using a tungsten reflection target, at an

84 accelerating voltage of 100 kV and current of 99 μ A using an exposure time of 708 ms. The scan was
85 filtered with a 1 mm copper filter, and 2142 projections were taken over a 360° rotation. The voxel
86 size of the resulting dataset was 12.128 μ m. The 3D volumes were reconstructed using CT Pro (Nikon
87 Metrology, Tring, UK) and imported into the program Avizo Lite 9.0 (FEI Visualization Sciences
88 Group) to generate 3D surfaces and take electronic measurements of the specimen.

89 In a study of a large sample of skulls of different species of bat, Shi et al. (2018) demonstrated that
90 the differences were minimal between linear measurements taken on physical specimens in
91 comparison with those taken on the surface of digital specimens. Measurements (mm) taken on the
92 digital specimen are defined as follows, C – M3: maxillary toothrow length from the anterior of the
93 canine to the posterior of the third molar; C1 – C1: greatest breadth across the upper canines; M3 –
94 M3: greatest breadth across the third upper molars; ZB: greatest zygomatic breadth; ML: mandible
95 length from anterior of the first lower incisor to the posterior part of the condyle (this differs from
96 the measurement of Miller and Allen (1928) where the incisors are excluded); and c – m3:
97 mandibular toothrow length from anterior of the lower canine to the posterior of the third lower
98 molar.

99 Comparative material:

100 *Myotis austroriparius* NHMUK 1928.5.8.1.

101 *Myotis lucifugus* NHMUK 1907.7.7.636 – 1907.7.7.650, NHMUK 1938.9.21.1 – 1938.9.21.3.

102 *Myotis yumanensis* NHMUK 1892.10.7.3 – 4; NHMUK 1898.6.4.106; NHMUK 1904.3.3.3; NHMUK
103 1907.7.7.3360; NHMUK 1912.11.22.1; NHMUK 1961.474 – 1961.475.

104 The following acronyms are used in the text: Gray's Manuscript Catalogue of Mammals (GMCM);
105 Hudson's Bay Company (HBC); Natural History Museum, London (NHM); code for specimen numbers
106 in the collection of the Natural History Museum, London (NHMUK); and Zoological Society of
107 London's Museum (ZSM).

108 **Results**

109 **Thomas Drummond and the geographical origin of his specimen collections from North America**

110 There is some uncertainty over Thomas Drummond's date of birth, cited variously as 1780, 1790 and
111 1793, although he was known to be the younger brother of the botanist James Drummond born in
112 1786 or 1787 and their sister Margaret born in 1788. His baptismal date of 8 April 1793 was however
113 recorded in Forfar, Angus, Scotland, according to Nelson (1990), who explained that children at that
114 time were usually baptised within a few weeks of birth. His death was reliably recorded as occurring
115 in 1835. Thomas Drummond was born and raised in Scotland, working firstly as an estate gardener
116 and then as a nurseryman. He was principally a botanist with a particular interest in bryophytes,
117 contributing to a work on Scottish plants (Hooker 1821) and publishing a two-volume exsiccate
118 (published collections of dried herbarium specimens) of Scottish mosses (*Musci scotici* 1824 – 1825);
119 however, in the following years he was to prove his abilities in the far wider sphere as a botanical
120 and zoological collector.

121 Drummond undertook two separate expeditions to the New World (Fig. 1), firstly as assistant
122 naturalist to Dr John Richardson (1787–1865) on the Sir John Franklin Second Overland Expedition to
123 Canada and secondly on an independent expedition to the United States of America. The first
124 expedition, which extended from 1825 to 1827 was well documented; the results of the zoological
125 collections were published by Richardson (1828; 1829; 1836) and Swainson and Richardson (1831),
126 Drummond's itinerary and account of his journey were recorded (Drummond 1830) and details of his
127 botanical results were reported by Hooker (1840). A summary of Drummond's itinerary was
128 provided by Preble (1908) and Houston and Street (1959), who also recorded the birds Drummond
129 collected in Saskatchewan.

130 Richardson and Drummond may have worked together for a short while initially, and again for a
131 longer period at the end of the expedition, but for the greater duration the two worked
132 independently. While the main expeditionary party, including Richardson, travelled northwest,

133 Drummond remained at Cumberland House (one of Hudson's Bay Company's trading posts) from 28
134 June to 20 August 1825 (see Fig. 2; Appendix), then with an HBC brigade ascended the Saskatchewan
135 River, heading for the Rocky Mountains. The party arrived at Carlton House on 1 September 1825
136 but due to hostility from the local people, continued its journey, taking the North branch of the
137 Saskatchewan River. Drummond collected throughout this part of the journey, apparently walking
138 during the day while the boats travelled farther up the river and re-joined them at the nightly
139 encampments. He left specimens at Edmonton House, another important HBC trading post c. 400
140 miles (644 km) (from Carlton House) before continuing overland to Fort Assinaboine [Assiniboine]
141 on the Red Deer River [Athabasca River]. He proceeded on horseback through the heavily wooded
142 country alongside the river to Jasper's House on the edge of the Rocky Mountains, an estimated
143 distance of c. 200 miles (322 km), arriving early in October 1825 (see Fig. 2).

144 The party continued with the brigade along the Athabasca River and reached the commencement of
145 the Portage to the Columbia River. At this point, Drummond decided not to continue to cross the
146 Rocky Mountains and while the HBC brigade continued with their crossing Drummond remained
147 behind with local hunters. Between 18 October 1825 and 1 January 1826 Drummond travelled
148 slowly along the Assiniboine River, changed his route to remain outside the mountains because of
149 the difficulties of travel on horseback through heavy snow and reached the Baptiste River, where he
150 built a brushwood hut and remained alone for the winter. He left his hut on the Baptiste River on 1
151 April 1826 and reached Jasper's House within six days, using snowshoes to travel the distance of 150
152 – 200 miles (241 – 322 km). Drummond then travelled westward to a small lake about halfway
153 between Jasper's House and the start of the Portage, where he stayed until the returning HBC
154 brigade arrived on 6 May 1826 and the entire party returned to Jasper's House.

155 Drummond remained in the vicinity of Jasper's House until 15 June 1826 then, with one guide,
156 skirted along the mountains to the north for c. 60 miles (97 km), until they reached Lac-la-Pierre
157 [Rock Lake, see Howell (1938)]. They remained in the vicinity of Lac-la-Pierre, making various

158 excursions including one of c 30 miles (48 km) west to Wolf Plain, and then travelled about 20 miles
159 (32 km) southwest to Grande Saline, before retracing the journey on c. 20 July 1826 and deposited
160 specimens at Jasper's House.

161 Drummond, now accompanied by a hunter and his family, then travelled via Lac-la-Pierre to Smoking
162 River [Smoky River], a tributary of the Peace River (mentioned by Richardson (1829) and, according
163 to Drummond, c. 200 miles (322 km) in a direct line from Jasper's House). They remained there until
164 the latter part of September 1826 before returning to Edmonton House.

165 Drummond then joined an HBC brigade with the intention of crossing the portage to the Columbia
166 River in anticipation of a change in plant biogeography. They followed a tributary of the Athabasca
167 River, and at the top of the pass c. 15–20 miles (24–32 km) above the commencement of the
168 Portage they reached a small lake, named the Committee's Punch Bowl. They then descended to the
169 Portage River and reached the Boat Encampment on the Columbia River at the western end of the
170 portage on 17 October 1826. At this point he left the brigade and began to prepare to re-cross the
171 Rocky Mountains, arriving at Jasper's House for the final time on 30 October 1826.

172 Severe winter conditions forced a halt of the descent of the Athabasca River after seven days and
173 the remainder of the journey to Fort Assiniboine was on foot. He returned to Edmonton House in
174 the middle of December 1826, where he dealt with the specimens he had collected. He left
175 accompanied by two guides in the middle of March 1827, travelling overland on what was to prove a
176 long and difficult journey, using dog-drawn sledges to transport the loads and arrived at Carlton
177 House on 5 April 1827. Here he met Richardson, and both collected mammal and bird specimens in
178 that vicinity until the end of May, when Richardson departed on his return journey to the British
179 Isles. Drummond remained at Carlton House until 14 July 1827, using it as a base for excursions
180 along the South and North branches of the Saskatchewan River, before travelling to Cumberland
181 House, arriving there on 19 July 1827. His departure route included the portage of the Grand Rapids
182 at the entrance to Lake Winnipeg, Norway House and York Factory near the coast of Hudson's Bay.

183 In summary, Drummond had three main collecting periods: specimens collected on the initial
184 journey to Edmonton House; his principal collection of specimens amassed in the eastern regions of
185 the Rocky Mountains for a period of over a year (see Fig. 2); and specimens collected with
186 Richardson in the vicinity of Carlton House. Richardson (*in* Swainson and Richardson 1831: xiv) when
187 referring to birds stated that: “Many of the specimens ... were all prepared by Mr Drummond or
188 myself.” The same is likely to be true of the mammals as the style of preparation is consistent for all
189 small mammals sourced from both men. As this was a funded naval expedition, specimens collected
190 during the expedition would have been shipped directly to the UK. Probably all the mammalian
191 specimens were examined by Richardson, who made frequent references to and comparisons with
192 specimens collected by Drummond in the Rocky Mountains (Richardson 1829). Many of Richardson’s
193 specimens, including those collected by Drummond, were donated to the NHM, others to the ZSM,
194 some of which were also subsequently acquired by the NHM.

195 In 1831, Drummond again ventured eastwards, this time to the southern and eastern states of the
196 USA, starting in New York (Fig. 3) and progressing until his untimely death in Cuba in 1835.
197 Information on the itinerary of the early part of Drummond’s travels and the botanical results were
198 based on letters from Drummond to one of his main sponsors, William J. Hooker, Professor of
199 Botany at Glasgow University, and the person to whom all his collections were sent (Hooker 1834).
200 Drummond arrived in New York on 25 April 1831 and after obtaining letters of permission from the
201 Government in Washington and Baltimore, travelled on foot from Frederickstown [Frederick,
202 Maryland] across the Allegheny Mountains to Wheeling, on the Ohio River, then by steamboat to
203 Louisville where a severe illness prevented him from collecting. He had moved on to St. Louis by July
204 1831, where his illness recurred for several weeks, however he evidently recuperated sufficiently to
205 engage in small-scale collecting as recounted in a letter from New Orleans dated 14 December 1831,
206 which accompanied a batch of specimens collected chiefly from St. Louis. Drummond apparently
207 also sent specimens at this time to Richardson (1836: 70) who recorded receiving a new species of
208 fish *Otolithus drummondii* from New Orleans but whether mammal specimens were also sent to

209 Richardson during the North American expedition is unclear, except for the statement that “Mr
210 Drummond also sent me several specimens of different species (of *Geomys*) from various parts of
211 the United States, ...” (Richardson 1837: 156). A letter to Hooker from Covington, Louisiana, dated 2
212 September 1832, accompanied a box containing the remainder of the specimens collected in
213 Louisiana, which was received in the UK in July 1833. This letter, apparently written when
214 Drummond was moving on to Texas, was the last of the published letters but in a footnote (Hooker
215 1834: 184) stated: “Two collections of extremely interesting plants have since been received from
216 Texas ...” and “... will form the subject of a separate paper.” There are no details of Drummond’s
217 itinerary in Texas, because the promised separate paper never materialised in the same format, the
218 results of Drummond’s entire botanical collections being subsumed with those of other collectors in
219 the comprehensive paper published six years later (Hooker 1840) and five years after Drummond’s
220 death in 1835. Evidently Drummond made a third collection in Texas, according to Hooker (1840: 88)
221 “... species is also found as far South as Galveston Bay, Texas. (No.310 of Mr Drummond’s 3rd
222 collection.)” The dates of Drummond’s collections in Texas are uncertain, conservatively from 1833
223 to 1834, however according to Sayre (1971: 193) Drummond was in Texas from March 1833 to
224 December 1834, and in Florida from January to February 1835, before sailing for Havana, Cuba on 9
225 February 1835. That Drummond spent a short time in Florida is corroborated by Hooker (1840: 132)
226 “The same, or a very nearly aligned species, was found by Mr Drummond at Apalachicola in West
227 Florida.”

228 In addition to Drummond’s botanical material, Hooker (1834: 59 – 60) received collections of
229 mollusc shells, insects and reptiles that were included in the parcels sent to him in Glasgow for
230 onward dispersal to relevant researchers. Although there is no mention of the inclusion of
231 mammalian specimens amongst the collections sent to Hooker, such specimens evidently were
232 received by him, as documented in the NHM Archives. The entry for 13 February 1836 of the Report
233 Book (DF 205/2: 26 - 27) reads:

234 “The following specimens are offered at the prices annexed – They are all desirable for the
235 respective Coll[ections] sh[ould] the Trustees be pleased to sanction their purchase.

236 10 skins of Mammalia at 4^d [sic] / each – from Texas – 2. 0. 0. (£2 0 shillings 0 pence; decimal £2.00
237 the equivalent of £225.60 in 2019)

238 Three bottles of snakes and lizards, from Texas – 1. 10. 0. (£1 and 10 shillings; decimal £1.5)

239 A collection of land and freshwater shells, from the same place – 2. 2. 0. (£2 and 2 shillings; decimal
240 £2.1).

241 (The above are offered by Dr Hooker, on acc[ount] of Mr Drummond’s widow.)”

242 With minor discrepancies (12 rather than 10), this record for the mammal specimens correlates with
243 the entry in the 1837 Register and specimen labels.

244 **Drummond’s Specimens and Localities**

245 Prior to Canada’s independence in 1867, Canada and the USA were referred to as North America and
246 this was the main, and sometimes the only, locality applied to all of Drummond’s specimens. Most of
247 Drummond’s specimens collected from present-day Canada were recorded either from the sub-
248 localities of Carlton House or the Rocky Mountains, with Texas and a few other states recorded for
249 the USA. This is problematic for those specimens from Drummond that are simply marked as ‘North
250 America’.

251 **Carlton House**

252 All the specimens labelled Carlton House (Table 1) were donated by Richardson and one of these,
253 *Marmota monax* (Linnaeus, 1758) (NHMUK GMCM 94c) was apparently one of two specimens of this
254 species collected by Drummond (see Richardson 1829: 147). However, Richardson donated nine
255 other specimens from this locality, and since both men collected there during April and May 1827,
256 and Drummond (1830) recorded the presence of all three species of *Spermophilus* (currently

257 assigned to three distinct genera), it seems highly likely that Drummond collected some of these
258 specimens (see Table 1). The only specimen of note from this locality collected on the expedition is
259 the holotype of *Mustela longicauda* Bonaparte, 1838 (now *Mustela frenata* Lichtenstein, 1831).

260 **Saskatchewan Plains**

261 Drummond reported depositing specimens at Edmonton House, one of HBC's main staging posts,
262 but there are no definite records of mammal specimens collected by Drummond on 'la grande
263 prairie' [the plains of Saskatchewan]. The Plains of Saskatchewan is the locality of the holotype of
264 *Geomys borealis* Richardson, 1837 (NHMUK GMCM 55a) a synonym of *Thomomys talpoides*
265 Richardson, 1828. This specimen was donated by Richardson but there is no information on the
266 collector, although Richardson (1837: 156) mentioned that specimens of different geomyid species
267 were obtained from Drummond and his contemporary, David Douglas, another early explorer and
268 collector in North America.

269 The type description of *Sorex palustris* Richardson, 1828 (NHMUK 1842.10.7.1) included a huge
270 distributional range of this shrew from Hudson's Bay to the Rocky Mountains (as described by Hall
271 and Kelson, 1959: 40) but as a known Drummond specimen the possible range could be contracted
272 slightly to anywhere on route from Cumberland House to the Rocky Mountains. The same applies to
273 the holotype of *Sorex forsteri* Richardson, 1828 (NHMUK 1842.10.7.2), also collected by Drummond
274 [and currently considered a synonym of *Sorex cinereus* Kerr, 1792.](#)

275 **Rocky Mountains**

276 Richardson (1828; 1829) and Gray (1843) routinely referred to the Rocky Mountains as the origin of
277 Drummond's specimens and rarely provided more precise locations. All but one of the twelve
278 specimens from this general location donated by Richardson were collected by Drummond (see
279 Table 1). It is probable that this specimen of *Ochotona princeps* (NHMUK 1855.12.24.119),
280 purchased by NHM from ZSM nearly three decades after the expedition, also was collected by

281 Drummond but mistakenly attributed to Richardson, the probable donor, who never travelled to the
282 Rocky Mountains, but who also obtained specimens from other collectors such as Douglas. The
283 localities of the type specimens collected by Drummond and described from the general location of
284 the Rocky Mountains have been further refined by subsequent authors.

285 For *Martes americana abietinoides* Gray, 1865 (NHMUK 1842.12.9.5), the type locality was restricted
286 to the edge of the humid western slope of the Rocky Mountains, somewhere between Kicking Horse
287 Pass and the Columbia River (see Rhoads 1902: 451). This location of Kicking Horse Pass (51°27'10" N
288 116°17'00" W) appears however to be too far to the southeast for Drummond's travels (see Fig. 2)
289 so should be amended to a less precise locality of between latitude 52° – 54° N and longitude 117°
290 30' – 118° 30' W, which encompasses the region between the Boat Encampment on the Columbia
291 River, Jasper's House and Lac-la-Pierre. This refinement of the type locality may be significant for
292 biodiversity and conservation studies as *M. a. abietinoides* is regarded as a valid subspecies.

293 For *Myoxus drummondi* Richardson, 1828 (NHMUK 1842.10.7.6), the type locality is probably in the
294 region of Jasper House, Alberta (Preble 1908: 176; Goldman 1910: 99). Currently considered a valid
295 subspecies, the distribution of *Neotoma cinerea drummondi* includes eastern British Columbia and
296 western Alberta (Pardiñas et al. 2017).

297 The holotype of *Arvicola (Lemmus) helvolus* Richardson, 1828 (NHMUK 1842.10.7.11) apparently
298 originated from near the headwaters of one of the southern tributaries of the Peace River, or
299 between there and the Jasper House region, Alberta (Preble 1908: 182). The distribution of *Lemmus*
300 *trimucronatus helvolus* includes S. Yukon, N. British Columbia and N. W. Alberta (Shenbrot and
301 Krasnov 2005; Pardiñas et al. 2017) but there are a few more southerly records in British Columbia
302 plus a southerly outlier collected in 1965 from Sunwapta Pass, Jasper National Park, Alberta, 52° 12'
303 N 117°09' W (Yale Peabody Museum MAM 012377). This raises a variety of questions, especially as
304 no other specimens attributable to this taxon were encountered during explorations of the

305 Athabasca – Mackenzie River (Preble 1908). Should both southerly locality records be considered
306 doubtful, or might they represent relict populations?

307 Preble (1908: 198) suggested that the holotype of *Lepus (Lagomys) princeps* Richardson, 1828
308 (NHMUK 1842.10.7.12) (*Ochotona princeps* (Richardson, 1828) originated from near the sources of
309 the Elk [Athabaska [sic]] River, presumably based on Richardson's (1829: 227) statement that: "and
310 Mr Drummond killed several near the sources of the Elk River." Hall and Kelson (1959: 250)
311 confirmed this as the headwaters of the Athabasca River, near Athabasca Pass, Alberta.

312 Two specimens of *Spermophilus lateralis* (Say, 1823) (NHMUK GMCM 131a, NHMUK GMCM 131b)
313 (now in the genus *Callospermophilus*) are possible candidates among those recorded from the Rocky
314 Mountains at latitude 57° N (Richardson 1829: 175), however there is no evidence that Drummond
315 travelled farther north than 54° N in the Rocky Mountains and according to Preble (1908: 166) these
316 specimens were probably collected in the region of Jasper House. The current distribution of this
317 distinctively marked squirrel, *Callospermophilus lateralis tescorum* Hollister, 1911, is E. British
318 Columbia and W. Alberta (Koprovski et al. 2016).

319 The note on the back of the original label of one specimen of *Microtus pennsylvanicus* (Ord, 1815)
320 (NHMUK 1842.10.7.7), reads "Large mouse, mountain prairies. Dives well when pursued.
321 Drummond." According to Richardson (1829: 120) the species was collected by Drummond near the
322 foot of the Rocky Mountains, whereas Preble (1908: 190) suggested that the locality was probably in
323 the region of Jasper House.

324 *Microtus xanthognathus* (Leach, 1815) (NHMUK GMCM 132a) may be one of the specimens to which
325 Richardson (1829: 123) referred as "common in the immediate vicinity of Fort Franklin; and Mr
326 Drummond found it in abundance on the Rocky Mountains in latitude 56°". Richardson is recorded
327 as the source of this specimen; if it originated from Fort Franklin, then it would have been obtained
328 by Richardson, not Drummond; if it was collected by Drummond from the Rocky Mountains, then
329 the latitude given was probably too far to the north. The current distribution of this species is farther

330 to the north and west of this specimen record, ranging from Yukon and the Northwest Territories,
331 extreme NW British Columbia, N and central Alberta and westward to Hudson Bay (Pardiñas et al.
332 2017).

333 **Drummond's untraced specimens from Rocky Mountains**

334 According to Richardson (1829: 161) *Arctomys parryi erythrogluteia*, a synonym of *Urocitellus*
335 *columbianus* (Ord, 1815), was procured by Mr Drummond on the Rocky Mountains, "near the source
336 of the Elk River, in latitude 57°". Preble (1908: 165) pointed out that the Elk River of Richardson is an
337 alternative name for the Athabasca River and that Drummond did not travel as far north as latitude
338 57° N. Drummond (1830: 212) stated that he brought home specimens of *Arctomys parryi* that were
339 abundant on the mountains near Wolf's Plain. He located Wolf Plain at about 30 miles west from
340 Lac-la-Pierre (Drummond 1830: 199), which is c. 25 miles NW of the lower end of Jasper Lake
341 according to Howell (1938: 88). Howell consequently considered that this would fix the type locality
342 of *Arctomys parryi erythrogluteia* Richardson, 1829 as near the headwaters of Sulphur River, a
343 branch of Smoky River. The name *A. p. erythrogluteia* does not appear in any NHM or ZSM archival
344 records but two specimens of *U. columbianus* donated by Richardson (NHMUK 1842.12.9.12 and
345 1855.10.16.256) may be topotypical.

346 The habitat of *Pteromys alpinus* Richardson, 1828: 519 is "The vallies [*sic*] in the Rocky Mountains."
347 *Pteromys sabrinus alpinus* was recorded by Richardson (1829: 195) as "This animal was discovered
348 by Mr Drummond, on the Rocky Mountains, living in dense pine forests. I [Richardson] have received
349 specimens of it from the head of the Elk [Athabasca] River, and also from the south branch of the
350 Mackenzie." Preble (1908: 173) stated that it was "... described by Richardson from specimens taken
351 by Drummond near the sources of the Elk River (Athabasca)." However, since Richardson is
352 unspecific about the source of all his specimens, this choice ignores the possibility that Richardson's
353 reference to specimens also from the south branch of the Mackenzie, may have originated from the
354 collections made by members of the main expedition or, since the tributaries of the Mackenzie

355 include the Peace River and its tributary, the Smoky River, might also potentially be Drummond
356 specimens. Nevertheless, Preble's interpretation appears to be appropriate.

357 The description and figure of *Arvicola drummondi* Audubon and Bachman, 1854 was based on a
358 Drummond specimen from the valleys of the Rocky Mountains. If, as stated by Audubon and
359 Bachman (1854: 167), Drummond deposited this specimen in ZSM, then it possibly was purchased
360 subsequently by NHM although there is no evidence to indicate that this was the case. The taxon is
361 recognised as a widely distributed subspecies, *Microtus pennsylvanicus drummondi* (Audubon and
362 Bachman, 1854) (Pardiñas et al. 2017)

363 **United States of America**

364 Most of the specimens that Drummond collected in the USA were recorded from Texas or 'Texas?',
365 including *Didelphis virginiana* Kerr, 1792, *Mephitis mephitis* (Schreber, 1776) and *Neotoma floridana*
366 (Ord, 1818) (see Table 1). Two bats, *Lasiurus seminolus* (Rhoads, 1895), were recorded from New
367 York and *Sciurus carolinensis* Gmelin, 1788 from Louisiana but there is some doubt about the states
368 where the other specimens were collected. Two of Drummond's specimens, *Procyon lotor* (Linnaeus,
369 1758) (NHMUK 1837.4.8.116) and an unnamed species of *Sciurus* (NHMUK 1837.4.8.114) supposedly
370 from Virginia, are unlikely to be from this state, unless they were collected during the early part of
371 Drummond's expedition as he walked from Frederickstown (Frederick in Maryland), across the
372 Alleghenies to Wheeling (both in West Virginia, but included in the state of Virginia between 1790
373 and 1860).

374 There is some confusion over the type material of *Lepus douglasii* that Gray (1837) based on two
375 varieties differentiated by slight differences in pelage. No locality was given for Var. 1 but California
376 for Var. 2, the species description ending with "Inhabits North America, Texas: ? called the Marsh
377 Hare." "Texas?" is written on the label of the lectotype (NHMUK GMCM 92a) but "California" is
378 probably erroneously written on the label of the paralectotype (NHMUK GMCM 92b), as the GMCM
379 catalogue entry for 92a and 92b clearly reads: "Purch. Mrs. Drummond 1836, Texas?". In Gray

380 (1843: 127) four specimens are recorded from California? Texas? and all from David Douglas's
381 collection, with no mention of Drummond. In Thomas' manuscript catalogue, the entry 387c under
382 *Lepus palustris* (currently *Sylvilagus palustris* (Bachman, 1837)), was listed as an adult skin from
383 California ZS (Zoological Society) (Douglas) 53.8.29.26 but the statement: "One of the types of *L.*
384 *douglasi* Gr." was crossed out. The next entry, 387d is also of an adult skin listed as "N. America,
385 Drummond, 92a" and in separate smaller writing "co-type of *douglasi*, with 92b." There are various
386 problems with the records of these specimens, not least why Gray should give the name '*douglasii*'
387 rather than '*drummondi*' to specimens collected by Drummond. Thomas (1927: 554) resolved the
388 problem by formally designating the Drummond specimen GMCM 92a as the lectotype and GMCM
389 92b as the lectoparatype (paralectotype) both with the type locality of "Texas?". The current
390 distribution of *Sylvilagus palustris* is from S. E. Virginia through the Carolinas and Alabama to Florida
391 but does not include Texas. Texas is however included in the range of *Sylvilagus aquaticus*
392 (Bachman, 1837) (Schai-Braun and Hackländer 2016). Since on genetic evidence both species are
393 regarded as sister taxa the specific identity and type locality of *Lepus douglasii* remains in doubt.

394 **No Locality**

395 **History of the specimen 1837.4.8.127 (627); GMCM 89b**

396 The specimen was first recorded with an individual number by John Edward Gray in his manuscript
397 Catalogue 1 Primates and Chiroptera (GMCM 1) as: "89b *Vespertilio carolii* N. America. Purchased
398 [from] Drummond." The Register entry for this specimen was: "1837.4.8.127 (627) *Vespertilio* N.
399 America; Mr Drummond; Mam. Chir. 89b." It was one of a small series of mammals and reptiles with
400 the same information of N. America and Mr Drummond, which was purchased from Sir W. J. Hooker,
401 Glasgow.

402 The specimen was first recorded in print (Gray, 1843: 26) under the name *Vespertilio caroli* [sic]
403 Temminck, 1840 with the information: "N. America. From Mr Drummond's collection." *Vespertilio*
404 *carolii* is currently regarded as a synonym of *Myotis lucifugus* (Le Conte, 1831), a species distributed

405 from Labrador and Newfoundland in Canada to Alaska and southwards to California, Arizona and
406 New Mexico (Simmons 2005).

407 There are two uncertain references to this specimen in Dobson (1878: 325 – 327). The first is:
408 “*Vespertilio albescens* ‘i’ adult skin. N. America (?) Mr Drummond [sic]”. *Myotis albescens* (E. Geoffroy,
409 1806) is distributed from Mexico, through Central to South America, so seems an unlikely candidate
410 for a bat collected by Drummond. The second reference is to “*Vespertilio carolii* ‘a’. adult skin. N. W.
411 America” however, there is no named source for this specimen.

412 The next reference, nearly a century after the specimen’s probable collection, is in the revision of
413 *Myotis* by Miller and Allen (1928). On page 16 under (*Myotis*) *austroriparius* the authors refer to “A
414 specimen in the British Museum, collected by Drummond, is labelled ‘North America’. It may have
415 come from the interior of Canada.” In the key on page 37, the distribution of *M. austroriparius*
416 (Rhoads, 1897) was recorded as “Florida, Indiana and Saskatchewan?” On page 78 under specimens
417 examined, a specimen was recorded as “?Canada: 1 skin (BM)” and on page 80 the external
418 measurements were recorded for this specimen as “Canada? 37.4.8.127 B.M.” This is the first
419 association with Canada or Saskatchewan and was presumably based on the authors’ incorrect
420 assumption that Drummond collected only in Canada.

421 In his account of the bats of Saskatchewan, Rand (1943) recorded *M. austroriparius* as an old and
422 doubtful record from a specimen in the British Museum and stated that the occurrence was
423 questionable. The record was similarly discounted by Anderson (1946: 189) as: “(Canadian record.
424 One doubtful record, 37.4.8.127, British Museum; exact locality unknown)”, and was ignored in
425 subsequent treatises of the mammals of Saskatchewan (Beck 1958) and of Canada (Banfield 1974),
426 and in accounts of the species (LaVal 1970; Jones and Manning 1989).

427 **Description of the specimen 1837.4.8.127**

428 This is a skin in fragile condition, with the skull still in the skin, showing some characters of the
429 anterior upper dentition. The information recorded on the label was “N. America Mr Drummond”.
430 Because of its fragility, the decision was taken to use computerized tomography (CT) scans to

431 examine the skull. These scans revealed that at some stage during specimen preparation, very small
432 glass eyes had been inserted into the orbits, presumably to make a mounted or partially mounted
433 specimen. The scans provided some good images of the skull and dentition (see Fig. 4) and
434 confirmed the generic identification of the specimen, as *Myotis* is distinguished from other North
435 American vespertilionids by the dental formula of $I\ 2/3\ C\ 1/1\ PM\ 3/3\ M\ 3/3 = 38$. Unfortunately, the
436 cranium had been fractured, perhaps during insertion of the glass eyes, so that cranial length proved
437 impossible to measure. Nevertheless, measurements of the mandible, maxillary and mandibular
438 tooththrows were feasible and morphological features were clearly shown, including the presence of a
439 sagittal crest. One of the key external characters used to discriminate between species of North
440 American and Canadian *Myotis* (see Miller and Allen 1928; Hall 1981) is the presence of a keel on the
441 calcar in contrast to either a very weakly developed or absent keel, which is the condition found in
442 the Drummond specimen. From the external measurements and these cranio-dental measurements,
443 it was apparent that the specimen was within the size range of three species of *Myotis*: *M.*
444 *austroriparius*, *M. lucifugus* and *M. yumanensis* (H. Allen, 1864) (see Table 2), in which the keel on
445 the calcar is either lacking or weakly developed. The presence of a sagittal crest on the skull
446 however, clearly eliminated *M. lucifugus* and *M. yumanensis* with the conclusion that Miller and
447 Allen's (1928) identification of the Drummond specimen as *M. austroriparius* was correct. Since
448 *Myotis austroriparius* is distributed from Indiana and North Carolina south to Florida in southeastern
449 USA and west to Texas and Oklahoma (Simmons 2005), a record from as far north as Canada would
450 be distinctly suspicious, except as a possible example of vagrancy.

451 **Other specimens lacking locality data**

452 Of the 12 specimens probably collected by Drummond that lack locality information other than
453 North America, two specimens of *Marmota monax* (Linnaeus, 1758) (NHMUK 1842.12.9.10 –
454 1842.12.9.11) were more likely to have been collected on Drummond's first trip to Canada, because
455 the known range extends no farther south on Drummond's route than northern Louisiana.

456 Furthermore, one of them may have been collected from the vicinity of Carlton House. The current
457 extensive distribution of *Procyon lotor* is such that the specimen (NHMUK GMCM 92c) could have
458 originated from Canada or the USA. However, Richardson (1829) indicated that this species was
459 found in southern Canada as far N as latitude 50°, well outside the route of Drummond's travels, and
460 the assertion by Latham (2008) that the northward range extension into Canada from southwestern
461 USA occurred in the late 1800s to early 1900s, suggests that it is more likely that this specimen
462 originated from Drummond's second expedition to the USA. The other specimens, mostly purchased
463 from Hooker on behalf of Mrs Drummond, are also more likely to have originated from Drummond's
464 expedition to the USA. All six specimens are problematic for various reasons. Two bats, NHMUK
465 1837.4.8.119, registered as *Lasiurus pruinosus* Say, 1823 (now *Lasiurus cinereus* (Palisot de Beauvois,
466 1796)) and NHMUK 1837.4.8.126 *Vespertilio carolii* Temminck, 1840 (a synonym of *Myotis lucifugus*
467 (Le Conte, 1831)) have not been traced. Three of the four specimens (NHMUK 1837.4.8.120 –
468 1837.4.8.122) registered as *Mus leucogaster* were entered in Thomas' manuscript catalogue under
469 the name of *Peromyscus leucopus* (Rafinesque, 1818) and were rendered duplicates in 1917, so are
470 no longer in the collection. The name *leucogaster* is not considered to be a synonym of *P. leucopus*
471 but Thomas evidently identified them as such rather than as *Onychomys leucogaster* (Wied-
472 Neuwied, 1841). The fourth specimen (NHMUK 1837.4.8.123) is immature and currently regarded as
473 an unidentified species of *Reithrodontomys* Giglioli, 1874.

474 **Discussion**

475 Among the many aims of the two overland expeditions to the northern part of North America (pre-
476 Confederation Canada) led by Sir John Franklin was to explore and map the land, discover and
477 consolidate viable trade routes, and investigate the mineral, plant and faunal resources of the land.
478 In both overland expeditions Richardson served both as medical doctor and naturalist, but by
479 employing Drummond during the second expedition it was possible to considerably expand
480 knowledge of a much more extensive area.

481 Drummond was able to use existing trade routes established by the HBC and benefited by
482 accompanying HBC brigades for the main part of his outward journey and on several occasions
483 during his expedition in 1826. This support, general assistance and protection must have materially
484 increased his ability to collect and transport specimens. By contrast, Drummond must have been
485 constrained by his first winter months alone for much of the time and by the difficulties of travel
486 with few guides back to Carlton House during the late winter and spring of 1827.

487 There is no information about the collection methods that Drummond employed. For the first
488 expedition in Canada, it is probable that he was able to profit from the advice, skills and experience
489 of the professional trappers belonging to the HBC brigade and equally from local hunters. Their
490 experience would naturally be concentrated on trapping fur-bearing mammals from the size of
491 squirrels and mustelids upwards, so it is interesting that Drummond also succeeded in collecting
492 much smaller mammals, such as voles, shrews and bats, which would have required a variety of
493 different techniques.

494 Information on Drummond's field preparation techniques is also lacking, although again it is likely
495 that they would be based on similar methods to those of the fur-trading HBC. That many of his
496 specimens were preserved with the skull within the skin, suggests they were eviscerated and either
497 dried, if feasible, or preserved by other methods, with the skull and perhaps the skeleton inside for
498 transport. His reference to a poorly de-fleshed deer that was carried from the Columbia River over a
499 very long distance until, on the last part of his journey towards Carlton House, the specimen had to
500 be sacrificed to provide food and prevent starvation, does suggest that the skeleton or some part of
501 it was retained in some specimens. Drummond twice deposited specimens at Edmonton House. He
502 apparently used Jasper's House as a base and for storing specimens in between his lengthy collecting
503 excursions, as he returned there on five separate occasions. The logistics of transporting specimens
504 must have been daunting in the extreme. Whether Drummond was solely responsible for
505 transporting all the specimens he had collected during the entire duration of the expedition, as

506 seems most probable, or whether specimens were transported in separate batches on earlier
507 occasions by the HBC staff, is a matter for conjecture.

508 When embarking on his expedition to the USA, Drummond benefited from his hard-won experience
509 of collecting in Canada. Travel in the USA had many advantages over that in Canada in not having to
510 contend with such hard winter conditions, travel along the major waterways was well established
511 and communications were such that he was able to despatch specimens back to Scotland from
512 major centres at regular intervals. The major problem that he encountered was poor health, as he
513 succumbed to a severe illness early in the expedition.

514 Bearing in mind that Drummond was first and foremost a botanist, his account revealed that most
515 probably he had some familiarity with the local mammalian fauna before the expedition began or
516 less likely, that he rapidly acquired a knowledge of basic identification of the animals he observed
517 and collected. On his first expedition, Drummond referred to several larger mammals, such as rocky
518 mountain sheep (bighorn sheep, *Ovis canadensis* Shaw, 1804), 'buffalo' (American bison, *Bison bison*
519 (Linnaeus, 1758)) and deer but usually in the context of shooting them for provisions and some of
520 the ones that he had intended to retain as specimens, were also eventually consumed when the
521 necessity proved pressing. There is no record that specimens of any of these larger mammals were
522 received by Richardson and lodged with ZSM or NHM, with the exception of the head of a grizzly
523 bear (*Ursus arctos*) that Drummond collected, which was used by the artist Landseer for one of the
524 plates in Richardson (1829: 25, pl. 1). Sadly, this specimen cannot be traced and there is no listing of
525 it in ZSM or NHM records.

526 Nothing suggests that Drummond sold or presented any specimens directly to NHM. His specimens
527 entered the collection indirectly from three main sources: via Richardson who presented many of
528 the study specimens that resulted from the expeditions to Canada directly to NHM; via specimens
529 presented by Richardson to ZSM, which were subsequently purchased by NHM when the ZSM
530 collections were sold; via Hooker who sold them on behalf of Drummond's widow. Because of his

531 position as Assistant Naturalist to Richardson, all the specimens collected by Drummond in Canada
532 were Naval property and none would have been available for private sale. In contrast, while
533 Drummond may have been obliged to collect on behalf of some of his sponsors for his expedition to
534 the USA, it seems highly likely that he intended to sell a proportion for his own benefit.

535 It appears counter-intuitive, however that specimens collected by Drummond during his first
536 expedition to Canada, were accessioned into the NHM collection several years after those obtained
537 by him during his second expedition to the USA. All the specimens registered in 1842 collected by
538 Drummond and donated by Richardson have been traced to the Canadian species accounts
539 published before the start of Drummond's second expedition to the USA (Richardson 1829).
540 Richardson was appointed as Chief Medical Officer at Melville Hospital, Chatham from 1827 – 1838
541 and, although there is no direct information, it is probable that he used this hospital as a base for
542 studying all the specimens resulting from the Franklin expeditions and evidently continued to use
543 them for further publications (Richardson 1936; 1937; Swainson and Richardson 1831). Richardson
544 may have transferred this material to the Haslar Royal Naval Hospital, Gosport when he was
545 appointed as Senior Physician there in 1838, perhaps with the intention of incorporating the
546 specimens into the Haslar Hospital Museum. However, he evidently donated many of the mammal
547 specimens to NHM subsequently to his promotion to Inspector of Hospitals in 1840, perhaps
548 influenced by Gray who was keen to enhance the NHM collection that Richardson had actively used
549 for comparative material during his studies.

550 Archived records show that the Drummond specimens were sold to NHM in 1836 by Hooker, acting
551 as an agent for Drummond's widow, and registered in 1837. Information is less clear-cut for these
552 specimens, with more than half untraceable or lacking any locality details and only five positively
553 recorded from the USA. While it is impossible to be certain, the preponderance of evidence suggests
554 that the sixth specimen, 1837.4.8.127, whose identity is here confirmed as *Myotis austroriparius*,
555 also originated from Drummond's second expedition to the USA and not from Saskatchewan.

556 The study has shown that several of the historical locations in the Rocky Mountains lie beyond the
557 bounds of currently accepted distributions. From his own account, the outer boundaries of
558 Drummond's travel within the Rocky Mountains are well proscribed, although actual specimen
559 locations within those boundaries are less readily assigned. One of the most problematic is the
560 current distribution of *Lemmus trimucronatus*, which is well to the north of the location of the type
561 specimen of *L. t. helvolus* which, with the second outlying record from slightly farther south in
562 Alberta and the few south-western specimen records in British Columbia poses several interesting
563 questions worthy of further investigation. Although relatively few, it is unlikely that all these records
564 based on preserved specimens, are erroneous. Do these southern outliers represent one or more
565 relict populations? This question may be addressed by comparative molecular and isotope analyses.
566 A less extreme example is *Microtus xanthognathus* where the currently accepted distribution is
567 farther to the north and west than the historical record. Another intriguing question that might be
568 addressed by modern techniques, is the specific identity and location of the type material of *Lepus*
569 *douglasii*, where the taxonomy of *Sylvilagus palustris* and *S. aquaticus* is in a state of flux.

570 The contributions of the early naturalists are important and should not be forgotten. In conclusion, it
571 is conjectured that historical collections such as this do indeed remain relevant for current and
572 future studies. They still have much to offer for understanding temporal changes in geographical
573 distribution, which in some cases may be linked to climate change, and for biodiversity and
574 conservation studies. Inclusion in comparative phylogenetic analyses may confirm existing
575 taxonomies or reveal surprising differences.

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588 The authors declare there are no competing interests.

589 **Contributors' statement**

590 SGS initiated the project and PDJ investigated specimens and archival data. Both were responsible
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594 **Data availability**

595 The data are available by application to NHM curatorial staff. CT scans of the bat skull will be posted
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728 **Figures**

729 Figure 1. Map of North America. Box A includes the region where Drummond collected specimens
730 during his first expedition to Canada from 1825 to 1827, with details of his route shown in in Figs. 2.
731 Box B includes the region traversed by Drummond during his second expedition to the U.S.A. from
732 1831 to 1834, with the route shown in detail in Fig. 3. Adapted from a map produced by the
733 Cartographic Research Laboratory, University of Alabama.

734 Figure 2. Route of Drummond's expedition from Cumberland House in Saskatchewan, across Alberta
735 and into the Rocky Mountains. 1. Cumberland House; 2. Carlton House; 3. Edmonton House; 4. Fort
736 Assiniboine; 5. Jasper's House; 6. Commencement of the Portage; 7. Lac-la-Pierre, 8. Committees'
737 Punch Bowl; 9. West end of the Portage and Boat Encampment; note that these two historical sites
738 currently lie beneath the Kinbasket Lake Reservoir of the Columbia River. Sa – Saskatchewan River;
739 NSa – North Saskatchewan River; At – Athabasca River; Sm – Smoky River; Co – Columbia River.

740 Timeline. 1. June – August 1825; 2. 1 September 1825 (no halt); 3. (1st) 22 September 1825; 4. (1st) 1
741 or 2 October 1825; 5. (1st) 11 or 12 October 1825; 6. 16 – 18 October 1825; travel along Assiniboine
742 River to hut on Baptiste River October 1825 – 1 January 1826; overwinter in hut January – 27 March
743 1826; 5. (2nd) early April 1826; small lake between Jasper's House and the Portage April to 6 May
744 1826; 5. (3rd) May – 15 June 1826; 7. June – c. 20 July 1826; 5. (4th) July 1826; via 7. Lac-la-Pierre to
745 Smoky River July – September 1826; 3. (2nd) c. September 1826; 8. and 9. September to October
746 1826; 5. (5th) 30 October – November 1826; 4. (2nd) c. 22 November – early December 1826; 3. (3rd)
747 December 1826 – mid-March 1827; 2. 5 April – 14 July 1827; 1. 19 July 1827.

748

749 Figure 3. Route taken by Drummond across the USA: 1. New York; 2. Philadelphia; 3. Baltimore; 4.
750 Washington; 5. Frederick (Fredericktown); across the Alleghenies (not marked) to 6. Wheeling; 7.
751 Louisville; 8. St Louis; 9. New Orleans; 10. Covington, Louisiana, then westwards into Texas. Oh –
752 Ohio River; Mr – Missouri River; Mi – Mississippi River. Timeline. 1. 25 April 1831 – early May 1831;

753 2. 7 May 1831; 8. 19 July 1831; 9. 6 December 1831 – summer 1832; 10. 2 September 1832; Texas
754 March 1833 – December 1834.

755 Figure 4. Scans of the skull of NHMUK 1837.4.8.127. (a) Dorsal view of the skull showing the
756 presence of a distinct sagittal crest on the cranium. The cranium is fractured on the rostrum in the
757 maxillary / frontal region, with the braincase displaced posteriorly and at an angle to the anterior of
758 the skull, revealing the posterior part of the mandible. (b) Ventral view of the skull. The glass eye
759 inserted into the right orbit is still in position. Scale equals 5 mm. (c) Occlusal view of the mandible.
760 Scale equals 10 mm. (d) Lateral view of right mandibular ramus. Scale equals 10 mm.