Hamilton Amateur Astronomers

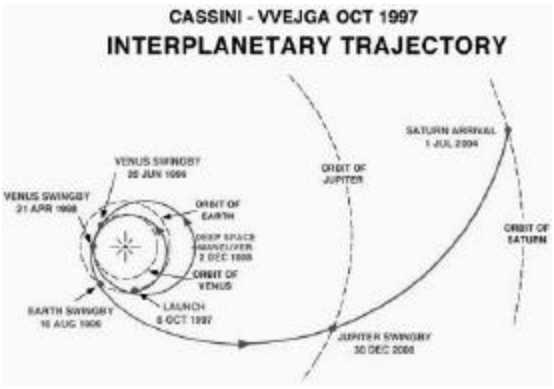
Event Horizon

December 1999 Volume 7 Issue 2

The Cassini Mission

Much has changed in the three hundred or so years since the Italian-French astronomer Jean-Dominique Cassini (1625-1712) gazed upon Saturn's rings and was credited with discovering four of the planet's two dozen moons. But as NASA launches the planetary probe named in his honor, it's testimony that -- three centuries later -- some things remain the same, specifically humankind's fascination with Saturn and our celestial neighbors.

NASA's Cassini mission lifted off on October 15, 1997, and will arrive at Saturn in June 2004, where it will embark upon a four-year exploration of the planet, its giant moon Titan, and several of its smaller moons. The Cassini spacecraft is about two stories tall and, with fuel, weighs more than 12,000 pounds. This includes the Huygens probe, a separate spacecraft that, once near Saturn, will detach from Cassini and parachute down to Titan, where it will explore the giant moon's dense atmosphere and record images of its surface.



The Cassini spacecraft reflects multinational cooperation. The European Space Agency (ESA) built the Huygens Titan probe, named for the Dutch mathematician and astronomer Christian Huygens (1629-1695), who determined the shape of Saturn's rings and discovered Titan. The Italian Space Agency (ASI) provided Cassini's high-gain antenna.

Cassini is taking the long way to Saturn, but for good reason.

After liftoff, Cassini will head in the opposite direction of its Saturn destination, toward Venus. Using Venus' gravitational pull -- a sort of slingshot effect called gravity-assist flyby -- Cassini will swing around the planet in April 1998 and again in June 1999, picking up speed each time. These flybys will increase Cassini's speed relative to the Sun sufficiently so that it can climb out of the Sun's deep gravitational well and reach Saturn.

Cassini will also fly by Earth (August 1999) and Jupiter (December 2000) before finally having enough speed to carry it on to Saturn, where it is scheduled to arrive in July 2004.

The mission's scientific goals are to investigate Saturn, its atmosphere, its magnetic field, Titan, and several of the planet's small, icy moons. To achieve this, Cassini carries eighteen instruments, six of them on the Huygens Titan probe. The data sent back from Cassini will help scientists on Earth better understand Saturn's internal structure, the structure and composition of its atmosphere, its wind patterns, and more. From that, scientists hope to get a better understanding of Saturn's origin and evolution, and perhaps our own.

Scientists will examine Titan's atmospheric composition and chemistry, which may be similar to a young Earth's. Titan has an Earth-like, nitrogen-based atmosphere and a surface many believe features lakes of ethane and methane. The Huygens probe will take images and

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Chair's Report

'Tis the end of the Calendar year, Christmas is almost upon us, and the change of the century is about to happen. All this … and time for another Chair's report.

Before we *look* forward, there are some very important issues that should be *brought* forward. Over the past couple of months I have been working some very long and hard hours and this has put a definite crimp in my style as chair of the. To the point that I have been unable to carry out my job a Chair with any degree of reasonability. The whole board has jumped in to ensure a seamless running of the. The most notable person in this is Stewart Attlesey. His yeoman's like actions in running a smashing meeting last month has not gone unnoticed by me. So at this time I would like to publicly thank the board in general and Stewart in particular for their great help.

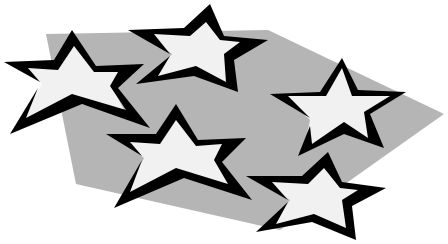
Now onto another thank you: while Everett Cerns has been thanked by Stewart Attlesey, the past Chair, for the terrific telescope he made for the HAJA kids, I would like to do the same. This not only because it's a wonderfully well-made scope but also because it has an air about it that screams out "children!". It is a fun scope and all we need now is a clear night with a bunch of kids and, ***KAZAM!,*** we will have magic. Thank you, Everett, for all your hard work.

You know it is the festive season when the lights go up, they start playing *White Christmas* in malls, and another Mars probe goes fizzle. If you are looking for stocking stuffers, the calendars are all gone and the handbooks are on backorder, but we might be able to find some more key chains. Instead of a new telescope this year, my wife is hoping for a Vermont Castings woodstove and I shall get a cord of wood. I can read S&T beside it if I am good.

I hope all people who, in whatever way they choose to celebrate the coming season, have a healthy and warm time of it.

A final gift for all of you is that as the year draws to a close, the century turns over and a thousand-year mark is passed. Astronomers all should know that it is next year that is the turn of the Millennium and not this year -- the true gift of intellectual arrogance (the ultimate Y2K bug) I pass on to you. Have a Happy New Year as well!

Grant
dixon@netaccess.on.ca



HAMILTON AMATEUR ASTRONOMERS

Event Horizon is a publication of the Hamilton Amateur Astronomers (HAA).

The HAA is an amateur astronomy club dedicated to the promotion and enjoyment of astronomy for people of all ages and experience levels

The cost of the subscription is included in the $15 individual or $20 family membership fee for the year. Event Horizon is published a minimum of 10 times a year.

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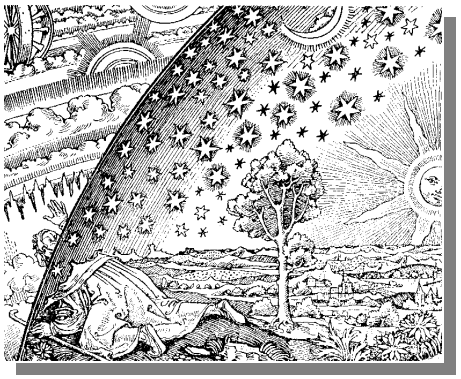


Constellation of the Month - Orion

by Margaret Walton

Orion has been associated in all ancient civilizations with great heroes or warriors. In Greek mythology, he was the son of Neptune and a sea-nymph. He was handsome, tall and strong. He was a great hunter who boasted he could kill all living beasts. The goddess Gaea was alarmed at this boast and sent a scorpion to kill him. He was saved by the healer Aesculopius (Ophiuchus), who killed the scorpion and healed Orion. This is played out in the sky when Scorpius arises as Orion sinks. Ophiuchus crushes the scorpion under him and then Orion rises.

The celestial equator runs through Orion, making Orion visible from all places on the Earth except the Arctic and Antarctic regions. Orion culminates in mid-December.

Stars

Betelgeuse – This is a red supergiant about 300-400x larger than our sun. Its magnitude is 0.5 and is about 425 light years away. The name translates as 'Armpit of the Giant'.

Rigel – This is a blue-white supergiant of magnitude 0.12 and is the 7th brightest star in the sky. It is about 1,000 light years away and has a fainter blue companion.

Objects

M42 (NGC1976) Great Orion Nebula. This is a very bright, large diffuse nebula illuminated by four stars known as the Trapezium. The trapezium is the centre of an intense, star forming region. Two other fainter stars in the Trapezium can also be viewed under good conditions. Sir William Hershel began his observing career by viewing the Orion Nebula with a reflecting telescope (made by himself) in 1774. This is one of the most incredible objects in the sky. It can also be viewed through binoculars.

M43 (NGC1982). This is part of the Great Orion Nebula. It is a large, bright nebula just north of M43.

NGC2022. Planetary Nebula. This appears as a faint disk. It is described as a bright, small round nebula of magnitude 11.6.

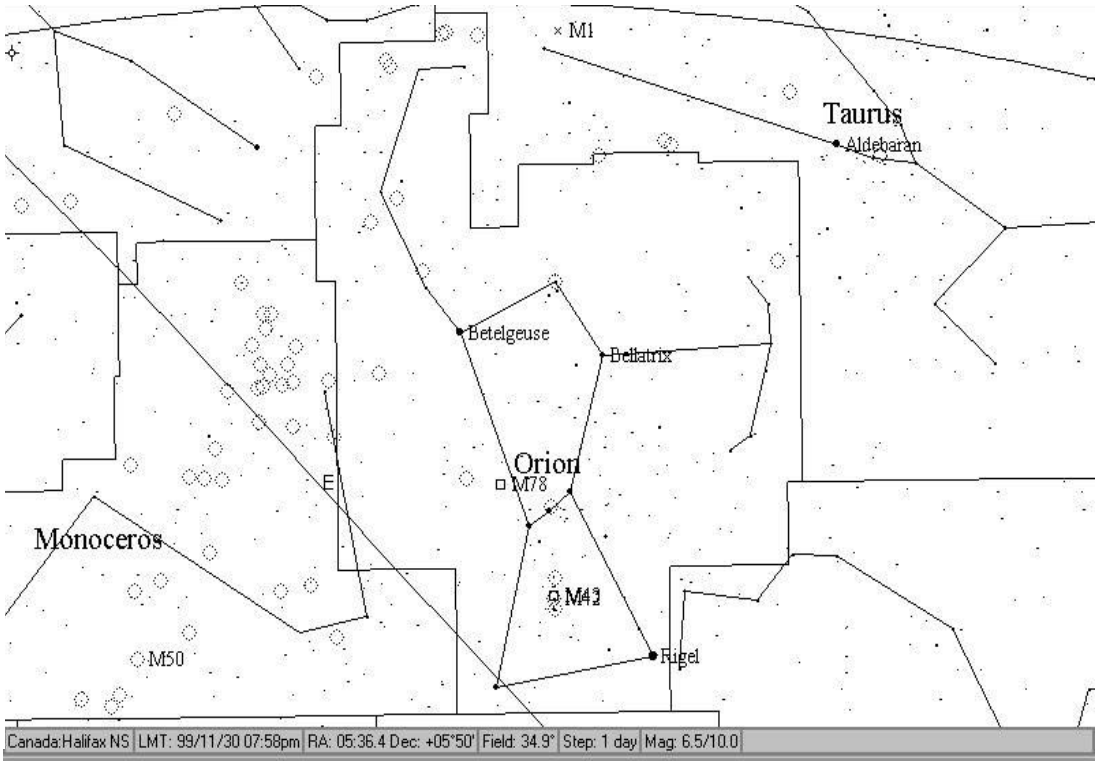
NGC2024. Flame Nebula. This is an area of faint nebulosity surrounding a star. It is visible in 6" or larger scopes. It is large and includes the Horsehead Nebula (IC434).

M78(NGC2068). This is a bright, large reflection nebula containing 3 stars.

NGC2112. This is an open cluster of magnitude 8.4. It is a large, rich cluster containing about 50 stars and is visible through binoculars.

NGC2141. This is an open cluster of magnitude 9.4. It is a small, rich cluster containing about 100 stars.

NGC2194. This is an open cluster of magnitude 8.5. It is a large, rich cluster containing about 80 stars and can be seen with binoculars.



Callisto and her son Arcas

Callisto was the favorite companion of the goddess Diana. She accompanied Diana on the hunt and attended her at her bath after the hunt. One day the god Jupiter caught a glimpse of the beautiful Callisto and fell in love with her. Knowing that Diana had warned Callisto of the deceitful ways of men and gods, Jupiter assumed the guise of Diana.

In this disguise, Jupiter seduced the beautiful Callisto. Callisto succumbed to the beautiful seductive words of Jupiter, and in Jupiter's loving embrace, she conceived a child. When Jupiter's wife Juno saw this evidence of Jupiter's infidelity she became enraged, and changed Callisto into a bear.

Callisto was ashamed and afraid, and fled into the woods, not to see her son for many years. One day, when Arcas was a young man, he decided to go hunting and went into the woods where his mother Callisto, the bear, resided. Callisto saw her son, whom she had not seen for many years. Forgetting she was a bear, she rushed forward to embrace him. Arcas only saw a bear rushing down on him. He lifted his bow and let fly an arrow to the mark.

At the last moment Jupiter intervened and cast Callisto and her son into the heavens as the constellations Ursa Major, the Great Bear, and Bootes, the Bear Warden. Arcas is always standing next

Cassini (continued)

(Continued from page 1)

gather data from Titan's surface, hoping to discover whether or not lakes cover the moon. Scientists believe that Titan's surface may be covered with the residue of a sticky, brown organic rain.

For four years, Cassini will make about sixty orbits of varying sizes and orientations around Saturn. Some orbits will take 100 days, some less than 10. Some will bring the spacecraft to within 110,000 miles of Saturn's center; others will take it 2 million miles away.

Most of the orbits will occur in, or close to, Saturn's equatorial plane, where the planet's rings and many of its moons are located. Some orbits, however, will take Cassini above or below that mark to get better views of the planet's poles.

Links of the Month

The Links of the Month for December were inspired by the theme for our General Meeting's featured talk on Sir William Herschel by Jeff Collinson.

The first page is a listing of the "Herschel 400" complete with images of each object and a printable observing sheet. The URL is ***http://www.stud.ifi.uio.no/~mikkels/h400.html***. Herschel was the first person to discover infrared radiation so I have chosen the following web site that is devoted to infrared astronomy: ***http://www.ipac.caltech.edu/Outreach/Edu/outreach.html***. When I was looking for information on the planet Uranus, which was discovered by Herschel of course, I came across the Stardate Online web site at ***http://stardate.utexas.edu/default.html***. This looks like good site to bookmark and if you follow the links they have a page about Uranus.

The members of HAJA would like to thank **Everett Cairns** for spending a great deal of time and effort completing the telescope for HAJA use. It is a wonderful gift and much appreciated by all HAJA members.

The next meeting of HAJA will be Tuesday, December 14, 1999. The following meeting will be Tuesday, January 18, 2000. HAJA - the junior astronomers, usually meets at McMaster University in the room beside the planetarium, at 7pm.

For more information on HAJA contact Rosa Assalone at 540-8793.

Ask Stella: The Life Cycles of Stars

Our question this month is from an entire class of curious kids -- Mrs. Jamison's 6th grade science class at Eugene A. Tighe in New Jersey, to be exact. They write:

We would like to know if you could possibly make an analogy of a star's life to the stages of human life to the life cycle of a star. We are studying the birth of a star(nebula), protostar, developed stars, Supergiant--low mass stars become a black dwarf, or a massive star ending in a black hole. Any ideas would be helpful--like is the protostar comparable to a toddler stage, etc....Thank you for your attention to this question. Mrs. Jamison's 6th grade science class

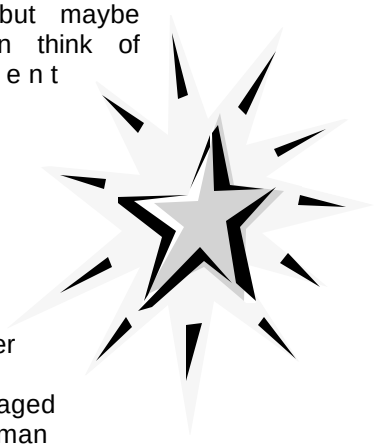
And Stella, (ever one to put off doing a few calculations for the sake of wide-eyed kids) responds:

Hi Guys,

Wow, impressed that you're studying stars in the 6th grade. When I was that age, I thought stars were just these little pointy things instead of gigantic nuclear furnaces that make up all the elements in our bodies. Looks like I'm gonna have more competition for grant money soon.

To answer your question, yes, I think you can compare a star's life with that of a human being. But the question of which stages are comparable is a difficult one, because the stages of of a person's life aren't the same length as those of a star. However, I'll give it a try.

How many stages are there in a person's life? I came up with these, but maybe you can think of different ones.



- embryo
- fetus
- baby
- toddler
- child
- teenager
- adult
- middle-aged woman/man
- old woman/man

What about a star? In your question, you listed some of the stages:

nebula
protostar
developed star
(astronomers call this the "main sequence" phase)

supergiant
black dwarf
black hole

My list would be a little different. Actually, I'd make two lists, one for low mass-stars and one for high-mass stars. Mass is just the amount of matter (stuff) inside an object. The idea of mass is similar to that of weight, but not exactly the same. It might help you to think of those two ideas as the same for now.

1: Low mass stars

nebula
- The star-to-be collapses from a cold, dark cloud of gas.

protostar (T-Tauri stage)
- The ball of gas continues to collapse. It heats up as it gets smaller. The T-Tauri star gains mass because gas is still falling onto it, but it also ejects gas in two gigantic jets.

main sequence star
- The star gets hot enough that hydrogen fusion can begin in the core (10 million degrees Kelvin)

red giant
- The star runs out of hydrogen in the core so fusion stops. No fusion means no heat and no heat means no more gas pressure. At this stage there's no longer anything to balance the inward pressure of gravity. The star's core collapses and gets hotter. That makes the outer layers of the star bulge outward until they cool down.

The cool outer layers go from yellow-white to red.

Think of a candle flame. The hottest part is blue, the second hottest part is yellow-white and the coolest (outermost) part is orange or red. Although a red giant has a super-hot core, it's outer layers are cool.

helium flash
- The star's core gets hot enough to begin helium fusion. (100 million K)

asyptotic giant branch (AGB) star
- Helium fusion is happening in the core and hydrogen fusion is happening in a shell around the core. Sometimes the star changes brightness wavers at this stage, like a guttering candle flame. When this happens, the star becomes an RR-Lyrae variable.

black dwarf

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The Life Cycles of Stars

(Continued from page 5)

- The star runs out of helium. Because it's only a little star, it can't get hot enough to use other elements as fuel, so it just sits there and cools off.

2: Medium mass stars

These start out in the same way as low-mass stars, But after they might have more than one red giant and AGB stage. And after that, something different happens.

planetary nebula
- The star is getting old. It begins to blow off its outer shell, causing huge amounts of gas to stream into space.

white dwarf
- After most of the gas has blown away there is a tiny core left, about as big as the Earth (this is very small for stars -- even the Sun is a million times bigger than the Earth). No fusion is happening any more.

3: High mass stars

The biggest, brightest stars also have the shortest lifespans. In a few millions or tens of millions of years they go from nebula to protostar to main sequence star. But after that you can get

supergiant
- This is the same as a red giant except bigger and brighter. Supergiants can be red or blue.

supernova
- When the star has a substantial iron core, fusion is no longer possible. The star ends its life in a tremendous explosion where all the elements heavier than iron (like nickel, copper, silver, gold, mercury, uranium, plutonium) are made.

neutron star or black hole
- After the explosion the star becomes either a tiny, rapidly spinning neutron star (about the size of a city) or a mysterious black hole. Only the most massive stars get to this stage.

Now, as far as comparing these stages to a human life, you can have lots of fun. I would match up the stages in the following way:

embryo = nebula
- A nebula isn't really a star, just like an embryo isn't really a person, it's a potential person. The nebula is also warm and dark, like the inside of a womb.

child/teenager = T-Tauri star
-T-Tauri stars are energetic and unpredictable. They change their brightness in a matter of hours or days. In the same way, young people often laugh or cry for reasons that adults find hard to understand.

-T-Tauri stars are also hard to keep an eye on because they're hidden by dark clouds. Kids also have a way of disappearing on you. Or maybe you can't see them, but boy can you hear them!

adult = main sequence star
-Main sequence stars are stable. They've realized their potential and have settled down to a life of doing what stars do. This phase is the longest of a star's life, just as adulthood is the longest phase of a human life.

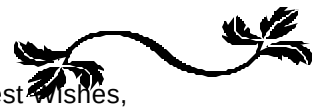
mid-life change = red giant phase/helium flash/AGB star/ and, or supergiant
- Often adults change their job or their ideas or their style of living when they're in their 40s or 50s and their children have left home. The bodies of women and men begin to change, just like the body of a star changes when it goes from hydrogen to helium fusion. This happens in different ways for different people.

old age = black dwarf/white dwarf/supernova/black hole

- Old age is not the same for any two people. Some find old age to be a very stable and happy time, some don't. Some people become brighter and more productive when they're old, but other people believe their youth was the best part of their lives.

One place where this analogy really breaks down is with having children. Humans are able to have children when they're quite young, but stars can't produce other stars during their own lifetimes. One generation of stars contributes only a little bit to the formation of the next generation.

Anyway, I've really got to get some research done now, but it was fun answering your question. I hope you continue to be curious about the stars.



Best wishes,
Stella

Do you have a question that's keeping you up at night? Then

Beginners' Page

Finding Your Way Around The Sky - Selecting The Sky Map That's Right For You.

Whether you've bought your first telescope and need something to look at; or want to learn the constellations; or just want to find out what that smudge is you see in the sky at the cottage; (or ALL of the above!); you need a sky map or star chart as we astronomers call them.

There are many star charts available - which one is right for you?

Firstly, it helps to recognize that each star chart shows a different amount of the sky. Obviously, a chart that covers the entire sky can only show the brightest of stars. Otherwise it would be a confusing jumble.

The simplest star chart is a planisphere. This is a rotating disk with a window that shows all the constellations visible from your latitude at the date and time you select. Planispheres are very useful for helping you figure out which constellations are visible. They don't show which planets are up, nor are they helpful for identifying the constellations. Because of their small size (generally 4" to 8" in diameter) and the resulting map projection, planispheres show distorted views of the constellations.

To help you identify the constellations, I recommend the monthly sky maps found in the centre of Sky & Telescope, Astronomy or Sky News magazines. These are excellent for finding constellations because they also show a horizon that offers a scale against which you can judge the relative size of the constellation you are trying to find. They also show the location of any planets that happen to be visible. These maps are good for finding constellations from the city or other light polluted areas only, though. They only show the brightest of stars. If you are observing from the country or a cottage/ campground where there is little or no artificial light, the sky will be much darker and many more, fainter, stars will be visible. You need a star chart

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The Magnitude Scale

by Ann Tekatch

Astronomers measure the relative brightness of stars using a magnitude scale. The brighter a star is, the lower its magnitude.

The brightest star in the sky is Sirius found in the constellation Canis Major (which is located below the more well-known constellation, Orion). This star is magnitude -1.4.

As a comparison, in the city, the dimmest stars we can see are about magnitude 4.0. Whereas, the dimmest stars visible to the naked eye under the darkest of skies is between magnitudes 6.0 and 7.0.

Each step in the scale means a difference of

Beginners' Page (continued)

(Continued from page 7)

that shows fainter stars. For these observers, I recommend Wil Tirion's Bright Star Atlas. This atlas of star charts shows all the stars visible to the naked eye under very dark skies as well as the brighter deep sky objects (galaxies, star clusters and nebulae) tha can be seen either naked eye or with small telescopes or binoculars. The Bright Star Atlas can be used in the city with small telescopes and binoculars because such instruments gather enough light to allow you to see the fainter stars.

If you own a larger telescope (4" - 8" in aperture or diameter), you'll need a star chart that shows even fainter stars. Sky Atlas 2000 is a necessity! It shows not only faint stars (to magnitude 9), but all the deep sky objects that can be viewed in a mid-sized telescope.

If you're lucky enough to own a large telescope (10" +), you need serious help!! I use Sky Atlas 2000 and supplement it with Uranometria when observing with my 12.5" reflector. (Uranometria's charts detail much smaller areas of the sky, enabling them to plot very dim stars and deep sky objects.)

If you have a gigantic telescope (18" +), you can still use Sky Atlas 2000 to locate star fields in your finderscope, then Uranometria to close in on the general area you're interested in. After that, you'll need to use one of the computer-based chart generating programs that are available. These programs make use of databases listing stars to ridiculously dim magnitudes like 20! Unfortunately, you'll

Did you know that...

although they must have witnessed them, the Egyptians never recorded a single solar or lunar eclipse.

Rob Roy

CALENDAR OF EVENTS

- Tuesday, December 14, 7pm — **HAJA** - We will meet at McMaster University, in the Burke Science Building, room B148. For more information contact Rosa Assalone 540-8793
- January 7, 8, 28, 29 ~ 8pm — **BINBROOK OBSERVING NIGHTS** - For confirmation or directions call Bret Culver 575-9492, Marg Walton 627-7361, Rob Roy 692-3245
- Friday, January 14, 2000 7:30pm — **HAA GENERAL MEETING** - At the Spectator Building auditorium.
- Tuesday, January 18, 2000 7pm — **HAJA** - We will meet at McMaster University, in the Burke Science Building, room B148. For more information contact Rosa Assalone 540-8793