Rochester Academy of Science

BULLETIN

"An organization of people in the Natural Sciences" *May 2022; Vol. 76, #5*

President's Annual Report

With all the practice that we have had over the past two years, this year's Annual Meeting of the Rochester Academy of Science was much easier to organize than the past two. We have learned a lot and our predecessors would be amazed at what we can do with a meeting in our digital age. It is a great accomplishment to have never missed holding our annual meeting throughout the Great Depression and through World War II, and now the COVID-19 pandemic.

All our sections—Anthropology, Astronomy, Fossil, Life Sciences, and Mineral—adapted to circumstances over the past two years and all have returned to their full range of activities, holding meetings and lectures both over the internet as well as in-person. We have had nationally known lecturers who never could have made the trip to Rochester, and increased attendances with members and guests outside the local area. Alliances and shared programming have been established with science societies in other parts of the state and the country.

In addition to our annual meeting in 2021, we also had our spring lecture in which Dr. Sarah Lewis of the Lewis Lab of evolutionary ecology at Tufts University gave a fascinating talk on *The Wondrous World of Fireflies*.

We also held our annual scientific paper session at Nazareth College in November after missing 2020. This included our live Larry King Memorial Fall lecture given by SUNY Buffalo Professor of Environment and Sustainability Dr. Howard Lasker on the impact of climate change on coral communities. Our student grants committee reviewed numerous applications at the end of the year and made five research grants to undergraduates for nearly $2400. Our monthly Bulletin did not miss an issue and continued to improve in event description and original content under the direction of our editor.

Our success is due to the tireless efforts of scores of leaders and volunteers within the Academy and its sections. I am very grateful to all those who have had a hand in our 2021 success. This also includes all our members who take such an active interest in our events and programs.

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Annual Spring Lecture Available for Viewing on Website

At our annual meeting, Dr. John O'Shea gave a lecture on "Ice, Water, and Ancient Hunters." Dr. O'Shea's team has done underwater archaeology in Lake Huron and discovered extensive remains of post-Ice Age Paleo-Indian hunting activity. He reviewed the glacial creation of the Great Lakes noting that water level has varied between as much as 100 meters over current level to low water conditions that exposed what is now lakebed over 100 meters deep.

A key early Holocene exposure is the Alpena-Amberley Ridge, a high ridge of limestone and dolomite bedrock. This was demonstrably a corridor for the migration of caribou, an important resource to the early hunters. The land was a mix of spruce forest, swamps, and small lakes. There has been virtually no sediment deposited on the ridge and the surface today was the dry land surface. Spruce logs 9000 years old are found lying on the bottom, peat deposits from 9600 years ago still have recognizable plants, pollen samples determine the ancient plant cover and its location, and hunting structures built by paleo Indians are readily apparent.

This fascinating lecture is on the RAS website publications page at https://rasny.org/publications.

You will see what they have found, what they have learned, and how they know what they know.

Michael Grenier, President RAS

Early Holocene Lake Huron Area, courtesy National Geographic, labels added.

Events for May 2022

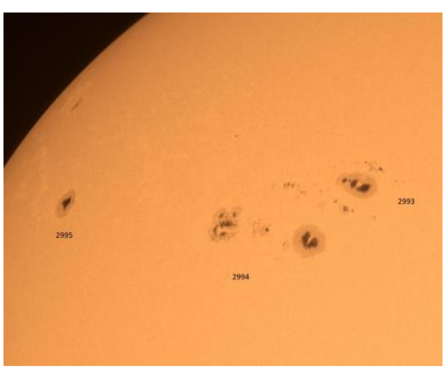
For updates to events, check the Academy website http://www.rasny.org and section websites.

1 Sun: Astronomy Open House
Open House: 12:00 p.m. - 3:00 p.m. Observatory tours and work parties. Farash Center for Observational Astronomy, 8355 County Road. For cancellations contact Roger McDonough, site manager, at rdmcdogz@aol.com.

3 Tue: Fossil Section Meeting
7:00 p.m. Meeting will be held in the community meeting room at the NEQALS building, 1030 Jackson Rd., Webster 14580. It will also be broadcast on Zoom and is open to all RAS members and guests. Speaker: Section member Michael Grenier. Topic: Recent Dinosaur Research Findings. For meeting details and login info see the FossiLetter or Contact Michael Grenier at paleo@frontier.com.

4 Wed: Astronomy Board Meeting
7:00 p.m. Zoom meeting. ASRAS members welcome. Contact: Mark Minarich at mminaric@rochester.rr.com.

6 Fri: Astronomy Members Meeting
7:30 p.m. – 10:00 p.m. RIT Carlson Center for Imaging Science, CAR-1125. Parking Lot F. Meeting will be held in person at RIT as well as virtually via Zoom. Speaker: David Bishop, ASRAS Vice President. Topic: Astronomy year in review. Contact: Mark Minarich at mminaric@rochester.rr.com.



Sunspots photographed on April 20 at 11:58 a.m. from Webster NY. Photo credit: Kevin Lyons. More info at https://spaceweather.com/.

7 Sat: Fossil Field Trip
Road Cut Near Tioga, PA. A large road cut near Tioga PA exposes Upper Devonian strata of the Frasnian Lock Haven Group. The rock is primarily siltstone and sandstone and contains the fauna of brachiopods and bivalves. This site was visited during the 2017 New York State Geological Association annual meeting in 2017, and detailed information on the site can be found in the NYSGA 2017 guidebook.
About a week or so before the trip Dan Krisher, President of the Fossil Section, will send an email out to all Section members concerning this field trip. All interested members should get back to Dan Krisher via email at least 2 days before the trip and he'll respond back with additional information for the field trip as soon as your email is received. Dan Krisher will send out a final email to all attendees the night before the trip. To contact Dan Krisher call him at (585) 698-3147 or DLKFossil@gmail.com.

18 Wed: RAS Board Meeting
7:00 p.m. Virtual meeting using Zoom. For details, contact Michael Grenier at mgrenier@frontiernet.net.

21 Sat: Life Sciences - Herbarium Workshop
10:00 a.m. – 2 p.m. The Life Sciences section will hold a workshop at the RAS Herbarium, located in the basement of the Rochester Museum and Science Center (RMSC).
At RMSC go to the front desk to meet other participants. You must be fully vaccinated, and masks are required for all visitors at RMSC. We will be working on re-mounting herbarium specimens; no special experience required. You may bring a lunch or buy lunch at the Cafe. If you plan to attend, please send RSVP or any inquiries to Elizabeth Pixley, herbarium curator, at eypixley@gmail.com, or call (585) 334-0977.

21 Sat: Fossil Section Field Trip
10:00 a.m. – 1:00 p.m. The Gulf Railroad Cut just west of Lockport, NY. Collecting will be in the Silurian Rochester Shale. For further information contact Dan Krisher at DLKFossil@gmail.com.

24 Tue: Mineral Virtual
7:00 p.m. Zoom meeting. Meetings this academic year are held on the 4th Tuesday of the month. At this meeting we will learn about pseudomorphs, i.e., minerals that have the external crystal shape of another mineral. Have you ever wondered how this happens? Dr. Howard Heitner will enlighten us with his presentation, "Pseudomorphs, Trickster Mineral Specimens." A link for the meeting will be emailed to members. Guests welcome. Contact: J. Dudley at juttasd@aol.com

28 Sat – 29 Sun: Astronomy Member Observing
New moon member observing, starting at dusk till last person leaves. Farash Center for Observational Astronomy, 8355 County Road 14 Ionia, NY 14475. For weather related cancellations or changes contact Mark Minarich at mminaric@rochester.rr.com.

Announcement of RAS Election Results

At the Annual Meeting of the Rochester Academy of Science on April 14, 2022, the following Directors were re-elected to a ***three-year term ending in 2025***.

Tony Golumbeck
Jeff Gutterman

At the same time, the following officers were re-elected to a ***one-year term ending in 2023.***

Michael Grenier	**President**
Dan Krisher	**VP & Fossil**
Helen D. Haller	**Secretary**
William Hallahan	**Treasurer**

Art and Science

Inscrutable Smile of the Universe: DaVinci in Space

Paula Santirocco — ASRAS member, artist, poet, musician, and stargazer.

The sky is full of asterisms, most notably the constellations which are so familiar, and yet are not related to each other at all except by our ancestors' imaginations. And then there are the more obscure objects, like the Coathanger cluster within the Summer triangle, which I remember finding for the first time with glee as a star hopping youth. Sometimes I would not have been surprised to see the smile of the Cheshire cat grinning down upon me.

But I came across a Hubble photo recently which set this amateur artist's mind spinning. I looked at this edge-on image of the spiral galaxy NGC 7172. In the constellation Piscis Austrinus, the galaxy is about 110 million light-years from earth. It was its dust lane that caught my eye, and I found myself looking at the Mona Lisa smile.

Figure 1: Tendrils of dark dust threading across the heart of the spiral galaxy NGC 7172. Hubble image from the NASA/ESA - ESA/Hubble & NASA. Photo Credit: DJ Rosario, A, Barth; Acknowledgment: L. Shatz.

Leonardo da Vinci was the true Renaissance man who had boundless curiosity and we are familiar with his prescient invention sketches and the many notebooks he kept of his studies. He drew anatomy from cadavers (which was a taboo at the time to "defile" a body) so he could use his knowledge of the internal workings of muscle and bone to aid his unique and accurate drawing and painting of the human body. A well-known page (c.1508) from his notebooks shows chillingly detailed study of the human mouth.

Figure 2: Photo of Leonardo sketchbook, Royal Collection Trust/ ©Her Majesty Queen Elizabeth II 2017.

He drew a line at the top of the page, easy to overlook, but considered by many to be the sketch of the smile of Mona Lisa. When superimposed over the finished painting, this relationship is mighty convincing.

Figure 3: Closeup of smile of figure 2, top center.

This is what I saw in the dust trails of NGC 7172. I was struck by this similarity to Da Vinci's line drawing. Do you see the Mona Lisa smile in this pastel-like line in the heavens? For me, it was not a far cry to pull up a picture and compare it to this:

Figure 4: Comparison of dust belt of NGC 7172 and the Mona Lisa smile (figure 5 below)

Nothing more than a cosmic coincidence, it still hit me strongly enough that I wanted to share this. Thank you to Rochester Academy of Science and the Astronomy Section for their interest in this subject.

Figure 5: Mona Lisa by Leonardo da Vinci; Louvre, Paris, French Republic.

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Paula Santirocco's artwork and poetry can be seen at her virtual gallery: https://www.paulasgallery.com/.

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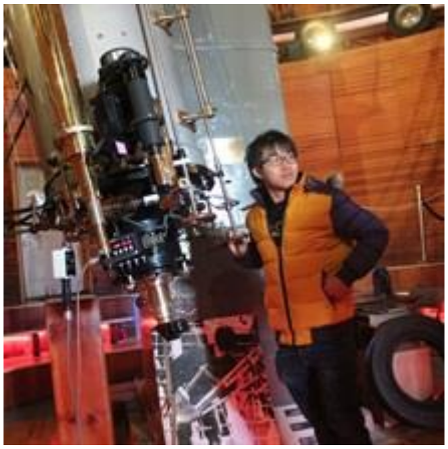
Graduate Student Research

Star Formation and Cosmic Noon

Jitrapon Lertprasertpong, School of Physics and Astronomy, Rochester Institute of Technology



Jitrapon Lertprasertpong

(Editor's note: the following is a synopsis of a presentation Jitrapon Lertprasertpong made to the Astronomy Section of the Rochester Academy of Science on April 1, 2002.)

There are two dominant populations of galaxies— the blue, star-forming, less massive, and mainly spiral galaxies, shown in figure 1, and the red, passive, massive, and mainly elliptical galaxies shown in figure 2.

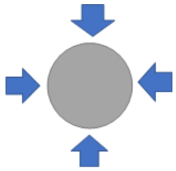
Figure 1: Barred Spiral Galaxy NGC 1300, and example of a blue, star forming galaxy. https://hubblesite.org/contents/media/images/2005/01/1636-Image.html.

Figure 2: Giant elliptical galaxy NGC 1316 in Fornax Cluster, an example of a red, passive galaxy. https://www.eso.org/public/images/eso0024a/.

Star formation is part of galaxy formation

Galaxy formation follows the following branched steps:

1. Dark matter halo collapse



2. Gas clouds collapse, starting star formation

3. Disk formation, creating spiral galaxies

4a. Running out of gas (Quenched)

or, alternatively

4b. Mergers, driving gas out of the galaxy.

5. Becoming elliptical galaxies (Quenched)

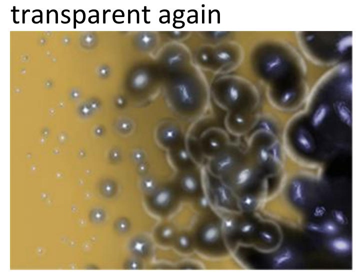
Where are we now on the cosmic timescale?

The cosmic time scale of galaxy evolution can be roughly divided into the following periods:

Cosmic Dark Age - Big Bang, 13.78 billion years ago

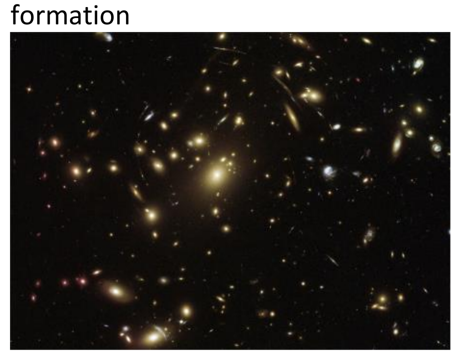
Cosmic Dawn - First Star, Galaxy formation, 13.5 billion years ago

Reionization – the universe becomes transparent again



Cosmic Noon - Peak of star formation, 10 billion years ago

Quenching – decline in star formation



Present day – Cosmic Happy hour?

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We have already passed the Cosmic Noon. Star formation has reached its peak 10 billion years ago. Galaxies formed approximately half of their stellar masses, and the star formation began declining.

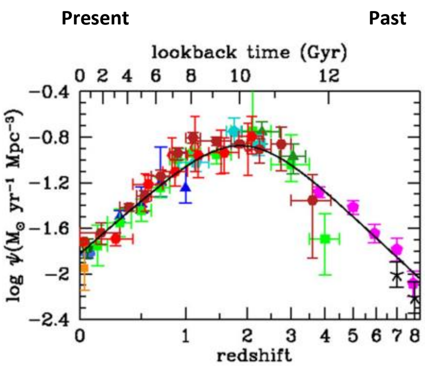

Figure 3: Star formation rates versus redshift (lower axis) and lookback time (upper axis). The star formation rates were determined from infrared and ultraviolet observations. The peak around redshifts 2 and 3, or "cosmic noon", is evident. [Madau & Dickinson, 2014]

What's going on?

Quenching

There are two main modes of quenching – the starving of gas and dust that is needed as raw material for star formation:

1. Internal quenching
2. Environmental quenching

Quenching: Internal Effects

Gas inflow: Insufficient gas inflow can stop star formation (Cosmological Starvation)

Mergers: Destroy the disk, Remove gas out of galaxy

Active Galactic Nuclei outflows: Radiation energy removes gas out of galaxy

Supernova outflow: Removes gas out of galaxy

Quenching: Environmental Effects

Ram Pressure stripping: losing gas from pressure after passing through dense gas in the halo.

Tidal stripping: gas and stars are pulled from tidal forces

Research on Environment Quenching Effects

Will be using the Keck observatory 10-meter telescope in Hawaii.

Figure 4: Twin 10-meter Keck telescopes. Note: lasers are used to control adaptive optics to counter atmospheric turbulence. https://www.keckobservatory.org/about/keck-observatory/

Spectrographic data from extragalactic fields can improve the measurement of the environmental data.

Research in progress: Additional data reduction, Redshift extraction, and creating density map of galaxies.

Conclusions

Star formation is an integral part of galaxy evolution.

We have already passed the peak of star formation (cosmic noon).

There are various mechanisms that can quench the star formation.

References

Fossati, M., Wilman, D. J., Mendel, J. T., et al. 2017, ApJ, 835, 153, doi: 10.3847/1538-4357/835/2/153

Li, P., Wang, H., Mo, H. J., Wang, E., & Hong, H. 2020, ApJ, 902, 75, doi: 10.3847/1538-4357/abb66c

Man, A., & Belli, S. 2018, Nature Astronomy, 2, 695, doi: 10.1038/s41550-018-0558-

Nielsen, N. M., Kacprzak, G. G., Pointon, S. K., et al. 2020, The Astrophysical Journal, 904, 164, doi: 10.3847/1538-4357/abc561

Schawinski, K., Urry, C. M., Simmons, B. D., et al. 2014, Monthly Notices of the Royal Astronomical Society, 440, 889, doi: 10.1093/mnras/stu32

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Featured Article

Blade Patterns Intrinsic to Steel Edged Weapons, Part 2

Lee A. Jones, M.D., retired Pathologist, Syracuse, New York.

[Editor's Note: This article is a continuation of the featured article from the March 2022 RAS bulletin.

*Dr. Jones has had a lifelong scientific passion about historical swords. He is co-author of the text **Swords of the Viking Age** (© Lee A. Jones, Ewart Oakeshott, and Ian G. Peirce, Boydell Press, 2002), as well as host of the Mediæval Sword Resource Site: http://www.vikingsword.com. His materials are used in college anthropology courses, and he analyzes the swords of his own rather large and broad collection using X-Ray Spectroscopy to discover what that methodology can reveal. The result of this project is the subject of a future paper. This article is a reprint from his text, can be found on his website, and will be serialized in subsequent editions of the RAS Bulletin.]*

Coarsely Laminated Steel: Pamor of the Keris

The *keris* is a type of edged weapon characteristic of the Malay peninsula, Java, and other areas of the South Seas. Figure 1, below, is a photograph of a *keris* blade which discloses patterns (*pamor*) upon the surface which also reflect the internal structure of the blade. These swords were made up of a billet

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composed of alternating layers of steel and of iron containing nickel.

Figure 1: Balinese keris, probably earlier 20th century, with a blade pamor formed by coarsely laminated contrasting steel alloys. In this case, the layers are oriented parallel to the plane of the blade (mlumah) and have been intentionally manipulated to intersect with the ultimate etched blade surface to create the pattern. (Photo credit Lee A. Jones.)

In earlier blades, the nickel alloy came from meteoric material while artificial alloys have frequently been used since the 19th century. The patterns may have an appearance resembling contour lines as seen on a map or weathered geologic strata seen from the air. To create this pattern the contrasting materials are welded together in sandwich fashion and then folded back over upon themselves a few times to yield a few thousand layers (six folds in the example given by Solyom (1978), p. 9 - 10). Even if no deliberate attempt was made to mechanically influence the pattern achieved by deforming the layers, the process of manual forging will result in irregularities of the thickness of particular layers in different parts of the blade.

The pattern achieved from the final grinding will depend upon how the newly created surface intersects with the layers. In the photograph above, the layers are nearly parallel to the blade face, undulating mildly, so that when ground, wide bands of contrasting metal are seen. Towards the central spine and edges, where the plane of stock removal cuts across the layers more acutely, the bands appear narrower. Many different patterns can be achieved by manipulating the blade before final forging and grinding. Drilling shallow holes into the incomplete blade and then forging the area flat results in bull's eye-like structures.

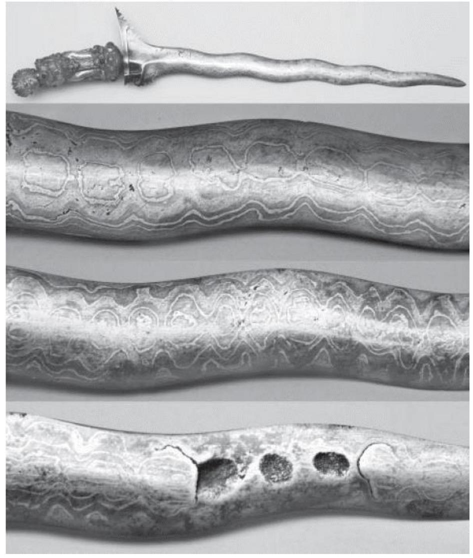

Figure 2: Another Balinese keris, probably later 19th century, with a blade pamor formed by relatively coarsely laminated contrasting steel alloys, the lighter steel containing nickel for sharp contrast. Aesthetics in Bali lean more towards a polished blade, such as this example, than the etched surface currently favored in Java. In this example, the layers are again oriented parallel to the plane of the blade (mlumah) and have been intentionally distorted by shallow holes or punch work prior to the surface being reforged flat to create the pattern. Repeated cleaning and polishing have disclosed a once hidden zone of failed weld adherence (cold shut) between two layers and depressions are now left where the surface has fallen away over the defect. Adjacent cracks foretell further surface losses should the blade be polished again. (Photo credit: Lee A. Jones.)

Other blades show structures built up by lines engraved into the material before it is again forged flat and then polished, exactly analogous to the *kirk narduban* of Persian and Indian blades. *Keris* may also show a piled construction or twisted rod pattern-welding exactly as that seen in European Migration Period and Viking Age blades that are discussed below.

Finely Laminated Steel

Japanese sword blades show a variable grain structure which arises as a result of folding the billet from which the sword is being formed back upon itself many times (up to, but usually fewer than twenty, which would give just over a million layers). The concept here is simple: when dealing with steel of varying composition, maximum strength and reliability may be achieved by averaging weak and strong areas by forming a laminated structure. The repeated working will also partially exclude and break up larger slag inclusions, further reducing potential seeds for failure. The closeup photographs of figure 3 below show the grain (*hada*) of a 13th century sword that lost its tip in antiquity, and which therefore has seen fewer subsequent polishings with the compensation of retaining more surface steel.

Figure 3: Japanese wakizashi ex tachi with foci of mokume (burl) hada (grain) in a predominant background of itame (wood) hada. This mid to late Kamakura era Aoe school blade lost its tip in antiquity and therefore has seen fewer subsequent polishings; the polishing technique (hadori) masks the true hamon ('temper' line). (Photo credit: Lee A. Jones.)

This *hada* of moderately fine wood grain-like pattern was exposed as the sword was ground and polished and represents a tangential cut through many layers of steel just as the wood grain in a tabletop represents tangential cuts through a tree's growth rings.

A recent study (Mäder, 2009) involved the polishing of some European early medieval (6th - 8th century) blades by a skilled Japanese polisher. It should not be surprising that a fine grain (*hada*) structure very similar to that characteristic of

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Japanese swords was revealed, as many cycles of heating, flattening, folding and forge welding are the best way to optimize the quality of steel originating from bloomery iron.

Differential Heat Treatment

Figure 4 below is a photograph of a Japanese *tanto* (dagger) blade from the 17th century. In the blade close-up the wood grain-like pattern which results from the many layers of steel making up the blade is again evident. Additionally, a wandering misty pattern of increased brightness (*nioi*) may be seen about one-third to a half of the distance back from the edge which represents the *hamon* or 'tempering line' and is composed of a band of what metallurgists call martensite.

Figure 4: Nioi appearing as a misty line along the hamon in a 17th Century Japanese tanto (dagger) blade. As the hamon is a boundary formed at the time of quenching, the term 'temper line' is a misnomer. (Photo credit: Lee A. Jones.)

Larger crystals termed *nie* may also be observed when cooling has been slower or the temperature higher, as have been exposed in the close-up photograph above of a tired (worn from many polishings) *tanto*. In Japanese swords, the differential tempering is achieved by a technique in which the swordsmith applies varying thicknesses of different types of clay to the surface of the blade before it is quenched. Thicker and more insulating clay over the back and body of the blade slows cooling and results in less brittle and more malleable iron there, while the edge cools more quickly and is harder, but also more brittle. In this way, a hard sharp edge may be part of a sword without excessively increasing the brittleness of the entire blade (Kapp, 1987).

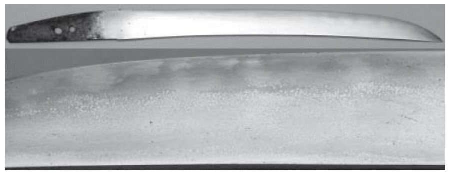

Figure 5: Nie beside the hamon in a tired 15th Century Mino tanto. Nie may be more evident in over-polished blades, as the repeated polishings are exposing deeper areas which would have cooled more slowly when the sword was quenched. (Photo credit: Lee A. Jones.)

Thus, we see that, aside from its overall form, two of the most critical aesthetic features of the Japanese sword, the nature of its grain and its *hamon*, both reflect appearances that derive directly from the smith's attempts to optimize his material and to produce a strong, durable and highly functional sharp sword.

Complex Constructions: Piled Blade Structures

The polished surfaces of the *nihonto* give scant clue that the majority of traditionally made Japanese swords have been built up from several steels of varying properties, each employed to its best advantage, but this covert construction is critical to the weapon's performance. Cross-sections reveal softer, more malleable steel composing the core of the blade to provide resistance to breakage and the hardest, most sharpenable steel placed at the edge. Other steels with intermediate properties may form the back and the sides of the blade. One flaw (*kizu*) demonstrating the effectiveness of this construction is *ha gire* or a crack perpendicular to the blade's length and through the harder steel of the edge but stopped from further propagation by the softer body or core steel. While this damage renders a blade worthless for future combat use, such a blade could succeed, through this ingenious construction, in not catastrophically failing its wielder in a moment of need. Such 'piled' structures most likely initially evolved from the need of smiths to join together multiple small pieces of steel to form a larger fabrication such as a sword blade. A composition of several rods welded together and running the length of the blade, such piled structures allowed a smith to localize desired properties by empirically joining together irons with differing properties. Additionally, selected rods could be carburized to increase hardness by increasing carbon content. Piled construction provides another advantage in that, like the cycle of heating, flattening, folding and forge welding, it averages the strengths and weaknesses of the individual components lessening the risk of a critical flaw. Such a construction has been employed in many cultures particularly as they have forged larger, longer blades. In many cases, like the *nihonto*, no special effort appears to have been made to highlight this detail of construction.

In some cases, only centuries or decades of natural environmental etching have come to differentiate the components by variation in the developed patina. However, very often etching and differential staining would have to be used to develop the patterns as part of the initial finishing treatment of the blade, possibly as an indicator of quality. In many cases such construction has clearly been intentionally further manipulated for decorative purposes.

Pleiner (1993) documents an abundance of variations of piled blade structures in Celtic swords from as early as 500 B.C. In Europe, such piled structures continued to be employed well into the medieval era until improved steels increasingly became available to swordsmiths in later medieval times, after which swords were forged of altogether homogeneous material or had a homogeneous core with only edges of harder material welded on.

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ROCHESTER AREA RESEARCH IN REVIEW

Evidence of a piled construction is evident upon the surfaces of Tibetan swords and in the sword-*daos* of the adjoining Naga culture, which are regarded as having been imported from Tibet or made from imported Tibetan iron rods in Tibetan style (See Rawson (1968), p. 63 – 64 and figs. 37 & 38).

Figure 6: The wide blade of this early 20th century Philippine barong shows several bands of alternating contrasting patination which converge at the tip and towards the hilt where the blade narrows. This evidence of piled construction is barely visible on the opposite blade face.

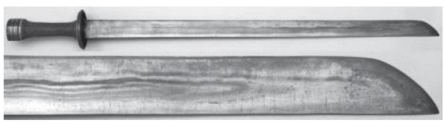

Figure 7: Tibetan dpa dam (straight backed saber) typical of the type carried by nomads in the Kham area of eastern Tibet, lightly etched to reveal a type of piled construction in which the body of the blade is composed of a nested set of rods turned back upon themselves at the tip end like hairpins. (Photo credit: Lee A. Jones.)

This article will be continued in subsequent editions of the RAS Bulletin.

References:

http://www.vikingsword.com/ethsword/erefs.html

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April 26, 2022, Cornell University, Microrobot collectives display versatile movement patterns.

April 25, 2022, University at Buffalo (UB), Study identifies gaps in monitoring of streams.

April 21, 2022, Cornell University, In western floodplains, species adapt to bullfrog, sunfish invaders.

April 20, 2022, UB, 'Dative epitaxy': A new way to stack crystal films.

April 11, 2022, University of Rochester Medical Center (URMC), Study links fracking, drinking water pollution, and infant health.

April 7, 2022, Syracuse University, Can artificial intelligence reveal why languages change over time?

April 1, 2022, URMC, New research shows survival rate improvement for extremely pre-term infants.

March 29, 2022, Binghamton University, Spiders use webs to extend their hearing.

March 22, 2022, Binghamton University, Emotion, stress cues in social media posts might be early warnings in epilepsy deaths.

March 17, 2022, Rochester Institute of Technology, Massive study shows urbanization drives adaptive evolution.

Announcement

2022 RAS Scientific Paper Session

The Rochester Academy of Science 2022 Scientific Paper Session will be hosted at the Rochester Museum and Science Center on October 29, 2022. For more information see https://rasny.org/ or contact William Hallahan at whallah3@naz.edu

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