

Supplementary information to

A new caenagnathid dinosaur from the Upper Cretaceous Wangshi Group of Shandong, China, with comments on size variation among oviraptorosaurs

Yilun Yu¹, Kebai Wang², Shuqing Chen², Corwin Sullivan^{3,4}, Shuo Wang^{5,6}, Peiye Wang², Xing Xu⁷

¹Yuan Pei College, Peking University, Beijing, China

²Zhucheng Dinosaur Museum, Zhucheng, Shandong, China

³Department of Biological Sciences, University of Alberta, Edmonton, Alberta, T6G 2E9, Canada

⁴Philip J. Currie Dinosaur Museum, Wembley, Alberta, T0H 3S0, Canada

⁵Laboratory of Vertebrate Evolution, College of Life Science, Capital Normal University, Beijing 100048, China.

⁶State Key Laboratory of Palaeobiology and Stratigraphy, Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, Nanjing, 210008, China.

⁷Key Laboratory of Vertebrate Evolution and Human Origins, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China

***Materials & Correspondence.** Requests for materials and correspondence should be addressed to X.X. (xingxu@vip.sina.com)

Supplementary information includes:

- 1. Measurements of the *Anomalipes zhaoi* holotype**
- 2. Phylogenetic analyses**
- 3. Supplementary figures**
- 4. Supplementary references**

1. Measurements of the *Anomalipes zhaoi* holotype

	Length	Proximal transverse width	Distal transverse width	Least shaft diameter	Distal anteroposterior thickness	Ascending process of astragalus length
Femur	277+	70.0	?	29.6	?	\
Tibia	325+	?	61.9	34.4	14.5	108.6
Fibula	170+	?	?	?	?	\
Metatarsal III	167	13.6	22.6	9.4	20.3	\
Proximal phalanx	37.4	12.7	15.7	11.3	11.8	\
Ungual	51.4	11.1	3.02	?	?	\

+ indicates incomplete measurement, ? missing data, \ inapplicable.

2. Phylogenetic analyses

We initially carried out an analysis intended to determine the approximate systematic position of *Anomalipes zhaoi* among coelurosaurian theropods, using a recently published dataset from a comprehensive analysis of coelurosaurian phylogeny by Brusatte et al. ¹ with *Anomalipes zhaoi* and 13 new characters added in (see below). The complete, modified matrix, which we term the Brusatte et al. Matrix, is given below. Figure S1 shows the strict consensus of 73 most parsimonious trees produced by analysis of the Brusatte et al. Matrix. Our second and third analyses, intended to assess the systematic position of *Anomalipes zhaoi* within the Oviraptorosauria, used recently published datasets from analyses of oviraptorosaurian phylogeny carried out separately by Lamanna et al. (2014)² and by Funston and Currie (2016). In each case some characters were recoded, and new characters (see below) and *Anomalipes zhaoi* were added in. The complete, modified versions of these matrices, which we term the Lamanna et al. Matrix and the Funston and Currie Matrix, are also given below. Figures S2 shows the strict consensus of the 860 most parsimonious trees produced by analysis of the Lamanna et al. Matrix.

New characters added to the Brusatte et al. Matrix

854. Femur head, shape: subspherical (0); anteroposteriorly compressed (1).

855. Femur, femoral head, orientation: medial (0); dorsomedial (1)
856. Femur, femoral head, posterior deflection: absent (0); present, femoral head more posteriorly positioned than greater trochanter (1)
857. Femur, greater trochanter, anteroposterior width: less than or sub-equal to anteroposterior width of femoral head (0); greater than anteroposterior width of femoral head (1)
858. Femur, greater trochanter, anteroposterior width: slightly greater than anteroposterior diameter of proximal portion of femoral shaft (0); much greater than anteroposterior diameter of proximal portion of femoral shaft (1)
859. Femur, accessory trochanter: confluent with lesser trochanter (0); separate from lesser trochanter (1)
860. Femur, accessory trochanter: subdued (0); prominent (1)
861. Tibia, distal articular surface, outline: sub-triangular (0); sub-rectangular (1)
862. Metatarsal III, proximal articular surface: rectangular (0); triangular (1); irregular (2)
863. Metatarsal III, anterior flange near proximal end: absent (0); present (1)
864. Metatarsal III, distal articulation, medial hemicondyle, transverse width: sub-equal to transverse width of lateral hemicondyle (0); much less than transverse width of lateral hemicondyle (1)

Complete, modified Brusatte et al. Matrix

Allosaurus_fragilis ?10000?000000001000110010001012001110110010??000000
0000001000000000001000100000000000101010010000000100101000000000010000000000
???0000000000000000?10000000000010001001000000100010000011000000100000000
00000000000100000000000?0?000?0011000010000001000011100021011000000000200000
0000?0000??0000000?00000?0000000010000[01]0?0?0?0?0?0000020?00?0000000101000
?0?0010000?00000000000001000010?01000??0000000?000?0000020000000000000?00000?
00?0010000000020000?000100??001100000[01]0?000000001000000001100000000001000
11000000021121001001000100?1???000000000100??10?0000?00000000000011000?100?
000?0?1000000000???000?0001001000010100000000000000010200000000000000000001
0000000000020101[01]0000100000000000000000000100000010?00010000010201100000000
011000000001000000000000001001000100
000000??000000000000000000000?000001000000000000000?00000010?00

Sinraptor_dongi ?10000?000?0001000100000001012000010110010?00?000
000000010000?00000100?10?000000000101010010000000100101000000000001?????0??
1?10?
0000?000?000?00?000000?0?000?001100001001000100000100002101???00000000000000
000?0000??0000000?00000?0000000010000???00?00??00?????2?????????????1010???????

????????????????????????????1?????0?000?00000000200000000000000000?00?00?0?
??00020000?0001?0??0011000?????????00010000000000000000001000001100000002102
100000?010?00?10000000000000100??01?0000?00000000000?11000?100?010?0?100?00?0
01000?0010000100100001010?0?00000000000112000000?00???00000010000?000000201
01??0??1000000????????????000010010?0000?000010201101010?00011000000??1?000000
00000001001000??0??000000000100?00000000000000??????00000000?0000000000000
000000000000?0010?00000?0000000100000000000

Dromaeosaurus_albertensis ?0??001000000000010??0??0?01??01110????1111????101?
1001100??00000010011111000?0000101001?????????????????????????????????????
????????????????????1??11?1?0????00?????00
?0?00??1?????????1?00??011000100?0?????????????0??0000?00000?0000?0000000?0
0000?00??
?????00??0????0?????????010121?000?0?00?0??
???????0????0??0?0??0?????0?0100?00?00?????????????????????0????00000100000
???????0??????0001001?0?0???00?00?????0?0?10?????????000?1000000010???0000
0000001120100000000?0?00010???
????????????????????0?000?0?????????????0?0?010?????????????????????0200000??
?????????????????????????????????????0?1?0??110????????????????000?0?????????00

Deinonychus_antirrhopus ?0010????1???????1?0000?011100011100011111100?1??
00001110100000?0100111?1000?0100101000?110001100?1121011????00110111121?????1
?1101110010011100000100221110101020220?01111211201?1111000000000100011010010
000000001100000?00010?0010002110000011110110000?00000122000000000?0????000??
??0??????????00000?000000000000?[01]0?0????????????20000?000?000111000?0?0010
000?0000000000000101?0??00000??0100000?000?0000000000000000000000000000?0010
0000000?????????0?1????00111????????0000????00001?10?0010001?000001010?00?0??
?????00?0?0?0?0????00001000000??01?00?0?00000001?????????????????0?0?10010
00?000?00????????????????00000000001120100?0000?0????00000000?00001000100???
?00000?1101010000100??1?0000????????????????00000?000000000?00?100?00?0001?1
??0?000010?100000000010?010??00?000000000000000000000000000000000?0????000000000100??
1101?000110???200?10001?0000????000

Velociraptor_mongoliensis ?001001001000012011200001011100011100012111?10?010
1000011101000000010011111000101001010000110001100111210111110001101111211101
01111111100100111000001002211101110202202011112212011111?00000000011101101001
0000000001100000000011?00101021100000111001100000000000112000000000000?00000
0?0000??0000000?0000?0000?00000000[01]0?00??000?00000020000?000?000111000?0?
001000??000000000000010100??00000?0100000?0000000000000000000000000000000?
0110000000010[12]21?0001101100011100000?100000000?0100001?10?0010001?0?000101
01000000??0?0?01?00?0???000001000000??01?0000?00000001001?0?0??000?00110
100?0???01000?000?000001001000?000000000000?00?112010000??????00000??????????

[illegible]

Bambiraptor_feinbergorum ?0010??001000012010[02]00?010111000?1100012111?100
0101?00011?0?0?000?0100?1111000?010010100??1110?1100?1??100?0?1100[01]1011??2?
???0101011011110?001?100000111?211?0101?202202?111022100??111000000000100011
01?000000000001100000000011?0010?021100??11?110??0000?000000122000?00000?0??0
0000??0000??0000000?1?000??000000000100??0??0?0?0?0000020000?00000?011?000?
0?0?1000??000000000?00010?????00000??0000000?000?00000000000000000000000000?00
?011?100000000121?000110??00011101100?10000000010100001?10?0110001?000001000
1000000??0?0?0?1?00?0????000001000000??01?0000?00000001??1?0?????000??001101
?????????????????0?????????????????0?000?000?1120100?????????????0000000?0000100
01011000?000001110101000010?00100000110?01?010000000?00000?000000000?0001?00
0??00001?10?0?100010?100?????????????????0?000?????00?00?00????000000??00001000000
000100?0???10000110100200?10001??01?11??????

Tianyuraptor_ostromi

??01????????????0???111????????0??1?????
????????????????0?0?0?1010?0??0????????0?0?0?1??01?0112??????1??00?0111
10?001?1100001112?1??0?1102223?21111022?0???1?110????????00?11???000?0?0??1?
?00?0?01???1011?0???0?????1?0????????0????2?000?0?????????????????????
????????0????????0?00?00???00000?0?00?000?0?0?????????????????????????
????????????????00?1?0???10????????????0?0???????20?101??????????1?????????
?0000?10?000?1????????????????????????0?????????????????????????????????
??0?????????
????????????????????0????????????????????????????01?1?1??00?0?0???000?????????
????0????0?0??00???0???0?0??0????0?0??0???0?0????????????????0????0???
0????????????????????0010???????0?0????????0?0??????1?????

Sinornithosaurus_millenii

0001????0????????00???1110???1000111100?1???1??0??????00?00100??1???010
100??100??????1??1??????0??00?1??1??????01?1?1101110?0????0000?00?201?01?
112023?2?111022?2?1??1???????110001?1100?0?00010001??0000???011011110020000
00111100?00?00???000???20000?000????0?000????0???00000??1000?00?00?0????0?
0??0??????00?0?[12]0000???0?000100?00?0?010?0?00????????????????0000?0000
?0000?0?0?00????000?0?0000?00?0??0111?11000??????01??10000111?1100?100000
0?010100000000?0000000?0?00000001000200???0??0??1??00?0???000000000000?00?0
000?00000001??1????0?000?001101????????0????????????????????001000?0101
12010000? ?????100?0????????????????????0011101???00?000????????0?01?????
????????0?0???00000?0?00000?000?1??0?0????10????0?00????0?0???0100????0?
???00000???001?000????0?000100?011????0110???0???000???00????????0

Microraptor_zhaoianus

0????????????????100????????????????????????????0??010?0?1???0?0100
0000????001?1??01?2100?01???0110?1212111?01?10111111010?111000011012111??01
12023?2?1110221201?11111??00?0001110111110?100?000?11?000???1010111100?0?0?
?1?110???0?00?0?00???20??0?000????????????????????0?0?????00001000?[01]
0?00?0000?001000200???0?000?01???10?0???10100?000??1?0?000????????000??????0?
00?0000000000????000?00??000000000??1211111??00?021???011011???1?1?1100?100000
0????????????????????0???
??000???1?????????????
????????00????????????00001????????01???1?10000?000???0000?0?01??10????0?0000
0?0???00????0???0?00?0?0???1????0000???10?0?00???0?010??????0???0?00?000?0?0
00000?000?10?000000010????????0?1??0????1???1??00??100???0

Graciliraptor_lujiatunensis

??
????????????????020???1????????????????????0???11?12????????????0101
1?1100001????????????????????????????0?0?010?[01]11?1??0?0?00?????????
????0????????????????00????????????200????????????????????????????

??0?????10?0???000?0?????????10?000
0??00?000??10?????????????????????????????
?000???
???
?????????0?????????????????????????????????????1????00?00?????????????????????????00
00????00?????100?0?0?0?????0?0?????00?0?00?????01?????????????????0?0?00????
?????????????0?000?10?????????0?0????????????????????????????????

Hesperonychus_elizabethae ??
???
????????????????21?010????????????221211?????????????????????1????????????1?????????
?0?1???
???
???
???
???
???
??01000?0110?01????????????
?????????????0???0?????1??
??

Pyroraptor_olympius ???
??0?????????1????????????
?001??01??1?????????0?????????
??0?????0??
??
??0????????????????????????
??
??
????????????????????????????????????0?0?????????0????????????????????????????????
?0?????????????????0?????????????????0??
??

Rahonavis_ostromi ???
????????????????????????????????0?????????????????011121???1?01?011112?12?????????0??1
1??011?????0?01111?10111120?3?2012101?121??21110001000?011101101?0100????0??1?
????0?10001011111??
?????????????0011000[01]0????????????????2?????????????1100?????????????????????010
100????????????????0000000?000000000100000000?00000000?001?01????0???????0?1?11?
????1????????00??
??
??100?1??0?0?0011?????0?????0?100000???01?
?10???0?0???00?0???00????????????00?0?00?1????0000?0?0???????0???010???????????

Buitreraptor_gonzalezorum ?0010????????????00001011?00????????100?10??01?
0????????00?001?????????0210??100?0010111100111?110???100011012[012]121?????
?01101111010?1?1?0?????11?101??12[02]23?01?1?1?120???11?0??0??1?011?0?1110000
?????0??1????????1101000110011000???0?????0000?0?00?10200?00?0???????????0????
???0?000101???0?????00000000000[01]0?????????01000100?0?0?00?0?10000?0?001100
??00000100000001?100????????????????000????00????0?00?0?????????0?00?000?0010?00???
????????????1????0010??1100?0000???00?0?????????1?11?00?0???010?0101?0??0???00000
??1100?????????0000???0?0?0?0????????????????100?????000?000?0????????????????????
0?????????????????0?000???0?1?2?????????????????000????????0001001000?0?0000011101
0100???0?001?0000???????01000???00?0?0?????????0?0?000???????????00????0?1000100?0
???????01000?????0?00010000000000???000000?0?0?01000?0?001???????10????11100?
00010001?000???????0?

Austroraptor ?0000?????????????????2?1?0????????12?0001????????
 ??????????0?011?????????210?10????0011?001????11????????????????????????????
 ??00???????0????????????????????????????????????1?????0?0?0?0?[12]1?????????0????
 0?????????????????11?00??01??00?????????????1[12]20??0?0????????????????????????
 ??????????0??00?00????????????????????????????????????0?0?001100??00??0000000???
 ???
 ??????????00?0?????????0?10100?0000010??1???????1?????????????????????????????0
 ??01?01?????????????????????0?10?00????????????00000?000?00?????????????????0?0010
 000????????????????????000???????0001001101????????????????101????????????????????
 ????????000???????00?00?????????0?????0?0?????????????????????????????0?0001000?
 ???0?0?????0000???????00?0?????0?????01?1????1????1?0?0001?????????????0

[illegible]

????????????21100001???00????????????????00?0????????????????????????????
??
??
????????????????1?10???00?0?000000????????????????????????????????????
??0?00?00?00?00?00?
????????10??
?????0?0????????????????????0????????????????????????????00????????????
????????????????????1????????????????00????????????

Mahakala_omnogovae ?????????????101????????????????1?00?????
0?0011????????????????02????1?00?0?11?011?211?1?100011012210????????
????00?1110000?100?211101?2????????????0111100???0?011001101?00000?00?
?11?0????0000????00????????0????????0????1[01]2?0????0????????????0??1
?00????????0000010000[01]0????????????????????10??[01]0???0?0000???0??
????????100????0?0???000000?0?001?0???000000000?00000000?001?00?000???1
???0?????011?0???????000000????????????????0???0????????????????????
????????????????????????????????0????000?00?????0????????????00010????
????????????????0????????????????0000????0?01?000?????000????????00????00
100000?????0100000?0?000?100?0?000?0???0?0?0???1?10???00????????0???
010?20???0?0?0?????000000000?0?0100000000010?0???1?000???10???01???0?0
0011???000

Atrociraptor_marshalli ?????????????[02]00?0??1010????????????
?????????00?010???????0?0000101001????????????????????????????????
??0???0?
????????????21?00?0?111???????1????????0????????????????????0??
?0??
??
????????00001?1???1???0?0?000?01????????????????????????????
??0????0?00????
?????????0?0????????????0????0????????????????????000????????
????????????????0?1????????????00????????

Utahraptor ?????????????[02]00?0???????0?001????
????????????????????0???0101??1???0?1100?1??1???????0?011????????1
01?1????????0?0???????0?01????????11?????0111?00?0?001000100???10????
11?0???????0????0????????1???0?????0???10???0???0????????????
????????000000????????20000?000000????????????????
????????????00????0?000000000000?0000????0?10????????????
????????00????000001????????????????1???0?00010?0????????
??

??
????01????????00????????????0????0????????????00????????0????????????
????????????000????????????????1????????????????????

Adasaurus_mongoliensis ?0010????0????2????????????0????0?1??11?1?0?101?
?001?0????0????0?1??0????????????01100?11?0111?10?111[01]100??011?1?1?????1?
111111????????????1022111010102?2202?1?11221001?111000000?000?11010010010??0
0??00110?0?0?0001??00100????????11????????00?0????1????????0????????00?00??
000?0????????000?0010000[01]0????????????200?0??00?01110?????????????
????????????????????????00?0000000000000000000000000?002??11?00??00??21?
000?0?00001?1????????0??0??0????????????????????????0????????1?00????
??0000010??000?0?00?0?000??????0????????0????????????????????0????????
????????0??????11201??10
0000?0?01????????????0?0??00?0??????000?00???10????????????????????00
?????0?00??????????000000??000010000?00010????????01?????????????????
???

Achillobator_giganticus ????????????????????01?1????????????????????
????????????????????0000101?????0?01100?11210?????0?011?11????????101??
????????00??10220??11010102102?011011?001?21110?0???00?000?101???0?????1??
0????001??00100021100??0??100??????0????????????????????????????????
????????0000????????????????20000?0?0?0?0?10????????????????????
????????????00??0?00000??000?00000?00000?00000?00000?00000?00000?0?
????????00????????00?001??0?0?000??1????????????????????????????
??
????????????????10????????????0100????????????????????100000?0101?010000
0?1000????????0????????0?01????1?0?0?0????????01?0????????0?00?????
???0000000??0000100??????1????????????1?1????0?00????????

Sauornitholestes_langsto ????????????????????????????111????????
11????0????????????????100101?00?11000110011121011011100?1011?1?1????????11
1????????000111221?1?1?1?2?0????????????11?0???00?001101??00??00?0?1??0
0?0000010?001000????????1110011?????0????1220????????0????????0000??
????????0????????????????????????0??00??1????????????????????
????????????0????????????????????????0??00????????00111??
????00?00????????00?01?0?0?0?000?00????????????????????
????????????????????000?00?1???0000????????????????????0??0000000
????????????????0????????????1?0????????????????????
????????????????0?????0????????????0????????????1?01????????0?????
?00????????????????11????????????0????????

Sauornithoides_mongolien ?00??1?1??1101???0?110001?1000??????2????????

???1?010?100?0010??1????0001110101?????????1???0??1?????100??1?????????????????
?????????????????????????????02012020?010??10[01]1?11110??????????0???10?01?????0?
?1?0??????????010??11000??0?1?01?0?????0?000?????0?0000????0?1000?0?0???????
???0000??0?0??00100?0???
??????????????????00??????0?0???00000000000000?20?02100000000000201001?10??
?1110?1??????????00?0100000??2??11?0?0?1?0100010100?00??0?0?0???0?0?0?????
?????00??0?0?????1???????000?0?????????????
0????????????????0?0?????00000????????????0?0?????0?0?0?????????????????????
???1?010??????????00????00000????????00?00?0??0?0?00?0?????????1?????0?000?
0????0????????????????????0?00?????0?101?0??????1???0?????0?0?0001011?????0

Zanabazar_junior ?00101?12?110100?001?000??100000???2022000?21?0?
?11100?????100?001???1????000111010100?????????????????1?1000?1020?1?????????
????????????????????????????2????????????????????????????011????2????????00??
00???11??????0??110000000100000???1?00?????00?000????001??0?00?????????
??0000?0?00??????0[01]0???
????????????????????????????????00010000?0000??2???1?0??00000201001?11??
1110?1??????????00??100000??2??11?0?0?1?0100010100?000??0?0?????0?0?0?????
?10??000?00?0????????????????????000?00011010????????????????000?00000???00
00???000?001?????????0???00000?????????????????0?????????????????????
????0????????????0?0??????0000????????????0????00?0?0????????????01?00?00
00????????????????????????????0?00????100100?????????1???000?0?????????0?

Xixiasaurus ?????????????????01000101110?????2?22?????????
???????0?00?001???????000201??01?0?????????????????????????????????
??????????00?1??0???00?????
??????????????1?000000??01?0000????00?????000000??00?????????????????
???
0?????0??0?0?????????????????
????00???110100??2?01100?0?1?01000101000000??0?0?????????????????
????????????????????000?0????????????????????????????????????010?000??
????????????000000???
????????????000?0???0?0???0?0????????????0?0????????0100?????????
0????????????????????1?010?????1????????000???????????

Byronosaurus_jaffei ?????101???101?1100110001011?0?????20220?????????1
?100?????0000001??11???000211??01?0?0?????010121???????0?02?????????
????????????????????????????????????1???0?0?0?????21?????????0????0
???1??????????11000000?1?00???0?0?000?0???000000?????????0??????????0
?0???0???0010???
????????????????????????000????????????????????000200011?0?????????1?
?????????00??100000??2?011?0?0?1?0100010100?00??0?0?????0?0?0?????????0?

????????????????????0????????0????????????00?000000?????0?00?0
0????????0?????0?0000????????1????????????????????????????????
????????????????000????????0????000????????????????00?0100????????
????????????????00????????1?0?0?1???1????????000?0???????????

Sinornithoides_youngi ?0?01????????????1?000??1??0????00??2??????1????
????????00?0010?????0001110?01?????11?001????????0011?102121011???1?00?
1?101?0???100000????21?01?02??30???11?0?001??1110????0???1?000110001?0?0?0
?1?00?0???0???0010?0?00000????0?0?0?0?00??0?2000000?0????????????????00?
????1?00?000????????[01]0?0????????0?0?20?0?00000?0??1000??0?1000??00?0???
?????0?010?0000??000000?00?0?000???00000000000000020?02100000000?????
?101?????1?010100??1?000????????????????????????????????0?????????????????
????????????????????????????????????000?0????????????????????????????????
????????????????????????????0?0?00????????0?0????????????00?110101?000?000????
??????????1?????0????000??00?0???0???0?00?0?1???0????100????0?0??????0??
?000?000??00??10?000????0?00??00000000010????0?1?0?0101???0???0?????????
???

Mei_long ?0????????0???????11010????0?11?002012100001?10
10??100?????00010010??1?0000?021??01?0011011100011?2110?01??0110222111?1???
?111?11100?0?1?1000001?012111?1??1200302?1110221?[01]?0111100?0101001000??1100
11?0?0000??000000?000100?1?0?1?000000?001?0?0000?000001020000?000??????00
?0?0?000?0101??????0?0000010000[01]0?0??????0100020?00?00000?0111000?0?00
00000?0000000?000?01?1?0???00000????00000?00000010000?00000000000?000021?011
00000?0???20???1010??101100?1100?10?0000?110?0?0?0????????0?1?01????0????00?
????????????0????????????00????????????????1???0????0???0???0????????????
????????????????????0?000????????????0??????0?0000????????0?0?????????????
??1?1?0????????????????????????0?????00??00?0?0????0???0???1?0?000?1001
??00?0001?0?010???0???0?0000000000?000???00??0??00?000000100????????01????
?????0?0??0?????????

Jinfengopteryx_elegans ?0????????????????1?01???2000????????1?00?0???1???1
00?????00?00?0?1?0?000?1???0???1????????????????????02???2?200??????11011
10?????100000????1????????????????2??0????????0????????????????0?0?00????0
0????????????01?000001???0?0?0?????0????200?0?000????????????????????0?
?????0?000??0?0?0?0????????????00?0???0?0?01???0????????????????????
??10?0000?????????0??11?01?????
??????000?110?????0?01??1???0????????0????00????????????????????0?????
????????????????????0???0???0????????????????????????????0?00??????
????????????????0????????????0??????0???1?0???00???0????????????????
0????????????0?0?00????00???1?0???0??????0????????????000?????????
?0?0??????00????????001?0????????????????????000????????????

Anchiornis_huxleyi

000100????????11010??11100????0?2?000??1???11????????000?01??1????0002
0???01??0?101??00?0??010?01???01101220?01????01111110000??100000010?21?1001
1020?202?1?1122121???1?1?000??1?01?000121100010?1000?1??00?0??????0?11?011000
001???0??00????000???030000?000????????0??????0??????0??????00000?0000[01
J]0?0??????0000020000?0?00?0?10000????10?0??0??????????????10?01000?0?00?
00?00?00000??????????00000?0?00?0100000000??????00??1110?1?1?1100010??000
?110?0?0?01?010?0?0?1??101?00?0?00?0????????????0????????1???000?0???2????
??????1????????00????0???0????????????????????????????????0?000?01????????0
??????0?0000????????0???000?????000?????1???00??0000100000??0?01????????0???
??0?0??00?00?0??100?00?00??11?0?0000??????0????????0???1000???0???0?0?0
000000??00?0??????00100??0??0?01????????000??00????????0

Xiaotingia

?00????????????????1?1???111000????0?2????????11?

????????001001??1???00??020??01??0?0???1?0????10?01????1????10????01?0
1111?10???1000001011?1110?1102122????102?12[01]????????10??????1?0100010100
00?1??0?10?00??0010?011000??1???00?0????000???22000?000?????????????
?0000??????0?000?10000??0??????010002??????????11?000?0?00??0???0?0?0?
??0????????0100??1?00000??0?0000????????????????0?0?02???10000??????00
??1?????1?1100?10??000?110?0?0?01??1???0????0???0????0????????????0????
????1???00????????????????????????0???0???0?????????????????????????
??0?00???1????????0????????00????????0????????????0011????0???000010?00
0????????????0??????0???00000?0??100?00?00?1??1?0?????0???0????????0???
?000????0???0?000?000????0????????0?100??0????0101???0???000??00?11????
0

Aurornis

?0010????????????0101???11100??000?1?0?????????

????????00?001??????0?020????1?0??????0??????0???0?0?221?00????01?0
1111?0???10000?001?011????02122020??10????????????????0??100000?000000?
1??0?0?00????111?011?0000????0???000??0000??20000?000?????????????
???0?????000?0?0?000?0????????00???2??0??????0?0?010??????0?????????
????10?0?00?0?00?00?0000000????????????0???0?????1??010000??????0???1?1
?1??1??1000100?000?110?0?0?01??10??0?1??101?001???000????????????0?????
?10??000?0?02??????00????????00???0?????????????????????????????
0???0??1????????0????????00????????????????????0???01???1???00??0000100000?
????????????0??????0???00?0?0?100?00?00????1?0???0??????0????????0?????0
0?????0?????0?000000????????????00100????????0????????00??????1?????

Eosinopteryx

00010????????????1?01????000????0?1?0????0??1????????????00?001??????0002
0????1?0?0??????0??????????0?0?231?10??????1101111?0???100000?001?1?1??1?0
2002?20??10????????????????????00?1??0001000000?1?0?0?00?00??011?0???00?????

[illegible]

[illegible]

Archaeopteryx_lithographi

Confuciusornis_sanctus

10010????????????1?000?00?0001???0??2??0??0??00?01??????000010000?10?0001?1
?????????0?????????1021?0?2??0?2????4??111?11010??13111000?11110000001121?1?1?
?12000?2?111023?2??12??10??11??120211010030?0000000001102000??00?0101??11?1000
11001?????0?????000?123001[01]00120?????????10??00??011200??01[12]0111110000001
100001001000120000?00?0000?0??0??010000000?000211??0010000000010102101011[01]
?10?0000001010000000001010100100011000011000?0000000[01]000??2000001101110?0
0??1100?10?0000?110?00000??1?00?0000?0?01?0?10100?00??????????1??00?0????000000
0??000??01?02??00100000?0??????000?00??0????????????????????????????????????0
0010??0?0?00??10????????????0??????0001?000??0??0?00111?0?1?000?100??????0
??0??1?????????0??00?0??00?00?0??100000?0?0?1?0?0??0?0??0?00?0?????010????
???0?????0?0000?0?0?????0?0?????0?0000100?0?0????01??????????1???????????????

Jeholornis_prima

10????0????????1??0??0????001????????????????0??????????0000?1??00?00?1?1??
????????0????????0??0?1?0?11??02111031??01?0??011031110001??1000001011?1?0?0?01
?0??2??1?221?10??????01????0101101003000000000??0??1000??00?010????1??000?1
?????0??0?0?0??12300?10010????????????????0??000?00000?00?000000100000?0?
?001??0000?00000?0?1000120001000?0010000?000?0000?00001000010110000?0000000
00000?00000?010000000001000001000?00000001100????????011?1110???1?1100?10?000
0?110?00000?????????0?0?????0????????????????????0?????????0?000?????????????
????????????????000?000????????????????????????????????0?00?0?0??????????
????????????????0?0?0000??????0?0011101?1?0??000??0000?0?01????????0?????
00?0??00?0?0?100000?00??1?10??0?00??????00??????010??????0????0??0?0?00
0?00??000?????0?0000100??0????0??????????1?1?1?????????????

Jixiangornis_orientalis

100????????????????0010????001????0?0?00000?????0100?????000001????0?0?1??0
????????00?0???1?00????1??20??02??1031??11?1?00011031110001101000001112101010
212000020101?221?10?2?11?001??1?01[12]1101003000?00?000?0??1000??00?0100??111?
001?1????????00?000000?12300?00010????????????????????0?????000?00?0000?11?0
?10?11?0?????0000000000?0010011210010?0?0000000?000??0?0??0?010?00100?00
00?001000000?00?0000?00000100000?00?0000?001100????????00??11????01?1100?10?
0000?11?00000?????????0?0?????0????????????????????0?????????0?0?????????
????????????????????0????????????????????????????????00010??0?????????
?????????????0????????????????????????????0?1?00?00????????????????0????
?0?0??00?0?0?100?00??0????0????????????00????????0????????????0??0?0?
????????????????00100??0????0??????????1???????????????

Yanornis_martini

?00??????????????1?010????0?11??0??2??0?????00??
?????????0000011??0??000?1??00?0?0??1??0??????4?1?????04?????110?01103
1110?011?130010????????????????23?010?2??10??1??0?0121[23]0000300000?00

01???00?0?????0???21?1?0?????????????????0?????300100012?????????10??????1???
?????????????0?0011?00???0210?[12]?10100001010?1?11?112100111?0101?0101?1000
0?0?????021[01]101311[01]1100[01]100?0?1?0?0?00?????0?00?1110[01]?1?00?1?0?0
1100???????01?1?1???????1100?11?001?11?????0?????????0?0?????0?0?????0?0?????
???????0?????????0?0??
?????????????????0???0?0?0????????????????????????0?????0?0?0?0?0?0?0?0?0?0?0?0?0?0?1?
00??100??0000?0?01?????????0?????0?0??00?0?0?0?100000?00?1?0?0?????????????00
?????????0????000????0??????000?00?????????????00100?????????0?1?????????0?
1?????????????

Apsaravis_ukhaana ??????????????????0????????????????????????????
?????????0002?1?0?0?????????????????1?11?10200?1???5?100021??24?????1?0101103
11000011113003??000?1???1?201000?2?021?23?03?12?010?0???1??12130100?00000??20?
??1?20?0?????0?00??21????????????????????????????????300?10?????????????????0?1[01]
?????1?0?????????20010?[01]001??21??1?????????00000?0?100012101111?01011010[12]01
11110000101021110?[23]120100?11??20?1[01]0010?11?110?101211211111?0000?1?0?01
101????????011?????0?1????????0001??
??
??0?????????01??0?0?0?0?001110001000
1?1?0?1?0000????01?010?????????0000?000?????????0?0?0?1?????????00?00100?????
0?????0?0?????0????0000000?0?00000?0?000?0?0?000?10?????????0?0?11???0?0?????
?????????????

Yixianornis
100?????2?021??1?????0?01?????0?1?1?0?????????????????0100?????000?010??0?00?0012
0???10?01???1???0000??1?0?40?0???0024???11?1100011031110?0010130000100021?101
?212003020001023?23?0211?0??1?????2130100100000?000?0??1000?20??0?000001????
???????0?0?0?0?0?0?1230010001??????01??1????????11[01]????1?0?????10?2001100
0?11021??[12]?10100001010?1110112100111100?0110?0?01?000??0?01021[01]10?3120
1100[01]100?00100?00?002?101?????11110[01]?1?00??1?0?001100?????00011?11?01???
?0100?10?000??1???0?????
????????????????????????0???
????????????????????0?????????????00?0?????????00111?0??000?100?1?000????01????
?????0?????0?0??00?0?0?100?00?0?0?1?????????0??0?0??00?0??0?0??0?0??0?0??0?
?0?0??000?00?0??00?0??0?00100?????????0?11???0?1?????????????????

Sapeornis ?001?????????????0?010??11000????00??21?0?00????0
?????0????0000010??10?00000020?????00?????1???000????0?211??0210004??100?????21
101111010011100000101121?00?212000?201[01]00221210?????1?01??1001210?10030000
000000?0??2000?0??0100?0111?000???1???00?0?0?0000??23000000000?0?????????????
?????????????0?00??0000000010000100?????????0000020000?00000?010001000?0?01010?0
010000?0??010?1[01]10?11100?0[01]00?0000?0000?00?000?00?00?000001?00??0?000

Cathayornis ?0????????????????1?010????0?1????????0????????
 ?????????00????????????00001?????0???????[02]???????3????2????4???0??11?02?1
 031110?011?1300?0?01111?0?00?12000?201?1022?23????????1???0?[12]1[01]1?0?3000?
 0???00????0??1?0?0?0100???111????????0?0???????0????2300[01]0?012?????????????
 ????????????0?????0???0111?0010?20??1?10110?101????010?01200010010110[01]?01
 020111110?[01]?1????210120?11?01?0101011?0?000001???1?0?0?1[01]1?0???????????0?
 ?01110????????01???????01????????0???110?00000?????????0?0?0100?10100?000????
 ??????????0?????????0??00????????????????????????????000?000?0?0????????????????
 ??????????????????0?00?000?????????????????0?0100?????0????????????????00111?
 0???0????????0000????????????0?????0?0???00?0?0?????00?00?1?1?0????????????

[illegible]

Vorona

??

??

??

??

????????0?????2??

??

??

??

??

00??

??

??

00?00??

????????110?000000010??????????0?????0?????1???1????????

[illegible]

????????????????????0?????0?????001?????????????????????
0????????????21?[12]000100010???111011?????????????????????
??0?0????????1?1?????????
????????????0???
??0?00?00?????
????????0?0?0????????????????????????1?1????0?????????????????
????????????????????1????????????????????????00?????????????
????????????0?1????????????????0?????????????

Pengornis_houi ?0010????????10010?0?00????0?12?0????0?
???0????000?001?????0?0?00?001????20??0??2???????4???1????2?10
31111?0????03?001?1????????????2??2???????1????211??0?000?0?000?
?0?0?00??0??11?1?000????????00???00001230000?000?????????????
???0????0??0011?00100???????01[01]00?00????0?1?012111[01]0?011010001[01][
01]1????1?1?1??10[12][12]0??1?1?11????0???00?0???0?0[01]?1?00??1?11?0?0?0
?100???????01????00?01?1001011???1?110?00000???0?0?0?0?0100?0????00?????
????????0????????0?000????2????????????????0?0?0?????????????
????????????0?0?0?0?0?00???0????0?0100?0?0?0?1?0????????00111?
0?1000???0???0000????????0????0?0?0?0?0???00?00?1?0?0?0???1?
????????0?0???1?00????0?0???0?0???00?1????00100????????1?1?????
?000???????????

Hesperornis ?0????????????00010100?00????00021?001???00
???00????1?000?001???1?0001?021???00??10101110?2100??11?50100?210?24??11??10??0
0103111???????3?0202100?1??01000???021023?03?12???0001??11?1213110010?0?00
??01?1?0000?000???00??2??1?1111???0?????10000??10?1?10?1121200110?1010??1110
011100??00?0???1010121011000012?0?000100100?0???10?0???00011??0???????0???0?
??0????????????????????20?110000111211021111002111122122002?0????00?????
?0001?0???0?000?0100?11???1?01?00000????????0?1?0100?0????00????????0???0?
?0????????0?00????????????00?0???????0?0?0?0?0?????????????????
????????0?000??0????????????????000????0?0?000????0???01?????????
201?000???01????????0???00?0???0?00?0????00????1?0?0?0?0?0?????????
??0????000????????0????0000????00????????001?0????0???1????????000?????
???????

Baptornis ?????????????????????????????????????
????????????????????????????2??????5???????24?????????????
????????????????????????????212?????????????????
????????2????????????????????[12]????????11001?00?1?????
????121011000012???012?0????01?10?0???000?0?0????0?0?0?0?01?[01]1
[01]????????20?1100001112110211110021111?21020?2?????????????
??

Ichthyornis ?????00???????1220????????????????????000111????0??
 ?????????000??1????1000??0210??10???1?01111?2100?1???5?000?21??34??01?100?001
 031110?011113003??0102?1??10212000????21023??3?12??10011??11?1213110??00?0??2
 0????00????0??00????21??????????0?????????????012300[12]0?11??????????10[01]1?1
 11011101001020??0101?1200111?101[12]?211022010100001010?1111011211011110010110
 111010000101[01]10112111123120110011?12001[01]0010?112110211110021111[12]2?1000
 02?0??011?100?20???0110??1?000?00100?11??01?01????????????????????????0?00?00
 ???1?0????00????????????????????
 ???????0????0100????0?00?0000?00????????000?0? ?????00?000??0?1?0000??????0??
 00111?00100?0?10201??000????01?0??????0???0000?0?0???0?0?1???00??0??1?????00
 0??00100?0???001??01??2?0?00000?00000000????0000????00?111?0?00001????10?1?0?0
 ?11?0??0???0?0?0???????????

[illegible]

Lithornis

100????????????01010100?00?111??2?02?00?0????????????10000?00????02?101?1
?????????1???????2???????[67]?1????????????[12]?11000010311110011?13003??000210
101?20200102??2102?????12?01000???11?12130100?????0??200?01?2010???0?0?0???21??
?12??????????00???00000??300?11212100?0001111010110?11[01]1101?1111?01?101210
12?0111[12]1211122110100?01011011110112101111100110001[12]11100001010101011111
13130110[01]11102[01]0120110?11211020110002111122210010[01]?000011?1????????011
?111??00????????01???1???
??0????????????????0????????????????
????????????????????????????????????0??????0?0????????????????????????????????1?000????
????????????????????????????0??0??
????????????0000??

Hongshanornis_longicrest

101????????????11010????0?11???0???00? ?????????????????000?001?00????1?1?1
0???0?0?01?1?0???????[234]? ????????4???1?1?011103111000111130020?0112???01
?20???????2??23?23??2??100?1?????21[23]01000000000?000?01?1???????0?0?0???1?1?
0???????????0????0000?1?300???012????????????????????????000?????1????0?????1
10???????01?0??11???0?10???21000111???110???2???0???????????1??2000?000100?0
??0?0?000????????1???1100??[01]?00??2?0???1????????????????????0100?11?001?1
1?????0????????0????????0??????0??????????????0????????0?0?????????????????
????????????????0????????????????????????????????????0?0?0???0????????0?????
?????0??????0????????????????01?1?0?000?0?10????????????????????0????0?0???
00????0??100?00?0????0????????1???00????????0????????????0?0?0?????????
0????????00100????????0????????????1??????????????

Liaoningornis_longidigitu ???
??3??1??0
??100?1????0?21211003000????0?????????
????????????????????????0???
????????????011?01????????0???0? ?????????????????????0????01???2????????
????????????????01?1?0??00111110201000?00????????????????????????????
??
??
????????????????????????????????????0????????????????????????0????0?0
???00????????00?0?0????????????????????????0????????????????????????
????????????0010????????0????????????1?????????????

Crypturellus_undulatus

10????012?020002?2001010100?00?111?12002100001011100010???1?10000?000??102?00
1?1????????1110111122100?01107?110??12?24??121?11010010311011011113003??00121
0001?202201120021023?23?12?01000100110121301?0???01000200001?20000200?0?0010

21???120??01?????0???00000103002112121[01]010001111101011001101111111100101
01210101121121211112?10100021011010111112100111110110001201100001110101011111
031401011111020?120110?11211020211002111122210010110?011?1010200000111111000
0??1100?10??01??11??
????????????????????0??0?????
??2?????????????????
?????0??
????????????0????????????0??

Gallus_gallus

100???102?021002?2000010100?00?111?120021?0001?1000001????1?10010000000002110
1?1????????101[01]1111221?0?01007?120??12?24??1[12]1?11012010311020011113003??
001211111?2?2001120021023?23?12?0100011011??213010010001000200100?20100200?0?
0???21???121??01???0??00???00000103001102121211111221101111111111101100011010
11121010112011121112110100021011111111210011111011000120110000101110101111
1131401001211021?121111?112110202110021111322200111?00?0110001020?000111111?0
00?0010110??01??11??
????????????????????0??0?????
??2?????????????????
?????0??
????????????0????????????0??

Crax_pauxi

1001011?2?021000?001010100?00?111?120021000011100000100??1?1000000000002110
1?1????????1000111122100?111?7?120??12?24??121?11002010311121011113003??00021
00?1?2?2001120021023?03?12?0100011011?12130100100010002001?1?20100200?0?0???2
1???121??01?????00???0000010300210212121111122110111111111110110001101011121
01011201112111121101000210111111112100111110110001201100001011101011111314
01011211021?111111?1121102021100211113222001101000011000?020?000111110000?11
100011??01??11??
????????????????0??0?????????
??2?????????????????
?0??
?????????0????????????0??

Anas_platyrhynchus

100???102?021002?2101001100?00?111?10002??00?1?100010?0???1?10200000100?02110
1?1????????101?1111221?0?011?7?11???10?2410121?11011110311111011113003??001200
0?1?2?2001120021023?13?12?0100011011?121311?0???010002101?1?20100?00?0?0?1021
???121????????00???000001130021021211111122110211121111101100011110111210
101020111211113120100101010?1[01]1111121000111001100012011000010111011111123
1401010111021?111110?111110102110021111[23]2210010210?0011?10?020?000111111?00

0??0100?11?01?11??
????????????????????0??
??2????????????
????0??
????????????0????????????0??

Chauna_torquata

000??1012?0210002?101010100?00?111?100021?00010100010100??1?100000000?002110
1?1????????1011101112100?111?7?11???1012412111?1000001031111011113103??00121
01?1?2?200102?021023?23?12?0100011011??213010010000000200101?20100000?0?0?102
1???121??01?????00???000000123001102121[12]11110221101111211111101100011110111
2101210201112111140101001010111110111211021110011000120110000101110101111123
140101111021?111111?112110202120021111222200100100001100010200010111110000?
11101?11?01??11??
????????????????0??0????
??2????????????
??0??
????????????????0??

Pedopenna

??

??
??0?0?0?0010????????
??
??
??
????????????????????????00?000?????0?0?0?00?????0???11????????0??
??
??
??00???0??
00????????00?0????????????????????????0????????????????????
????????0?10????????????????????????????????

Epidendrosaurus

??0??1???????

????????10????????01????0?????0?????1????????????????????001??
1??0?????001????????????????????????????0??????0000030?0?0?0????1?
????????????1????????????????????????3?0????????????????????
???0?????0????????????????0?0?0?????1???0?????0???0????????
0?????000????????????????????100?00000?0?0?0?010??????00?????1????
???0??00??
????????????????0???0????????????????????????????????
????????????????????0011?????0????????????????????0?
???0?0??00????????0?00?0????????????????????0????????0?
????????????????0010????????0????????????????

Epidexipteryx

?01????????????????1?????00????0??2?0011?????
????????100?0?0???00001020???10000????????????0?[01]???1?1?123??10?0????
0101?010?0?????00?1?????????022?????011?03?0?????????0????011?0?0?10?000???0
0??1?1?0???00?0?00???0?0?????????1??2?????0??????2?0?????0?????????0??????????
??????????000?0????00?0?0?????????????0?0?0?????1???0????????????00?[01]0????
??10?0?0?0???10?00?0?0?????????1??11
??1????????????0?00?100????0?????????0?????????0?????0?????????????????????
?????????????????????????????????0????0????????????????????????????????????002
00??02?????????0??????0?1????????????????????????0011??1???0????00?????????0
1?????????0?????0?0?????????0???0?0???0?????????0?????????????????0?????00????
?0???0???0?????????0?????????001?00?????????????????0???????????????

Incisivosaurus_gauthieri

?00?00?01?001??1??100011101001001?010?12000011000101
011010111210100001001?1?000210?00?0?????????????????????????????????
??00?00?01
?0?0?0?0?????????100000001000102?00010?100?????0000000000100001?0000??000010
1?1100?0000???
??01020?00???0?000?0?
0????????????11?110000????100000?0?0000?000?0?000???1000??1?00?0???000?110?
?010??01?0000?00000??00?00????0100?0111000????????????????001000000010000????
00200??02?1?000000000????00110?????????????????????????????????????
????????????????????????????100?????????????0?0?001????????????????????0201100
???0?0?0?????0?????????000?0???????????

Citipati_osmolskae

?001001001001??221000101111?01011?000102100011000
010001000110121120?0100010111?1?????????1011101100101211001??201??002200111?01
11200110100100?11000001000211001??02012020??10111111?2101000000000?000000000
000000000011020000000?0?001000?000002011???0??[01]00002000122000100000000110
2?1??0000??0000010001010??0000020011000[01]0?00?0010000101020?????0????111000
?0?0010000?000000000000?00100?0?0?0???0000000???00000?2000000000000000000
2?000?000000000020?000110??00[01]10?011011000000011?1100001????1000001?0?0001?
11000?001???1002??0???0?0???000?000??000?01?0000?0000000000100????100??0111
000????????????????101000000010000????10201???2?1?0000000???0?????????????????
????????????????????10???00?00????????????????????????????0?0?0???00100????000?00?
?0???0?00?????????0?0?00010???0?00211?????????0?00?000?0??????0?????0?000010
0?0100????10?????????1?00?0?00011???100

Oviraptor_philoceratops

?00?0?????01?1????0??1??111?1011???0???1?0?11???01?0
???0?11?121120?01?00?01?1?1????????????????????????????0????????????????12??1??
???00???10?00?00??1??0????????????????????????0????0???0?0????00?00000???2
?00?0????????????10000?0?0??????0?0???0????00??0?00??????10?0?00?0?00?00?1
?1????00???00?100????0????????01010?0?00?0?0????1?100?????1100???0????????00????

[illegible]

?11??0?????00000??00?????1?000000010??1?1?0?????10???0???0?10?000????11???0??
?010000000100000000??000100?000000010?????????0??1?0??00?1???1??01011???000

Rinchenia_mongoliensis ?00?0???0?????????0111?1???1?11?00010??00???0000??
???00??1?12112??01000??111?1????????????????1?????????????0????220?????????2??1?
??00?0???1??0001000?1?????1????????????????1?????????0???0??0?0??????0??00??001??
2?00?????????????0?????00??????00??210??????2??0120?????????10?0?10?0???0?????
???????0??
??????????????00??0?00??002?0????
????????00?1?1?00001????1?0001?0?0001?11?0?0?1???1??????????0???000?000??000
??01?00???0?000000?0???????100??0????0????????????????????????????????0?????????
??1?1001?????????
????????????????????0????????????????????0????????????????0????????????11????????????
???????0????????????????????0????????????0????????????0????????????0????????????0

Conchoraptor_gracilis ?0010?????????1???00111?1???1?11?000??21000110?00??
??1?0???121120?010?0?0111?1?????????01010110010??1?012?110??10????01?1????200
11000010??????0010002100010102002020??101101[01]1?11010000??00010000010?000??
000?001102?0?0000?0?0010001000002001??????0?0?0200012?????000000000? ??????1
0???0100100????????000??0?010??
????????????????????????????00?00??000002000000000000?0000?002?01?????????0?020?
000?0?0?002?00??????????0011?1?00001????1?000?1?0?0?01?11?0?0?01????0?2???????
0????0?0?00?0?0?0?01?00??0?00?000?0?0?????100?0??00?0?????????????????10???0
???????0???0?0?
????????????????????????????0?0????010????010????0????0?????10?????00?0????
???21?????????????????0?000000????????????0?1?00???????00? ??????????0?0?????
??1?00

Chiostenotes_pergracilis ?????1??01?01101??0???1?110?0?????????????????????0101
0??????21120?00000201???1????????????????1101?12????1?12???0????????????????101?1
??????????00?100021?00101022120201110?111[01]??01??100??00?100000200000??000?0
?1??20?0?000?0?00100????????????????????000?????[12]????10????????001????00?????
?????01?10???0???0011?00????????????????20000?00000? ?????????????????????
????????????????????00000?00??00000?00?0??????000000?0??0000?0001020?00???
0???????1???????0?001????????????????1?0?00??0????????????????????????????
??1000001000?????
?00200???2?1?000??0000?????????0??????0?0?00???1000?0?????????????0?0??10100
0?????1?0100?0?0?00??00000?001?0??1?1?000?01?????1?0?????10????000?0?0????02
?1???0110?1??????000000000??00????00?00010?0?0?????1?0?0??????0?1?00???11
??00

Avimimus_portentosus ?00?0???10011?00??0??1?1??????1???1????00?11??001

Segnosaurus_galbinensis ??
 ???????21??10?0000?000???0100?001????????1?????????1?0?0?????????????????????0?10?1
 ?00000????0???20011100102020221?0110201101?11001?00?00?11000000021?0??00?01?1
 ??0?0???00?0?010?00??????????0?????????00????????0????????????????????????????????????0

?0????0????????????????????????????????0?????0????1????1???0010000?00100000???????
????????????????00?00000??10?????00?????000000000??21?0????00?????????????????
?2?????????0???
??
??
??
????????????0?00????????????????0?01?0?0?1??1????????2??????0??110????????1??????1
0100??1?1112221011111112?111201????????0??1????????????????????????????

Erlikosaurus_andrewsi ?0012???2?0?1?1??1010011100??0001?1000001000010000
000000??11112100100000020001?001001001?????????????????????????????????????
????????0??0000?021?0?00??11
?00?0?00??????????0?00000010010?00000?000???0?000002000001???10?0100??000
0?0?10000?0000??1?0?0010000?0010000000
??00000000????????0000?0????000?????
000?0?????????0????01?0001100????1?10000?0?00?0?100000000???0?0?00?00?0???00
0001000000??00?0200?00000101000?00001?000?000?0?00????????????????00000001101?
???0??010010002000000000000000?????0????????????????????????????????0?00??????
????????????????????????????????????0000??????00?0??0?011????????2?????????????
11210?11??????1?0?1????????????????????????1?01001000???01?????????010?0?01??0
??????

Alxasaurus_elsesitaiensis ??
?????210?100????????????1001001?????????0?01010000?1?0101002?0?1??????????0?00
0??0?10?0000120?11??0??1?20?21???11?????????1????0????????00000?10000?001?1??0
0?0??00?0?0??00?????????0?????????0????0????0?????????????????????????????
0??00????0??00??[01]0????????????????0????????0??11??01?????0?0??010000?????????
??10?0100??000000??0??0????????????????????????????????1000000?0????????0?????????
????????????000??
??0??002
0????????????????????0????????????11101????1??0?11??0?00??010?0????01????????2
????????????????200?0????1?1??0?0????1??1?100?????0000000??1??0???0?00???11?0
????01100??11?1????1111????1?00???10?1???0????????????1??????????????

Neimongosaurus ??
??????????21????0????????????0??001?1??000?110101?1?0?10?2?1?1?02200????????000
1010000????????????111001?2????????????????????0??00????0??000000021?00????0??
1??00?0??00?0????0?????????0????????????1[12]200?0????????????????????
?????????0????00?0000?0????????00000200?0?00000?0?11001?0?0?10?0???010000?0?
00????????????????0????????20?00?????0?00000000?0210?????0????????0????
?????2?1100?000??
??
0????2????????????????????0??????0??1??11?????0??01?10?0?00???????21?2??????

Erlliansaurus ???

??10??1?????????1???????????????0?0???10
?0?0???00000????1?0?1??????????????2??1???10??0?0?0001?0?00?????????00????????
?????????????0?????????????????????0??????200?????????????????????????????????????
??????0????0????????????????????????????????????01?0?0?10?0???010000???00010???????
100???000000???????????20?00???????0?????????????????0?????????????????????????????
????000??
??
???????????????0????????????????????????????????????0?0?1?0?01????????????????02?0???1?00
0???????????????00100???????0?????????00???100?????00?11????????????????011?111111?
?11?1???0?1?11111011?0?????????1?????????0?1??????01?0?0?????

[illegible][illegible]

????????????111?01?2020221100?0201101????????????????????????????1?????
??00??010??
??
??????00?000000?10??2????????
??
??
????????????????????????????1??1????????????????????2?020?10?1101????????
????????????0?01????1??1?12212
1100??

Nanshiungosaurus_brevispinus ???
????????????????????????????1??????101?121??0????????????????????
??
????????????????????0????1????????????????????????????????????2
00??0??
??0??2????????
??
??
???0????????1??1??0????????????????????21?2??10??01????????
??????????01??0??1????????????????????????????1????????11222??11?
??

Therizinosaurus ???
??0010?000
0????0?00200????????????????????????????0?0?11000000021?0????00????
????????????????????????????????????00????????????????????????
??????????0????????????????2000??00000?01?1001?0?0?10?0??010000????010?????
100??00000????????????????????????????????0?0100????????????????
?????00??
??
????????????????????????????????00?1010?00100101????????????
????????????001?0??????0????????10??0000????????????111011111?
????????????2?111?0??????1??01????0????????????

Haplocheirus ?0010???00010?0?12011011101112001?000020100?0?101
0??0001?0010000010110110?1000001101010100??10?0?0111201??0?00001?0??0?00??
???100210001210?0?00010??001?00?101002010010?011000?00000000?0000?0000000??0
0?1110001100010001?0??0010?01000000000??0000001?00000?102000000000????00??0
0??0??000000?0?0?0?0000?000?000??0?0????????20000?000000010101????100
???000?00????????0??00000?0000000?00?000100200000????000?0?0?0??0100?00
0??0?0????????00?0????????0?0000001?00001??0?0000000?0?01000000?0??11??0?
0?01??01?0???000001000000??00??100?00000000000?000????00?0?0?0????001????

[illegible]

Achillesaurus ??

??020???2??????????????????????????

?????????????????10???01?2?????????????????????1?????0???1?01000?0???00?????????1?????

?????0?????0?????????????????????????0??

??

???????0?????????????2???00000000?0???0??

??

??

??00?0?????????0????????00?0????

0????????????????????????????????????11????????????????11?????????????0?????????????000????

???1???0?00?????????????0?????0????????????????????????????????

Mononykus_olecranus ?????00???????112????????????????????????????????

[illegible]

[illegible]

Ceratonykus ?0010???2???10????????????????????11???10?201?0?0?0100
 ???0????????????01?0????????????????????????1?1????????????????????????10????0?
 2???0??1????????212?0003???00????????????
 ?????????0????0????????????????????0????????????????????00???????1????111????????
 ?????????????????21????0?????0000?0???01????????????????0?????????????????
 ?????????????????????????????00000000?000?000?00?0????????????????1???10?0????
 ?????????0?0????????????????????????????0????????????1?0????0????0?000??0
 ??02???0?0000?0?0?0?00?000?0???0????????????????0?0?00????????0?0?????
 ?????????????????0? ??????0001??
 ??0?0?1000??????0????????????????1?????1?00?0????????????1????????????????
 ?????????????????00?00001??????????01????????????????????????0

Linhenykus

??
??111?101?1?1?0???2010020?2??????10?0???1?
?????????0?21110?????????2?????????????????????0?1010001????2?2?0?030?0000???0???1?
?????????0?????0?????????????????????????????01????????????????????????????????????
?????????0?0012?0?????210?????0?????20?0???0?0?0?????????????????????10000???0??????
??31?????00?0?0??????1?2000000000000?000?000?001?????0?0?????????1??????0???
??????????02??
??
????????????????????????0??????0001?01000?????0??????1?????????????????????????????0?0?00
?0?0???000???00?0?????1?0?0????????????1011?????????111?1???0?????????????0?????
?00????????????01?00?00001??????????0?1?110?0?????????????????????00

Xixianykus

??
??102?00?21201??0????????????????????
?????????????????0?01?1?1?200000?20022?3??03?02?011011101121211??3???000??????11?
??????00?0?00?0?0?????????????????????????0????????????????????????????????????
?????????0?0010000??
??????????????00?000000?1?2000000000000?000?000?0?????????????????????????????0???
??
??
??1000?0????????????????????????000110000???01?010?00?0
?00010?0?????????????????????????0?1???1011????????????111??11?????????????0????????
?0?0000?000010000000001?????????0????100????1???1?00011001???

Nqwebasaurus

?0?????????????????02????2010?????????0100?00??1????
?0?00?????????????????????????02????1?????00?11001???1????????????????????????01
02?000???0?0?10110?????????????????????????00?????0?0000100010000000?000?1???0?
?????0?0?0???0???01?00?0?00?????????????????10200?????????????????????????????0
0?????????????????????????0????????????20?????0?0???0101?0??????10?0????????????
???????00000???00000?????????00????????????00?0???00?0?0?00000???????0?????0
?0??????????0?001?????????????0?0?????0???0?????????0???0?????0????????????
?????????1?????????????????????000?0?0?0?????????????????????00????????????
?????????????????????????0?????????????????????000?01?0?1?0?0????????????
?????????0???00?0???00???0?111?0???1???0?012?????100?00010000100001??????0?
?????????????0?????????????????0?000010?????????0????????????1?1???0????????0?

Shenzhousaurus_orientalis

???0?????????????????21000??10?0??1???000??00?000?0????
?????????0?00000000??0?0?0?1?2?0?0?1????????????000??1???0???00000???0????????
?????????????010000000??11000100101?000001100??00001?0?????????????????0??1?1?0
011?????00???0010??10000010?????????00?0?00???0???000?000?????????????????00??
??0??????0?00?0?100?0?0?0??
?????????0?????0?00000?00000?0002?000?????????????????????????00?????????????????000

[illegible]

0????????????????010????????????????????????????????

Struthiomimus_altus ?00010?110?0??1010210002011101?1100000000000000
10???0001?01??0001000001020001?1?????????001?1011000011100010100000000100100??
???011200120000001201001000000110001101011000001?0010000011000100010000020?
?00001111110121110000?0?0010001000000001?????00?1?0000??2210???0???????????0
?0?1????000????0?00??00?0000?0000[01]0?0????????????200?0?0?000?0101001?0?001
0000??00000000000?100000??00000?00000000?000000000200?00000000000000?00?021
000000?10022000000?0??0?00?00?????????0010000000000?00?0000?01?0?010000000000
00???0??0?01??01?0????0000010?0000??01?0000??0000101?00?0??000000??00?0?0?????
?????????????1000011010?00???00210???0?000000000????????????00??00?00001000011
?????000000000200?110101?10100100?01011?0000000000000100010000011100111111?1
?110000??000010000001100001000110100???1??0?00001100000000000??000?000000000
100?0?0?101?1110000?0000?1010????????????

Gallimimus_bullatus ?00010?110110101010210002011?01011000000000000000
10000001?010000000000001020001?1?????????00111011000011100010100000000100100??
???0112001200000??20100100000011000110101100000110010000011000100010000020?
?000001111110121110000?0?0010001000000001?????000110000000221000?000000010000
00?0000??00000?0?10200??1000000010000[01]0?0????????????20010?0000000101001?0
?0010000?0000000000000100001??00000??0000020?0000000002000000000000000000?000
?021000000?1002??0000?00??0000000??????0000100000000000??0?0000?01?0?01000000
000000??0??0?01??01?0????000001000000??01?0000?00000101000?000000000?000?0?0
00?????????????????0010000111100000???00210?0?0000000000000000?????????000000?0000
1000011[12]000000000000020011?0101010100100?0101100000000000000100?100011101
1111011001?110001??000010000001100001000110100???1100000001100000000000??000
0000000000010000?001010111000010000?1010?000??11?0??

Garudimimus_brevipes ?000?????01101????02?00020101000??0000000000000000
00?00001?0100000000000002?001?1???????0??011?????0001?10001?100??00?????10?????
?????????????????????0000001100?????????????0?001000001?000?000?000001000000?0
1??1110?2?1?0?00?0?0?000100000000?????0000100000010???00?0000?001000000?0000
??0000010110000??00000000010000???0??
?????????????????????????????00?0000000002000000000000000000000000?021?0???0000??
??00???0??001000?????????00??0000000000002?0000?00?0?010000000000000??0??0?01?
?01?0???000001000000??01?0000??000000000000000000000000?00?0?000??00?010???????0
01000000010???0??00210???0000000000000000?????????0?0?00?0000??0001110000000??
?????????????010100100?0101?0000000?000000100?10001111?????001000?1?0001??000
0???????????000010110100?????000?????????000000?00000000000000010000?0010??01
??0011??00?111?00000001?100

Pelecanimimus_polydon ?00???????1???????2100?2?1??0000??000000?0000????

Harpymimus_okladnikovi ?0????????????????2100?????0?????000000000000???
 ??????????000000?0000????1?1200??1???0???1??0?00??10001?100000?00?001???????0
 ?1?001200000000010?10?00???????1????????????00?00?????0?0?010000010?0000010
 11????1?0???00?0?0???001?00000?1?0???00?0000??11?10000000????????????0??????
 ??????0000?00?00000?0000[01]0????????????????????????????10?01?0?0010000?00000
 0000000????0?010?00000?0000000?0?0000?00????00000000?00000?00??11?0000?0????
 ?????0??????000?????????0?001?0000000000????0????0?0?0????0000?000???0?0?01??0
 ?????????????????????0???1?00?????0????????????00000?00?0????????????????????????
 ?????????????00210??000????????0????????????0??????0000?00000?1?0????0000??2001?00
 ?01?1?0010?????????0?????????00?0?0001100100011??0??0?11?00????000???00000100
 0????011??0?01??00000110?000000000??0?00??0?000?100?01??1?1?01?00?000???1
 ????????????????

Sinornithomimus ?0001?????1?0?????1?21000??1010001?0000000000000000
000?000?0?0??00000000?00?????1?1?????????0001?0?10?0???100?1?1??0?00?0?0?100?????
?010200120000?01101001000000110001101011000001?00?00000110001000?000?010??00
0001011100121?1??00?0?0010?01000000001?????00001000000?02100000000?????????????
?00??000001?1?0??????00000001?000?0?0??????????????20010?00?00?0101001?0?0010000
?0000000000??01000010?00000??00000000?00000000020000000000000000??00??1100?0

[illegible]

Huaxiagnathus_orientalis ?00?0????????????0001???1???0????00?0????????????
 ???????00?0010????????00010?1010?00?0????1????????0?????00?0?002010????00000
 0000?00?010000000020?0?000100201?000012?0???0?????0?0?010000000?0?011?0000
 ???00?0?00?0?0010?0100000?0?1?00???0????0000??200???0000????????????????????
 ?????????????00?00?1?0?[01]0?0???????0000020?00?0?0?0?010100?????10?0???0????
 ??????????????010???000??00?00?00000?????000?0?00?0?0?0???100000000????????
 000????00000?0?00??000000?01??00000??0?00?0?00?10000000000??1????????????????
 ?????????00?00????????????????????????????????????0????????????????????????????
 ???????02?00???0???????????????????1?0?00???????0?0?0000?????0?0001100???1?0?000
 ??00000?0????????????0?????0?0???0?0?00?101000??01?0?00?0?00001000?000?0????
 ???0?????10????00????0?0?0?0000????0???0???0000100????????????????????0000??????

???????

Sinosauropteryx_prima

000?0????????????0001???1???0????0000????00?0????????00?01???????1?0001
001010?000?01??100????1?0?0???00?110000201?????00000000?10??010000?00020????
??0100201?000?11?0?1?00?0?000?0?01000000000?011??0000?000?0?00?0?000??01000
0000?1?00?00????000?0??20000?000????????????0??????0101???????0000?0??0?00[
01]0?0????????????0?00?0?00?0?010?000????10?0??00?00?0??????????1??0100??0000
000?00000?0?2????00?0?00?0?00?0??0100000000???????000?10??000?0???????0000
?01??0000??1??1???0?1?0?00?0????0????????????????????00?0?0?????????????
????????????????0????????????????????????????????02?00??0?0??????????
????000100?????0?0?0010?????0?00111?0???110?000?00000?0?0??0?0??0?0?
00?0??0?000?00?11100??0000?00?0?0?001000?0?0?0????010????1100??0000??0?00
0?00000?000?????0000100????100????????????000????????????

Compsognathus_longipes

?00?0????????????00101?1??00???00000????000????0
00?????0?00000100?1?001000010010101000?01??1010???1?0?0???000?0120002010????
?0?000000?10????0?000000?????0?01002010000012?0????????00?00010000000000011
00?00????0?0???00?0?0010001100000001?00000000?0?000?020000?0000?0?0?0?????
0???0000????01?0?0000000010000[01]0?0???????00?0?20000?0?0?0?010100????0?1000
???0???00????????????010????0?0?00?0?000?00????00?0?0000?00000?0010000000
0???????00???000000?0?????00000?001?001000?1?0100?0001000000000000??0??0??0
?000?00?0???0000000?00?0?01?12???????000???????11?000?????????????????????
0????????????????02000?00000020000?0???????1?0000???????000?0000?0????0?????
01???1????00????0?0?0?0?0?0?0?0000?0???0?000000?101000?00?0?0?000?0010?
??0?0???0?0??10????1100??0000???0???0?00????00?????0000100?0010100??1?0???
?????001????????????

Juravenator_starki

0000????????????00010??11000?1???00000?0000?0????00?????0?0000010???0???000
100101?00?0???1?????0?????00??100002010????000000000000???0000000000?011
00????????????????0????00?????0?0?000000?10?000?0??0?0?00?0?0?????01000000
0?1?00?0?000?0000???20000?000????????????0????????000?00??00??0?0?
??????[01]00002??0?????0101000?0?0010000?000?000?000??0?0???100???0000?0?
??00?000??2??00?????000?0?0000?00100000000???????00??00?0?00??00?0?0000?0
11000?00?01?0100?00?1?00000000000?00???0?0?00?00?0???0000000?0000?01?10??
?000?00???????11?000?00?0?0?????00????????0????????????????02000?00?0???0??
?0?????0?010????????????????????0000?00??1?0?000?????0????????0?????0??
???0?0??00000?0??101?00??00?0?0?0??0???0?0?0?0?0?0???0???0?0???000??0?0
00?0?????0?0????????00100?0????00?1?????0??00????????????

Sinocalliopteryx

Mirischia
 ???
 ???0?0?0????????????????????????????
 ?????????????0???????0001?02000???0121001000101110???0?????????????1????????????
 ?????????0010??
 ???????0?1?0??
 ??????????0???00?0?000??
 ???
 ???
 ?????????????????????????????0???000????????????????????????1?????0?0?00?000?1?0?0????
 ??????????????????0?????0?0?0???0????????????1????????????????????????????000?0
 ???00?00?000????????????????0????????0????1?00?001???

[illegible]

Tanycolagreus ?000?????????????00?0?????0???00110???????0?00?
????????????????????10?00?????1?????????????0011?000?????0???0?0?0???????0000
00000011?1000000????????????????????11001000001100000001000000000000?00?
??0??000?????0?0??00????????????????1???1???[01]2000???0????????????????00??
0?0?????????0?00001000??0?0????????????2000?0000000101000?0?0010000?00000000
00000100000??01000??00000?????????002000000000000000000000?00100?00000??????
?0?0????????????????00000?????001000?????????????????0?????021000000?000?0???
???????????????0?0?00???????0?0?000?000????????????????????????????????????
?????????????????????????0????????????????????00001????????0011001001000000??
????????00???0000000000000000000?000?????00100000000?0?0?0?100?10000000000001
01000?????????????0000000000?????????0?000000000010?????0?0?100101221011???1?
?????????????

Zuolong ?0000?????????????0000010111?0???000?00000011000
00?????1000?????????????????00010?101??1?010001000?????1???000000?0000?????????????
???????000?0?????0?????00?0100?????????????01100110000110?00?0???00010?0?00?????
?0?0100?????00???0???0011000000???0???00???1???0??0002000??0000?????????????????00???0
000000?????????????010?0?10?0?0?????????????????????????????????????0?????10000?0000000
00000010000?????????????????00?0?0?00?0020000?????????0000?000?0?1???0??????????????
??0???000100?????????0???00?????0000000000000?00000001000???????1???0???00?0000???
?????????????????0?????0000?00000?0?000??10???0010?0001101?00000?????????????????????
?????????????????????????????????0???????????100???????00000?0?0???000???0?????00000????
?0?00000?0?0?0?00000000000?????000?000?00?0?0???0???0000?000?0???0?????????????000

011????0?0?0000?0?00000?00??0?0???0000000???00??0?????1?0?10??000??01?0?01
??0000001?000

Bicentenario ?????????00?1?????0?0?????00?00????????????00??
?????????????????????0?000000001????????????100?????????0?????????????????????0?0
0????????????0?1????0??10?????????????????0??00000?10??0?110????????0??????????1???
?0?????????????????00?0??0?0??????????????1???0?????????00????????0?????00??????
?????0??0010????0????????????????2???0??0??0??0??0?001?????00000000?0????????
?????????????0?0??0???2000?00000000????????????0?????????????????????0????????
?????????00????????0?????????0??00?0?0?????????????????????????????0?0000000??
?????????????00000000?1??
1?2?00?000?0?0?????0?????????????????????????1?00?0?0??00?0?????0?0?0???????0000
?02???00?0?????00????????0?????00?????0??00??0?0?????00??00?????0?????00??0
0?0?????0?0?????00?????00?????????0?????0?0?0?1?0?????00?????????

Kileskus ??????????????????0?01120111????????????????????????
?????????????????????????00000?101??
???00?00?0?0????????????
?????????????????1?0000?0??0?00?????1?????????0?001????????????????????????
??
??
??
?????????1011201???000?0000?0000?0??
??100010??
?????????00???0
0?????00?????????????????1?????0?????????????????????????????0????????????????
?????????????????????1?????????????????????0?????????????000

Guanlong ?00020?000000?010[01]100011201112000?00110000001
0000000000?10???00000010?00??200000001010?100?00000000011100000000000?0???0
0??????000000100000?0100000003000010000100200000001110010000011000?00110000
100000000000000000000000000?0?0010001100000001100?00?11101102?1120000?0010????
0000?000?00?0000000?0?0???000000010000?0?????????????20000?0?????0101?00?0
?0010000?0000000000000010000???01000?0000000?00000000020000000000000000000
?00100?0000020?20?000?00??0001000?????000000000000112010?1000?00?1000001010
000?003?0000?0?00?10001000001100010?01?1000?0000000000000?1000011?000000
?00000?????????????020?01000100000000000?0?000000010?????010100???????0000
10000210000?0?0000010001000000000000001000000?0110000000100000?0000000?00011
00000100?010010?1000100000000000010000000000?001001000000000000000000?000000
0000000010100???1?0011?1001??1000001?0?0?????????

Sinotyrannus ??????????????????0?01???101????????????????????
?????????00?0?1???????0?0000101?????????????0????????????????????????

?????????0?00?0?0?000???0?0??
???00?????????1?0000?0??100?0?????11?????????00?001?????????????????????????????0?
???
?????????00?000?0?0???0???????
???00?????01?2?1??10??0??1?00????1??
???0?????????
?????????????0???0001?????????
?????????0?0?????0?????????????0?1?????????????????????????????0?????????????????
???00????????????????

Proceratosaurus_bradleyi ?00?2?????????????00011?01112000?00?????????00?00??
?????000?00000010?00?120000000101011???
???00?0????0?
0??0?????????????110000?0?1100?00?11?0?1?2?????00000100000?????????00??0?00??10
?0????00???
???0?????0?????????
?????????00?0010112?10?1000?00?1?0000101????0?????????????????0?1000100000110001?
?????0???0???00000000?0?0?????????????0000?000?0???0?0?0?????00100????0001??
?10?00000001000?????11000???
?????????????????????????0?00?0?????????????1???0?0?????????????????????????0?0010?????
???1?0?1?????????????????000??????????????

Dilong_paradoxus ?0002??000000??0?100011??1112000?00110?000010000
000100?????00000000?00??200000001010?1?0000?0001?0??1000?????0??0?0?0??0?????
??0000001100?????0000000?00??1?00110201?0?0001?00?000?0?00?00010000100?0000
?00000?0?00000?000?0?0010001000000001100?00111?110201?20?000000???00000???0
?0??0000010110000???000?000?00?00?0?0?????????????20000?0?0?0?0101000?0?0010000
?0000000000000?0?0???1000?0000000???0?0000020000000000000000000?00?0?1000?0
000?0?20?00???010000100???????000000000010002?11?1000100?0?00000000000103??
0100?00??00010111100001100010?00?1100?000000000010????00000?000100?????????
?????????020?010?010?0???01001??10?10002?00?11?????01110000000100000100001????
???00000110001????10000?0001?0000??0110000000000000?010000000??11000????1?01?
01001????00?00??00??00000?00100?00?0000010?0?000000???000?0?000?0001?100?
??1??10112???0??0000??0??????????

Eotyrannus_lengi ??????????????????000120??12??0???110???????????0?
?????????0?000?0?0??1???20000000101012?00?????01?0??1????????????????????????000
000010?????????0?0???0???00000?0?00??00?0??
?00?0?????0?????0?1?000?00??10?0121???111?0?211?0000?0?????????????????0?00?0010
0???00?0?0??0?0010?0?0?????????????????200?0?0?000?0?0?0?0?0010000?0000000?000
0?????????????00?????????????????0?????????????????????????????0?????????????????
?1?????????????0?00?????1?00101???????00?0?01?????01000?1010??1??0?00?00??????????

Juratyranant ???

????????????????????????????????0?00?0000001?10?00000?0????????????????????

????????????00?00?01000011010110000011?01??0??10????0????????????????????1???

????00???0010????????????????????2????11????????????????????????????????

?????0?00100?0?0??

????????????00?000000000?0?00?000?000????????????1????????????????????1?0????

??

??

????????????0???????00?100011?00100?0????????????????100000011001000????1100

001????????????????0??01?1?1????000????????0????????????0000?0???????

?0000000?0000?0000????????????1??1?????11??0????1?????????????

Dryptosaurus

????????????????????20????????????????????

?????????0?0?0?2?????0000101?1?????????????????????0????00????????????????

?10??????10?0??????????[01]?0?0?2??????101?01001100010001000?2???0????????

0?0??????0?0????????????00??????????????11???0????????????????????????

????0??????????0????????????????????????????????0?0?0010000?00????????????

????????????????0??????00200000000000?000?0????????????????????????

??????00?01????????????????????0????????????????????????????????????

??2

12?1?1??10?????????????????1?0???01

2?1?0111?????1????0?????0????????????0????????????000000????????????00?1

???00????????00?0000?00001????01?????????0?1???0?0?0???1000010???

Appalachiosaurus ??????????????????0?0?201110?????120?????????????
??????00000?000?0??????00001010?2?????????????????????0?0?00?????????????????
????????????????????????????000010120?10???10???01001100010001000002?0?00?????0???
?0???????0?00100?11000000?1???1?021?????????????000?0?????000?????0?????????
?0000??0????????????0??
????????????????00???????002000000000000?0000?000?00?????????????????????????
?????????00?????1???????000?000?01?010111?101??1?0020?01?10?0?0????????????????
??000000010100010?00????????????????11?1
10??1?????????0??1?????2?0????????????????????????????0????????????????????????1
?01110???11111111021?0000????????????0????0?0?000????????0000000??00?0?0??
?0????????????????????00?0?00000001???0??????01?????1?00000??100???010200

Bistahieversor ?1102?????????10?2200002?01110000?001201000?211000
00?????????00000000?20??2?000000101012?0????????????????????????????????
??0????????????2??????10?00??
00?0?0?0??????????1200000011?00?00213?0?112?????0000000?????????10?0?0?00001?
??0?0?0?00?0????????????????????????????????????00?0????????????????????????
??11?????????0?????
?????????????0?1011001000?1010101?010111010101002010001001???10000??00000020
000211000010000??1111111?1?1001011001211111?01000?010011111?????11?111101?101
11111100?11212101100112?10??2?00????111?????????????????0111?1????????????????
?????????011?????01101111?120010000????????????1??1?0?0?0????????????????????0
??0??11001?????1?????????000?11?????????

Albertosaurus_sarcophagus ?1102??000000?100220000220111000000012010000211000
00?000100000000000000020??200000001010120?????0?10?001?100?0????000?0????0????
??000000010000???011001031200110000001012001000110??0?00?1000??0010000020000
0001000000000000?000?0?0010?01200000011000?0021310111210201100000000??00000
100?00??0000010010000??0000000010000?0?0??????0000020000?00000?0001001?0?00
10000?000000000000010?0?????000???00?00?0000000002000000000000000000?00?01
00000??020100?000??0?001100?0110?000000101110110010000[01]1001[01]10010111010
2011100211[01]1[01]1101?00100000010001020100200110010001111101111111101011001
111111000[01]000111[01][01]1111000010110111111101111110011121211100?12?10?121
011??????1????????????????1111102011111?1021111110211101??1??1???111111111220
10000000??00000101?011010?100010?000??00?000000100?000000??0?00??110??0000000
0??0000?000000000101100111010111?????0100000011??????????

Gorgosaurus_libratus ?11020?000000110022000022011100000001201000021100
000100010000000000000002001200000001010120?0000010000101000000?000000000000?
00001000000001000000101100103120011000000101200100011010010001000?000100000
2000000010000000000000000?0?001000120000001100010021310111210201100000000000
00000100000??0000010?10000??0000000010000[01]0?0??????0000020000?00000?0001

001?0?0010000?00000000000001000010??1000??0000000?00000000020000000000000000
00000?0010000000020100?000100??00110000110?000000101110110010000[01]100101001
0111010201120021101[02]1?010001000000100010201002001100100011111011111111010
11001111111000100011111111??00110110111111110111111100111212111100112?10?12101
1???????1????1101????1?0?0111110201011111021111010211101?011?1?2?11111111?2201
000000010000001011011010?100010?00001000000000100000000000?0000110?00000000
0??0000?000000000101100111101011110?0?0000001100?00???00

Alioramus ?01020?00000011002200?0?20111000000012010000211
0000010001000000000000000200?20??000010101?000000010000111000000?00?00?0??000
????????????????????????????120011000[01]001012?010?????001001100?0?01000?02?
?000??10??000000?0?0000???010??11000000110001?0213101?12102???000?000000000
00100000?00000100?0000?00000?00100?0?0?????????????????????????????????????
????????????????????????????????????00?0??000??2000000000000000000?0?0?1?0????
0020110?00???0?0011000? ??????0???00111?2???001110111110?0111010100120121001
02111010111000100001020000100000010110111201111111001011001111111?1011100110
1110100011011011110110111011110011121211110??10000??000001000011110?1012210
11111????????????????1111010??????1?1111121??00?111?12?0100000?????0???0?1?1?01
0??000?????????0???01?0000?000000?0?????????0000?0?00???0?000?1??1101111
?1?1??1011??0?000?1101000000000

Teratophoneus ?1?0???0??????0??2?????0111?00????1201??????0000
??????????00??0000????????000010101??1?????????????????????????????????????
????????????????0????????????????????????????????0????????????????????????0????0?
??????????????1?0000?01????????3????????0???000????????????10?0?0??00?001???0??
???0??1?????????????????????????????
??100????????????????????
????????????????????0???0?01????????????2?021?0001??10?????????0???01?1?????0?
??01??1?1??21?111?100111101211????????????????????011?1?120?1????1??1100?11?
????????11????????10?????????1?????????????????1?01???1????????????????011?1?
1??????????????000????????????????0?0????????????????????0?0?????????????
????????????????????????????????1?????1?????????00??1???????????

Daspletosaurus ?11020?000000?1002200002201010000000120100002110
000010001000000000000002001200000001010120100000100001?100?0????000?0?0???0??
????000000010000??111001031200110000001012001000110??0100?1000??00100000200
00000100000000000000000?0?0010?0020000001100010121310111210201100000000???000
00100?00???000010010000?0000000010000?0?0??????0000020000?00000?0001001?0?
0010000?0000000000000010??0???1000?0000?00?0000000002000000000000000000?00??
01000000?020110?000?0?00110000110?00000010111012001102011002111021111010210
1201210101[12]11111111111101101020000211001011[01]11211212111111100?111012211
111110111001101111[01]1001111101111011111111111100111222111101112?1001210110001

1101111021111??????11111?211?111?112111??1??111?1??1????2?11????11?12???00000?
?11000????1??1?010?1000???000?1000?0?????0?000000000???0011000?0?????????????
?????????11011110??1?????????000?11??????????

Tyrannosaurus_rex ?12020?01100011002200002201010000000120100002110
0000100010000000000000002001200000001010120100000100001010000001000000000000
?0????0000000010000???111001031200110000001012001000110100100110001000100000
2000000010000000000000000?0?00100002000000210001012131012121020110000000000
000000100000??0000010010000??0000000010000[01]0?0???????0000020000?000000000
1001?0?0010000?000000000000010000????1000??000??00?0000000002000000000000000
000000?0010000000020100?000?00??00110000110?0000001111112001102101[01]0[13]01
102111101021112010??10121011111011[01]1101111021010211001011111211[12]12111111
1001111212301111111111011011111111111011020111111111112112221211011121111
121121111101111102111121111111111102110111112111111021111111221121111111111
12211000000010000001011011010?1000100000??000000000110000000000100001100?10
000000??00000000000000010111011110101111011010000001101000010?00

Tarbosaurus_baatar ??2020?011000?10022000022010100000001201000021100
0001000100000000000000020012000000010101201000001000010100000?1000000000000?
??????000000010000?011110010312001100000010120010001101001000100010001000002
000000010000000000000000?0?00100002000000210001012131012121020110000000000
00000100000??0000010010000??0000000010000?0?0?????????????20000?00000?0001001
?0?0010000?000000000000010000????1000??0000000?0000000002000000?00000000000
00?0010000000020100?000?00??00110000?????0000111111200110210111301102111101
021012010??1012111111101111101111021010211001011112112121111110001112123011
1111111101101111111111110110201111111111121122212?1011121111211211111?111
?1021112??1??1?1111102110111?112111111021111111221121111111112211000000010
000001011011010?1000?000000100000000011000000000010000110??10000000??000000
000000001011011110101111011??00000011??????????

Anomalipes

zhaoi ???
??
??121101????????????0?01????????????????????
??
??
??
????????????????????????????????????0?0????????????0?0????????????0?0????????
??
??
??
??1000???00100?00?000?0?
??1????????????????????????????????11?
0?00?0?0????????????????10?0?0?0?????11011001111

New characters added to Lamanna et al. Matrix

- 231. Femur, greater trochanter, anteroposterior width: less than or sub-equal to anteroposterior width of femoral head (0); greater than anteroposterior width of femoral head (1)
- 232. Accessory trochanter: present (0), absent (1)
- 233. Accessory trochanter: minor (0), significant (1)
- 234. Notch between lesser trochanter and greater trochanter: present (0), absent (1)
- 235. MT III proximal end: wide (0), mediolaterally narrow (1)
- 236. MT III, distal articulation, medial hemicondyle, transverse width, sub-equal to transverse width of lateral hemicondyle (0); much less than transverse width of lateral hemicondyle (1)
- 237. MT III, anterior flange near proximal end: absent (0), present (1)
- 238. MT III, longitudinal groove on distal articular surface: absent (0), present (1)
- 239. Femur, posterior trochanter: present, developed as a slight tubercle or flange (0), present, hypertrophied into a 'shelf-like' structure (in combination with development of the trochanteric shelf) (1), absent (2)
- 240. Metatarsus, proximodistal length: greater than 44% of length of tibia (0), between 44-38% of length of tibia (1), less than 38% of length of tibia (2)
- 241. Femur head, shape: subspherical (0), anteroposteriorly compressed (1)
- 242. Femur, femoral head: orientation: medial (0); dorsomedial (1)
- 243. Femur, accessory trochanter: confluent with lesser trochanter (0); separate from lesser trochanter (1)
- 244. Femur, femoral head, posterior displacement: absent (0); present, femoral head more posteriorly positioned than greater trochanter (1)
- 245. Femur, greater trochanter, anteroposterior width: less than or approximately equal to anteroposterior diameter of proximal portion of femoral shaft (0); greater than anteroposterior diameter of proximal portion of femoral shaft (1)
- 246. Metatarsal III, proximal articular surface: rectangular (0); triangular (1)

Lamanna et al. Matrix

Herrerasaurus_ischigualastensis

1?????????1?11?????21?????????1??1000??0????????????????????????????1?????????1?12122?
?10011???1??1??22??0??1?????????????1???101101?211????????????????????????????????0??

?001001000000?0??1??????????????0?????????0??11?0?0??0??00??????0??????????

Rinchenia_mongoliensis

11122?0111110111????1211111111?11110101110011111?1111121?111111121111111111121
2?011001111111121221110011?1010010102?12101000??????01101121101????111111????
??1101?001011??????00111?????00000001???????1?10???1110?0?0?0?????????????
??????0

Citipati_osmolskae

11?2221?1111011?1111211111?111?1111011111?????111????11?1?11111????1?11?111212
20110011111111122???????1????????????????0?101?2????????????????????????????11
011001011?01010?0??1100000000000000100?????010100?01110?001000100?0??1?10??02
000?0?0

Zamyn_Khondt_oviraptorid

11222211111011111121111111111111011111111111111211111111121111111111212
2011001111111121221110111?10100101021021010110112111010012110011121111111100
0101101?001011?0000010??110?0000000000?0100???00?1?100??11???001?0?00?0?0???0
??????????

Khaan_mckennai

1022111?1111011?11212111111111?1100011100?111?111111??0??1?????1??????111111212
10110011111111?1221110??1????00?0102??210??1101021110?000110001?1211111?11000
10100110010010010100111110?000?00100000100000?01?1100?1?10101000?0000[01]011
?100001100?010

Conchoraptor_gracilis

101211111110111112121111111111110001110?111111?1111211111111121111111111?1
2?011001111111121221110111?2010010101112101111001211101000210001112111111110
0010101????????110???1??11??????????????0?????11?00?011?0?0000011?0??0?1?00??
021?????0

Machairasaurus_leptonychus

??
??2????????????????????????0012????
??111110????????????????????00????????????????
?????????1????????????????????

Nemegtomaia_barsboldi

11120111111011111112101111111?110001011011?111111?1??11?1111112111111111121
2?11100111111?1121221110[02]11?201????????????????????10002?00?1????11?????
???10111101011?12?11??1111000000010000001000?0??1???1??11?1?1?0001?000????????
??????????

Anzu_wyliei ?1??101100?1100?????????????????0?000?????10
11??100?1??1??0?011?????1121011?02011200111111?121221110211?1?10010?02?021000
10????1110???1?2?1?11021111111?????1?000010100000??01?0?0?10112111011111??111

1?110101101?00101021201110??010???1?001?0?

Hagryphus_giganteus ??
??0010??
??000010????????????????????2????????????????
?????????1????????????????????

Elmisaurus_rarus ???
??001?????
????????????????????101????????????000010?0????????????????11??10????????????
?????????1??1???1000??????0

Nomingia_gobiensis ???
??00?1?01?00101020?????????????
??1101101111101111111????????????????1?00????????????????11???0???1??
?1???????1?10????????00???

Epichirostenotes_curriei ????????01?010?????1?????????????????????1
10?1?1?0????????????????????????????????0?1?11?1?2????????????????
????????021????????????????????1????????????????11?0?0???1????
????????10???????????????

‘Caenagnathus’ ??
???11211110201120011112?112??2?????????????????????????????????
????????????00010100????????111121111111????????????1?010??0?????
???????????????

Macrophalangia_canadensis ??
??
????????????????0011????????????????0?????????????????????????????
????????0???????????????

Banjilong
11?210111???011110212111111011??1101???0??11?111??????111121?0111??11?212
1??000110??1?11?122?1??111
11001011????????110?????0?00000????????????00?0?000?0?????????????
?

Caudipteryx_dongi ??
????????????????????????????????????01?0????????0010?1?201
00?011?2011000211????100012????????00?001000????????01?10????0??1
????????????00000?0?01?????????

Ganzhousaurus_nankangensis ??

????????????????1[01]111?21?[12]011001????111??2????????0??0?????????
????????????????????0001????1?001?11?????1??????0?001?10?0?????0???
??????111??0????????0000??????0

Jiangxisaurus_ganzhouensis

1????????????????11?????1?001??????11??????????1??1?????11111??101?
1?0011?111????122??10????????1??????1?1100?0?10????0??????????????????1
?001?10?2????????????0?00000?0????????1?0????????00?000?????????????

Nankangia_jiangxiensis

??
????????????????11101?2????100????????2?????1???1??1?0?0011001????????
01110111111211001111????????1101?0??????1?00??11????0?1???1???11??????01??
?11?0??0?0?00??1?1????1?00??0?

Ojoraptorsaurus_boerei

??
??
????????02????????????????????????????????????1?????????????????
????????????????????

Shixinggia_oblita

??
??1?2?1??1??????????????????1
10000000????1????1????????????????????01????????????????????????
????????????????????00?0??

Similicaudipteryx_yixianensis

??
??0?11?0?1?0??1?2??????1??????0?0
01?21110????????0?0?12????????????????00????????????????0????????????
?????10????????????2000???

Wulatelong_gobiensis

11?2211?11?1?1??02121?111?1??1?111001?00??11????????????1111????????????1
01????1??11????12??????1???100???2?????????1?????1100?21111121??????000?01?
?????????0?????011????????????000????1????1?10?101??????????0?0????1???1???
10

Yulong_mini

1020101110110111121010111010?01000111010?111110110?0??????0????11111121
220110011[01]1111?12122?100??1????001?10??[01]?0000101?21010?110?10?0?0?1?0?
?11?001010?11001011?11000?100110?????0?0000010??????1?????1110?01000?00????
????????0?????

Anomalipes_zhaoi

??
??

????????????????1110??000?0????????????????????????????????????00?????
?1????????????????100?112110110000

New characters added to Funston and Currie Matrix

- 251. Accessory trochanter: present (0), absent (1)
- 252. Notch between lesser trochanter and greater trochanter: present (0), absent (1)
- 253. MT III proximal end: wide (0), mediolaterally narrow (1)
- 254. MT III, distal articulation, medial hemicondyle, transverse width: sub-equal to transverse width of lateral hemicondyle (0); much less than transverse width of lateral hemicondyle (1)
- 255. Mt III, anterior flange near proximal end: absent (0), present (1)
- 256. Metatarsal III, longitudinal groove on distal articular surface: absent (0), present (1)
- 257. Femur head, shape: subspherical (0), anteroposteriorly compressed (1)
- 258. Femur, femoral head, posterior displacement: absent (0); present, femoral head more posteriorly positioned than greater trochanter (1)
- 259. Femur, greater trochanter, anteroposterior width: less than or approximately equal to anteroposterior diameter of proximal portion of femoral shaft (0); greater than anteroposterior diameter of proximal portion of femoral shaft (1)
- 260. Metatarsal III, proximal articular surface: rectangular (0); triangular (1)
- 261. Femur, greater trochanter, anteroposterior width: less than or sub-equal to anteroposterior width of femoral head (0); greater than anteroposterior width of femoral head (1)
- 262. Accessory trochanter: minor (0), significant (1)
- 263. Femur, posterior trochanter: present, developed as a slight tubercle or flange (0), present, hypertrophied into a 'shelf-like' structure (in combination with development of the trochanteric shelf) (1), absent (2)
- 264. Femur, femoral head: orientation: medial (0); dorsomedial (1)

Funston and Currie Matrix

Herrerasaurus_ischigualastensis

??1111?2????11
001????????????2???0??1????????0????1?1011??1???0???112?11?112??011101????????01
01???0011????00??0000000?0?????0?1?1?1??0??1?0???1????0??00????????????????????
????00????000?0021

1?????????1?11?????21?????????1??1000??0????????????????????????1?????????1?12122?
?10011??1?1?1?22??0??1????????????1???101101?211????????????????????????????0??
?001001000000??0??1????????????????0?????????0??11?0?0??0??00??0????????????????
000??0???????????

11122?0111110111???1211111111?11110101110011111?1111121?11111112111111111121
2?01100111111111221110011?1010010102?12101000??????01101121101????111111????
??1101?001011???????00111?????00000001???????1?10???1110?0?0?0?????????????
???????000?

11?2221?1111011?1111211111?111?1111011111?????111???11?1?11111???1?11?111212
201100111111111122??????1??????????????0?101?2????????????????????????????????11
011001011?01010?0??1100000000000000100?????010100?01110?001000100?0?0?????00?
0??00?000?

```
112222111110111111211111111111110111111111111121111111112111111111212
20110011111112122110111?1010010102102101011011211101001211001112111111100
0101101?001011?0000010??110?0000000000?0100??00?1?100??11??001?0??00?00???
??????????000?
```

1022111?1111011?11212111111111?1100011100?111?111111??0??1????1?????111111212
1011001111111?1?221110??1????00?0102??210??1101021110?000110001?121111?11000
10100110010010010100111110?000?001000001000000?01?1100?1?10101000?0000100????
??00000000?000?

Conchoraptor_gracilis

10121111111011111212111111111110001110?1111111?1111211111111121111111111?1
2?011001111111121221110111?2010010101112101111001211101000210001112111111110
0010101????????110???1??11????????????0?????11?00?011?0?0000011?0??000?????
00000000?000?

100??0??0??2?

Machairasaurus_leptonychus

??
??2????????????????????????0012????
??111110????????????????????00????????????????
????????1????????????????????

??????????????

Nemegtomaia_barsboldi

11120111111011111112101111111?110001011011?111111?1??11?1111112111111111121
2?11100111111?1121221110211?201????????????????????10002??00?1????11????????
10111101011?12?11?1111000000010000001000??0??1??1?11?1?1?0001?000?00?000????
??????000?

??????????????

Heyuannia_huangi

????????????????????????????????????1?????????????
????????????????????????1??2121??1001???1?????21???21-
12????1?????121?11000002?20???01?1100111?1????????????1?1?1011112?2101?1????
???0?00000100?0?0?0101?00?1?11?0??0?00001??????000000000000?

100???0?1???1

Ingenia_yanshini

??????1????????????11????1?11000111?0111111
???11?11?1?111?1???111111212?01100111111112122?110011?2010010101012101100
001202001001210001112111111100010?011?1010111121210111110000000000000100?00
00?1?100001?1?0??0?000010?0000000000000?000?

10000000101?11

Gigantoraptor_erlianensis

??1121111202011
100111112???1?2????????0010?0?00?00000?11?1?1?1????????1?1111111000?0???
0001010000????????0??0001001110100??0?????1????110??112?10????????010?00
0??011?01111101111?10

Caenagnathasia_martinsoni

??2101?1????12
0????????????2?1002?1?0?1??10?1????????????0001
???0????????????011?111?1??0????????0????????????????????

?0???0001?1?20

Caenagnathus_collinsi

??1021011102011
200111111112??2????????????1??111101?001?????00
010101?1?????????11011210111111?????1?????????01?0010??201??1????????????0???0??
000?00???000?0021

Leptorhynchus_elegans

??12111?1????12
00???????1????2??111????0001
???0???????0???0111121?10???????????1???????????0?????0?????1?????111100111111??
1??10?0???0????

Elmisaurus_rarus

????????????????????????????????0??
????????????????????0??10????????2????1?????011????????????????11?1???1111??0?????
???000?10?0????????????????????11????1????????????????????1??111111111011120??1
1??1000???0????

Apatoraptor_pennatus

??

????????????????0?1???121111102011100111111112??211002111?????????2?011100100111
0111???101???????????101?????????00010100010?10?????01?11?1111111210?????1?10
1?11??011??101?01????111????????????1001????????????

Chirostenotes_pergracilis

??1121111102011
2001111121112??2????????111?????????10?????0???1??11??21101???111?1?1100110???0
0010100?100101000?0111121111111112?1111???????1??010???01??1000??11110000110
01001100010?00??0?120

Hagryphus_giganteus

??

??0010???
????????????????????????????????????000010????????????????????2????????????????
?????????1????00? ?????????????1????????????

Anzu_wyliei ?1??101100?1100????????????????0?000?????10
11??100?1??1??0?011?????1121011?02011200111111?121221110211?1?10010?02?021000
10????1110???1?2?1?110211111111?????1?000010100000?01?0??0110112111011111??111
1?110101101?00101021201110???1??1????0????000000?????0??110

Nomingia_gobiensis ???
??00?1?01?00101020?????????????
??11101101111101111111????????????????????1?00????????????????????111??0???1??
?1???????1??10????????????????????

0?????0??01?0

Epichirostenotes_curriei ????????01?010?????1????????????????????????1
10?1?1??0????????????????????????????????????2?1?11?1??2?????????????????
??????????021????????????????????????????1????????????????????111??0?0???1?????
??????????10?0????????????????????????????

Banji_long
11?210111????011110212111111011??11101????0??11?1111????????1111121?0111??11?212
1??000110??1?11?122?1??111
11001011????????110?????0?00000????????????00?0?000?0?????0?????????????
????????????????

Caudipteryx_dongi ???
??01?0????????????0010?1?201
00?011?2011000211?????100012?????????00?001000????????????01?10????0??1
????????????00000?????000000000????001????????

Ganzhousaurus_nankangensis ?????????????????????????????????????
????????????????????1111?21?2011001?????111???2?????????0???0?????????????
????????????????????0001?????1?001?11?????1???????0?001?10?0?????0?????????
?111??0????????????000000000?????0000???0???

Jiangxisaurus_ganzhouensis
1????????????????11??????1?001??????11????????1??1?????11111??101?
1?0011?111????122??10????????1??????1?1100?0?10???0????????????????1
?001?10??2????????????0?00000?0????????1?0????????00?00?????????????
????????????

Nankangia_jiangxiensis ?????????????????????????????????
????????????????11101?2?????100????????2?????1??1??1?0?0011001????????
011101111111211001111????????1101??0???????1?00??11????0?1??1????11???????01??
?11?0???0?0?00????????????????11????0?0??10

Shixinggia_oblita ??
 ???1221??1????????????????????1
 10000000????1????1????????????????????????01????????????????????????????????
 ???00?????0

Similicaudipteryx_yixianensis ??
 ???011?0?1?0??1?2??????1??????0?0
 01?21110??????0?0?12????????????????00????????????????0?????????????
 ?????10?????0????000?0000??????1???0?0??20

Wulatelong_gobiensis
 11?2211?11?1?1???02121?111?1??1?111001??00??11????????????1111??????????????1
 01????1?11???12??????1???100????2????????1?????1100?21111121??????000?01?
 ?????????0?????011????????????000????1????1?10?101??????????0?0?0??????0000
 00?????1?????10????

Yulong_mini
 1020101110110111121010111010?01000111010?111110110??0??????0?????11111121
 2201100111111?12122?100??1????001?10??1?0000101?21010?110?10??0?0?1?0??11?0
 01010?11001011?11000?100110?????0?0000010??????1?????1110?01000?00?0000???
 ?000000000?????0??????????

Luoyanggia_liudianensis ??
 ?????????????????????000??????0????????????2?????????????????????????????
 0?1?011????1????????????????0?????????1?00??0?000????????00??????1?????
 ?????0????10????????????????????????????

Ningyuansaurus_wangi
 10????????0??0?????????
 ?????????0?0????00??????1??0??00?0?1?20?0?100?11000?0?1?????1?0??2?0??
 0?????0???01000????????????0??10????0??1??????????00000????????????????
 ???????????????

Protarchaeopteryx_robusta ?????0?????????????????????????????????????
 ?????????????????0??????0????????0?0?????1??????1????????1011?21111
 ?100?011?0????????000120????????00000?000?0????????????00??????0?????
 ?????????00?0?0????000000000????????????

Anomalopes_zhaoi ??
 ???
 ?????????????1110??000?0????????????????????????????????00??????1??
 ?????????????01????00??1???0?111111001011

5. Oviraptorosaurian body size data

We compiled a dataset containing estimated body masses for all oviraptorosaurian dinosaurs for which a femoral length measurement was available, in order to investigate size evolution in Oviraptorosauria. Body masses were calculated using an empirical equation based on a statistical correlation between body mass and femoral length ³. We aware that this equation probably produces results that are not as accurate as those generated by some recently developed empirical equations ⁴, but we nevertheless consider the equation we have chosen appropriate for our study given that length measurements are readily available.

Estimated body masses (kg)

Chirostenotes pergracilis 54.8

Microvenator celer 2.9

Citipati osmolskae 121.7

Khaan mckennai 12.1

Ingenia yanshini 24.0

*Conchoraptor gracilis** 10.0

Oviraptor philoceratops 51.0

*Rinchenia mongoliensis** 73.2

Caudipteryx zoui 5.2

*Incisivosaurus gauthieri** 8.5

Protarchaeopteryx robusta 2.7

Avimimus portentosus 10.9

*Heyuannia huangi** 19.5

Gigantoraptor erlianensis 3246.1

CM 78003 247.8

*Hagryphus giganteus** 179.6

Nomingia gobiensis 41.8

*Machairasaurus leptonykus** 30.4

*Nemegtomaia barsboldi** 88.8

*Banji long** 2.8

3. Supplementary figures

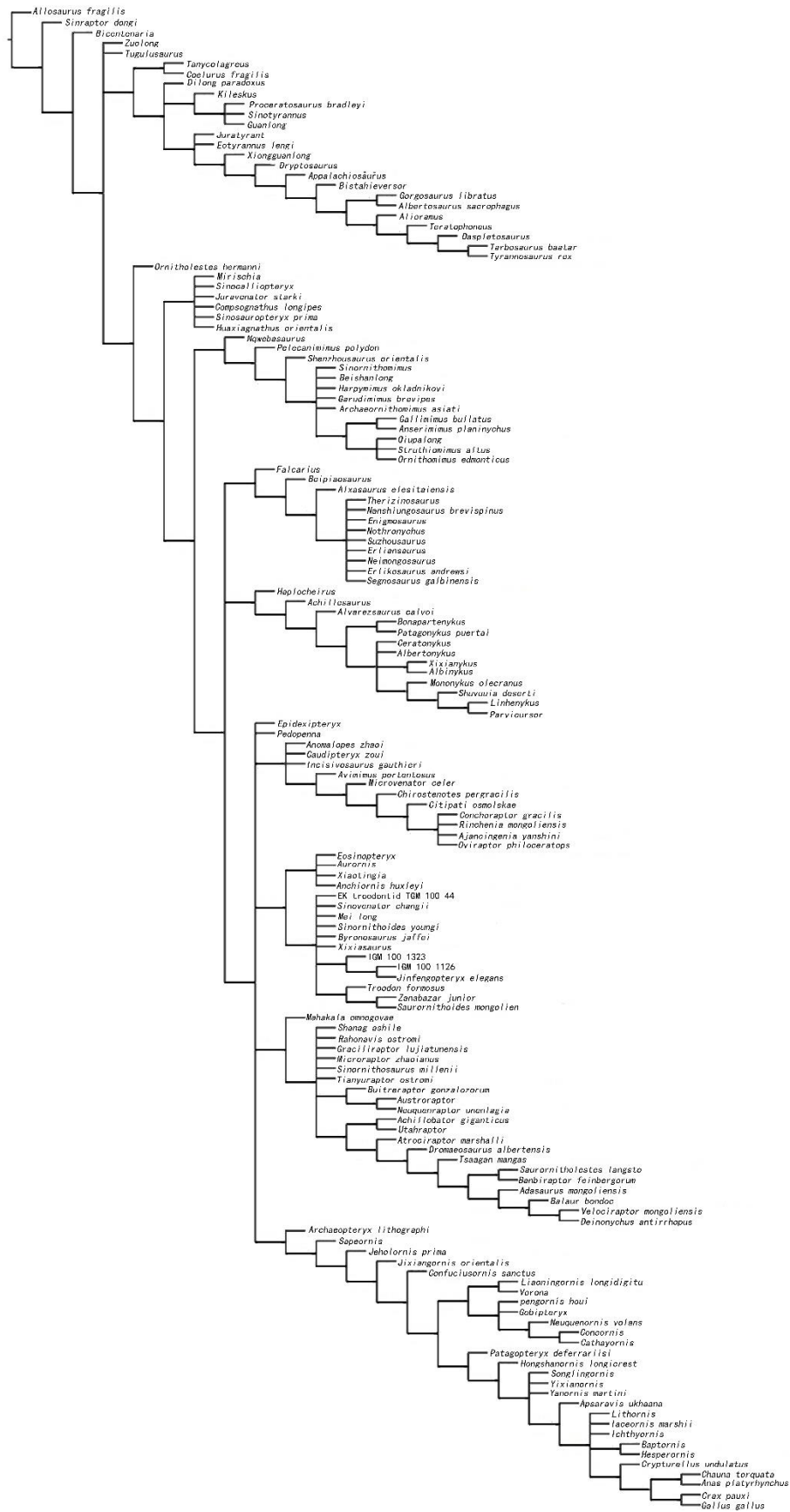


Figure S1. Strict consensus of 73 most parsimonious trees (length 3516, CI 0.311, RI 0.775) produced by our analysis of the modified Brusatte et al. Matrix.

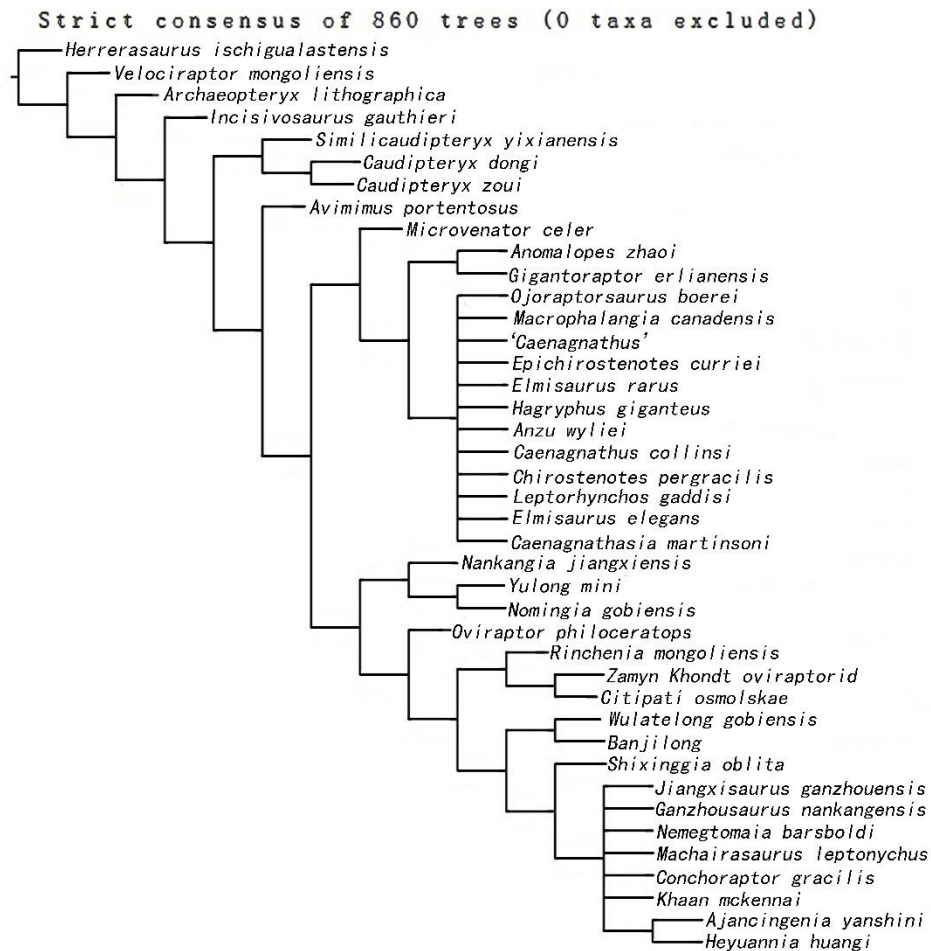


Figure S2. Strict consensus of 860 most parsimonious trees (length 552, CI 0.524, RI 0.687) produced by our analysis of the modified Lammana et al. Matrix

4. Supplementary references

- 1 Brusatte, S. L., Lloyd, G. T., Wang, S. C. & Norell, M. A. Gradual assembly of avian body plan culminated in rapid rates of evolution across the dinosaur-bird transition. *Current Biology* **24**, 2386-2392, doi:10.1016/j.cub.2014.08.034. (2014).
- 2 Lamanna, M. C., Sues, H. D. & Schachner, E. R. A new large-bodied oviraptorosauriantheropod dinosaur from the latest Cretaceous of western North America. *Plos One* **10**, e0125843 (2014).
- 3 Christiansen, P. & Fariña, R. A. Mass prediction in theropod dinosaurs. *Historical Biology* **16**, 85-92 (2004).
- 4 Campione, N. E., Evans, D. C., Brown, C. M. & Carrano, M. T. Body mass estimation in non-avian bipeds using a theoretical conversion to quadrupedal stylopodial proportions. *Methods in Ecology and Evolution* **5**, 913-923 (2014).