

M.A.P.S *Digest*

Official Publication of
Mid-America Paleontology Society
<http://www.midamericapaleo.org>

Volume 46, Number 1
Jan.-April 2023



“A LOVE OF FOSSILS BRINGS US TOGETHER”

Calendar

NOTE: Until further notice, all MAPS monthly meetings will be held virtually via ZOOM, NOT in-person in Trowbridge Hall. Check the website and watch for e-mails for further information.

2023

March 18 & 19

ESCONI Gem, Mineral, & Fossil Show

Location: DuPage County Fairgrounds, Wheaton, IL

Sat. 10:00 am-5:00 pm; Sun. 10:00 am-4:00 pm

Info: www.esconi.org

March 25 & 26

CVRMS Show

Location: Hawkeye Downs, Cedar Rapids

Sat. 8:30 am-6:00 pm; Sun. 9:30 am-4:00 pm

Theme: "The Wonderful World of Agates"

Info: www.cedarvalleyrockclub.org

October 20-22

MAPS EXPO XLIV

Location: Orr Building

Illinois State Fairgrounds

Springfield, Illinois

Theme: The Devonian II

Keynote Speaker: Jed Day

Topic: TBA

Info: www.midamericapaleo.org

New in 2023: Live auction on site

Saturday!

****EXPO 2023 Info & Registration will appear in the May Issue of the MAPS Digest****

Contributions to Digest Needed

The Digest editors encourage the members to submit articles for publication in the Digest issues. The Digest is for the members and should reflect their interests. If you have specimens that you collected and would like to share with other members or would like to describe a favorite collecting site, please write an article in Word, Times New Roman size 12 font, single spaced with one-inch margins, and send to the editors. Photos and diagrams can be e-mailed separately or incorporated in the article.

John: Fossilnautiloid@aol.com

Chris: CDCozart@aol.com

Call for Papers

The theme for the **2023 EXPO** is **The Devonian II**. Any paper dealing with fossils, stratigraphy, or site-specific paleontology relating to the Devonian Period would be appreciated. The papers should be in Word, Times New Roman, size 12 Font, single spaced with one-inch margins, and e-mailed to one of the Digest Editors by the **last week of August 2023**. Diagrams/Photos can be sent separately or imbedded in text. (See article p. 3 this issue for Devonian teaser.)

John: Fossilnautiloid@aol.com

Chris: CDCozart@aol.com

DUES INFO

Please send your \$20 2023 MAPS dues to:

Dale Stout

2237 Meadowbrook Drive S.E.

Cedar Rapids, Iowa 52403

About the Cover

Pictured is a specimen of *Tetranodoceras sp.*, a large gyroconic nautiloid cephalopod, collected from the Devonian Solon Member of the Cedar Valley Group at the Brooks Quarry, Independence, IA. Collected, prepared, and photographed by MAPS member John Catalani.

Evolution in the Devonian

John A. Catalani

As you probably know, I dabble mainly in Ordovician rocks of the mid-west. However, the Devonian Period has always fascinated me because the pace of vertebrate evolution increased dramatically toward the end of the period resulting in the appearance of a veritable gaggle of unique and interesting animals. Several papers have been published in the British journal *Nature* that caught my attention. The first concerned the earliest record of live birth in the fossil record and the second described, more completely than previously, another “intermediate” in the stem-group lineage of tetrapods. In both reports, the animals described lived during the Late Devonian (see Time Scale), which is divided into the earlier Frasnian Stage and the later Famennian Stage (approximately 385-360 million years ago).

	PERIODS	EPOCHS	STANDARD STAGES AND COMMON USAGE
	DEVONIAN	CARB.	MISS.
LATE			
		FRASNIAN	
MIDDLE		GIVETIAN	
		EIFELIAN	
		EMSIAN	
		PRAGIAN	
EARLY		LOCHKOVIAN	

Devonian Time Scale

As any collector will tell you, fossils that tell a story are the most interesting be they a horseshoe crab fossilized at the end of its trail in the mud, a monoplacophoran jammed into the living chamber of a nautiloid, or a Green River fish fossilized in the act of eating (or choking on) another fish. And we are all familiar, I’m sure, with those incredible ichthyosaur fossils from the Jurassic of Holzmaden, Germany, some displaying a carbonized outline of the body and at least one capturing the process of live birth, tail first, of a juvenile. Well, a fossil has been uncovered that pushes back live birth in vertebrates by some 200 million years.

In the first paper, John Long and colleagues (2008) described a new ptyctodontid placoderm--a jawed fish with an armored head--found near Gogo Station in Western Australia in rocks that are early Frasnian in age (approximately 380 million years old). They named the animal *Materpiscis attenboroughi*--*Materpiscis* is Latin for “mother fish” and *attenboroughi* honors the renowned naturalist Sir David Attenborough (classy choice). The reason for the name and for the significance of the specimen is that in the upper body cavity of the fossilized adult fish is preserved a partial skeleton, consisting of unbroken fragile bones, that appears to belong “to the same species based on characteristic tooth-plate and marginal plate morphology” (p. 650). The authors concluded that this is a preserved embryo--evidence for live birth of fully-formed juveniles in the Paleozoic. Since “the location of the preserved embryo close to the vertebral column suggests that it is in the uterus rather than the gut” (p. 650), it is unlikely that the partial skeleton is the remains of an ingested meal. The presence of various preserved soft tissues, some interpreted as an umbilical cord between the adult and the partial skeleton while others are regarded by the authors as representing a possible yolk sac, further supported their conclusion. Several additional previously-collected specimens of fish from the same locality were found, under closer examination, to also contain

embryos. These embryos were originally interpreted as simple clusters of scales, presumably the remains of a last meal. The relative position of the scales in the body of the adult fish, however, is the same as the embryo in *Materpiscis* indicating that these are, most likely, also fossilized embryos. At the end of the abstract, the authors concluded that “the new discovery points to internal fertilization and viviparity in vertebrates as originating earliest within placoderms” (p. 650).

As mentioned above, the tempo of vertebrate evolution was significantly accelerated beginning around the late Middle Devonian. During the rest of the Devonian, fish began to change by experimenting with

new adaptations and exploiting new habitats. The result was the initial appearance and diversification of tetrapods, the group to which all of us land vertebrates belong. It was assumed that during this time period the water-to-land transition took place but the fossil record has shown, so far anyway, that true five-toed fully-functional terrestrial tetrapods did not appear until the following geologic period, the Carboniferous. However, that does not diminish the significance of the fish-to-tetrapod transition which was achieved during the Devonian. Now, I am by no means as familiar with vertebrates as I am with nautiloids but I have always been curious about this evolutionary event. Those of you that belong to my generation can probably remember the traditional explanation that we were told in school: air-gulping lobe-finned fish, such as *Eusthenopteron*, with bones articulated in their pectoral fins crawled from pond to pond during droughts in the Devonian thus strengthening their developing “legs”. (The extant coelacanth, often referred to as a “living-fossil”, is a lobe-finned fish.) Given enough time, the result was a tetrapod, such as *Ichthyostega* discovered in eastern Greenland, which was assumed to have been fully adapted to life on land. When I began teaching, I conveyed that same story to my students during our evolution unit and showed them the film “This Land” that presented viewers with a picture of a fossil of *Eusthenopteron* and, using models, illustrated the water-to-land transition. Problem was, transitional forms beyond *Eusthenopteron* were lacking and *Ichthyostega* was viewed at the time as a more-or-less fully-functional land-living tetrapod. Fortunately, continued aggressive collecting resulted in the discovery of a number of intermediate forms collected from many locations around the globe.

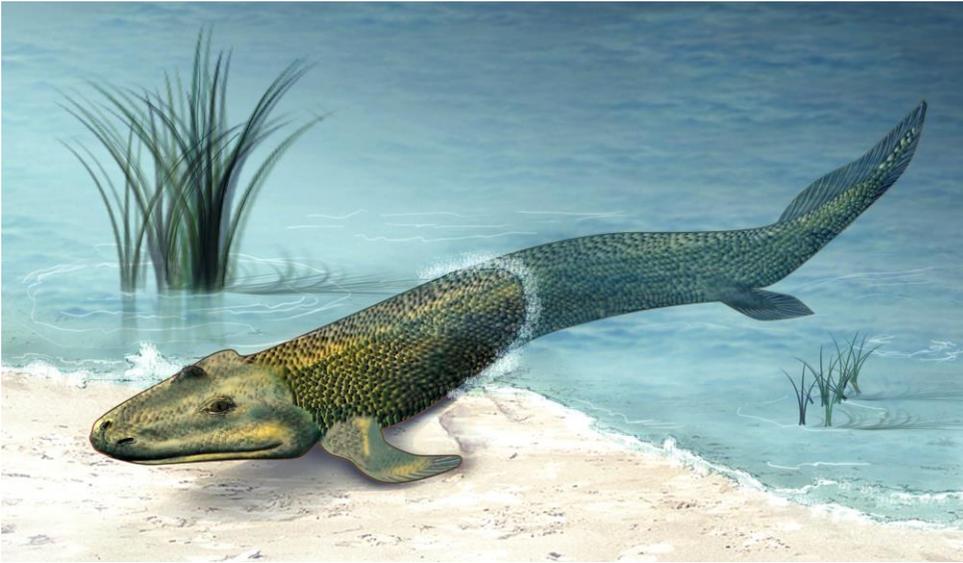
These intermediate forms, most found and/or described in the last 20-or-so years, while not always in a direct line to fully-developed land-based tetrapods, displayed the changes in body form, eye position, respiratory structures, auditory receptors, and, of course, limbs required to gradually transform fish-like animals into tetrapod-like animals. These fossils have provided us with a virtual “time-lapse” view of how evolution works: adaptations gradually accumulated over millions of years through a series of intermediate forms producing a new group of animals adapted to take advantage of a previously unexploited environment. The specific adaptations illustrated by these fossil specimens were pretty much what we expected should occur in the stem-group lineage as fish evolved into animals with four limbs that ended in digits instead of ray fins. When evaluating such transitions, researchers are primarily concerned with how each of the intermediates relates to the forms that both preceded and succeeded them in the sequence so that adaptations can be tracked through time from inception to full development as well as identifying which structures are plesiomorphic (primitive), which are apomorphic (derived), and which are autapomorphic (unique).

In the second paper, Per Ahlberg and colleagues (2008) re-described, using new specimens, one of these transitional forms, *Ventastega curonica*, that had been originally described in 1994 from fragmentary fossils found in rocks of the Ketleri Formation (late Famennian) from western Latvia. The new material, collected from the original site, allowed the authors to not only more fully describe the critter but also evaluate its importance and position in the tetrapod stem-group sequence. The new fossils consisted of additional skull elements that were previously missing as well as various clavicle and pelvic bones. Although structures in the skull, such as a “spade-shaped snout and large dorsally positioned orbits” (p. 1199), gave it an early-tetrapod shape, morphometric analysis showed that the proportions of the skull were more fish-like. Another interesting feature in the skull was the large size, compared to other stem-group members, of the spiracular opening, which was probably accompanied by a greater volume of the spiracular chamber--features that were at first used to facilitate air-breathing and were eventually instrumental in the development of the vertebrate middle-ear. This trend, enlargement of these structures through time, “has been interpreted to indicate increased reliance on air-breathing among the tetrapod stem members” (p. 1201). The authors also concluded that changes in skull morphology were gradual during the transition from fish to tetrapod. The morphology of clavicle and pelvic structures were also tetrapod-like and the authors conjectured that *Ventastega* probably possessed limbs with digits and would, therefore, be classified as a true tetrapod. As to the position of *Ventastega* in the sequence of intermediate forms, the authors stated that the suite of characters possessed by *Ventastega* “conforms remarkably well to prior

expectations of what a transitional form at that particular point in the phylogeny [between *Tiktaalik* and *Acanthostega*] should be like” (p. 1203). They cautioned, however, that detailed analysis of these intermediates, both those known and those yet to be discovered, may reveal that they possessed morphological characters different from more crownward positioned taxa without these features having been uniquely derived. Such a scenario has the potential to significantly modify our assessment of the stem-group lineage and the position of taxa on that sequence. At the very least, “this demonstrates the presence of considerable morphological diversification among the earliest tetrapods” (p. 1203).

A very brief description of several of these intermediate forms will serve to illustrate some of the morphological changes that have been observed in the fossilized specimens during the fish-to-tetrapod transition. Besides *Eusthenopteron*, there are several fish that have been described that display increasingly tetrapod-like structures. One of these stem-group members was the fish *Panderichthys* found in rocks of the Lode Formation of Latvia, which is interpreted as being either late Givetian or early Frasnian in age. *Panderichthys* does occur, however, in rocks definitely known to be early Frasnian in age located in other Baltic States and Russia. *Panderichthys* presented researchers with an interesting combination of primitive (pelvic girdle) and derived (pelvic fin) structures. In addition, the pelvic fin of *Panderichthys* was more primitive and smaller than its pectoral fin indicating that “the transformations from fin to limb first began in the pectoral appendage” (Boisvert 2005, p. 1147). Locomotion along the shallow-water substrate or possibly even on land was feasible for *Panderichthys* and would have been facilitated mainly by the pectoral fins, similar to the method of locomotion on land undertaken by the extant “walking catfish”, in contrast to true land-tetrapods which rely primarily on the hindlimbs. In another study, Brazeau and Ahlberg (2006) examined a well-preserved skull of *Panderichthys*, which had a large spiracular opening and an expanded spiracular chamber, and concluded that “the middle ear of early tetrapods evolved initially as part of a spiracular breathing apparatus” (p.318).

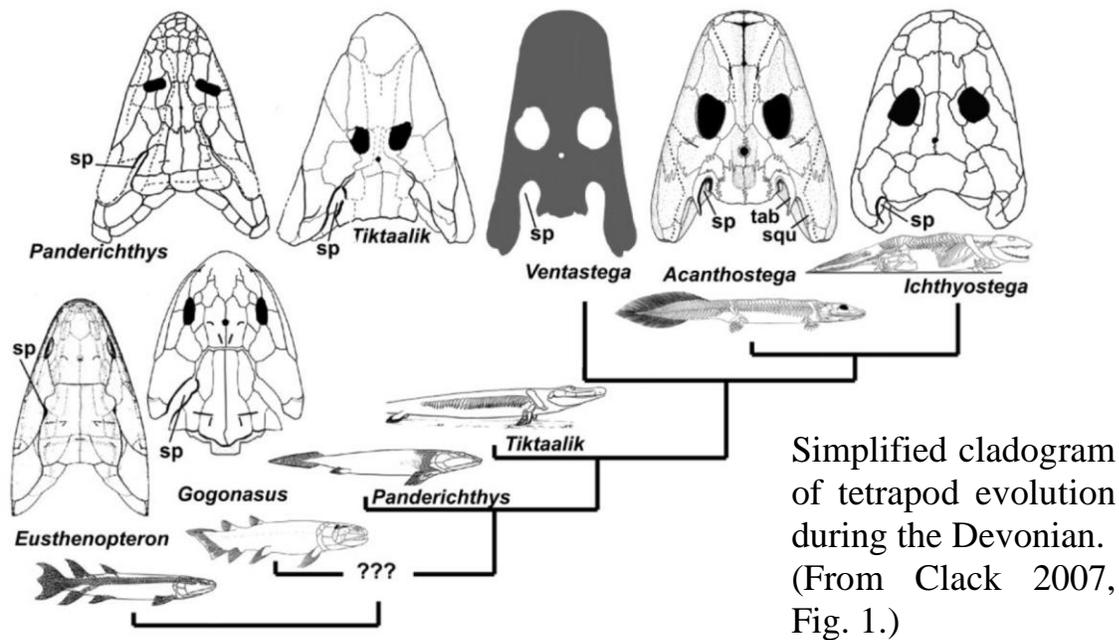
Possibly the most celebrated stem-group individual found recently is *Tiktaalik roseae* (Daeschler *et al.* 2006). Collected in rocks of the Fram Formation (early Frasnian) of Ellesmere Island, *Tiktaalik* possessed several significant tetrapod-like derived features. These features included a flattened skull and elongated snout suggestive of a shift from suction feeding to a carnivorous lifestyle, eyes located on the dorsum of the skull, wider spiracular opening and expanded spiracular chamber (similar to that of *Ventastega*) indicating more advanced respiratory abilities, and pectoral fins with articulated bones more advanced than in *Eusthenopteron* but still retaining fish-type fins. Additionally, the loss of extrascapular bones meant that the shoulder of *Tiktaalik* was not firmly attached to the skull--in other words, *Tiktaalik* was the first vertebrate that enjoyed the advantages of a flexible neck. Along with these derived features, *Tiktaalik* also possessed primitive features such as a lower jaw similar to that of *Panderichthys*. The authors have placed *Tiktaalik* in the “morphological gap” between *Panderichthys* and *Acanthostega* and stated that “transitional fossils such as *Tiktaalik* make the distinction between fish and the earliest tetrapods increasingly difficult to draw” (p. 762). The same can be said, we are discovering, about the “line” between aquatic and fully terrestrial tetrapods. Further analysis of the pectoral appendage of *Tiktaalik* revealed a set of derived tetrapod-like structures that placed the appendage “morphologically and functionally transitional between a fin and a limb” (Shubin *et al.* 2006, p. 764). The flexible neck, decoupled shoulder, and more advanced pectoral fin endowed *Tiktaalik* with a greater range in motion of the shoulder and wrist joints. This increased flexibility would have facilitated not only complex locomotion along the substrate but also a more upright stance to lift and support the body above the substrate as well as to lift its head above water to gulp air. It may even have been possible for *Tiktaalik* to make brief forays onto land to, say, avoid predators. Thus, the discovery of *Tiktaalik* has provided us not only with an additional transitional form along the stem-group sequence but also with significant insights into the evolution of tetrapod-like limbs and mobility.



Restoration of *Tiktaalik roseae* by Zina Deretsky via Wikipedia.

After *Ventastega*, the two succeeding crownward members of the stem lineage are *Acanthostega* and *Ichthyostega* both from the late Famennian of East Greenland and known from extensive, well-preserved material. These two taxa had much in common such as backward-directed hindlimbs shaped more like paddles for swimming than legs for walking, fish-like tails that facilitated movement in water, and multi-digit limbs--eight digits on the limbs of *Acanthostega* and seven digits on the hindlimbs of *Ichthyostega* (Clack 2006). They were contemporaries in space and time but inhabited different environments--*Acanthostega* was almost exclusively aquatic while at the time it was thought that *Ichthyostega* was at least partially terrestrial. Several structural limitations confined *Acanthostega* to the water including internal gills, wrist and ankle joints incapable of bearing weight on land, and primitive pectoral structures. However, the forelimbs of *Acanthostega* probably both aided the animal in its movement on stream/lake bottoms and assisted it in lifting its head out of stagnant, poorly-oxygenated water to gulp air. Analysis of the limb structures of *Acanthostega* forced researchers to reject the previously accepted scenario for limb development--lobe-finned fish crawled onto land thus strengthening fins that eventually evolved into legs--and to replace it with a new sequence of events in which “limbs with digits evolved while the animals still lived and moved predominantly in water, so that the limbs were viewed as an ‘exaptation’ co-opted for terrestrial locomotion only later” (Clack 2006, p. 172). *Ichthyostega* had a more developed pectoral region suggesting the animal was better adapted to locomotion on land than other stem-group members although its rigid spinal column limited its flexibility to vertical rather than horizontal body motion which would have restricted its movement on land. However, it also possessed specialized ear structures adapted for use under water indicating that *Ichthyostega* was also, possibly primarily, aquatic.

These and other intermediaries are providing us with information on both the specific adaptations required for constructing a true tetrapod and the timing of the appearance of these adaptations in the stem-group lineage. This, then, is the developing story of how fish evolved into early tetrapods; tetrapods that eventually left the water for a life on land and diversified into all subsequent terrestrial vertebrates--a dynamic story of evolution in action. Analysis of the derived features possessed by these intermediates and assessment of the environments each inhabited reinforces the view that most tetrapod-like structures evolved in the water and not on land as had been previously assumed. Continued aggressive collecting has resulted in an ever increasing diversity of fossil specimens that, when coupled with state-of-the-art analysis, has forced us to alter our concept of evolutionary transformations from a traditional view of “missing links” as individual species or forms that link two well-known animal groups to a more realistic and holistic view that involves a suite of transitional forms--members of a continuum that delineate an evolutionary trend often resulting in a lifestyle change such as the water-to-land transition.



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(Modified from *American Paleontologist*, 2008, 16(4):37-42.)

Additional Restorations



Restoration of *Eusthenopteron* in classic, but inaccurate, pose (by Jeff Kubina via Wikimedia Commons).



Restoration of *Ventastega* (© N. Tamura via Wikimedia Commons).



Restoration of *Acanthostega* by Raul Martin.



Restoration of
Ichthyostega by
Walter Myers.

Mid-America Paleontology Society Board Meeting Minutes August 29, 2022, by Zoom

Board members present: Marv Houg, Jim Preslicka, Tom Williams, Doug DeRosear, John Catalani, Karl Stuekerjuergen, Bob Rondinelli, Tiffany Adrain (scribe).

Marv called the meeting to order at 7:23 PM.

Secretary's Report: Minutes of the July 5th meeting were published in the Digest. Minutes of August 14th meeting (fieldtrip) were taken by Marv who will send typed copy to John. John motioned to accept July 5th and August 14th minutes. Bob seconded. Minutes approved.

Treasurer's Report: Jim reported a balance of \$15,165.71 in checking and \$2,177.07 in savings. All table fee checks that have been received so far have been deposited. Dale motioned to approve Treasurer's Report, Bob seconded; Report accepted.

2022 Show Discussion

- Date set for October 21-23, 2022.
- Tom to send emails to dealers regarding set up being 1.00PM to 6:00PM on Thursday. John said it is prominent in the Digest. Reminder that Friday opens at 9:00AM, although cards say 8.00AM.
- Insurance with Relion: Marv will call Tammy about the contract for insurance.
- Security: Tom did a cost analysis for security price increases and suggested that since security is 24/7 at the Fairground, show security could be 5.00PM to 9.00PM Friday and Saturday nights. Orr Building doors are locked securely out of Expo hours. Tom will advise dealers to secure small, valuable items.
- Floor plan: Tom will send names of dealers to Marv for floor plan. Silent auction is in the center of the room, not corner.

- Advertising: Tom submitted the newspaper ad and will check publication times and save copies. Tom contacted Paleo Joe about Facebook posts. Tom has started to send information to local school districts beyond “Backpack” advertising. Tom will talk to Gary Olsen about school programmes for next year. Tiffany will send membership information and application form from John with Expo flyer to Paleo societies.
- Programs: Dale still has some program slots to fill. John suggested larger, landscape format projector screen for widescreen PowerPoint presentations.
- Membership: John asked about the number of MAPS members; Jim said approximately 225. Tiffany suggested displaying a poster encouraging attendees to join MAPS.
- Admission donations: Marv has containers for voluntary entrance donations. Tom will ask Ed about something to secure them on.
- Live Auction: no Paleo Prospectors trip this year, so will need some good donations for the live auction. Tom will promote this to dealers in next e-mail.
- Tiffany will print posters if Dale can get details by October 1.
- Expo Digest: John will send friendly reminders to outstanding authors in early September.
- Kids’ activities: Tiffany will contact Jed Day about kids’ activities. Tiffany will provide fossil hunt books for giveaways.

2023 Show

- Speaker: Tom is looking for suggestions for a speaker for and has been inquiring about donations for speakers in collaboration with Illinois State University and University of Illinois Urbana-Champaign. Need an approximate cost.
- Cards: Tom suggested cards be prepared for 2023 show. John made a motion to print 12,000 cards for the 2023 Expo in orange. Tom seconded; motion carried.

MAPS Website: website security has been updated. The secure website address is: <https://midamericapaleo.org>.

Audit committee: Dale and Tiffany to meet with Jim to complete audit.

Award nominations: nominations for MAPS awards are welcomed. John will send Board a list of past awardees. Dale will compile a list of program presenters.

Board Insurance: Marv asked Relion about insurance for MAPS Board of Directors. Marv, Karl, Jim and Tiffany will form a sub-committee to complete non-profit insurance form.

Next meeting: Monday September 26, 7.00pm

Dale motioned to adjourn the meeting, Doug seconded, meeting was adjourned at 8:35 PM.

Mid-America Paleontology Society Board Meeting Minutes September 28, 2022, by Zoom

Board members present: Marv Houg, Dale Stout, Jim Preslicka, Tom Williams, John Catalani, Karl Stuekerjuergen, Bob Rondinelli, Tiffany Adrain (scribe).

Marv called the meeting to order at 7.09pm.

Secretary's Report: Tiffany circulated the Minutes from the August 29, 2022 meeting by email. Karl motioned to approve the Minutes; Dale seconded. Minutes approved.

Treasurer's Report – Jim circulated the Treasurer's Report by email. Most of the Expo expenses are now paid except Digest, cards for 2023 and show security. Tom says there are more table fees to be collected and deposited including at show. 140+ tables have been sold (not including free tables) to over 40 dealers. Tom has tax forms for them. Marv has list of dealers. John motioned to approve Treasurer's Report, Tom seconded. Report approved.

Expo 2022, October 21 – 23.

- Status of contract, deposit, insurance: contract for Orr building has been signed and the deposit, insurance and cleaning fee paid. Marv is waiting for the insurance policy number which he will send to Illinois Fairgrounds.
- Opening times: Tables set-up opens at 1pm on Thursday 20th October – will need help from motel dealers. Tom will be at the Orr Building at 7am on Friday but needs phone number for Fairground security to have the doors unlocked. Marv will send him the list of numbers that Ed sent him. Tom will check with Ed which number to use. Expo registration Digest has updated opening times. Tom noted that we need two big signs that say donations welcome.
- Floor plan: revised floor plan circulated with assigned tables. The Silent Auction is in the center. Amy Preslicka will run the Silent Auction. Tom will give everyone a small packet including a flyer asking for good auction donations.
- Advertising: Tom is looking out for the advert in the Illinois Times and Science Guide. Paleo Joe is posting on Facebook, please repost to your sites. Tiffany sent flyer and membership info to fossil clubs.
- PA system: Jim to collect PA system from Oakdale. Dale to take the one he has from CVRMS. Dale will bring screen for programs. John reminded Dale about need for a bigger screen.
- Programs: Dale has speakers lined up. John Catalani has stepped in as keynote speaker as Don Bissett is no longer available. John will send abstract info to Dale. Dale will issue a preliminary news release without specifics on programs, but including Live Auction and Keynote Speaker (both in Northfield Inn). Marv will check in with Dan Cooper.

MAPS bank account: Tom is on checking account now, still need to add Dale.

Digest: next Digest after Expo will be January.

Membership: Number of members was discussed. Please encourage new members to join.

Next meeting: Expo 2022.

Jim motioned to adjourn the meeting. Bob seconded. Meeting was adjourned at 8:28 PM.

The Mid-America Paleontology Society (MAPS) was formed to promote popular interest in the subject of paleontology; to encourage the proper collecting, study, preparation, and display of fossil material; and to assist other individuals, groups, and institutions interested in the various aspects of paleontology. It is a non-profit society incorporated under the laws of the State of Iowa.

Membership in MAPS is open to anyone, anywhere who is sincerely interested in fossils and the aims of the Society.

Membership fee: \$20.00 per household covers one year's issues of DIGESTS. All Canadian and Overseas members receive the DIGEST by air letter post. For new members and those who renew more than 3 issues past their due date, the year begins with the first available issue. Institution or Library fee is \$25.00.

MAPS meetings are held on the 2nd Saturday of January, February, September, and November and at FOSSIL EXPO in October. Meetings are scheduled for 1 p.m. in Trowbridge Hall, University of Iowa, Iowa City, Iowa. One annual International Fossil Exposition is held in October.

The MAPS official publication, MAPS DIGEST, is published 4 times per year – Jan-April, May EXPO Registration, June-Sept, and October EXPO Edition. View MAPS web page at: <http://www.midamericapaleo.org>

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