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GEOL 104 Dinosaurs: A Natural History  
Video Assignment

DUE: Wed. Sept. 30

Documentaries represent one of the main media by which scientific information reaches the general public. For this assignment, you'll be looking a series of three different TV documentaries that reflect different approaches and techniques used to uncover the life and death of different dinosaurs. As it happens the three documentaries are all about theropods (carnivorous dinosaurs): I would have liked to have included some herbivorous dinosaurs in this, but there aren't as many good documentaries about them yet!

These videos are available for watching via Dial Access in the NonPrint Media lab in the basement of Hornbake Library during the week of September 20-26. (Dial Access is a program by which the videos are shown on a continuous basis during open hours: see <http://www.lib.umd.edu/NPRINT/dialaccess.html> for more details.)

The first documentary is about half an hour long; the other two are each about one hour long. Each has a particular different emphasis, focusing on different particular dinosaurs. The documentaries in question are:

- "Allosaurus: Big Al Uncovered" A *Walking With Dinosaurs* Special (BBC) 2001.
- *The Mystery Dinosaur*. (Brave New Pictures) 2006. Broadcast occasionally on The Science Channel
- "The Four-Winged Dinosaur" *Nova* (PBS) 2008.

For each documentary, watch the video and answer the questions as you go along. You may want to see them more than once if you miss part of the question.

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“*Allosaurus: Big Al Uncovered*” A *Walking With Dinosaurs* Special (BBC) 2001

“*Allosaurus: The Ballad of Big Al*” was the first sequel to 1999’s *Walking with Dinosaurs*; in “The Ballad of Big Al” you see a recreation of the life and death of a particular *Allosaurus* individual. You may wish to watch it sometime. For this exercise, however, you are watching “*Allosaurus: Big Al Uncovered*”, which examines research into dinosaurs generally, *Allosaurus* specifically, and Big Al in particular.

The show begins by showing a team of paleontologists and volunteers digging up the remains of Big Al. Eventually you see scenes with Rebecca Hanna (who was the primary researcher in the study of this specimen).

1) In what type of sedimentary environment was the Big Al specimen buried?

The show moves over to interviews with Octávio Mateus at Lourinhã, Portugal, and his work on a nesting site for allosaurs.

2) Other than eggs and eggshells, what unusually rare sort of fossils did Mateus and his colleagues find?

3) What is the main function for the large pores in the dinosaur eggshells?

Extra Credit) What evidence was there that *Allosaurus* could feed (probably on insects) from birth?

In the collections of a museum, *Allosaurus*-specialist Paul Bybee discusses dinosaur growth.

4) Based on his research, how long it take for *Allosaurus* to reach adult body size?

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There is a discussion of brain development in alligators and birds as compared to the brains of *Allosaurus*. In birds the processing area is much larger than the sensory region; in alligators the sensory region is much larger than the processing area.

- 5) In terms of the development of these two regions, the brains of *Allosaurus* was more like  
[ birds | alligators ]. (Circle the correct answer)

The show examines the Cleveland-Lloyd Dinosaur Quarry, where over 44 individuals of *Allosaurus* were found buried.

- 6) According to the research, the most likely explanation for this great number of individuals was that:
- Allosaurus* traveled in packs of 100-200 individuals.
  - the Cleveland-Lloyd Dinosaur Quarry was at the end of a canyon, into which dinosaurs from all across the West were swept by a flood of phenomenal scale.
  - the Cleveland-Lloyd Dinosaur Quarry was a marshy environment that was a “predator trap”: *Allosaurus* was attracted to the decaying meat of trapped animals, only to be trapped themselves and becoming “bait” for even more *Allosaurus*.

Michael Stoskopf discusses the importance of heart and lungs in vertebrate biology.

- 7) In comparison with mammals and birds, the type of hearts and lungs found in alligators means that they:
- cannot move at high speeds.
  - cannot maintain high speeds or high levels of activity for very long.
  - cannot travel far from the water.

Dale Russell discusses “Willo”, a *Thescelosaurus* found with a mass of rock in its chest. As discussed here, at least some researchers think that it was a mineralized heart. (I am personally not convinced.)

Towards the end of the program, the show discusses Rebecca Hanna’s research on the pathologies (wounds and other damage) to Big Al.

- 8) What evidence is there that the damaged tail bones (chevrons) were not simply broken at the time that Big Al died?

- 9) What evidence is there that Big Al would have been unable to hunt during the last six months to 1 year of its life?

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*The Mystery Dinosaur* (Brave New Pictures) 2006

This documentary is of different scale than the other two. This was done as a one-off project by a small production company rather than part of a series supported by a big network (although it has been shown on The Science Channel, the Discovery Channel, and others).

The first half of this documentary concerns field work and the discovery of the specimen. It gives you a feel for some aspect of field collection, but isn't really germane to questions for this project. So just relax and watch until the specimen (called "Jane") gets back to the Burpee Museum of Natural History (a little museum in Rockford, Illinois) [that's about 12 minutes or so into the program].

10) So what is the "mystery"? That is, what question (really "pair of alternative hypotheses") is the **main debate** about the specimen "Jane"? (Circle the correct answer):

- a. Is Jane male or female?
- b. Was Jane primarily a hunter or a scavenger
- c. Was Jane an adult *Nanotyrannus*, or was "*Nanotyrannus*" just the juvenile stage of *Tyrannosaurus*?
- d. Did Jane die from disease, or was it killed by another dinosaur.

11) What is the main purpose(s) for making hard plastic casts (duplicates) of the individual bones of Jane?

12) Most of Jane's bones were in articulation (still joined together). What does that suggest about the time between its death and the burial of its skeleton? What about the place (environment) in which it died?

13) A series of features make Jane (or Jane plus the Cleveland "*Nanotyrannus*") skulls unique compared to other tyrannosaurs. In the list below, put a check or X next to those features which are mentioned that make Jane/"*Nanotyrannus*" distinct:

- \_\_\_\_\_ Foramen (hole) in the quadratojugal
- \_\_\_\_\_ Squamosal/quadratojugal projection into infratemporal fenestra
- \_\_\_\_\_ Fused nasals
- \_\_\_\_\_ Scapular blade broader
- \_\_\_\_\_ Higher tooth count (17 in dentary as opposed to 13 or less)
- \_\_\_\_\_ Presence of small teeth

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Jane was discovered (and this documentary filmed) at the same time Greg Erickson was developing his technique for determining how old individual dinosaurs were. He was able to sample Jane for comparison with his other tyrannosaurs.

14) According to Erickson, how old was Jane at the time of its death?

15) Does Jane's age/size relationship plot with the *Tyrannosaurus rex* growth curve, or does it indicate a totally different growth pattern?

As part of ongoing research, the Jane team was able to re-evaluate the features listed in question 13. Many of them turn out to be consistent with ontogenetic (that is, growth-related) changes from juvenile to adulthood.

16) After the re-evaluation, which of the characteristics from question 13 remains as a possible distinctive trait unique to Jane and the Cleveland "*Nanotyrannus*" skull?

Lawrence Witmer has been conducting a series of CT scans of the skulls of many dinosaurs, including the Cleveland skull.

17) Did Witmer's study show that the *Nanotyrannus* skulls were really juvenile *Tyrannosaurus rex*? If not, what did they find?

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“The Four-Winged Dinosaur” *Nova* (PBS) 2008

While the other two documentaries focused on one of the larger carnivorous dinosaurs of its environment, this one looks at a little one: the aptly-named *Microraptor*.

Extra Credit) What unusual **new** feature was first discovered in *Microraptor*?

18) What was the paleoenvironment of Liaoning 130 million years ago when *Microraptor* and the other fossils were formed?

19) What sort of material formed the sediment that allowed the wonderful preservation of the Liaoning fossils?

The documentary discusses the work of John Ostrom in the 1960s that modernized the study of dinosaurs and connected dinosaurs and birds.

20) Which two fossil genera were the main ones that Ostrom used in connecting birds and dinosaurs? (Circle the two names)

*Allosaurus*

*Archaeopteryx*

*Deinonychus*

*Hesperornis*

*Ichthyornis*

*Microraptor*

*Nanotyrannus*

*Velociraptor*

21) As they discuss in the documentary, what very important feature was left off of the raptors of *Jurassic Park*?

22) The documentary mentions that feathers can have important functions other than for flight. Name two of the functions they mention, with extra credit for a third.

23) According to the video, what is the function of **asymmetrical** feathers?

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The video discusses the work of Ken Dial (about which we will see more of in class).

24) True or False: Ken Dial showed that baby birds use powered wing flaps to run up walls, but that their wings were only used as passive parachutes (that is, they were not flapped) when they jumped off of heights?

[ True | False ] (Circle the correct answer)

The program spends some time examine the creation of two alternative models of *Microraptor*. Paleontologists Mark Norell and Xu Xing and artist Jason Brougham sculpt one model from measurements of many individuals; paleontologists Larry Martin and David Burnham prepared the second one from casts of a single specimen. These models are then evaluated by anatomists and paleontologists Farrish Jenkins and Steve Gatesy.

25) What major flaw did Jenkins and Gatesy find in the Martin & Burnham model?

The latter portion of the video concerns the possible use of long leg feathers in flight. (In class I will discuss my own hypothesis, which is not one of the ones they examined!) Eventually they have a poseable life restoration for use in the MIT wind tunnel. Below is a set of different positions they tried in the order they try them. For each, indicate the type of gliding result they found:

26) Legs relatively straight down:

27) Legs and feet tucked up against the body:

28) Biplane model (with metatarsal feathers sticking out laterally):

29) Biplane model, but with the legs held more forward:

30) Xu Xing's model: legs held backwards: